Science & News from the Rhode Island Natural History Survey

Rhode Island Naturalist

Volume 17 • Number 1 • Spring 2022

An Invasion of Amur Cork Tree (*Phellodendron amurense* Rupr.) in Rhode Island

By DAVID W. GREGG and HOPE LEESON

Introduction

The Rhode Island Natural History Survey completed a study on the invasion biology of Amur cork tree (*Phellodendron amurense* Rupr.), a tree known to be a serious forest invader in the Mid-Atlantic states but to this point of unknown significance in Rhode Island. The study indicated that *P. amurense* is a more serious threat to Rhode Island forest and forested wetland ecosystems than previously suspected. The study also provided practical lessons on which to base control protocols. The full project report can be accessed on the RINHS website (Leeson 2007).

In 2006, RINHS received funding from the U.S. Forest Service to establish two sites where foresters and other land stewards could learn practical lessons about the control of invasive plants in forest environments. The choice of target species and target forest environments were left up to RINHS. We established a study plot to look at Japanese barberry (*Berberis thunbergii*) in the badly invaded sugar maple stand at the Nettie Marie Jones Nature Preserve at URI's W. Alton Jones Campus in West Greenwich. Experiments with methods of control were undertaken there and tours of the plot were held in 2007. For the second plot, RINHS decided to break new ground in invasive biology and control, and we selected a site on Pojac Point in North Kingstown, Rhode Island, known to have at least one population of Amur cork tree. There are apparently no studies of invasion parameters or systematic studies of control methods for this species in the maritime-moderated climate and glacially derived soils of southern New England.

Background and Identification

Phellodendron amurense and its congener *P. chinense* (Family Rutaceae) are native to Asia. A revision of the genus identifies other commonly encountered species names as synonymous with these (Ma 2006). Of the two species, *P. amurense* has thicker outer bark and a loose inflorescence. Its native range includes northeast China, the Russian Far East, the Korean peninsula, and Japan. *P. chinense*, with thinner bark and a compact inflorescence, is native to central China. Neither species is highly cold-tolerant, but the thicker bark of *P. amurense* may be an adaptation to its generally colder native range. Its bark, which contains alkaloid compounds, is used in preparation of traditional Chinese medicines such as Huang Bo (Gan and Dai 1990).

Both species were introduced into North America as landscape ornamentals—*P. chinense* being successful in the southern US and *P. amurense* seeing wide use on the East Coast beginning after the Civil War (Grier and Grier 1928). *P. amurense* had naturalized into rich, moist forest soils in the mid-Atlantic area and on Long Island before 1950 (Lehr 1961).

Amur cork tree has light-green, opposite, compound leaves, with 5 to 13 leaflets that turn yellow in autumn, which could lead one to mistake the tree for ash (*Fraxinus* sp.). Male and female flowers occur on separate plants. The fruit is a drupe,

In This Issue:

RHODE ISLAND NATURAL HISTORY SURVEY
Providing Ecosystem Science and Information

with berries up to 1 cm in diameter held in clusters of up to two dozen. The berries begin shiny green and progress to dark purple and eventually black in August and September. The berries may persist in winter and finally drop to the ground still attached to their stems in spring. Bark is light tannish gray, crevassed, and "corky" (hence the name) to the touch. The inner bark is bright yellow. Although described in horticultural literature as hardy and versatile, this species appears to do better along the coast where winter cold and summer drying are moderate (Dirr 1998).

According to The Nature Conservancy, this tree is demonstrating invasive characteristics in suburban and urban fringe forests in the Northeast (Martin 2000). The Rhode Island Invasive Species Council lists *Phellodendron* as invasive and localized (RIISC 2020). Prevention and control methods have not been developed specifically for this relatively new invader but generalized protocols for woody species have typically been recommended.

Study Site and Design

In 2000, RINHS biologist Jackie Sones noted a population of Amur cork tree within unmanaged forested habitat on private land at Pojac Point. At the start of this project, this was the only Rhode Island population of *P. amurense* known to RINHS. The site is located within a depressional area west of Summer Pond (Fig. 1). Amur cork tree has become established in all strata of the forested habitat, which is otherwise dominated by a closed canopy of oak (*Quercus* spp.) and shagbark hickory (*Carya ovata*). White pine (*Pinus strobus*), big-toothed aspen (*Populus grandidentata*), and red maple (*Acer rubrum*) are also present as native components of the system. The shrub understory contains several non-native invasive species common to Rhode Island's suburban forested habitats, such as multiflora rose (*Rosa multiflora*), Asiatic bittersweet (*Celastrus orbiculatus*), winged euonymus (*Euonymus alatus*), and bird buckthorn (*Rhamnus frangula*). Two additional species, linden viburnum (*Viburnum dilatatum*) and black jetbead (*Rhodotypos scandens*), were also found at the Pojac Point site. Both species are emerging as potentially invasive on the New England landscape. Since this study began, *P. amurense* has been identified in horticultural and naturalized conditions in several other locations around the state, including a landscape planting of some eight trees located on the Kingston campus of URI. Field work proceeded along two parallel tracks: 1) to learn more about the invasion biology of *P. amurense* as revealed at the site and 2) to study the effectiveness of different control methods on this species under local conditions.

Figure 1. *P. amurense* (flagged) at Pojac Point with Summer Pond in the background (photo by H. Leeson).

Invasion Biology

When we began this project, all *P. amurense* specimens in the vicinity of the study area with stem diameters larger than approximately 4 cm were cored using a Haglöf 4.3-mm increment borer. Twenty specimens with smaller stem diameters were cross-sectioned. Samples of native canopy trees located within the plots were also cored. Cores were taken at approximately 45 cm above the ground, sections at 20 cm. The cores and sections were air dried, glued to pine blocks, and shaved with a razor blade to achieve clear views of growth rings and other features. For each sample, the total number of annual growth rings and the thickness of each ring relative to others in the same core were plotted following Sheppard (2002). In all there were usable cores or sections from 59 *P. amurense*, 2 oaks, and 2 aspens. Fourteen of the *P. amurense* cores represented three discrete individuals having six, four, and four stems.

The oldest specimens for any species at the site were for *P. amurense*, with two at 70 years and one at 69 years old. Three multi-stemmed specimens with stem dates around 50 years old may also represent trees from this age range that

(continued on page 4)

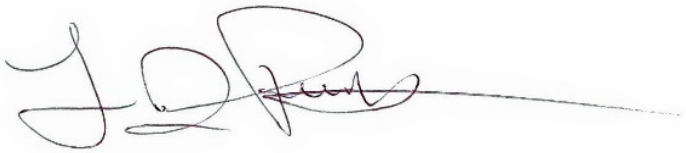
President's Corner: Another Very Good Year

Lou Perrotti, President,
Board of Directors

I am happy to report that, despite 2021 being another year of COVID-19 and the restrictions it brought, the Survey succeeded in providing engaging programs and learning opportunities (both virtual and in person) to our members and friends. We had everything from plant walks to butterfly tagging, Wednesday teas, and new in 2021—a fossil hunting expedition. There was a fantastic mix of programs to suit everyone's natural history interests. A highlight of 2021 was our ability to host an in-person BioBlitz at Mercy Woods Preserve in Cumberland. It went off without a hitch . . . fun was had by all, the finds of mushrooms and other fungi were phenomenal, and 786 species were counted in total. We ended the year on a high note, with a successful annual appeal, several large private donations, and additional contributions to the Henry & Teresa Godzala Research Fund, which makes annual grants for small research projects. As you know, all of these efforts and events take a village to plan, organize, and pull off—especially in the shadow of a pandemic. Thanks to those of you who participated and helped make things happen!

On behalf of the Board, I would like to extend our gratitude to the Survey staff. Together they continue to build a portfolio of interesting projects and programs that keep the Survey relevant to our membership and colleagues. Their ability to identify funding opportunities that align with our mission, and willingness to pursue them across a broad array of sources, is a great asset. We are proud that the Survey manages to attract and retain high quality staff, both professional and volunteer, who are continuing our efforts to update the biodiversity database, website, and library collection. Our signature event—BioBlitz—continues to build the Survey's reputation by bringing science to the community, and vice versa. The Staff's sure handling of this event, and the many projects and programs they manage all year long, keeps moving our vision forward.

Finally, I would like to thank all of you who show up in support of the Survey through memberships, donations, attendance at our events, and collaborative work. We value each one of you and look forward to many more years of sharing, and celebrating the biodiversity and natural history of our great state together. Another exciting year of events is planned and already underway for 2022! I hope you'll join us for something soon!



Amur Cork Tree (continued from page 2)

had been cut down and subsequently sprouted from stumps. After this recruitment episode from the late 1930s, periods of substantial recruitment occurred around 1955 and around 1981 (Fig. 2). The oldest non-*Phellodendron* tree in the area was a black oak (*Q. velutina*) approximately 60 years old. The aspens sampled proved to be approximately 46 years old.

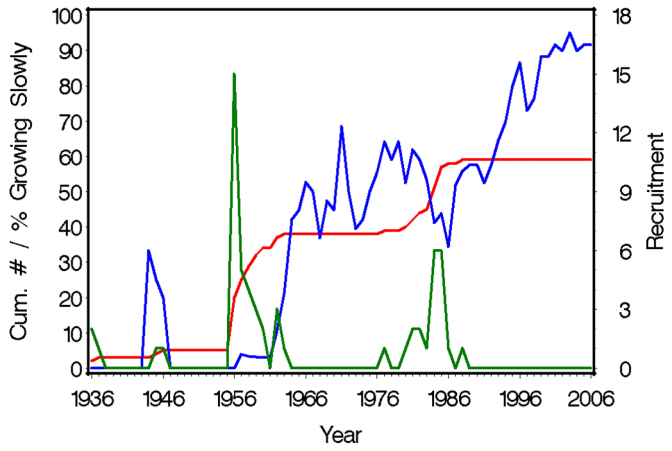


Figure 2. Amur cork tree growth as percent growing slowly (blue, left axis) compared to recruitment (green, right axis) and cumulative abundance (red, left axis) at Pojac Point.

Analysis of cores and sections showed *P. amurense* growth rate to be highly variable. Some annual growth rings were >1 cm in width and others accumulated <0.5 mm per year (Fig. 3). Virtually all the specimens alive before the late 1950s grew rapidly every year. Beginning around 1961, approximately 50% of the living trees grew slowly, though there was variability from year to year for any one tree. Beginning around 1993, approximately 95% of the trees were growing very slowly every year. For the small number of other species sampled the pattern was similar, although the timing was a little different, with markedly slower annual growth from the 1980s to the time of the sampling.

Of particular interest is the observation that, during the last 15 years, all size categories of *P. amurense* were growing at the same relatively slow rate. The smallest diameter plants studied, those less than 2 cm in diameter and less than 70 cm tall, were at first presumed to be recent seedlings because of their size. Analysis of growth rings, however, proved them to be between 21 and 25 years old, produced from a single cohort that sprouted in the mid-1980s. In fact, the growth rings in these specimens were so narrow that a precise count was at first impossible. Eventually, a specimen was found in which a wound had caused tissue to grow more rapidly on one side of the stem, allowing characteristic features of the highly compressed annual rings to be recognized. Another apparent category within the size distribution was made up of trees approximately 4 cm in diameter and 2–4 m in height. Although far smaller than the obviously mature canopy trees, these individuals were fruiting. Cores proved these to be from another distinct cohort that sprouted between 43 and 48 years ago, around the late 1950s.

Tree rings indicate that *P. amurense* was present at the study site by around 1936. It is also possible that *P. amurense* had been naturalized at the site substantially before this time but that no larger individuals survived the 1938 hurricane, which was particularly destructive in this area. Review of 1939 aerial photography of the site shows an agricultural area around Summer Pond, with some shrubby growth along the pond's southern margin. It is possible that the first *P. amurense* were seeded by birds or other wildlife using the pond and shoreline vegetation. Although land use was agricultural at the time, and unlikely to have ornamental plantings, there were large estates in the vicinity that may have provided a seed source. Further field work might identify much older surviving trees in the region or archival research could determine if records exist of plantings on nearby estates. Hurricane Carol, in 1954, was also very destructive in Rhode Island and a major episode of recruitment and rapid growth follows that time. The early 1980s cohort is not clearly related to hurricane history, but 1981 was a peak year for *Lymantria dispar* (spongy moth, see sidebar on page 6) populations in northeastern North America (Hajek et al. 1996). Defoliation of aspen and oak at the site may have been enough to release *P. amurense* from the understory. Research on the palatability of *P. amurense* to *L. dispar* could help elucidate this episode.

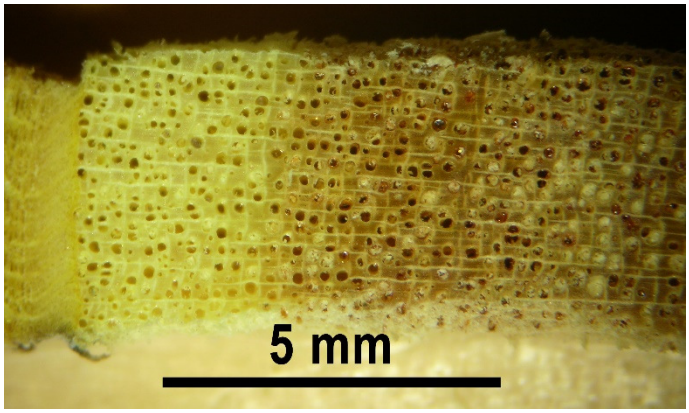


Figure 3. *P. amurense* core showing approximately 40 annual rings (photo by D. Gregg).

The association of recruitment with episodes of canopy damage is consistent with tree-ring data that clearly document *P. amurense*'s ability to remain alive and slowly growing in the understory and to accelerate its growth

rapidly upon release. The ability of *P. amurense* to fruit even when small and growing weakly in the understory is possibly a further adaptation to disturbance regimes such as wind damage.

Control Experiments

Using 20-m square experimental and control plots, three treatment strategies were tested in the fall of 2006. Following leaf drop, trees were treated with a variety of mechanical, cut-stem, and herbicide treatments. In one area trees larger than 5 cm in diameter were girdled using a broad-bladed knife, hatchet, or chainsaw, depending on size. Smaller trees and saplings were pulled from the ground by hand or with the assistance of a "weed wrench." In another plot, all *P. amurense* were cut down using loppers or a chainsaw. The stump surfaces were immediately treated with a 50% solution of RoundUp Pro® applied with a backpack sprayer. In a third area, a team applied a pre-mixed solution of trichlopyr (sold as Pathfinder II®) with a backpack sprayer and brass cone nozzle to the basal bark surface of each tree. For trees smaller than 5 cm in diameter, a band of herbicide was applied to the bark within the area from the root collar to 20 cm above the ground. For trees greater than 5 cm in diameter, 4 to 5 cuts per tree were made with a chainsaw through the outer bark 30 to 60 cm above the ground, a technique known as frailing. Herbicide was then applied directly to the cambium layer within the cuts. Due to the proximity to freshwater wetlands, permission to carry out the treatments was required from the Rhode Island Department of Environmental Management. For complete details of the treatments see Leeson (2007).

Monitoring for effectiveness of the treatments and the response of untreated vegetation to the release of canopy cover took place in early May and late June of 2007. All three treatments had an effect on *P. amurense*. The only method to remove 100% of the individual trees targeted was the cut-stem application of herbicide. The resulting opening in the canopy, however, has the potential to initiate rapid growth of other non-native species already present in the understory, as well as rapid growth of pioneer native species. Girdling without herbicide was moderately effective overall and most effective when the cuts reached down to the root collar. The method is easy to apply, trees are left to stand in place, and no herbicide is required. For basal bark herbicide application, it appears that success requires cuts to the cambium prior to application. Even with trees less than 5 cm in diameter, the spongy outer bark appeared to serve as a barrier to the herbicide. Hand pulling worked fairly well on smaller individuals, as the roots were relatively shallow. However, the brittle pith of unhealthy trees required a consistent pulling motion to keep the stem from breaking, and for larger specimens pulling up the lengthy root system caused significant soil disturbance. Where *P. amurense* occupied more than 25% of the canopy at the start of the study, substantial growth was noted for non-target understory species, likely a response to increased exposure to sunlight following the removal of canopy trees.

Conclusion

Analysis links recruitment and growth in *P. amurense* to plentiful sunlight. Under ideal conditions, it can grow rapidly and seed and germinate prolifically. Nonetheless, under closed-canopy conditions *P. amurense* remains viable at all sizes. Individuals less than 3 m tall and just 4 cm in diameter were shown to be almost 50 years old. Individuals only 1 m tall and 2 cm in diameter, approximately 25 years in age, were found to have produced fruit. The apparent competitive advantage that *P. amurense* has over native forest species is therefore due at least in part to its ability to persist and reproduce in a forest understory despite unfavorable light conditions, and to respond with quick growth and prolific seeding when the canopy is disturbed. Given this ability, *P. amurense* has the potential to out-compete native species, and to become a dominant feature in all canopy layers within forested habitats with moist soils. Habitats in Rhode Island typically associated with red maple, such as those found in forest hollows, adjacent to vernal pools, or along wooded swamp or pond margins (Greller et al. 1979) may be particularly vulnerable.

P. amurense's success is known to be limited in continental conditions characterized by extremes of heat and cold, but it is highly invasive in coastal plain portions of the Mid-Atlantic region with moderate climate (Lamont and Young 2002). It is clear that *P. amurense* is successful in Rhode Island. In addition to the study population, *P. amurense* can be found scattered throughout the woods at Pojac Point, along the Hunt River estuary to the north, and around a basin along Schoolhouse Road to the southeast. As climate change further moderates conditions, *P. amurense* will likely become even more successful in Rhode Island.

For control, *P. amurense*'s salient characteristics are its ability to re-sprout from stumps and the resistance to herbicides conferred by its corky bark. Cut-stem herbicide treatment was highly effective, as was hand pulling for smaller size categories.

Because of its invasive potential, horticultural use of *P. amurense* should be limited. Because *P. amurense* responds so vigorously to forest disturbance, those engaged in timber harvesting and habitat manipulation or restoration should be

aware of this species and prepared to control it aggressively if it is found in a project area.

Acknowledgements

Funding for this project was provided by the US Forest Service, Rhode Island Foundation, URI College of the Environment and Life Sciences, and private contributions. Other support was provided by URI W. Alton Jones Campus, Largess Forestry, Inc., the Champlin Foundations, Rhode Island Wild Plant Society, and the Lisa Lofland Gould Native Plant Program Fund. Special thanks to Tom Rawinski, Matt Largess, and Peggy Sharpe.

Literature Cited

Dirr, M.A. 1998. *Manual of Wood Landscape Plants: Their Identification, Ornamental Characteristics, Cultural, Propagation and Uses*, 5th ed. Stipes, Champaign, IL.

Gan, X.D., and K.M. Dai. 1990. Identification of the botanical origin of the Chinese drug Huang Bo. *Journal of the Shanghai Medical University* 17:57–60.

Greller, A.M., R.E. Calhoon, and E. Iglich. 1979. The upland, oak-dominated community of Forest Park, Queens County, New York. *Bulletin of the Torrey Botanical Club* 106:135–139.

Grier, N.M., and C.R. Grier. 1928. A list of plants growing under cultivation in the vicinity of Cold Spring Harbor, New York. *American Midland Naturalist* 11:307–387.

Hajek, A.E., J.S. Elkingon, and J.J. Witkosky. 1996. Introduction and spread of the fungal pathogen *Entomophaga maimaiga* (Zygomycetes : Entomothorales) along the leading edge of gypsy moth (Lepidoptera: Lymantriidae) spread. *Environmental Entomology* 25(5):1235–1247.

Lamont, E.E., and S.M. Young. 2002. Noteworthy plants reported from the Torrey Range, 2001. *Journal of the Torrey Botanical Society* 129:363–371.

Leeson, H.D. 2007. Invasive Plant Control Demonstration Plots, July 2006–August 2007: W. Alton Jones Campus, W. Greenwich, R.I., Pojac Point Road, N. Kingstown, R.I. Rhode Island Natural History Survey, Kingston, RI. https://rinhs.org/wp-content/uploads/2021/12/RINHS-USFS_Invasive-Species-Management_Final-Report-PRINT.pdf. Accessed 1 February 2022.

Lehr, J.H. 1961. Local flora notes. *Bulletin of the Torrey Botanical Club* 88:123–124.

Ma, J. 2006. A revision of *Phellodendron* (Rutaceae). *Edinburgh Journal of Botany* 63:131–151.

Ma, J., and A.R. Brach. 2007. The identity of cultivated *Phellodendron* (Rutaceae) in North America. *Journal of the Botanical Research Institute of Texas* 1:357–365.

Martin, T. 2000. Weed Alert! *Phellodendron amurense* Rupr. (Amur cork tree). Global Invasive Species Team, The Nature Conservancy, University of California, Davis, CA. https://www.invasive.org/gist/alert/alrtphel.html. Accessed 1 February 2022.

RIISC (Rhode Island Invasive Species Council). 2020. Invasive plants in Rhode Island. Rhode Island Natural History Survey, Kingston, RI. https://rinhs.org/wp-content/uploads/2021/10/Invasive-and-Weedy-Plants-in-RI-2020_-FINAL.pdf. Accessed 1 February 2022.

Sheppard, P.R. 2002. Introduction to cross dating: Skeleton plotting. Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ. http://tree.ltrr.arizona.edu/skeletonplot/introcrossdate.htm. Accessed 1 February 2022.

David Gregg *is the Executive Director of RINHS.* ***Hope Leeson*** *is an RINHS Contract Botanist; she directed this study.*

Editors' Note: *This article was originally written in 2008 for an issue of* Rhode Island Naturalist *that was never completed.*

A Moth by Any Other Name

The Entomological Society of America (ESA) and the Entomological Society of Canada have both adopted "spongy moth" as the new common name for the species *Lymantria dispar*. The name refers to the insect's distinctive sponge-like egg masses and is derived from translations of common names used for the insect in its native range and French-speaking Canada. The name replaces "gypsy moth," which ESA removed from its list of common names in July 2021 due to "gypsy" being an ethnic slur against the Roma people. Photos (all from bugwood.org): Adult (top left) by Gyorgy Csoka, Hungary Forest Research Institute; Larva (top right) by Karla Salp, Washington State Dept. of Agriculture: Female and egg mass (bottom right): by Jim Occi, BugPic.

Marine Mammals of Rhode Island: Common Dolphin

By ROBERT D. KENNEY

Introduction and Status

This installment in our series of marine mammal articles* will take a U-turn from the last two—from the rarest cetacean in our ocean, the North Atlantic right whale, to the most common (both in name and in fact). Common dolphins (*Delphinus delphis*) are probably the most abundant cetaceans off the Atlantic coast, with perhaps as many as a quarter million between Florida and Labrador. Naturally, they are not listed under the US Endangered Species Act and are classified as Least Concern on the IUCN Red List.

Common dolphins, along with bottlenose dolphins and harbor porpoises, were formerly caught for human consumption in the Black Sea by fishermen from Turkey, the Soviet Union, Romania, and Bulgaria. That fishery began in the late 19th Century, and tens of thousands of animals were taken annually. It ended in 1966, except in Turkey where it continued to 1983. In today's world, common dolphins are taken incidentally in a number of commercial fisheries worldwide, in particular in gillnets and in the eastern tropical Pacific purse-seine fishery for tuna. In the western North Atlantic, common dolphin bycatch mortalities have occurred in a number of different fisheries, mostly in trawls and gillnets, averaging a few hundred per year—too few to constitute a serious threat to the population.

Taxonomy

Our understanding of Mother Nature is never quite as neat as we'd like it to be. Common dolphins are a good case in point; over the years they have given me quite a headache. Although I first learned as a graduate student that there was just a single species with a global distribution, by 2001 when Pete August, Tom Husband, and I wrote the checklist of Rhode Island mammals for *Vertebrates of Rhode Island* (volume 2 of the RINHS Biota of Rhode Island series), the official position was that there were three species—the short-beaked common dolphin (*D. delphis*), the long-beaked common dolphin (*D. capensis*), and the very-long-beaked Indian Ocean common dolphin (*D. tropicalis*). We included both the short-beaked and long-beaked species in the checklist as potentially occurring in Rhode Island waters, but that turns out to have been a mistake. Later research showed that only short-beaked common dolphins occur in the North Atlantic. Scientists were also arguing about whether *D. tropicalis* was a valid species or simply a sub-species or variety of *D. capensis*, but at least that was not a concern for us here in New England. However, now that I've gotten completely used to writing out "short-beaked common dolphin," the latest conclusion from the Society for Marine Mammalogy's Committee on Taxonomy is that *D. capensis* is not a valid species. Genetic evidence is showing that longer-beaked forms in different parts of different oceans are not all closely related to each other, and may have evolved separately. In their words—"The long-beaked condition is apparently a convergent character state induced by regional ecology." So now we are back to where I started—there is a single worldwide species of just plain "common dolphin." But stay tuned—more genetic research is likely to lead to splitting off multiple long-beaked species in different oceanic regions around the globe.

Description

Common dolphins have the typical form of oceanic dolphins, with a streamlined body, a distinct beak, and a prominent dorsal fin (Fig. 1). They are slender, and range up to 2.3–2.6 m in length, with males slightly larger than females. The color pattern is striking and distinctive, leading to the alternative common names of "saddleback," "hourglass," or "criss-cross" dolphin. Dr. William Perrin from the NOAA Fisheries Science Center in La Jolla, California, developed a scheme for systematically classifying the pigmentation patterns of dolphins and porpoises. There are two areas of dorsal pigmentation—the "cape," which is generally smaller and more anterior, and the "dorsal overlay," which is larger and extends farther posteriorly. The overlap of the two results in the typical pattern for a particular species. In common dolphins the cape is yellowish-tan, wider in the front and narrower in the back. The dorsal overlay is light gray and opposite—narrower in front and wider in back. Where the two areas overlap, the color is dark gray to black, resulting in a rather narrow black band that starts at the head, widens to a sharp point directly below the dorsal fin (the "saddle," where the margins of the cape and the dorsal overlay cross), and then narrows to a point on the mid-back

* These articles are simplified and summarized from a technical report that was part of the Rhode Island Ocean SAMP in 2010. For details and full references to the literature, see that report at http://seagrant.gso.uri.edu/oceansamp/pdf/appendix/10-Kenney-MM&T.pdf.

behind the dorsal fin. In front of the saddle the color on the side is yellowish tan (the cape alone); behind it and onto the back near the tail the color is gray (dorsal overlay alone). The belly is white. The dorsal fin is tall, curved backward, in the middle of the back, and black, often with a paler gray center. The lips, flippers, flukes, and a small circle around the eye are black. There are thin black stripes from the upper beak to the eye, and from chin to the flipper.

Figure 1. An uncommonly good view of a common dolphin off the northeastern US, showing the distinctive color pattern that gives rise to the names "saddleback" or "hourglass" dolphin (photo by Todd Pusser, NOAA Northeast Fisheries Science Center, from the NEFSC Photo Gallery http://www.nefsc.noaa.gov/rcb/photogallery/).

Natural History

Common dolphins occur in tropical to temperate waters around the world. In the western North Atlantic, they occur from Iceland south, but the southern limit of the distribution is unclear and appears to vary between years. Older reports of common dolphins off Florida or in the Gulf of Mexico and Caribbean are likely to be misidentifications of Clymene dolphins (*Stenella clymene*), which for years were not recognized as a separate species. Common dolphins have an atypical seasonal pattern off the northeastern US, with peak abundance in fall and winter instead of summer—very different from all other dolphin species in the region.

Common dolphins are known to aggregate into extremely large herds at times, however those schools are composed of smaller groups of 20–30 related individuals. Large herds chased during tuna fishing would break up into successively smaller groups, but the smallest groups of 20–30 animals remained tightly aggregated and never separated. Offshore fishermen tell of seeing herds of common dolphins on Georges Bank that take hours to pass by. Off the northeastern US in 1979–1981, the average group size sighted was 55 dolphins, but the average was skewed by a few sightings of groups as large as 2,000 individuals.

Common dolphins feed on small fishes and squids, including species that school in near-surface waters and midwater species that occur near the surface at night. Tagging studies in the North Pacific showed that foraging dives commenced at dusk and continued all night long. They were apparently feeding on deep-scattering-layer fishes that migrate upwards at dusk and return to depth at dawn, as well as on the squid that were also feeding on the small fishes. They do not appear to be deep divers, with most dives to less than 50 m and only a few dives to as deep as 200 m.

Most information about reproduction and life history comes from populations where large numbers were taken either in directed fisheries, as in the Black Sea, or as bycatch in commercial fisheries, as in the eastern tropical Pacific. Sexual maturity occurs at 6–7 years of age and 195–208 cm total length in females, and 7–12 years and about 200 cm in males. Gestation is 10–11 months. Calves are born at about 80–90 cm in length, and wean in about 5 or 6 months, but begin feeding on solid food as young as 2–3 months. In the Pacific, there are two peaks in calving, in the spring and fall.

Historical Occurrence

In *The Mammals of Rhode Island*, Cronan and Brooks reported two historical records of common dolphins in Rhode Island—a specimen from Block Island with no date given and one captured alive in Point Judith Pond on 12 August 1966. The former most likely refers to the oldest known record in our area in the Smithsonian collection—a 203-cm dolphin captured (most likely harpooned) "off Block Island" on 7 August 1882. Other historical sources reported occasional strandings and sightings in both Massachusetts and New York. Of note was the occurrence of a herd of 30–40 common dolphins seen in the Hudson River in October 1936, almost as far upriver as Albany.

Recent Occurrence

Common dolphins occur in the waters off southern New England year-round, across much of the shelf but most commonly in waters deeper than about 60 m. Seasonality is not particularly strong, with 34% of records in spring, 26% in summer, 18% in fall, and 22% in winter. Abundance is actually highest during fall and winter, when they tend to occur in much larger groups. Common dolphins are the most likely dolphin species to be spotted in Narragansett Bay, usually in late fall or winter and occasionally up as far as the Providence River. In November 2016, Narragansett resident Dale Denelle captured a school on video between Point Judith and Block Island—while driving his boat with one hand and flying his drone with the other. His video, set to

music, is posted on-line for all to enjoy (https://www.youtube.com/watch?v=uVUBfr6EVsc).

Common dolphins are the most frequently stranded cetacean in Rhode Island, with strandings occurring year-round (see page 30 of the Spring 2021 issue of *Rhode Island Naturalist* for a photo of a common dolphin stranded on Block Island that January). In the Rhode Island Ocean SAMP report, we tabulated 23 strandings in Rhode Island in the 23 years between 1983 and 2005, averaging one per year. In the succeeding 15 years, 2006–2020, there were 86 more (5.7 per year average), with clear evidence of an increasing trend over time (Fig. 2). Strandings are even more frequent in Massachusetts, mostly on Cape Cod, where mass strandings of entire herds are common events. My graduate student C.T. Harry finished a master's thesis in 2015 that showed common dolphin stranding frequency in Massachusetts to be correlated with variability in the North Atlantic Oscillation (NAO). The NAO is a major driver of both climate and oceanographic conditions in the North Atlantic; and changing climate also could be behind the increase in common dolphin strandings in Rhode Island.

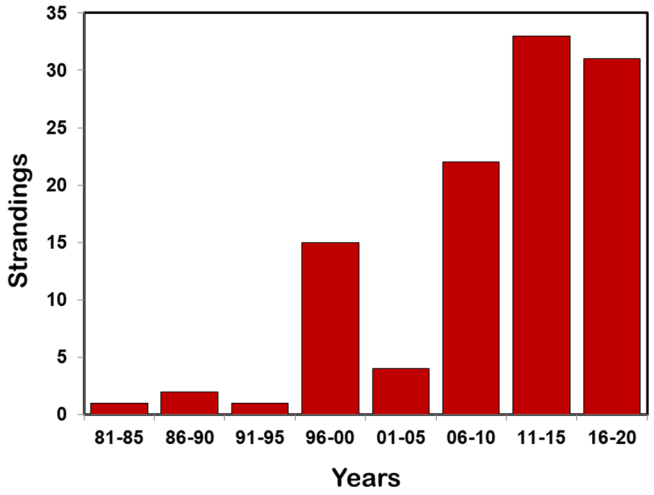


Figure 2. Five-year stranding frequencies for common dolphins in Rhode Island, 1983–2020 (data collected by Mystic Aquarium and the Northeast Regional Stranding Network).

There is also a clear seasonal pattern in common dolphin strandings in Rhode Island, but it has been changing (Fig. 3). In 1983–2005 the seasonal peak was in winter, with 10 of 23 strandings (43%) in December–February. In the following 15 years, strandings have spiked during October (25 of the 86), shifting the seasonal peak to fall, with 49% in September–November. For the complete 38-yr period, the seasonal stranding percentages were 29% in winter, 13% in spring, 14% in summer, and 44% in fall. Changing climate and warming ocean temperatures are likely culprits here as well.

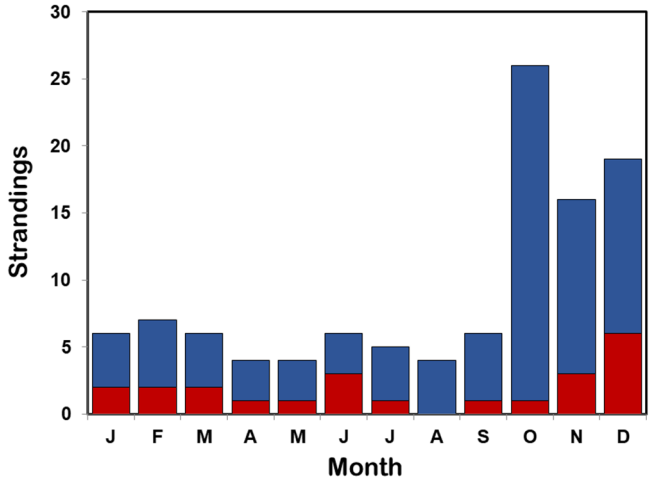


Figure 3. Monthly stranding frequencies for common dolphins in Rhode Island, 1983–2020 (red = 1983–2005; blue = 2006–2020).

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 a co-editor of* Rhode Island Naturalist.

Field Notes: A Truly Notorious Mushroom

By RYAN T. BOUCHARD and EMILY SCHMIDT

The Death Cap (*Amanita phalloides*) (Fig. 1), the most intimidating of mushrooms, has killed more humans than any other mushroom species. In recent years, ominous rumors have spread around the mushroom world: the Death Cap is now coming to your east coast backyard!

We've heard some credible friends talking about *Amanita phalloides* becoming more common along the east coast, apparently sometimes spreading from the west through ornamental tree transplants—and also through a disquieting switch of their mycorrhizal host-tree species, from the live oaks of the west to white pines here in the east. But we've also noticed some articles describing the spread of the Death Cap with an alarmist, almost clickbait type of angle. Some have pointed to climate change as the culprit, and it certainly could be playing a role, but it's important not to jump to conclusions. To really know if the Death Cap is trying to take over the world, any increase in frightening fungus sightings would have to be carefully weighed against the

increased number of mushroom hobbyists who are able to recognize a Death Cap when they actually find one.

Figure 1. Death Cap, *Amanita phalloides* (all the photographs accompanying this article were taken by the authors during the fall of 2021).

We also have to weigh this scary rumor against our own personal observations—or lack thereof. In 12 years of hardcore mushroom hunting in New England, we've found fewer than ten Death Cap patches. In contrast, we might find ten Destroying Angel patches in a single day, and during the autumn we tend to see at least one *every* day. The Destroying Angel is easily the most common deadly mushroom of our region. It is actually a species complex including *Amanita bisporigera*, *Amanita amerivirosa*, and several others; a microscope is required to differentiate them. The exact species really doesn't matter much; they all are plain white (Fig. 2), share the same common name, and are equally deadly. A Death Cap, on the other hand, remains a special find.

Ryan was really excited the first time he found Death Caps! It was early November in 2016, and they were right outside Newport Public Library, growing under linden trees (another known host) in the grass by the side of the road. The stalks had a swollen bulbous area at the base, with a large and obvious volva (a cup-like structure at the base), and the caps had an attractive greenish hue. Deadly mushrooms would be a concern in an area where children might be more likely to play than a roadside.

With both the Death Cap and the more common Destroying Angel, sometimes it only takes one mushroom to cause death. That's scary. We were interviewed last autumn by Brian Amaral of the *Boston Globe* for our opinion on the case of a Newport woman who ate a mushroom from her yard without identifying it. It turned out to be a deadly *Amanita*. It was impossible after the fact to determine the exact species, but going from the single photo she took (and from its effects on her health), it was certainly either a Death Cap or a Destroying Angel. She was lucky to survive—or rather, lucky that the skilled doctors of Newport Hospital saved her. She broke the main rule of mushroom hunting: "When in doubt, throw it out." You just don't eat something if you are in doubt about it, even if you are 99% sure it's safe and only 1% in doubt. She had owned one of our mushroom calendars at some point in the past, but had given it away as a gift.

Figure 2. Destroying Angel (*Amanita* sp.).

We also heard sad news about three different dogs in southern New England who died last year from eating deadly mushrooms. And those were just the ones we heard of. If we had to guess, Destroying Angels were most likely to blame, simply because they are the most common. In slightly more positive news, we also helped numerous folks figure out what mushroom their dog had just eaten, so they could tell their veterinarian whether it contained a deadly toxin. Fortunately, these dogs all survived, but only after they and their owners went through their own ordeals of varying severity. Many edible mushrooms will cause stomach upset if eaten raw; in addition, the fear alone can be traumatic.

Poisonous mushrooms—even those few that are deadly—can't poison you if you breathe their airborne spores, and they can't harm you through any amount of touching. So, to anyone who has the kind of dog who likes to graze on random things, we would caution you to regularly remove

mushrooms from the yard, by hand. The same goes for toddlers—don't take a chance, just remove the mushrooms. And don't worry, that method is not environmentally harsh. If the nearby trees are healthy, those amanitas will just keep on popping right back up!

The Death Cap is a frightening but fascinating fungus. Fear makes sense as a reaction, but it doesn't help as much as knowledge. We encourage our advanced students to collect these and other deadly mushrooms so they can study them in detail, while of course maintaining a healthy awareness of their deadly nature, and putting them in a safe place. There is little point in trying to stop the spores from spreading; they float in the atmosphere all around us every day. When you are done studying these menacing mushrooms, throw them in the garbage or the compost pile.

Figure 3. Developmental stages of *Amanita phalloides*, from a small "egg" (far left) to fully developed mushrooms. All show the cup-like volva at the base, and several show the ring around the stalk.

The Death Cap's shape changes dramatically as it matures (Fig. 3). It goes from a roundish "egg," shaped like an edible puffball at first, then breaking out of its relatively thick universal veil (the membranous top of the egg) and expanding into a stately mushroom with a tall straight stalk and a wide greenish-yellow cap. It has a pendant (skirt-like) ring around the stalk (Fig. 4). The stalk has a large and bulbous base, adding to the overall "phallic" appearance that inspired its species name. And it does not have warts on its cap, like you'd see on so many other species in the genus *Amanita*. On occasion: the cap retains a single large patch of universal veil—one extra-large wart (Fig. 5). You'll also notice that not all specimens have the telltale green hue. We have seen brownish, whitish, and yellowish specimens that more or less resemble other species.

So be observant. NEVER eat any unidentified mushroom (*especially* one with gills). And don't rely on our photos here or any other single source to make an identification. Don't forget the rule—"When in doubt, throw it out." Keep the children and pets from eating them, and everybody will be just fine.

Figure 4. A view of the underside of a Death Cap, showing the well-developed ring and closely crowded gills.

Figure 5. A Death Cap showing the large remnant of the universal veil (the white patch) remaining on top of the cap.

Ryan Bouchard *and* ***Emily Schmidt*** *are the founders of the Mushroom Hunting Foundation and offer a variety of classes, walks, and other resources for those interested in learning more (https://mushroomhunting.org/).*

Editors' Note: *This article is the first in what we hope will be an on-going series on interesting species of local fungi.*

Field Notes:
Rhode Island Osprey Monitoring Program

By JONATHAN SCOONES

The Rhode Island Osprey Monitoring Program was initiated in 1977 by the Rhode Island Department of Environmental Management (RIDEM). The goal was to observe the state's population of the osprey (*Pandion haliaetus*, Fig. 1) as it recovered from the effects of the pesticide DDT, which was used from the 1940s through the 1960s in Rhode Island. The monitoring program has been made possible by the efforts of many biologists, donors, and volunteers who have observed all known osprey nests in Rhode Island and carefully recorded the numbers of chicks fledged and the status of each nest.

Although DDT had been banned in the US in 1972, it continued to have negative effects on raptor populations. In 1976 the osprey was designated as an endangered species. The first statewide count by RIDEM in 1977 discovered only 12 active nests. In the 1940s, before DDT, it was estimated that there were over a thousand nests between Boston and New York. DDT had taken a major toll on the population of this fish-eating bird, with the poison working its way through the food chain and bio-accumulating in ospreys at the top. The result was very weak eggshells that easily broke when incubated.

Federal funding for RIDEM's monitoring ended in 2008. During 2009 RIDEM passed the management of the project to the Audubon Society of Rhode Island, which began collecting information in 2010, leaving a 1-year gap (See www.dem.ri.gov/programs/bnatres/fish-wild/pdf/osprey.pdf for a graph showing their monitoring results and the first 8 years of Audubon's). Today, more than 75 volunteer monitors continue to observe the state's osprey population each year (Table 1).

Volunteers are trained on how to carefully distinguish the behaviors of nesting birds to categorize each nest into the defined classes shown in the table. At an Inactive nest, birds could be present but no breeding behavior is observed. At a Housekeeping nest, a pair is observed at the nest but breeding behavior is not sustained through the season. The pair at an Active nest show sustained breeding behavior (e.g., nest building, copulation, incubation, feeding, etc.). Successful nests are a subset of the Active ones where fledglings (young birds with flight feathers) are observed.

Figure 1. A pair of adult ospreys and one fledgling (in the center) nearly ready for take-off (public domain photo from www.goodfreephotos.com).

In 2020, volunteers monitored the status of osprey nests in 27 Rhode Island communities (and 25 in 2021). Ospreys are no longer classified as endangered at the federal level and have recovered fabulously in Rhode Island—increasing from the 12 nests counted in 1977 to high values of 150 successful nests in 2015 and 151 in 2020. By watching these sentinels, we learn more about wildlife and natural habitats, as well as the level of human impacts on these unique species and special places. It is a great testament to the dedication of Rhode Island's volunteer monitors that this citizen-science program continues to thrive.

There are at least three webcams on osprey nests in Rhode Island where you can see nesting ospreys in action. There is one at the Narragansett Bay Commission sewage treatment plant at Bucklin Point in East Providence. Videos and photos from there are posted on YouTube. The other two both have live feeds that can be viewed on-line. There is one located next to the Pettaquamscutt (Narrow) River in South Kingstown operated by the Narrow River Preservation Association and Narrow River Land Trust (narrowriver.org/ospreycam/), and one at Marsh Meadows in Jamestown operated by the Conanicut Raptor Project (www.conanicutraptors.com/creek-nest-webcam/). To identify the sexes of the adult birds while you are watching one of the webcams, the female has a more distinct dark band across the upper chest, as if she were wearing a necklace.

***Jon Scoones** is the Manager of the Audubon Society of Rhode Island's Caratunk Wildlife Refuge in Seekonk, Massachusetts, and a member of the RINHS Board of Directors. If you are interested in participating as a monitor or helping the program in other ways, please contact Jon at rhodeislandosprey@gmail.com*

Table 1. Audubon Society of Rhode Island Osprey Monitoring Program results, 2010–2021. See the text for descriptions of the various nest categories.

Parameter Assessed	Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Monitors	60	64	70	70	66	96	108	110	93	80	87	76
Hours Monitored	*	*	*	*	819	1359	1358	1340	1066	1016	1528	934
Nest Sites Monitored	168	187	200	209	199	229	236	267	193	238	248	231
Inactive Nest Sites	52	62	59	50	54	26	64	57	21	63	66	36
Housekeeping Nests	*	16	15	8	5	11	13	24	6	4	6	7
Active Nests	*	108	126	138	127	156	159	145	166	123	176	163
Successful Nests	116	91	96	96	105	122	150	121	144	118	151	130
Fledglings in R.I.	171	159	178	168	186	239	297	226	275	212	298	237

*No data available.

Executive Director's Journal
Seeing Differences

By DAVID W. GREGG

A couple of months ago, I picked up the paper and read about a woman in Newport who'd nearly died after eating a mushroom she found growing in her back yard. (See the article on pages 9–11 for more details.) According to the story, she'd previously been eating lion's mane mushrooms (*Hericium* sp.; see the accompanying photo on the next page)—pale, shaggy-looking, covered with soft spines—that she'd she found growing on a stump in the yard. Did she assume this one—also pale, but with a domed cap and gills, growing in about the same place—was sufficiently similar to be okay to eat? My first thought was, how on earth would someone mistake an *Amanita* for a lion's mane mushroom? But not everyone perceives differences or similarities in the same way. Sometimes it is simply a matter of learning what the important differences are. For example, the signal difference between bees (four wings) and bee-mimicking flies (two wings) is immediately obvious to me, who has spent a lifetime fascinated by insects. But even for experienced naturalists with deep knowledge about plants or birds, for example, this difference might be news simply because they've never needed to see it. This story is also an example of something that comes up frequently in natural history—the difference between plain old difference and significant difference.

The ability to recognize and reason from similarities and differences is a fundamental cognitive process, helping us recognize our siblings, find our car in the parking lot, or tell a mockingbird from a catbird. This ability is the prerequisite for complicated or subtle cognitive exercises that we do all the time, including classification, metaphor, and analogy. People who have reduced abilities in these cognitive areas can have severe difficulties with a wide range of life activities. But for purposes of this column, I'm not talking about pathological impairment in cognition, just regular old blind spots, which give us plenty of food for thought all by themselves.

While some differences are important, there is so much going on in the world around us that our brains have developed sophisticated means to cut out stuff that's not important to us or to group together things that share meaningful features. We only bother to recognize differences that we need to or that we assess will be important for us somehow. Take the example of my mother and cars. To her, a car is an appliance whose function is take you from A to B. Small cars are for when you're just moving yourself and big ones are for when you have to move a lot of stuff. Honda Fit? Small car. Toyota Corolla? Small car. Lamborghini? Small car. If you were driving with her and a McLaren P1 were to go by you'd say, "Wow, did you see that amazing supercar!?" and she'd say, "What, that yellow one?" Different types of cars are not important to her, so she doesn't bother to distinguish them to any great degree.

Difference is the most important part of taxonomy, and hence what you have to get on top of whenever you set out to learn a new taxon. Birders know you look for eye rings and lines and wing bars on warblers but breast shading and wing markings to separate some raptors. This works on many levels. If you're interested in flies, to take one of the previous examples, you need to learn that the significant

difference between them and bees is the number of pairs of wings: two pairs on bees, one pair on flies. If you're interested in tiger beetles (sub-family Cicindelinae), you can pretty easily learn to distinguish them from other ground beetles by their general look and behavior, what British birders would call their "jizz." But to get any further you might need to look at whether the white marginal markings connect with the humeral lunule (you also need to learn many new terms) or leave a gap, or learn the difference between a long and short longitudinal stroke in the middle band, what I call their "f-hole" because the top of the whole beetle reminds me of the top of a violin.

Hericium americanum is the most common species of lion's mane mushroom in Rhode Island. It is also called bear's head tooth mushroom. It does not look very much like the *Amanita* sp. pictured on pages 10 and 11. (Photo from Wikimedia Commons).

One of the things you have to decide as you embark on your journey as a naturalist is whether you like what you have to do in order to find the significant difference in your chosen taxon. If you can't ever seem to see clearly though a microscope, you probably should give the ants a pass since the significant differences have to do with the number of antenna segments and the nature of the hairs on the head. If you don't like playing with a chemistry set, lichens might not be for you since there are several important ID characters involving applications of different chemicals.

As important as significant differences are insignificant differences—you need to learn how much individual variation there is in the species you're after. In traditional taxonomic determination, if you're looking at an individual specimen, there may be a point where you have to say it is *Celestrina* sp. (an azure butterfly). One of the reasons museums give for amassing large numbers of individuals of apparently the same species is to allow detection of subtle differences between species that are masked by individual variation. Now, new technologies such as digital analysis of sounds or DNA barcoding are redefining the boundary between significant and insignificant. Someone following a traditional dichotomous key would be able to identify a black-horned tree cricket (*Oecanthus nigricornis*), however without digital sound analysis, they would not be able to tell how far east the visually identical Forbes's tree cricket (*Oecanthus forbesi*) actually ranged.

For the scientific establishment, slogging through traditional taxonomic terrain has been terribly out of fashion lately, with keys published in obscure journals or weird-smelling jars filled with alcoholic minnows. Many scientists work with model organisms like mice or zebra fish or with molecules, and identify their subjects based on the catalog number at the scientific supply house. Some taxonomists have "modernized" with DNA barcoding or increasingly sophisticated statistical analysis of individual variation. Nonetheless, however you are able to do it, taxonomy—correctly identifying the organism that you have in your hands—is critical to nearly everything that follows.

And getting research right is only the most rarified use of our essentially human ability to identify significant difference. Significant difference is important for recognizing your locker in kindergarten, for knowing where to round off decimals in math class, and for knowing which mushrooms are safe to eat.

Focus On RINHS Organizational Members: South Kingstown Land Trust

By MATT ELDRIDGE

South Kingstown is home to some of the most beautiful landscapes in Rhode Island. The natural open spaces provide quiet forests for wildlife and hiking; rich soils for

farming; and pristine meadows, ponds, streams, wetlands, and estuaries.

The unique natural resources in South Kingstown foster a thriving environmental vitality that both residents and visitors value as a top community priority. In 1983, a group of citizens took this to heart and sought to protect South Kingstown's natural resources and open spaces in perpetuity.

As rising population and development pressure on farm and vacant land increased, this dedicated group, along with the town leaders, recognized that preserving the land would require concerted effort and action. A group coalesced and established the South Kingstown Land Trust (SKLT), with the mission to protect and steward natural resources, open spaces, and cultural landscapes for the benefit of the community now and forever.

Almost 40 years later, SKLT has worked with willing landowners to complete more than 175 land protection projects throughout the community. Every property, project, conservation goal, and landowner is different, and the land protection projects can take anywhere from 18 months to 18 years.

SKLT recently completed the protection of 17.9 acres of John Richmond's forested wetlands and pine-oak forest on Yawgoo Pond in West Kingston. The acquisition put SKLT's combined total of protected land over 3,000 acres, 123.4 acres of which surround Yawgoo Pond. The new parcel includes more than 400 feet of shoreline encompassing rare plants and thriving wildlife habitat. With the acquisition, approximately 1.2 miles of Yawgoo Pond's shoreline is protected.

The Land Trust works with volunteers and partner groups to achieve conservation goals. For example, SKLT was a partner with the University of Rhode Island's "Operation Spadefoot RI," a collaborative habitat restoration project to repopulate the endangered spadefoot toad. Alongside the project's many partners, including the Rhode Island Natural History Survey, SKLT staff and volunteers created two large, shallow spadefoot toad breeding pools in late April 2021 at an ideal SKLT property. Just a few months later in September, roughly 1,000 spadefoot toadlets were rescued from a rapidly drying ephemeral pool at another site by Lou Perrotti of Roger Williams Park Zoo and successfully released at SKLT's breeding pools.

Two views of the SKLT Woodcock Campus at Weeden Farm: Above is the sign at the roadside (photo by Ted Watson, SKLT board member); below shows the Welcome Center buildings (photo by Matt Eldridge).

The scope of work is only possible because of the breadth and variety of SKLT partners. The Land Trust works collaboratively with private landowners, neighborhood communities, public agencies, and other conservation organizations. Partners include the Rhode Island Natural History Survey, The Nature Conservancy, Audubon Society of Rhode Island, US Fish and Wildlife Service, USDA Natural Resources Conservation Service, Rhode Island Department of Environmental Management, Preserve Rhode Island, Matunuck Preservation Society, the town of South Kingstown, and more. SKLT also fosters partnerships with community organizations that work cooperatively with its mission, including the Rhode Island Land Trust Council, URI Master Gardeners, South County Garden Club of Rhode Island, Boy Scouts of America, and many more.

After a successful capital campaign in April of 2021, SKLT celebrated the completion of the Woodcock Campus at Weeden Farm and moved their offices from Robinson Street

in Wakefield to 17 Matunuck Beach Road in Matunuck. The bucolic Weeden Farm property features active farm fields, hiking trails, and now a Welcome Center with staff offices and a beautiful tractor shed, which sit adjacent to SKLT's beloved Barn meeting and program space.

In August of 2021, SKLT's accreditation was renewed by the Land Trust Accreditation Commission (LTAC), an independent program of the Land Trust Alliance—a national land conservation organization that represents more than 1,000 land trusts nationwide. Accreditation by the LTAC is a mark of distinction, proving that SKLT is committed to maintaining the community's trust in its conservation work. "Renewing our accreditation shows SKLT's ongoing commitment to permanent land conservation in South Kingstown," said Julia Landstreet, executive director. "We are a stronger organization than ever for having gone through the rigorous process. Our strength means our community's beautiful open spaces will be protected forever, making South Kingstown an even greater place for us and our children."

SKLT is governed by an active and accomplished board of directors and the work of its small staff is supplemented by passionate volunteers. All the organization's work is funded by individuals who believe in the mission to protect and conserve the land of South Kingstown, by government and private foundation grants, and by landowners who contribute toward the monitoring and defense of their protected property.

South Kingstown Land Trust welcomes visitors to explore over 14 miles of trails, visit the Perry Grist Mill, or come and see us at the Woodcock Campus. Office hours change with the seasons (check the website). To learn more about all the happenings at the land trust, check out our website at sklt.org and follow us on Facebook and Instagram. We encourage you to join as a member and help continue the crucial ongoing efforts to preserve open space.

Matt Eldridge *is the Marketing and Development Coordinator at South Kingstown Land Trust.*

2021 RINHS Awards

Candace Oviatt
2021 Distinguished Naturalist

Dr. Candace A. Oviatt has, through teaching and mentoring and by her example, been responsible for significant scientific advances in our understanding of Rhode Island's marine ecology as well as making numerous contributions to the conservation of Rhode Island ecosystems. For all this, she was presented with the 2021 Rhode Island Natural History Survey Distinguished Naturalist Award.

Candace has spent over 50 years, most of it at the University of Rhode Island, researching the estuarine ecology of Narragansett Bay, garnering a world-wide scientific reputation and recognition as a leading expert in the Bay's ecology. Her interest and keen ability to assess Rhode Island's ecosystems holistically is perhaps best reflected in her seminal work with Dr. Scott Nixon in Bissel Cove, North Kingstown. This study was among the first to develop a whole-system energy budget for salt marshes—and the first to contrast New England marshes with those closer to the equator. Oviatt and Nixon measured all components of the ecosystem, from the standing crop of *Spartina* to the fish species that dominate the tidal pools, and everything in between. This work, published in *Ecological Monographs*, is considered a classic in the field and has been cited more than 430 times. Her scientific publications, too numerous to list, all take similar approaches linking ecosystem components together to understand how systems function and respond to human impacts.

Candace's holistic approach to understanding marine ecosystems has been a cornerstone of her career, and the foundation to the science conducted at the Marine Ecosystems Research Laboratory (MERL). MERL was established at the University of Rhode Island's Graduate School of Oceanography in the early 1970s, with Candace serving as a key player from its inception. Over succeeding decades, she served as the MERL manager (1977–1984), associate

director (1984–1994), and director (1994–2000). The large, deep mesocosms that Candace developed at MERL and the pioneering research conducted in them fundamentally changed our understanding of how marine ecosystems function. They provided some of the most conclusive evidence of nitrogen-limitation in temperate estuaries at a time when there was still great debate about nitrogen versus phosphorus limitation and they linked increasing nutrient loads to numerous aspects of estuarine structure and function.

The impact of these early MERL studies cannot be overstated: they were revolutionary, among the first whole-system experiments in marine systems. These studies led communities to accept the role of nitrogen as the limiting nutrient in temperate estuaries and as a key driver of eutrophication. They still form the basic underpinning of our understanding of nutrients and eutrophication in coastal marine ecosystems today. With their experimental facilities, Candace and her colleagues designed three decades of experiments to determine how sewage alters estuarine systems, how estuaries filter and trap nutrients, and how grazing alters coastal primary production. This work has been instrumental in designing nutrient management plans for Narragansett Bay, and for estuarine systems throughout the United States and the world.

Candace's scientific impacts on Rhode Island's natural history are also reflected in her years of teaching and mentoring students. She has advised 34 graduate students (16 Masters and 18 PhDs) to date and is still advising. Further, she has served on over 121 graduate committees, highlighting how sought-after her expertise is. To her students, she is a steady and strong advisor who demanded, and succeeded, in getting the very best work while remaining unfailingly supportive and available to anyone whenever needed.

Possibly less highlighted than her academic career, but at least as important, is her ability to convey her science to project stakeholders, environmental managers, and the public. Such successful communication and engagement has had a monumental effect on how the region's populace views and preserves the Bay ecosystem. Candace's research on how changes in climate—at local and ocean-basin scales—and wastewater treatment have influenced the Bay's ecosystem has been a constant reference for state managers trying to balance initiatives for clean water and a prosperous economy. The impacts of her research and outreach on science-informed management will continue to have lasting, positive effects widely among non-academic Rhode Islanders.

It should also be noted that while Candace is a world-renowned marine ecologist, her passion for Nature does not stop with the ocean. Her hobbies center around enjoying the full range of natural resources that Rhode Island supports: she is an avid recreational bird watcher, equestrian, hiker, and a fierce advocate for natural resource conservation. This naturalist passion drives her to be an exceptional scientist and inspires others to reach for similar heights.

Candace Oviatt's contributions to the fields of Rhode Island ecology and natural history make her particularly deserving of the Rhode Island Natural History Survey's Distinguished Naturalist Award. Her impacts on marine ecology, conservation, management, and education are well apparent and will have long-lasting impacts for Rhode Island and beyond.

Adapted from the nomination letter submitted by M. Conor McManus (RIDEM Division of Marine Fisheries), Robinson W. Fulweiler (Boston University), and Jason S. Krumholz (McLaughlin Research Corporation)—all former PhD students in Professor Oviatt's lab.

Sindy Hempstead
2021 Posthumous Distinguished Naturalist

Mabel (Sindy) Hempstead (1925–2020) was the recipient of the 2021 Rhode Island Natural History Survey Posthumous Distinguished Naturalist Award. Sindy was 66 years old when she left retirement behind and became an accomplished botanist, sought-after field trip leader, mainstay of the Rhode Island Wild Plant Society, water-quality monitoring volunteer, and expert on the ecology and physiology of the fragrant waterlily (*Nymphaea odorata*). In

all this and more she added significantly to our knowledge of the natural history of Rhode Island.

Sindy Hempstead's interest in plants was evident from age four when she was growing up in Aurora, Illinois, west of Chicago. With post-secondary degrees in chemistry and an interest in teaching, Sindy's career included industrial chemistry, teaching math and science, oceanographic research, and raising four children. With career and children behind her, Hempstead began the Master's degree program in botany at URI. She produced a thesis, later published, on *Nymphaea odorata*. Sindy continued to pursue fieldwork until shortly before her passing, in 2020, at age 95, and many of her botanical field notes are now part of the Survey's archives.

Sindy Hempstead was a gentle presence and her approach one of quiet joy, though she was always game for a lively discussion about any topic that piqued her interest. Her Posthumous Distinguished Naturalist Award is recognition that she was a consummate naturalist, a committed advocate for the environment, and most of all, an inspiration to all.

Adapted from the nomination letter submitted by Keith Killingbeck. A longer remembrance was published in the spring 2021 issue of Rhode Island Naturalist.

Joyce Valentine-Kenney
2021 Founders' Award for Exceptional Service

The recipient of the 2021 Rhode Island Natural History Survey Founders' Award for Exceptional Service is Joyce Valentine-Kenney. As a volunteer and Director, and during her nearly 10 years as Treasurer, Joyce contributed more to the growth and maturation of the Survey than anyone else you can easily think of. Joyce joined the Survey's Board of Directors in 2004 and served as the Treasurer from 2005 until her passing in 2014. But her contributions extend considerably beyond that period. In the early 2000s, during the Survey's absorption of the Natural Heritage Program and The Nature Conservancy's science staff, Joyce volunteered her services as an accountant to set up the bookkeeping system we still use, develop an annual budget process, and ensure that personnel and financial policies met the highest standards. As spouse of long-time Survey Secretary and past President Bob Kenney, Joyce no doubt influenced many other decisions and priorities going back even earlier.

As a Certified Public Accountant with many years of experience in the business world, and with other nonprofits, when the Survey began growing rapidly around 2000, Joyce recognized the need to establish financial processes that were robust, flexible, and of the highest standard, but nonetheless simple to use and maintain. She selected the right software and hardware, wrote the new system, recruited other volunteers and advisers with accounting experience, trained staff, and, significantly, transitioned the old books into the new system without losing auditability. This was the first time the Survey was able to recruit the help of a person particularly qualified to juggle the books (all in the right way, of course).

Not only was Joyce Valentine-Kenney a master of debits, credits, and other money metrics, but she also really appreciated and enjoyed people and social dynamics and understood that finances were both the product of, and in the service of, people. With patience and good humor, Joyce trained Kira Stillwell, someone hired as a program manager, to do the bookkeeping. Her Treasurer's reports at the monthly and annual meetings presented easily digestible facts and analyses in ways that supported sometimes tough decisions. Her annual meeting reports were fact-filled and helpful, self-deprecating, and entertaining, not to say rousing. How many times have you ever heard the words "treasurer's report" and "rousing" in the same sentence? That is nothing short of miraculous.

More than just a crackerjack accountant and generous, sensitive advisor, Joyce helped out at most Survey events and made deep, personal connections with the rest of the Board, staff, and members of the Natural History Survey. Whether she was signing people in at BioBlitz, chatting about her

hobbies, inquiring after your family, contributing to a holiday party, or telling about adventures in her red Miata convertible (still on the road with her JVK license plate) or on her beloved sailboat *Elizabeth V*, Joyce's bright, positive personality helped set the tone for the whole Survey. She was unfailingly positive and always a pleasure to have around.

Joyce Valentine was born in Detroit in 1949, the daughter of Walter and Athena (Lagoudakis) Valentine, and grew up in the Detroit suburbs. Her career path in accounting was neither typical, direct, nor intentional. Her major during her first years at the University of Michigan was anthropology. Her main interest in the field was the behavior of non-human primates, so perhaps natural history was not as big a leap as it might seem. Her early work history included library assistant, nurse's aide, pumping gas at a Navy Exchange gas station, and taking phone orders for a flooring wholesaler. In Ithaca, New York, she was hired to work in the office for a home improvement center, and it was then that she started taking accounting classes to understand better what she was already doing on the job. When she and Bob moved to Rhode Island, she found a position as a staff accountant for a small CPA firm in Providence, and continued taking classes at several of the local colleges. Around 1981 she took a year off to attend URI full-time and finish her degree by taking all the non-major classes that she still needed, to take and pass the CPA exams, and to give birth to a daughter, Elizabeth (the sailboat's namesake). Now as a licensed CPA, she worked for two large firms and developed a specialty in non-profits. She also worked for periods as the controller of a real-estate developer and as Vice President for Finance at Dean College, and served on the boards of AIDS Project Rhode Island and the Community Visiting Nurses Association in Attleboro, Massachusetts. She finally came full circle back to a small firm in Newport, doing forensic accounting investigations.

As the Rhode Island Natural History Survey grew in size, influence, and complexity, Joyce was there to make sure that the financial infrastructure of our operation was sound and efficient. That, along with her good humor and seemingly boundless energy, helped drive the continued success of our organization. As a lynchpin of that success, Joyce Valentine-Kenney has more than earned the recognition of becoming the recipient of the 2021 Rhode Island Natural History Survey Founders' Award for Exceptional Service.

With Bob at Blyde River Canyon, South Africa, in 2007.

Adapted from the nomination letter submitted by Keith Killingbeck, with contributions by David Gregg, Kira Stillwell, and other Board members.

The Braz Family
2021 Golden Eye Award

The "Golden Eye" award recognizes a naturalist for reporting an extraordinary field find—a "good catch." The award recognizes not just luck, although luck certainly plays a part in many good discoveries in the field, but it commends the recipient for exemplifying what we call "natural historical values" such as curiosity, good use of available resources, and willingness to share knowledge. A Golden Eye award could recognize the discovery of a new species for Rhode Island, a rare or otherwise unusual species, an invasive species, or some other natural historical phenomenon that, although maybe not scientifically earth-shattering, nonetheless breaks down assumptions or makes us look at something in a surprising new way.

The 2021 Golden Eye recipient is the Braz family of Cumberland, Rhode Island, for their discovery of a blue-colored green frog, a discovery that was detailed in the Fall 2021 issue of the *Rhode Island Naturalist*. During the family's regular walks around a wetland in their neighbor-

hood, three-year-old Allyson pointed out that one of the green frogs at the edge of the pool was a bit different. In fact, it was noticeably blue. This inspired an email to state herpetologist Scott Buchanan and a posting to RIDEM's Herp Observer app. RIDEM herpetological bio-technician Liam Corcoran wrote in the *Rhode Island Naturalist* article that the rare color variation is caused by a reduction of carotenoid pigments in the skin. Although these color variations have been the subject of research, it is still not fully understood why they occur. This story perfectly exemplifies the Golden Eye award's purpose, to encourage all of us to have the curiosity and wonder of a child . . . who spots a BLUE frog.

Book Review:
The Best American Science & Nature Writing 2021

By ROBERT D. KENNEY

The Best American Science and Nature Writing 2021
Edited by Ed Yong, Series Editor Jaime Green
Mariner Books/HarperCollins, Boston, MA & New York, NY; 2021. xxv + 388 pp.
ISBN: 978-0-358-40016-6

In 2019 my daughter gave me a book for my birthday; it was that year's entry in this series. I liked the book well enough that I bought the 2020 volume and three earlier ones, and ordered the 2021 volume more than six months before it was published.

The Best American Science and Nature Writing 2021 is an anthology of articles published in 2020. We all remember what the number one science story was in 2020, and nearly half of the 26 pieces in the volume deal with COVID-19. Ed Yong's introduction spells it out: "The biggest story of the year—perhaps of the decade—was a science story, and science writers seemed to be ideally placed to tell it. . . . But the pandemic was not just a science story. It was an omni-crisis that warped and upended every aspect of our lives." He had begun 2020 on sabbatical from his job as a staff writer at *The Atlantic* to work on a book about experiencing the world through the senses of non-human animals, but quickly ended his book leave and spent the year reporting on the pandemic (for which he won a 2021 Pulitzer Prize). In 2018 he had written an article called "When the Next Plague Hits" that basically foretold the pandemic and was included in the 2019 volume of the series. Series editor Green says, half in jest, that she had to ask Yong to be the 2021 volume editor or else it would be half filled with his articles.

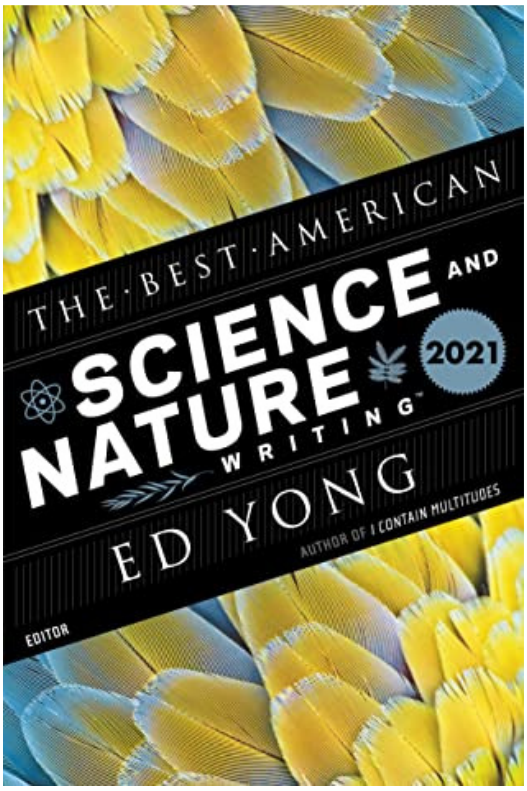
The book is divided into three sections—"Contagion," "Connections," and "Consequences." The "Contagion" section focuses entirely on COVID-19. In "I'm an ER Doctor in New York; None of Us Will Ever Be the Same," Helen Ouyang presents a sort of diary of the early days of the crisis beginning on March 8th, when the case count in New York was only 14. But she was in close contact with colleagues in northern Italy, where hospitals were already overwhelmed and rationing resources. She updates the New York case count over that first month, at first weekly and then more frequently, until by April 5th they had caught up to what was happening in Italy—going from 14 to 67,552.

"What Happened in Room 10?" by Katie Englehart centers on the Life Care Center nursing home in Kirkland, Washington, which was one of the earliest epicenters of the pandemic. Life Care was underprepared and understaffed, and eventually was fined over $600,000 by federal regulators for deficiencies. The article shows the complicated nexus of science, medicine, economics, public policy, and politics. It recounts some interesting history of how a vacuum-cleaner salesman decided to open a nursing home and eventually built the Life Care chain into the largest privately held long-term care company in the US. Despite published studies showing that 388,000 nursing-home residents die each year from infections acquired in the facility, and Obama-era regulations requiring better monitoring to prevent infections, industry lobbyists twice successfully convinced regulators during the Trump administration to scale back regulations they called "burdensome."

"The Scramble to Pluck 24 Billion Cherries in Eight Weeks" by Brooke Jarvis struck particularly close to home for me—I am father of a small farmer, both of us look forward every year to the price drop when Northwest sweet cherries go on sale, and my birthday "cake" of choice is a sour cherry pie. It focuses on the impacts of the pandemic on agricultural laborers—largely immigrants. While they were declared to be essential workers, they were also treated as more or less invisible and disposable.

The first article in the "Connections" section was about another viral disease, one that is 100% fatal—"Rabbit Fever" by Susan Orlean. Rabbit hemorrhagic disease (RHD), often called "rabbit Ebola," was originally identified in China. It infects the European rabbit, which is the species raised as pets and for meat production. An effective vaccine had been developed for the original strain (RHDV1), so it was of little concern in the US. A mutated version, RHDV2, first appeared in France in 2010, and started showing up in multiple places around the US in 2019. The disease can seem to explode out of nowhere in a veterinary clinic or other facility because rabbits, like many prey animals, mask symptoms of disease for as long as possible so as not to stand out to predators—they "play not-sick." The RHDV1 vaccine is ineffective against the new strain. A specific vaccine for RHDV2 is only available overseas, and not licensed for use in the US because it contains live, genetically modified virus. It also raises animal-welfare concerns because it is produced by infecting rabbits with the virus, then harvesting their livers after they die from the disease. Of even bigger concern, RHDV2 has now jumped to wild species, including black-tailed jackrabbits and cottontails, and has been detected in several western states. Unlike some wildlife vaccines that can be widely distributed in food, this vaccine must be injected and repeated yearly. We could be on the verge of an epizootic in wild rabbits that could spread widely.

I found "An Atlas of the Cosmos" by Shannon Stirone especially fascinating. She compared two maps of the known universe—both subject to the undeniable fact that what we can know about the boundaries of the universe is limited by what we can see. One of the oldest known maps in existence is the "Imago Mundi"—a Mesopotamian clay tablet from the 7th or 6th Century BCE. One line of the cuneiform inscription on the tablet says that it represents "the four quadrants of the known universe." In contrast, a new mapping project got underway in October 2019 at the Kitt Peak Observatory in Arizona, using a new Dark Energy Spectroscopic Instrument (DESI). The DESI mission is to look 11 billion years back in time, when galaxies were just forming, to create the most detailed map yet of the universe. DESI is expected to "see" about 150,000 galaxies each night, rarely looking at the same one twice, so that it will map over 40 million galaxies during its 5-year mission.

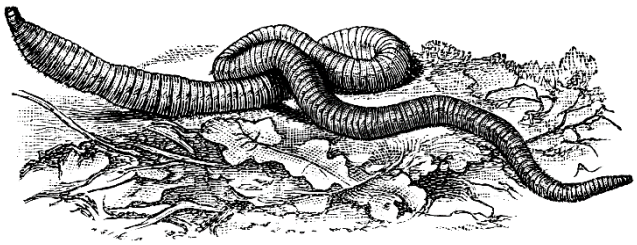


The number two science story of 2020 or any other recent year has to be climate change. "The Empty Space Where Normal Once Lived" by Bathsheba Demuth (assistant professor of history and environment and society at Brown) links climate change and COVID-19 (not the only piece in the book to do so). In terms of the sheer density of concepts presented, this short article (barely over 5 pages) may be the richest in the book. On the summer solstice in 2019, she was in Siberia continuing her research on how Yankee whaling impacted indigenous communities on the opposite side of the globe. That day her temperature and Siberia's were the same at 100.4°F. She had been dealing with "long COVID" for months, but Siberia's "fever" was worse, averaging more than 9 degrees above long-term averages. She likens 19th century whaling in the Arctic to light Rhode Island with 20th century coal mining in Siberia to generate electricity to power Soviet industry. She laments that the phenomenon of shifting baselines makes us forget how things should really be—"Long COVID and climate change are alike in this: live ill for long enough, and the absence of health threatens to become normal."

Three articles in the "Consequences" section speak to topics closer to natural history. "Fish Out of Water" by Maya L. Kapoor deals with the endangered Yaqui catfish, the only catfish native to the western US. Its only remaining habitat

in the US is in the San Bernadino National Wildlife Refuge in Arizona; 98% of the species' habitat is in Mexico. Withdrawal of 700,000 gallons of freshwater a day for construction of the border wall, exempted from review under the National Environmental Policy Act and being rushed to get as much done before the 2020 presidential election as possible, was destroying what little habitat remains. "Long May They Reign" by Nora Caplan-Bricker, is about monarch butterflies in the western US and some of the scientists and volunteers working to conserve the species. Populations are declining because of neonicotinoid pesticides and other toxins, climate change, and habitat destruction.

"Cancel Earthworms" by Julia Rosen is about "global worming." We think that earthworms make soil healthy, but the opposite is true—healthy soil attracts earthworms. The earthworm that we think of as normal in Rhode Island is actually a non-native species introduced from Europe, which has now been established on every continent except Antarctica. Other species are also being spread—notably the recently discovered snake or jumping worm. The glaciers that covered much of North America killed native earthworms, so when the earliest colonists settled here there were few native earthworms in northeastern forests, mainly restricted to rotting logs and wetlands. Charles Darwin studied earthworms for 40 years, and calculated that they can move 10 tons of soil per acre per year. Forests without worms have a thick layer of leaf litter that takes decades to decompose and provides habitat and food for many species—insects, other invertebrates, amphibians, birds, small mammals, and native plants. Earthworms can decompose that layer in just a few years, releasing nutrients far faster than the plants can utilize them and decimating invertebrate populations. They could even destroy the forest in the long run by eliminating understory plants, leaving only the saplings of the dominant trees for the deer to browse upon, so the forest cannot renew itself.



(From Thompson, 1916, *Outlines of Zoology*, D. Appleton, New York. https://etc.usf.edu/clipart)

The other articles in the book are just as interesting as those highlighted above. For those who want even more, at the end it includes a list of "other notable science and nature writing of 2020" that runs to 78 titles. The 26 contributions in this book come from 16 original sources. *The Atlantic* led the pack with 5, leading me to think about subscribing for myself. The others with more than one showed a distinct trend—the *New York Times Magazine* (3), the *New York Times* (2), and the *New Yorker* (2). One of the real values I see in these annual anthologies is the breadth of topics covered each year—far more than I could find on my own without the able guidance of the editors. I wholeheartedly recommend this book and its future companions, and advise all to keep an eye out for the earlier volumes the next time you visit your favorite used-book stores.

Bob Kenney *is an Emeritus Marine Research Scientist at the URI Graduate School of Oceanography, a board member of RINHS, and a co-editor of* Rhode Island Naturalist.

HOW OLD AM I?

Special Issue 3 of *Rhode Island Naturalist* was published in November 2021. Written by Deirdre Robinson, it is a photographic guide to identifying the ages of saltmarsh sparrow nestlings. We expect this to become an important resource for scientists studying this imperiled bird species, who need to know nestling ages in order to safely band them at the right point in development. You can find it on our website; just go to https://rinhs.org/resource-library/, then type sparrow in the search box.

(ANSWER—5 days)

There are as many ways to build our knowledge of Rhode Island's animals, plants, and natural systems as there are people willing to help.

ANNUAL MEMBERSHIP in the Rhode Island Natural History Survey funds public events, helps conservationists and managers, and gives you a stake in the success!

Yes! I Want to Join the Survey.

I Can Help Connect People with Knowledge about Rhode Island's Animals, Plants, Geology, and Ecosystems.

Name _____

Address _____

City: _____ State: _____ Zip: _____

Email: _____

- ○ $25 Individual
- ○ $40 Family ($30 Senior Family)
- ○ $15 Student/Senior
- ○ $100 Organization

$ _____ Additional Gift for Mission Support

Join online by visiting www.rinhs.org and clicking the JOIN button. Or, make a check payable to RINHS and send it to the PO Box provided on the next page.

Rhode Island Naturalist © 2022

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

Annual Open House & Natural History Art Exhibit: Tuesday, March 22, 5:00–7:00 PM, at the Survey offices and outside in the courtyard, Bldg. 14, URI East Farm, Kingston (weather date March 23). Join us for warm company, sweet and savory treats, and the breadth of visual perspectives and delight that results when you mix science AND art. Photos, illustrations, water colors, paintings, and more from Ann Bianchi, David Chatowsky, Kathie Florsheim, Melissa Guillet, Aya Rothwell, Frances Topping, Robert J. Brennan III, Amy White, Brian O'Connor, Virginia Wootten, Chris Dodge, and Barbara Nowicki. Free, open to the public, and family friendly. RSVP to 401-874-5800 or http://tinyurl.com/2022openhouseartexhibit.

Annual Meeting and Lecture: Thursday, April 7, tentatively 7:00–8:30 PM. This will be a virtual event with a recap of the past year and board elections, followed by a fascinating talk by Alicia Lehrer, Executive Director of the Woonasquatucket River Watershed Council on making environmentalism and ecology relevant to an urban community. Watch for our "News to Use" email newsletter for more details and information on how to register.

BioBlitz 2022: The 23rd edition of the longest-running BioBlitz in the world is being planned for Friday and Saturday, June 10 and 11. This BioBlitz will be something quite different from any we have done before. Science Central will be at the Audubon Nature Center and Aquarium in Bristol, and we'll be BioBlitzing multiple sites from there north along the East Bay Bike Path (we're still working on the list). When the time comes you *must* pre-register to participate. Watch our "News to Use" email newsletter for announcments and details of orientation and registration.

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

RHODE ISLAND
NATURAL HISTORY SURVEY