# RINHewS

## The Newsletter of the Rhode Island Natural History Survey

Vol. 6, No. 2 November 1999

# *Rhode Island Goes Dry: The Drought of 1999*

With ponds filling and streams flowing strongly again, this summer's drought seems a distant memory. The 1999 drought was, however, the worst drought in the state since record-keeping began over 100 years ago, and the effect of the drought on Rhode Island's biota and ecosystems is far from clear.

In an effort to begin to understand those effects, we asked some Rhode Island scientists to share with us what they observed during the drought, what questions those observations brought to mind, and what areas they'd like to see more research to answer those questions. The responses we received follow. We welcome other observations and musings, and will include them in future issues of *RINHewS*.

**from Keith T. Killingbeck,** URI Department of Biological Sciences

*Observations and thoughts on the effects of the 1999 drought on senescing leaves*

I first noticed it on August 3 this past summer. No, it was not my surprise that the Boston Red Sox were still in the hunt for post-season play. It wasn't even my growing awareness that the summer was slipping away. Rather, it was color. Not the greens of summer, but the reds, yellows, ambers, and maroons of autumn. The note I wrote to myself said simply; "Sugar Maples by Rippy's—orange leaves."

The notes didn't end there. August 4; "birches almost completely yellow at the top of a hill near Rockville—fresh leaf litter covers the ground"—plants with colored leaves already = sumac, dogwood, birch, Red Maple, Sugar Maple, Tupelo." August 5: "Tupelo at Sawmill Pond with every leaf turned maroon, or partly so—Red Maple with all leaves completely red."

In most years, notes to myself like these are dated September, or October. So why the first week in August 1999? Drought. At least that is the answer supported most rigorously by what is known about the relationship between moisture availability and leaf senescence. The unprecedented deficit in available growing season moisture in Rhode Island, especially in June and July, appears to be the cue that triggered the onset of early leaf senescence in some species.

It has been conclusively established that the onset and rate of leaf senescence can be influenced dramatically by the amount of moisture available to a plant. In the face of drought, leaves of woody deciduous perennials begin to shutdown earlier than normal, and are often jettisoned well before the time of normal leaf drop. This is not so surprising when one realizes that the deciduous leaf habit is an adaptation evolved to deal with seasonally predictable drought. Deciduous plants discard their entire inventory of leaves before the onset of a predictable, annually repeated season in which sufficient moisture for normal growth is not present, or not available for uptake (i.e., snow, ice). Even in the tropics, the deciduous habit is common in ecosystems having a predictable "dry season" each year.

More notes. September 21; "Sassafras on Rt. 2 just started to turn." October 4; "Sassafras peak, much orange-bronze this year." Compare this last note to one I made in 1997, a year when precipitation in August alone was six inches above average—September 30; "Sassafras fully 'peachy' today on east side of Rt. 2." Peak color in Sassafras was virtually the same in both years. Does this mean that Sassafras reverted to a more normal senescence schedule after the rains received in September broke the drought of 1999? Or, was Sassafras always "on schedule" in 1999 despite the drought?

Questions such as these abound. Consider this: leaves of Red Maples usually begin to turn color in September and drop to the ground by mid to late October. The entire period of senescence lasts

*continued on p. 8*

## What's Inside?

# Research Reports

## *Looking for Low D.O: An All Night Adventure*
by Christopher Deacutis

This past summer, over 30 determined scientists set out on two separate evenings to take readings of dissolved oxygen (D.O.) across Narragansett Bay. The volunteers came from an impressive list of federal, multi-state, and university affiliations, as well as from the private sector and Save The Bay. Their goal? To gain a better insight into the pattern of dissolved oxygen fields in the Bay through voluntary participation in a coordinated D.O. "SWAT/Strike Force." The result? An impressive synoptic 12-hour view of the entire upper half of Narragansett Bay, including the Providence River, Upper Bay, Greenwich Bay, Mount Hope Bay, and the upper half of both the East and West Passage.

Why search for low D.O. in Narragansett Bay? I believe we have become overly complacent in assuming that low D.O. does not occur in the open waters of the Bay below Conimicut Point. Nationally, some researchers have pointed out that the incidence of hypoxia (dissolved oxygen < 2.0 ppm) and anoxia (no oxygen) is likely seriously underestimated in all but extremely degraded systems, due to its transitory nature (Summers *et al.* 1997).

In September of 1998, the Rhode Island Department of Environmental Management (RIDEM) Narragansett Bay Estuary Program (NBEP) and the Rhode Island Sea Grant/URI Coastal Institute cosponsored a workshop on nutrient removal for wastewater treatment facilities entitled "Nutrients And Narragansett Bay." At that workshop, I presented significant circumstantial evidence of sporadic hypoxia occurring in mid or late summer over large parts of the upper half of the Bay, with some troubled coves experiencing anoxia in late evening (Deacutis 1999). Such events may be brief (on the order of days or hours), but can have a significant and lethal effect on sensitive bottom species in the Bay.

Hypoxia/anoxia can be an extremely blunt hammer with widespread long-term consequences to estuaries. Robert Diaz recently noted that oxygen deficiency may be the most widespread anthropogenic impact to the marine environment in terms of localized mortality of benthic macrofauna (Diaz and Rosenberg 1995). In his words, "No other environmental variable of such ecological importance to coastal marine ecosystems around the world has changed so drastically in such a short period as dissolved oxygen...their occurrence [hypoxia and anoxia] in shallow coastal and estuarine areas appears to be increasing, most likely accelerated by human activities" (Diaz 1995).

Such events may be contributing to a qualitative shift in benthic communities toward more opportunistic species (Frithsen 1990), as well as a shift in the dominant fish community from benthic species to a pelagic community in Narragansett Bay over the last two decades (RIDEM Fish & Wildlife unpublished data). Scientists agree that the driving parameter behind low D.O. is the rapid growth of phytoplankton and/or macroalgae biomass in the Bay in response to high loadings of nitrogen. When these plants die, bacterial decomposition uses up much of the available oxygen in the bottom waters on very calm, hot nights in late summer, under conditions where the water column becomes stratified.

Following that conference, I called for the formation of a "strike force" made up of volunteer scientists who would be willing to go out on short notice to investigate large areas of the Bay for low oxygen. I agreed to coordinate the effort and to set up a monitoring scheme of stations, stratified by depth, for water-column profiles of the upper half of the Bay. Unfortunately there was no grant funding available for this venture, and I was concerned that the effort would be severely undermanned due to the "volunteer" aspect of the plan. I underestimated the generosity of scientists in our area: we had over ten boat crews volunteer for our first "baseline" survey. Scientists and volunteer monitors from a dizzying array of institutions and groups all showed up for a planning meeting. In addition, two private sector companies, New England Environmental Equipment and YSI MA volunteered to provide a boat and crew and use of several monitoring probes for this first survey.

And so on the evening of June 24, 1999, eleven boat crews set out in 20-28' boats from various parts of the Bay, ranging from URI/GSO to the East Providence Yacht Club, and from Roger Williams University to Fall River. A steady 20-knot wind blew out of the SW. The Bay watershed had been experiencing a history-breaking drought, so I was not expecting to see much in the way of low oxygen (the usual wisdom being that heavy rains are necessary to provide low-salinity waters and a slug of nutrients to set the Bay up for hypoxia in deep waters). Many of us met at the Prudence Island T-wharf for a cross-instrument calibration "dip-in." Each boat then set out to gather water column data at 8 to 16 preassigned stations across the upper half of the Bay. Using GPS to locate positions after dark, we profiled salinity, temperature, and dissolved oxygen at more than 110 stations from 7PM to midnight. After a brief rest stop at the Narragansett Bay National Estuarine Research Reserve (NBNERR) overnight facilities on

*The flotilla "Strike Force" gathers*

Prudence Island, we repeated the process at each station from 3AM to 7AM.

Because Narragansett Bay has always been classified as a "well-mixed" estuary below the Providence River (based on wind and tidal energies with low freshwater inputs), it has normally been assumed that mixing of the water column maintains adequate oxygen at all depths, especially when the wind is at the levels we were experiencing. The reality we saw in our results, mirrored in the ongoing studies by Dana Kester and others who are continuously recording levels of salinity, temperature, and dissolved oxygen at sites around the Bay, presents a different picture. We are now beginning to recognize that stratification of the water column can occur in open waters of the Bay well below Conimicut Point (mouth of the Providence River) during weak neap tides, even when moderate winds are blowing.

And our data reflected that stratification on this neap-tide evening. Although we expected low oxygen along the Providence River, we also found low (<3.5 ppm) oxygen at a number of stations well below Conimicut Point. The ship channel and deeper areas on the West side of the Upper Bay, the shallow (<10m) area of the upper West Passage north of Quonset, and parts of Greenwich Bay, all produced low-oxygen signals at or close to the bottom on this windy night. Due to the prevailing drought conditions we were experiencing, the D.O. data we recorded reflected conditions influenced mainly by point sources and baseline riverine and groundwater nutrient inputs.

Our second survey occurred on August 24-25, 1999, a beautiful, moonlit, and calm evening three days after a small rainstorm. Although I am still gathering the data from the groups that participated in the second survey, the data available indicate that oxygen conditions were not as low at most stations during this more-energetic spring-tide period. Nevertheless, there were still areas which showed depressed (<4.0 ppm) D.O., including deep areas on the west side of the Upper Bay and that problemmatic shallow area in the upper West Passage.

We hope to have a report of these results by late fall 1999 or early winter 2000. The greatest value will come from merging our data sets with GIS depth-contour maps of the Bay to get a better picture of the geographic extent of the depressed oxygen values we recorded. In addition, we need to repeat this work again next summer (I am hoping we can gather teams for one survey each month from June to early September). The greatest advances will come when our results can be joined to those of other researchers, like Dr. Kester, who are continuously recording oxygen levels at fixed stations in the Bay. Ultimately these data will provide a high-resolution hydrodynamic model of the Bay which encompasses D.O. relationships associated with biological productivity, organic decomposition rates, nutrient loads, and primary episodic physical driving factors. Such a model should provide fairly accurate predictions of short-term dissolved oxygen fields in the Bay, and could be linked to legally defensible nutrient loading limits for wastewater treatment plants.

I wish to thank sincerely all the volunteers who participated and remain a vital part of this effort. We have dedicated our efforts to the memory of our good friend and colleague, Mark Gould of Roger Williams University (one of the first "up to the plate" to join our band of insomniacs), whose untimely death greatly saddened all of us. For further information, email Christopher Deacutis RIDEM NBEP, email address: deacutis@etal.uri.edu

**Members of the D.O. "Strike Force" for Summer 99 were:**

*MA Coastal Zone Management:* Christian Krahforst, Jason Burtner
*Harvard School of Public Health:* James Shine, Aimee Vinturella, Julianna Connelly, Josh Das
*Brown University:* Warren Prell, David Murray, Nick Garrity
*Roger Williams University:* Andrew Tate, Bob Roser, Tim Scott, Stephen O'Shea, Skip Pomeroy, Paul Webb
*URI MERL:* Chris Melrose, Mike Traber, Mac Richardson, Tarquin Dorrington, Brandi Bornt; Lab Support: Laura Reed, Edwin Requintina, Candace Oviatt
*Save The Bay, Inc:* John Torgan, Topher Hamblett, Andy Lipsky
*EPA Narragansett:* Don Cobb, Kellie Merrell, Kelly Byron, John Lake, Mike Daly, Russ Ahlgren
*EPA Lexington:* Ray Thompson, Tim Bridges, Tom Faber,

Randy Rice, Melissa Grable
*RIDEM:* Joe Migliore, Brian Dolan, Bob Richardson, Scott Oshevski, Nicole Thomson, Christopher Deacutis
*Narragansett Bay Commission:* Taylor Ellis, Sharon Pavignano
*Narragansett Bay National Estuarine Research Reserve:* Al Beck, Susan Adamowicz
*US F&WS:* Tom Halavik
*YSI MA & NE3:* Roger Race, Derek Koloski

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***Christopher Deacutis** is Research Coordinator for the Narragansett Bay Estuary Program and the Narragansett Bay National Estuarine Research Reserve.*

## *Monitoring Narragansett Bay: A Joint State/Federal Program*

by Mark Berman

Narragansett Bay is in many ways the heart of Rhode Island. It is central to the history of the state and plays a key role in Rhode Island's industry, tourism, and recreation. Given the Bay's importance, it is somewhat surprising that until recently research on the Bay has been scattered and largely uncoordinated. Two years ago Senator Chafee sought to address this problem by leading Congress to approve funding for a comprehensive study of Narragansett Bay, to be managed jointly by the Rhode Island Department of Environmental Management and the Narragansett Laboratory of the National Marine Fisheries Service. The resulting Cooperative Bay Study comprises several different parts, including an enhanced assessment of the fish stocks and fisheries of Narragansett Bay, and a multifaceted evaluation of the ecological state (health) of the Bay. One component of the ecological study is a monitoring program, intended to increase our knowledge of the processes that control the Bay and provide the data needed by Bay managers to make informed decisions on issues affecting Rhode Island's most valuable resource.

The two main components of the monitoring program are a network of fixed-site hydrographic sensors and a monthly survey of the water chemistry, physics, and plankton of the Bay. The fixed-site network currently includes six sites chosen to represent major areas of the Bay. The sites are maintained and data from them are analyzed by researchers from URI's Graduate School of Oceanography, the Narragansett Bay National Estuarine Research Reserve, and Roger Williams University.

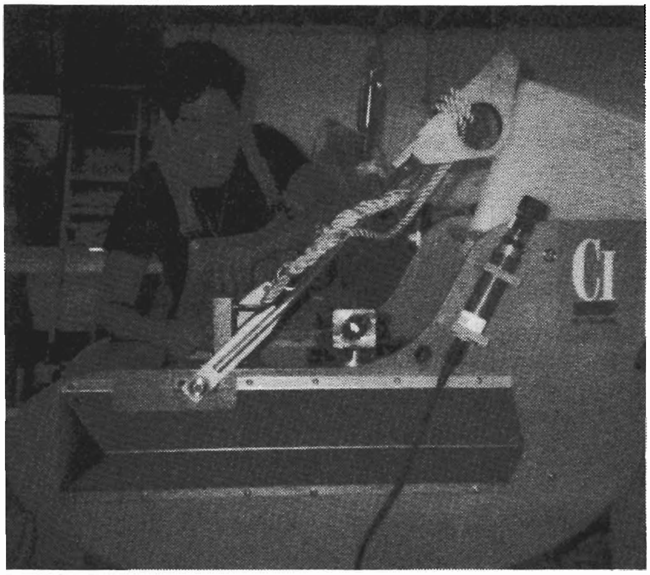

*Figure 1. Former graduate student Cynthia Suchman preparing the NuShuttle for a Bay transect.*

At each fixed-site location a set of sensors is deployed, either mounted on a pier or suspended beneath a buoy. Instruments are mounted at one or two depths, depending on the location; measurements include temperature, salinity, tide height, pH, dissolved oxygen concentration, turbidity, and chlorophyll fluorescence. The instruments monitor continuously, recording data every 15 minutes, and storing them internally or telemetering them to recording stations on a daily basis. Data from the fixed-site network, and other components of the Bay study, will soon be available over the Internet.

The fixed-site sampling program provides excellent temporal resolution of a limited suite of parameters. It has the ability to characterize short-term phenomena, such as ephemeral plankton blooms or hypoxic events. However, the fixed-site network is necessarily limited by its lack of geographical resolution. This weakness is dealt with in the Cooperative Bay Study by the addition of a second monitoring component: a set of monthly surveys carried out with an advanced towed-body oceanographic sampler. The Chelsea Instruments NuShuttle (Fig. 1) undulates through the water column, recording key biological, physical, and chemical parameters along the course of the transect. Its flight parameters—maximum depth, minimum depth, climb and dive rates, and minimum distance from bottom—are controlled in real-time from a shipboard computer. Instrumentation in the Narragansett Bay NuShuttle includes: 1) an altimeter for measuring distance from the bottom; 2) a CTD-fluorometer which measures variations of temperature and salinity with depth, as well as the amount of chlorophyll fluorescence (which can be used as an indication of the amount of phytoplankton present in the water); 3) a fast-repetition-rate fluorometer to measure primary production (the rate at which the phytoplankton are growing )(Kolber and Falkowski 1993); 4) a continuous plankton recorder (CPR) to collect and preserve zooplankton samples on a continuously moving silk filtering mesh (Colebrook 1960); 5) an optical plankton counter (OPC) (Herman 1992) which records the number and size of the zooplankton it encounters every half-second to show fine scale distribution of zooplankton (the OPC also records light attenuation, depth, and flow rate); 6) a dissolved oxygen sensor; and 7) a PAR sensor for measuring the amount of light reaching the phytoplankton to support photosynthesis.

At the end of a transect, data from all of the electronic instruments are downloaded to laboratory computers for display, analysis, and archiving. This part of the data management is typically completed within a few days of the sampling. Only the CPR collections take longer to analyze. At the end of a cruise, the CPR is disassembled, the filtering gauze is cut into segments representing different sections of the Bay, and the collected animals are counted and identified under a microscope.

Each month the NuShuttle is towed on a circular course around Narragansett Bay and its adjacent waters. Sampling starts off Quonset Point, and the transect proceeds south into Rhode Island Sound, then comes up the East Passage, does a loop into Mount Hope Bay, and moves up the Providence River as far as Fields Point before returning to the starting position (Fig. 2). Transects typically start at 7:00 AM and end at about 4:00 PM (sampling is limited to daylight hours because of the need to avoid the abundant fixed fishing gear in Narragansett Bay). Sampling days are selected to standardize tide phase and height between transects, to the extent possible. Tow speed is maintained at 8 knots and sampling depth varies with the water

**Narragansett Bay Transect**

QP = Quonset Point (start and end)
DI = Dutch Island
WR = Whale Rock
BB = NB Buoy
BP = Brenton Point
NB = Newport Bridge
PI = Prudence Island
MH = Mount Hope
CP = Conimicut Point
WN = Warwick Neck

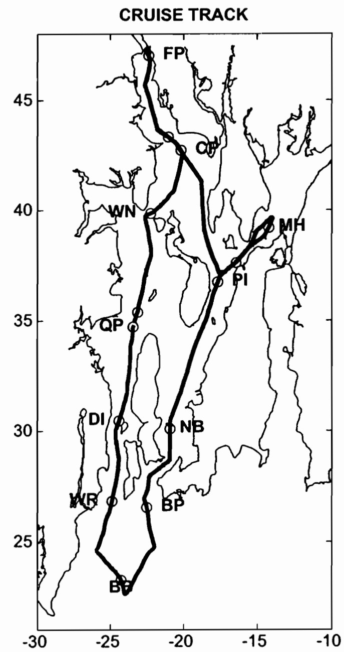


*Figure 2. Cruise track for the monthly transect.*

depth in different parts of the Bay between 5 and 20 m.

As of the writing of this article, we have conducted 19 monthly surveys. The data are being used to establish a baseline understanding of the "normal" annual cycle of the Narragansett Bay ecosystem. This will not only increase the understanding of the dynamics of the Bay and the factors that control them, but also will serve as a basis of comparison for future data collections. We hope to be able to see changes in the Bay ecology much more quickly than was previously possible. Thus Bay managers will be better able to assess the success of pollution-control measures and will be able to react to adverse conditions (e.g., algal blooms and hypoxic events) in time to mitigate damage.

Although this transect has been running for less than two years, we have seen several phenomena that have surprised us. For example, the production cycle of Narragansett Bay has traditionally been dominated by a large phytoplankton bloom in the late winter and early spring. This bloom would provide most of the year's supply of the organic material that would serve as the food source for zooplankton and many fish and shellfish species through much of the year. During the two winters we have been monitoring, our data have shown no sign of a spring bloom. Instead, the Bay's production has been dominated by a number of short-term blooms appearing in different areas of the upper Bay throughout the summer. Hypoxic events, periods of low dissolved oxygen levels that can threaten marine life, were thought to be relatively rare events in

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Narragansett Bay and limited to the Providence River and shallow, isolated embayments in the summer. However, the monthly surveys have shown hypoxic events to be more frequent and widespread than was previously believed. These findings may be a result of the warm winters we have experienced in the last two years, or they can be an indication that the dynamics of Narragansett Bay ecosystem are in a state of transition. Researchers involved in the Cooperative Bay Study are continuing to monitor the Bay's ecology to see if these trends continue, and to assess the impact that they might have on the varied uses of Narragansett Bay.

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*__Mark Berman__ is a research oceanographer with the National Marine Fisheries Service.*

## *Biological Control of Purple Loosestrife at Roger Williams Park Zoo*

by Lisa Tewksbury and Richard Casagrande

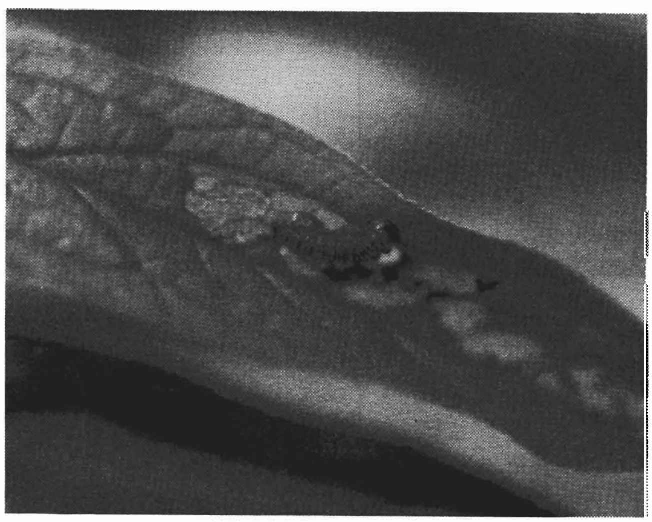
We became involved in biological control of Purple Loosestrife in 1994 at the request of Roger Williams Park Zoo, which wanted to control this invasive plant in its wetland. Anyone who has visited the wetland walk at the zoo in July or August will be familiar with the dense stands of purple flowers on both sides of the walk when Loosestrife is in bloom. The zoo wanted to remove the Loosestrife and encourage the growth of native wetland plants, but their hand-pulling efforts had been unsuccessful. At that time we were aware of the extent of Loosestrife invasion throughout Rhode Island wetlands, and we knew of the extensive biological control program under development for Loosestrife at the national level.

Purple Loosestrife *(Lythrum salicaria)* is an introduced plant that has become a serious wetland weed. Native to Europe, it was introduced into North America in the 1800s both accidentally (in ships' ballast) and intentionally for use as a medicinal herb and for ornamental purposes. Purple Loosestrife is a tall plant with a distinctive purple flowering spike. It possesses a strong rootstock that serves as a storage organ, allowing the plant to grow quickly in the spring and to dominate the native herbaceous canopy. With no native herbivores or pathogens in the United States, Loosestrife has spread rapidly and is currently distributed throughout the entire northern United States and southern Canada.

Although it has an attractive flower, Purple Loosestrife is considered a noxious weed because of its tendency to displace other types of aquatic vegetation. Dense stands of Purple Loosestrife eliminate the food and cover necessary for wetland wildlife such as ducks, geese, bog turtles, and muskrats. Purple Loosestrife displaces native vegetation and eliminates the shallow sandbars needed by many of these species.

The relative lack of success of control measures--e.g., mowing, hand pulling, flaming, chemical treatments, and water level management--has led to the current use of biological control against Purple Loosestrife. Biological control of an introduced weed such as Purple Loosestrife involves introducing natural enemies of the weed from its place of origin into its new home. The search for insect natural enemies began in Europe in the mid-1980s. One hundred and twenty insect species were found to feed on Purple Loosestrife in Europe. Of these insects, 14 were found to be host-specific to *Lythrum* species and 6 were recommended for further study as potential biological control agents in the USA. Following years of laboratory and field research on host specificity, five species were cleared for use in the USA.

From 1994 to 1996 we released *Galerucella calmariensis* and *Galerucella pusilla* at the zoo. The two *Galerucella* species are difficult to tell apart, and are generally reared and released together. They are small beetles (3-5 mm) which emerge from overwintering in May, lay eggs in May and June, and die in June. Each female can lay 300-400 eggs on



Galerucella *larva feeding on* Lythrum salicaria.

stems and leaf axils. The larvae feed on buds, leaves, and stems. They pupate in the soil and groundcover near Loosestrife plants. There is only one generation per year, and the newly emerged adults overwinter in leaf litter.

*Galerucella* beetles overwintered successfully in the zoo the first year after release, and during the summer of 1998 the beetles truly showed what they could do--the entire stand of Purple Loosestrife on the wetland walk was completely defoliated. The beetles prevented acres of loosestrife from setting seed, allowing many native plants to regain a foothold. We were expecting to see defoliation again in 1999, and were surprised that it had not occurred by the beginning of July, when first-generation adults were expected to go into the leaf litter to overwinter. Instead, an unusually large number of these adults laid eggs. The eggs hatched, larvae developed and pupated, and we had a massive second generation of adult *Galerucella*.

Employees at the zoo alerted us to the fact that swarms of insects were flying in the wetland area of the zoo. On August 6 we visited the zoo and found that there were hundreds of thousands of adult *Galerucella* in the wetland alternately flying, resting on plants, or feeding. At this time the Purple Loosestrife was totally defoliated. Adult *Galerucella* were seen resting on many species of plants in the same area as the defoliated loosestrife, but we observed only one plant species, Multiflora Rose (*Rosa multiflora*), to have *Galerucella* adults actively feeding on the plants, and causing significant damage.

We returned to the zoo on August 11 to evaluate the damage to Multiflora Rose from *Galerucella* feeding. All of these plants along the wetland boardwalk, which is in the immediate area of the Purple Loosestrife, were completely skeletonized. We also found one new shoot of Pussywillow (*Salix discolor*) that was skeletonized, and one leaf of Northern Bayberry (*Myrica pensylvanica*) that exhibited a small amount of feeding. There were adult *Galerucella* present, and feeding, on all these plants. It is important to note that these plants were the only ones that sustained feeding damage. There was no sign of feeding among the 12 other plant species that we examined in the wetland. The Multiflora Rose located 45 meters from the wetland boardwalk sustained only moderate damage, and there was no sign of injury on plants 150 meters away. The single leaf of bayberry and the single new shoot of willow, was the extent of this damage to these species, which are common in this wetland. By September 20, when we returned to the zoo again, all of the *Galerucella* had moved to overwintering sites.

We consider this feeding on Multiflora Rose to be merely incidental feeding damage. It does not represent a host shift. Adult beetles will not lay eggs on Multiflora Rose, and larvae will not develop on it. These insects are not attracted to these non-host plants, and we would be very surprised to see defoliation at any distance from the wetland. It is possible that in the future we'll continue to see starving beetles causing occasional defoliation of non-host plants growing within the wetland. Since Multiflora Rose is itself an invasive plant some occasional defoliation will not generate much concern. By September 20 the defoliated Multiflora Rose plants had already begun to show regrowth. Even with this ancillary damage in the wetland, it is hard to imagine another control alternative (certainly not herbicides) for Purple Loosestrife that is more specific than *Galerucella* beetles.

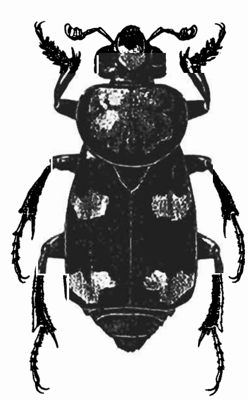
*__Lisa Tewksbury__ is a research associate at URI's Department of Plant Sciences. __Richard Casagrande__ is a professor at URI's Department of Plant Sciences.*

## *Roger Williams Park Zoo and the American Burying Beetle,* **Nicrophorus americanus,** *Recovery Program*

by Ming Lee Prospero

American Burying Beetles (ABB) were listed as a federally endangered species in 1989. Once found across most of the eastern and midwestern states of the United States, and in the southern regions of Ontario, Quebec, and Nova Scotia in Canada, ABBs are currently found only in small isolated populations. The remaining naturally occurring population east of the Mississippi River is found only on Block Island, off the southern coast of Rhode Island. West of the Mississippi River ABBs are found in eastern Oklahoma, Arkansas, eastern Kansas, central Nebraska, and in extreme southern South Dakota.

The direct causes of the beetles' decline remain unclear. Habitat loss, pesticides, and loss of larger carrion items, as well as other factors, may contribute to their loss. We do know that *Nicrophorus americanus* requires the largest vertebrate carrion in its



genus to reproduce (80-200 gram carcasses are needed) and that loss of available carrion and greater competition for existing carrion has had deleterious effects on the beetles' populations. In comparison, other *Nicrophorus* beetles found in North America are smaller and can readily reproduce using the carcasses of animals found in our landscape today.

In 1992, the U.S. Fish and Wildlife Service (USFWS) generated a recovery plan for the species, outlining tasks that will help ensure the future of the beetles. One of USFWS goals is to implement a reintroduction plan for this species using captive-reared animals. Since 1994, Roger Williams Park Zoo (RWPZ) has collaborated with USFWS on this aspect of the recovery effort.

The zoo breeds ABBs throughout the year for release on Nantucket Island, Massachusetts, where they were once found. The zoo's staff brings their animal husbandry expertise to this endeavor. By providing the essential components—compact soil in a brood bucket, a vertebrate carcass, and a pair of beetles—the zoo has been able to successfully raise over twenty generations of beetles.

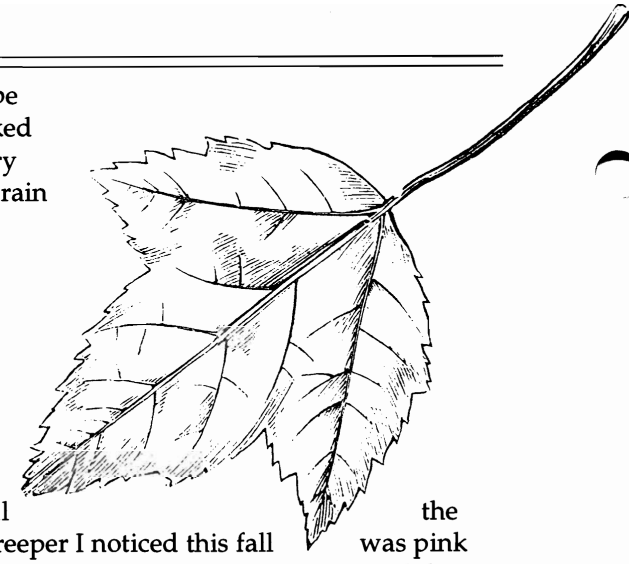
In 1999, RWPZ and USFWS released a total of 87 pairs of beetles and 19 single beetles, making this the largest release to date. In the past year this recovery program has become more widely known. The Discovery Channel featured the ABB in a twenty-minute segment, and the PBS children's show "Arthur" will be airing a small segment on the beetle this fall. Papers written by zoo staff have also been given at professional conferences highlighting the need for more collaborations between American Zoo Association organizations and agencies like USFWS.

***Ming Lee Prospero** is American Burying Beetle Project Coordinator/Zookeeper at the Roger Williams Park Zoo.*

## *Rhode Island Goes Dry*, *continued from p. 1*

approximately six weeks. Does this mean that Red Maples that began to senesce in early August this year should have dropped their leaves by mid to late September? Some clearly did, but most did not. Was senescence reversed, or retarded in maples that held their leaves well into the middle of October? Would all Red Maples have dropped their leaves in September if the drought had not broken during that month? Experiments with agricultural species, such as tobacco, indicate that senescence is reversible, at least until a plant reaches a threshold beyond which the process becomes irreversible. However, whether senescence is synchronously reversible on a grand scale in natural landscapes harboring a kaleidoscope of diverse species remains unknown.

Some events of the past year, such as the extraordinarily early senescence in birches and maples, appear to be clearly linked to the paltry amount of rain received during the growing season. Other relationships appear to be less clear. All the Virginia Creeper I noticed this fall was pink rather than the more normal red-maroon, and the colors of Poison Sumac and Sassafras appeared to be unusually flamboyant. Was this due to the drought of 1999? The cessation of El Niño? Sunspots? Global warming? The Curse of the Bambino? The point is that cause:effect relationships are often difficult to establish definitively. We may never know the exact degree to which all of the patterns and intricacies of this fall foliage season were linked to the drought of 1999.



One final note. October 12: "the Red Sox are still playing baseball, so discard the Curse of the Bambino theory."

**From Art Gold, Mark Stolt, Kelly Addy, Q. Kellogg,** URI Department of Natural Resources Science

In response to your request for information regarding ecological observations on the drought, we have an odd perspective.

We work on the role of riparian zones (streamside wetlands) on the watershed export of nitrate. We find that groundwater nitrate can be removed through denitrification, if the groundwater encounters a labile carbon source and anaerobic conditions. We find great variability in nitrogen dynamics between riparian zones and we seek to explain the controlling factors.

In most years we have great difficulties observing subsurface conditions. Usually, it takes a great effort for us to observe patterns of subsurface carbon, rooting patterns, and nitrogen dynamics. Most of our observations require laborious processes, using coring techniques, tracers, and isotopic chemistry to explore the subsurface.

This year, the groundwater at our study sites was at all-time lows. At the height of the drought we simply dug pits and looked deeper into the subsurface than ever before. In several situations, we found buried organic horizons, probably buried as a result of ancient hurricanes. These ancient horizons appear to be riddled with roots, even though they are located at depths that are typically inundated with groundwater. We are now investigating whether these ancient buried layers might serve as an important attractant for deep root penetration and whether these horizons can influence groundwater nitrate removal in riparian zones.

**From Nick Miller and Frank Golet,** URI Department of Natural Resources Science

We conducted surveys for breeding populations of Northern Waterthrushes (*Seiurus noveboracensis*) in very poorly drained forested wetlands located throughout Rhode Island during the drought year of 1999 and in the relatively wetter years of 1997 and 1998.

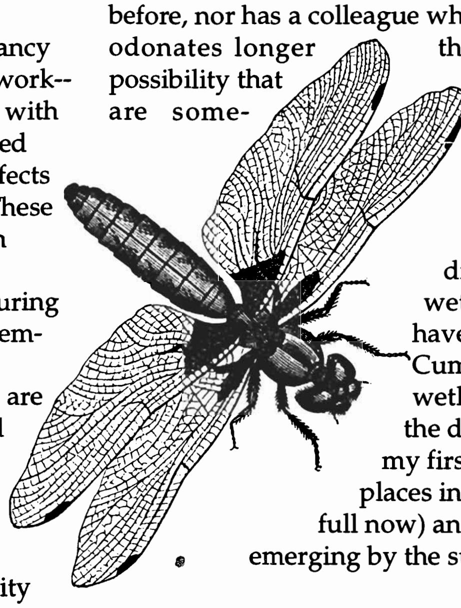
This species is swamp-dependent, foraging in saturated substrates and at the edges of surface water pools. The swamps were noticeably drier in 1999, than during the previous two years. Birds were surveyed in 79 plots located in 44 swamps. Forty-four of these plots were surveyed in 1997 and 35 were surveyed in 1998; all of the 79 plots were surveyed during 1999. Data collected in 1997 and 1998 were pooled to enable comparison with the drought year of 1999. We detected Northern Waterthrushes in 70% of the plots during 1997-98. During 1999, Waterthrushes were observed in only 52% of these plots. Variability in water levels may influence the presence and abundance of Northern Waterthrushes in Rhode Island forested wetlands. Analyses of Breeding Bird Survey (BBS) data have illustrated widely fluctuating trends in this species' population levels. Swamps that are typically toward the dry end of the moisture spectrum may be deserted during droughts, but may provide additional breeding habitat to bolster Northern Waterthrush populations during wetter years. We intend to investigate further these issues in future years.

**From Virginia Carpenter,** The Nature Conservancy

Most of my experience has come from my work--and that of volunteers--with dragonflies, either with the Rhode Island Atlas project or with the Ringed Boghaunter. By late July I began noticing the effects of the drought, particularly on small streams. These watercourses, which had been flowing nicely in June, were either completely dry or reduced to isolated pools of standing water. At this time during the odonate season, I spend time looking for members of a wonderful dragonfly genus called the Emeralds (Genus *Somatochlora*), many of which are found on streams. These dragonflies are named for their stunning emerald green eyes, which sparkle like Christmas tree ornaments. What I, and other Atlas volunteers, found was that the Emerald activity, even on these dried-up streams, was impressive. Adult dragonfly activity was centered around what water, if any, remained on the stream and, as you might expect, the activity at these pools was ceaseless. Male emeralds defended individual pools of water from other males and spent a lot of time hovering over these small areas to protect them. Also, despite the dearth of water, females were frequently observed ovipositing (laying eggs) on damp or dry stream sediments, whatever was available. And, now that streams are dry or severely reduced in flow, dirt roads look just like dry stream beds, so dragonflies were observed attempting to oviposit on the road as though it were a stream bed. The question remains, what happens to those eggs that are laid in a dry stream bed? Will there be Emeralds there next year?

Eric Biber, a graduate student at Yale, has been doing water quality and hydrology work at Ringed Boghaunter wetlands, which typically are acid fens/bogs. These sites dry up regularly, though not every year necessarily (they are not technically vernal pools), which keeps out the fish. Eric had water-monitoring wells in several sites this year, and found that for a period of time, the wetlands were not only dry, but the water table was as much as 2 feet below the surface! The Emerald question comes to mind again....just how drought-tolerant are these critters? We will know next year.

Another note: On September 19, while kayaking/ode hunting in Cumberland, I noticed several species of odonates emerging from the larval stage, other very teneral individuals that had clearly just emerged that day. The Common Green Darners (*Anax junius*) were not unexpected, as there is a contingent that emerges in late summer and then migrates south. The ones I saw on September 19 were probably travelers. However, it was quite startling to see the Forktails (Genus *Ischnura*) and Rubyspots (Genus *Hetaerina*) emerging this late. I've never seen this before, nor has a colleague who has been studying odonates longer than I have. I pose the possibility that these fall emergences are somehow drought (or after-the-drought) related....perhaps there were larvae that were stuck in the drought in a dry pond or wetland (unfortunately, I have no idea what this Cumberland pond/wetland looked like during the drought. Sunday was my first visit and like most places in northern RI, it is bank-full now) and then tricked into emerging by the sudden rising water.



*continued on p. 11*

# *Rhode Island Collections*

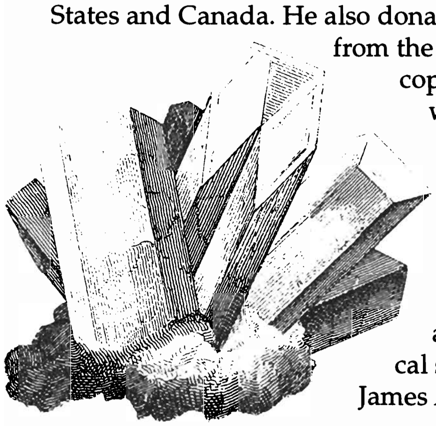
## *The Geology and Paleontology Collections of the Museum of Natural History at Roger Williams Park, Providence*

by Michael W. Kieron

When I volunteered to help reorganize the geological and paleontological collections at the Museum of Natural History in early 1992, I never imagined the scale the project would assume. Most of the paleontology collection was stored in deep wooden trays under glass wall cases in a closed exhibit gallery. Many of these specimens were covered with sixty years of accumulated dust while other specimens sat misidentified in oak drawers that were seldom opened. The mineralogical specimens were in wooden drawers, piled one upon each other, while the vault they would be stored in was being renovated. Yet what amazed me most were the sheer numbers of specimens. The hundreds of trays and drawers in paleontology held thousands of specimens, mostly of Pennsylvanian-aged plants from the coal mines abandoned so long ago in Rhode Island. Glancing into a drawer of mineral specimens, I saw a bournonite from Germany alongside Japanese stibnite and smithsonite from Greece. The drawer under it contained dozens of sphalerites from long-lost but not forgotten mines. I had no realization that such a hidden treasure existed in the state.

The nucleus of this collection was formed in 1896 when James M. Southwick (1846-1904) was chosen to become the museum's first director. Southwick had already established himself as a competent naturalist. Since the late 1870s he had worked with Frederick T. Jenks in Providence, where they sold natural history specimens and supplies. He contributed many self-collected specimens from classic localities from the eastern United States and Canada. He also donated ore minerals from the gold, silver, and copper mines that were opened in the great western metals boom.

The collection was further enlarged when the museum acquired about 2,500 geological specimens from James Angus (1819-1903) of New York, in memory of his brother-in-law, Providence City Auditor William D. Nisbet, in 1900. The collection consists largely of quartz and agate from Rio Grande Do Sul along with agatized wood from the western United States. This addition added a great aesthetic complement to the museum's collection.



Beginning in 1903, Herbert Scholfield (1872-1921) donated the first major Rhode Island fossil collection to the museum. Among the fossils he collected were the worm *Spirorbis carbonarius* and the freshwater bivalve *Antraconauta arenacea* from East Providence. Unfortunately a relapse of childhood tuberculosis forced him to return to the Trudeau Sanitarium in New York in 1902, from where he donated his fossils.

In 1904, Charles Abbott Davis (1868-1908) became the museum's second director, following the death of James Southwick. The museum received 200 Rhode Island plant fossils along with 30,000 mounted insects. His short tenure as director produced the most significant geological donations to the museum.

Not much is known about James H. Clarke (c. 1833-1904) except his collection of fossils, minerals, and mollusks. His 3,400 minerals added a global aspect not seen in the mineral collection before. He donated some of the museum's finest and largest pieces including a meteorite from Arizona and a stibnite from Japan. However, his 3,000 fossils from the Rhode Island Carboniferous are the crown jewels of the paleontology collection. The variety of his specimens cannot be surpassed. He added hundreds of *Calamites* from East Providence, about a thousand specimens from the abandoned Roger Williams coal mine in Cumberland, and hundreds more from the coal mines in Portsmouth and Cranston. There were also specimens from Pawtucket, Newport, Middletown, Warwick, and Providence. In the 1920s a new sphenopsid plant from Cumberland was found in his collection and named *Annularia clarkii* in Clarke's honor.

After Davis died in 1908, Harold L. Madison (1878-1947) became the museum's third director. He shifted the museum's direction from research to that of education and exhibition and received many large donations including that of Horace F. Carpenter (1842-1937), a Pawtucket chemist. Beginning in 1917, Carpenter bicycled in every morning with a large basket of minerals that he labeled with chemical formula, numbered, and placed according to the Dana System into the collections. Soon after donating more than 1,500 minerals it was found that all the labels started to fade from the new synthetic ink he was using and all of them had to be relabeled. His collection was smaller than Clarke's but of no less breadth. He added many rare and unusual specimens to the museum's mineral collection, including rare sulfosalts from Europe. Carpenter also added to the paleontology collection with many brachiopods, crinoids, and mollusks from the midwestern United States.

In 1925 William L. Bryant (c. 1871-1947) became director of the museum. He came to Providence from the Buffalo Museum of Science, where he had been director since 1909. His interests were with paleoichthyology and conodonts, and he described dozens of species during his tenure at the museum. He added hundreds of fossil fish from his own collections to the museum including many from the Devonian of Canada and Colorado with their accompanying glass negatives. It was during his tenure that the last great geological collection was added to the museum's collection. In the 1930s Susan F. Miner (c. 1867-1949) donated her collection of European minerals containing many specimens from England and Germany.

After the death of William L. Bryant in 1947 at the age of seventy-seven, the geological collections fell into disuse. The exhibits were taken down and stored away. Most of the fossils were placed without organization into trays and hidden under exhibit cases until the early 1990s, when their research and educational value were again realized. Since 1992 I have had the monumental task of reorganizing the collections where once again they can have both research and educational value.

Very often the best place to find undescribed species are in a museum's collection. Specimens collected a century ago in the collection could possibly expand the knowledge of Rhode Island's past environmental and geological history.

*__Michael Kieron__ has volunteered his expertise to the museum's earth sciences collection since 1992. He is past president of the Rhode Island Mineral Hunters and weekend naturalist at the Audubon Society of Rhode Island's Caratunk Refuge.*

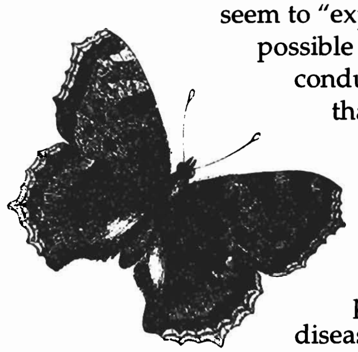
## *Rhode Island Goes Dry,* *continued from p. 9*

**From Harry Pavulaan,** author of the Rhode Island butterfly survey

I collected a Sachem Skipper in July. On July 11, I visited several areas in northern Rhode Island, to continue gathering field data for the ongoing Rhode Island butterfly survey. Along a powerline on the south side of Snake Hill Road in the southeastern corner of Glocester township, west of Greenville, I vouchered several different skippers, and managed to obtain several in my net at once, in at least one instance. I was not able to identify immediately some of these on location, due to time constraints and boggy condition of a portion of the powerline, making movement difficult.

At the time, I certainly had not expected to find the Sachem in Rhode Island, and stored the specimen away, believing it to be some other Skipper, perhaps a very late Indian Skipper, though it would have been out of season. This week, while identifying these specimens, I was surprised to learn that a Sachem was among them! It is a rather small male with a more orange tint beneath than those occurring commonly here in northern Virginia, where I live.

I attribute this, as well as several reports from nearby Massachusetts and Connecticut, to the very mild winter (allowing the species to overwinter in the larval stage much further north than most years), to the mild spring (allowing an early migration) and to the hot, dry summer (which this particular species seems to love). I don't know why Sachem Skippers love hot weather, but each of the past several summers here in northern Virginia, we've had severe drought conditions locally, and the Sachems seem to "explode" in numbers. It's possible that wet conditions are conducive to fungi or diseases that attack the larvae, or support the abundance of some types of predators. The prolonged hot, dry conditions might preclude predators or disease, but this has not been researched in Sachem Skippers.



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# URI Watershed Watch

by Linda T. Green

What's black and white and read all over? A round black and white disk, known as a "Secchi disk," named after its nineteenth-century inventor Angelo Secchi. What does that have to do with the URI Watershed Watch program? A lot. The Secchi disk is one of the most widely used water-quality monitoring devices in the world. Secchi disks get a lot of use here in Rhode Island by volunteer water quality monitors--trained citizen scientists--in the URI Watershed Watch program. Every week between May and November, Watershed Watch volunteers at over seventy locations are anchored out in the middle of their favorite lake, pond, or river impoundment, with their heads over the side of their boat. Seasick on a pond? No way. They are observing how much line they have to pay out before the Secchi disk disappears from view. Their 200+ weekly Secchi disk water clarity measurements, as well as a number of other water quality measurements, are recorded and sent to URI to become part of the largest lake water-quality database in Rhode Island.

The URI Watershed Watch program began in 1987 when members of the Wood-Pawcatuck Watershed Association (WPWA) realized that there were very little, if any, credible water quality data on the lakes, ponds, and smaller streams in the watershed. WPWA contacted Professor Arthur Gold of URI's Natural Resources Science Department, who had quite a bit of experience in lake monitoring in his home state of Michigan. URI Watershed Watch was developed through a partnership between URI Cooperative Extension and locally based organizations. Watershed Watch is an ecological monitoring program, stressing repetitive measurements over time to note conditions and track trends. I was brought in to coordinate the program and to emphasize the scientific rigor needed for quality, credible data. There was never any concern on our part that volunteers wouldn't be up to the tasks required of them.

Right from the start it was understood that conditions in the watershed—the land surrounding and draining to the water body of interest— were key to the water quality of the lake, pond, or stream. In order to understand what was happening in a watershed, monitoring needed to be done at a number of locations, reflecting a variety of environmental conditions. The choice of monitoring locations is often best directed by the concerns and interests of the local sponsoring organization. The people living in the watershed and utilizing the resources have considerable local knowledge about their watershed. WPWA Board member Mitch Salomon felt strongly that WPWA should also be responsible for recruiting its own volunteers. Recruiting Watershed Watch volunteers has also become a useful membership recruitment tool for a number of organizations!

Within a year the URI Watershed Watch program began to attract notice and new local sponsors. The Town of North Kingstown, the Narragansett Indian Tribe, and the North Stonington (CT) Citizens' Land Alliance were the next organizations to join. By 1999 there were over thirty-five local sponsors, including ten Rhode Island municipalities, a number of environmental and sporting organizations, the Narrow River Preservation Association, the Girl Scouts of Rhode Island, and the Pawtucket YMCA, as well as watershed associations, individual lake associations, and even individual lakeshore owners. RIDEM returned in 1999 as the most recent program sponsor, a much-appreciated acknowledgment of the credibility of volunteer water-quality monitoring data and support of the program.

URI Watershed Watch staff helps determine which water-quality measurements can be made by volunteers and which are best done by professionals. URI Watershed Watch develops monitoring procedures, purchases monitoring equipment and supplies, provides classroom and field training, conducts state-of-the-art laboratory analyses, and writes reports. The efforts of the nearly 250 volunteer monitors are the centerpiece of the program, allowing the program to be cost-effective but definitely not cost-free.

This watershed assessment program has expanded from in-lake monitoring to stream and river monitoring, salt pond and estuary monitoring, shoreline surveys, and habitat assessment. Advanced training programs for volunteer monitors have been held for identification and mapping of aquatic plants, more intensive dissolved-oxygen monitoring, and assuring quality data collection by volunteers. Watershed Watch is a founding member of the New England Regional Monitoring Collaborative.

URI Watershed Watch is one component of the integrated approach to responding to water quality issues that defines the Cooperative Extension Watershed Stewardship programs. Watershed Watch information often galvanizes local organizations and individuals to participate in other programs. These include the residential pollution prevention program

Home*A*Syst, the Municipal Training Program that helps communities identify pollution hotspots; the On-Site Wastewater Training Program where innovative methods of waste disposal are evaluated and installed in local communities; and the Geographic Information System training workshops that use computer-based mapping and information capabilities to visualize problems and solutions.

The heart of the URI Watershed Watch program beats only as strongly as the volunteers' involvement. Each year about 10-20% of volunteers decide not to return and at least 25% more volunteers are needed to fill their slots and expand the program. If you have questions about the Watershed Watch or might be interested in joining, please consult our web site at http://www.edc.uri.edu/uriww or give us a call at (401) 874-2905. We will begin planning for the 2000 season, our thirteenth, in February.

*__Linda Green__ is director of URI Watershed Watch.*

## Review: *The Ecology of Atlantic Shorelines*

by Candace Oviatt

**Bertness, Mark D., with illustrations by Kelly Benoit Bird. 1999. *The Ecology of Atlantic Shorelines*. Sinauer Associates, Inc. Sunderland, MA. USA 01375. 417p. ISBN. 0-87893-056-6 ($39.95 pbk).**

Two kinds of books are typically written about the seashore. The most common include charming, usually nicely illustrated, natural history books which often point out detrimental anthropogenic impacts. The other category includes the serious, and not so serious, scientific identification handbooks and guides which may serve beachcombers to taxonomic experts.

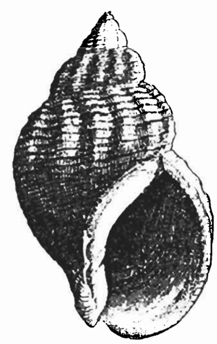
Mark Bertness has written a book which, for the first time, presents a serious scientific examination of the ecology of the Atlantic shoreline, supported by excellent illustrations. In his preface he notes that no such introduction to this shore has been available, although an earlier book, by Tom Carefoot, does address the ecology of Pacific seashores. This book is aimed at undergraduate ecologists but is written in a readable, non-jargon style, making it available to all who might have an interest in the organization and patterning of shore communities.

The book, in seven chapters, has two categories. The first four chapters deal with the basic ecology of shore habitats and the last three chapters describe specific communities. Chapter One describes the origin of the east coast of North America and physical forcing factors: ice, shifting sediment, tides, waves, and the surprising importance of introduced species. Chapter Two deals with production and consumption, and provides an overview of primary producers, the role of consumers in structuring communities, and how prey defend against predators. Chapter Three gives an original presentation of how recruitment strategies impact community assemblages. In this chapter, Bertness points out that external fertilization, which is common in marine organisms, is not an efficient process! Chapter Four examines zonation processes in shore habitats. The last three chapters describe rocky shores, soft-sediment habitats, and salt marsh communities, respectively. These chapters dissect the physical forcing functions and species-species interactions describing many that were new to me. In these chapters, 24% of the rocky shore illustrations, 32% of the soft-sediment illustrations, and 25% of the salt marsh community illustrations detail these structuring, species interactions. Much of Bertness' own research has been directed at puzzling out these interactions in salt marshes; the discussion of positive interactions in this habitat is particularly revealing.

Some weaknesses exist, particularly inaccuracies in the illustrations. Chapter Two suggests a less comprehensive knowledge than is apparent in other chapters. For example, diatoms and dinoflagellates are nowhere near as abundant as picoplankton; critical depth is not the same as compensation depth. Many illustrations have inaccuracies. For example, p. 43, Fig. 5, blue light should penetrate to greatest depths and red light only to shallow depths, not vice versa; p. 269, *Macoma* looks like *Nucula*; p. 280-281, these two amphipods actually have the same body type, not the differences shown; these same creatures appear again on p. 356, now as detritivores and scavengers in a different community. While these minor problems occur, they do not really detract from the high quality of the book.

Much of the book is original, reflecting ongoing research and current information. The references are up to date and thorough. The simple, elegant illustrations add to the quality of the book. Anybody with an interest in shoreline ecology should have a copy of this book.

*The Ecology of Atlantic Shorelines* is available through the RINHS Publications Catalogue. RINHS members receive a 10% discount on publication sales.

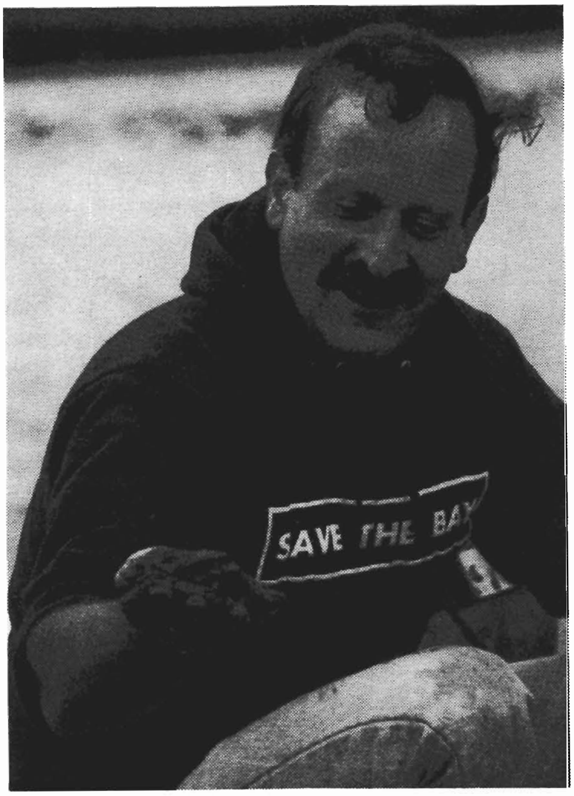


*__Candace Oviatt__ is Professor of Oceanography at the University of Rhode Island, and serves on the RINHS Board of Directors.*

# In Memoriam: Mark D. Gould
**1946 - 1999**

Waist deep in the Roger Williams University pond, a goofy hat on his head, all but disappearing in huge waders, covered with muck and surrounded by eager students...or leading a field trip, followed by out-of-breath students desperately trying to keep up with him--that is how many of us will fondly remember Mark Gould: teacher, friend, environmentalist, and splendid human being.

His sudden and unexpected death from a heart attack on June 9, 1999, at the age of 53, has left an immense void. The overwhelming shock and sadness reverberated through Rhode Island and beyond. To understand the impact Mark had on our lives one only had to listen to the testimonial comments made during his memorial service. A huge gathering of students, fellow faculty members, administrators, scientists, local fishermen, friends and family members poured out their grief, their deep sense of loss, their love and admiration for him.




Although born in Washington D.C., Mark was in fact a Rhode Islander at heart. He spent his early years in Newport, moved to South County in the late sixties and later chose to remain there with his family. He attended the University of Rhode Island from which he obtained bachelor's, master's, and doctoral degrees. From the beginning of his career at Roger Williams University in 1973 Mark was an effective leader. His energy and tireless work contributed to the success of the Marine Biology program and to the planning and development of the new science building. He was Division Coordinator of the Natural Sciences from 1978 to 1990, Dean of the School of Science and Mathematics from 1990 to 1994, and Dean of the College of Arts and Science from 1994 to 1997. From 1997 until his death he was the Director of the Center for Economic and Environmental Development.

First and foremost Mark was a teacher. He taught Invertebrate Zoology and several other advanced ecology courses, and was honored by the students with the Teacher of the Year award from 1985 to 1988. "Tough Love" would accurately describe his teacher-student philosophy. He challenged his students to think for themselves in a logical and scientific manner. He loathed "fuzzy thinking," insisted on rigor and would liberally use his K.I.S.S. stamp (Keep It Simple Stupid) on student papers. His teaching was full of levity. He was infamous for the Halloween costumes he wore to class and for the impossible April Fool's Day pop quizzes that students appreciated only after they realized they were bogus. He truly loved teaching and helping students realize their goals. This was evident in what his students said about him: "Mark Gould was the type of man who surrounded you with a wave of inspiration. He taught me to find answers by seeking the questions I had forgotten to ask" (Katie Fisher); "Mark had a gift for empowering other people" (Michael Baron); "Mark was my friend before he was my teacher" (Jenn Eral); and from an alumnus: "Without his mentorship and guidance, I wouldn't be where I am now in my career. He gave me the chance that eventually changed my life around." Michelle Burke vividly remembers one of his first comments to her: "I want to see you elbow-deep in gunk, I want to see you get your hands wet and dirty, so you have to clean the dirt from underneath your fingernails." And so, carried by Mark's enthusiasm, she dug in.

As a colleague, Mark was someone you could trust, count on, and bring your troubles to. He always had time to listen and to offer helpful and positive solutions. His passion and enthusiasm were contagious and inspirational. His whimsical sense of humor helped create a relaxed and gratifying learning environment. Many of you will remember his office, "the junkyard" as he called it, which was a museum to others. Visitors, including parents and prospective students, were fascinated by the quaint and incongruous collection of items, biological or otherwise, he had accumulated over the years. How he found anything there was a mystery to all, but he knew where everything was--at any time he could locate the very document, scientific article, or information one was seeking.

Mark was also a dedicated environmentalist who made significant contributions to many organizations. He was a member of numerous environmental groups including the Pawcatuck River Advisory Board, the Scientific Advisory Board for Narragansett Bay National Estuarine Research Reserve, and RIDEM Pesticide Relief Board; he also served on the board of directors for the Rhode Island Natural History Survey (of which he was a founding member) and Save the Bay, and was Chair of the Rhode Island contingent to implement part of the Clean Water Act. In addition, he was a member of the Ecological Society of America, Society of Nematologists, Sigma Xi, AAAS, American Fisheries Society, the Rhode Island Audubon Society, The Nature Conservancy, the Rhode Island Wild Plant Society, and other professional and local organizations. He also pursued several research interests and was the author of a number of scientific publications on ecological topics.

In addition to his educational and scientific accomplishments, Mark led a rich personal life. He lived with his wife Lisa and daughters Hannah and Meggan on the Queen's River in Usquepaugh, where he found peace and contentment. His strong moral values helped foster deep, loving, family bonds and an acute sense of community service. His family's generosity and desire to help others was marked by personal commitment which included welcoming into their home individuals or families in need of help. He had also found a spiritual outlet for his philosophy of life in Quakerism. He, along with his family, joined the Westerly Monthly Meeting of the Religious Society of Friends and rapidly became involved as influential members at the local, regional, and national level.

We have lost a cherished colleague and friend as well as a valued member of the academic and scientific communities. We will miss his energy, his enthusiasm and passion for the environment, and his endless dedication to students and to Rhode Island. In a statement to the Roger Williams University community, President Anthony Santoro summed up our loss: "Mark's passing is a devastating blow to the university he so capably helped lead for many years. His enthusiasm for Roger Williams and his profession knew no limits. The most serious blow, of course, is to the scores of future students who will be denied the opportunity to work with Mark." The sadness was echoed by Lucas Marks in a letter written to Mark the day after his death: "To Mark, ...I wish you could have met my parents. They wanted to meet the man that meant so much to their son. I knew they would have loved you as much as I did. I miss you and will remember you always."

***Martine Villalard-Bohnsack** and **Thomas Holstein** are with the Department of Biology at Roger Williams University.*

## *Scholarship Named in Mark Gould's Honor*

The Rhode Island Earth Day Committee has established the *Mark Gould Scholarship Fund for Environmental Education* in recognition of Mark's work and dedication in the environmental community. The Earth Day Committee will award a $500 scholarship for the Fall 2000 semester to a high school senior who plans to attend a Rhode Island institution for higher learning. The student must demonstrate an involvement in environmental studies and be interested in pursuing a career in this field (to include marine biology, geology, ecology, chemistry, landscape architecture, and related disciplines). The first award will be presented on April 29, 2000 at the Rhode Island Earth Day Festival.

Application forms are available at high school guidance counselor offices, or from the Rhode Island Earth Day Committee, c/o RIDEM, 235 Promenade Street, Suite 330, Providence, RI 02908; 1-800-CLEANRI or (401) 222-3434.

The Rhode Island Earth Day Committee is a joint project of the Environment Council of Rhode Island Education Fund and the Rhode Island Department of Environmental Management. Donations to the *Mark Gould Scholarship Fund* are welcome; make checks payable to the ECRI Education Fund, Box 40568, Providence, RI 02940 (donations to this fund are tax-deductible).

## *Many Thanks*

The Board of Directors of the Rhode Island Natural History Survey and the family of Mark Gould are very grateful for the donations made to RINHS in Mark's memory. The outpouring of sympathy and tangible support have been most appreciated. RINHS is using funds donated in Mark's memory to support work on the Biota of Rhode Island Project, which had Mark's enthusiastic endorsement.

Thanks also go to RINHS Advisory Board and Organizational Members, for their generosity during our spring appeal. These donations helped us begin to make the transition toward our partnership with the Agricultural Experiment Station, as explained in the *President's Corner* on p. 16.

We are grateful for other gifts made this year to RINHS, including: from Marilyn Massaro and the Museum of Natural History at Roger Williams Park, *Guide to the Photoarchives of the Museum of Natural History, Roger Williams Park, Providence, Rhode Island,* and the Elizabeth York Slide Collection [3 boxes of slides of New England wildflowers]; from Kate Phillips, granddaughter of Elizabeth "Benny" Phillips, her grandmother's slide collection; from Irene Stuckey, several books from her collection; and from the family of Mark Gould, a number of books from his collection.

## President's Corner
by Richard W. Enser

This issue of *RINHewS* marks the sixth year of its publication, and a little more than five years since the Rhode Island Natural History Survey was incorporated in May 1994. Peter August was elected the Survey's first President, followed by John Paul's term during the last three years, and I want to take this opportunity to recognize both individuals for their leadership of the Survey during its important incubation and nestling phases. Now as I step in for my three-year stint as President, I believe the Survey has weathered those crucial startup pitfalls and matured beyond the fledgling stage to become the state's primary conduit of biological information. Within a relatively short time the Survey has advanced its mission by:

• Presenting a series of increasingly well-attended conferences that have provided a forum for scientists, students, and the public to address various environmental and biodiversity issues. The next conference, scheduled for November 2000, will focus on *The Ecology of Rhode Island's Islands.*

• Offering a series of free public lectures in joint sponsorship with many Rhode Island agencies and organizations. Beginning in 1999, this program will be officially named the Mark D. Gould Memorial Lecture Series in memory of, and in tribute to, Professor Mark Gould, who was one of the founding members of the Rhode Island Natural History Survey.

• Facilitating the publication of *Vascular Flora of Rhode Island: A List of Native and Naturalized Plants; An Illustrated Key to the Seaweeds of New England*; and *The Natural Communities of Rhode Island: The Terrestrial System*, a slide lecture geared for the Junior-Senior High School level. Soon the Survey will publish the second volume in the "Biota of Rhode Island" series that will catalog the state's vertebrate fauna, and work is progressing on subsequent volumes detailing the invertebrates and nonvascular flora.

• Publishing a newsletter that provides an opportunity for area scientists and students to inform readers of their ongoing research, and also serves as the principal communication arm of the Survey to its membership.

• Applying for and receiving grants to: a) republish out-of-print literature, including *Rhode Island Geology for the Nongeologist*, by Alonzo Quinn; b) purchase and distribute storage cabinets for professional protection of in-state natural history collections; c) develop databases in conjunction with the Biota of Rhode Island Project.

• Implementing an assessment of Rhode Island's systematic collections with the intent of improving the curation of existing collections, and working toward the eventual consolidation of many collections within a single facility.

The last statement refers to both an accomplishment and a vision. Ultimately, a Rhode Island Biodiversity Center would not only house specimens for documentation and educational purposes, but would also support computerized databases, libraries, and other materials to serve collectively as the principal source of biological information in the state. Each member of RINHS could likely envision their own personal view of what such a Biodiversity Center might look like and how it might function, but at this juncture the most important issue to understand is that it can actually happen.

In less than a decade the Rhode Island Natural History Survey has greatly advanced its mission of "bringing together Rhode Island's ecologists and naturalists," but there is still much more to be done. A recent development that bodes well for the organization is a new partnership with the Rhode Island Agricultural Experiment Station in which the Survey will serve as the Station's principal contact with stakeholders for the Station's Natural Resources/Coastal Ecosystems program area. In return, the Station will provide partial support of the Survey's executive director. This agreement is an important step towards solidifying a full-time position, but it does not come without responsibility. We are still obligated to raise a large percentage of the Survey's operating costs, and it is primarily through the support of the membership that we will achieve budgetary goals.

Individual memberships are important, but how else can you support the Survey? First, let us hear from you. Tell us how the Survey can best support your activities. What do you want to see the RINHS become? What do you want it to provide? How can it best serve the scientific community of Rhode Island, the environmental regulatory community, and other constituencies? In addition to pondering these questions, think how you might actively work with one of the Survey's committees such as Education, Publications, Inventory and Monitoring, Systematic Collections, and others. It is difficult to contact each member individually, so seek out one of your elected Board members and inquire how you might become more involved. The survey can use your help in all areas. I look forward to working with you all as we continue to make the Rhode Island Natural History Survey a key element in the understanding and preservation of the state's natural diversity.

***Richard Enser** is coordinator of the Rhode Island Natural Heritage Program, and became the third president of the RINHS in September, 1999.*

## *RINHS Organizational Members: Special News & Events*

### *Exciting New Data for Rhode Island on the Web*

by Roland Duhaime, Duane Chapman, Alyson McCann, and Pete August

One of the goals of the **URI Environmental Data Center** is to make geospatial data available to the citizens and decision-makers of Rhode Island. For many years, we have distributed important data over the web, such as the Rhode Island GIS database and GPS Base Station correction files for the region (see www.edc.uri.edu/gis). Thanks to grant support from EPA, USDA NRCS, and the Rhode Island Agricultural Experiment Station we have made some exciting new additions to our web-based library of data and information.

• Digital Orthophotography — Statewide digital aerial photography is available at http://ortho.edc.uri.edu. The web interface is simple and easy to use; you have the ability to zoom into your own backyard or your favorite wetland or wildlife preserve. The resolution of the data set (pixel size) is 1 meter (3.3 feet) — sharp enough to make out houses — and is based on the 1:12,000 USGS Digital Orthophoto Quadrangle (DOQ) database. For those who are savvy with Geographic Information Systems, you may download images to your computer and view them using your favorite GIS software, such as ArcView or MapInfo. The software that makes the ortho server work and the excellent interface were developed by scientists at Massachusetts Institute of Technology.

• Digital Atlas of Rhode Island — Have you ever wondered where the wetlands were in your town or what watershed you live in? We have created a digital atlas of natural resources for the state and they are available at http://www.edc.uri.edu/riatlas/. The maps are created as gif images in two sizes, 8.5" x 11" or 20" x 20", on town and watershed bases. The maps show biodiversity information, wetlands, groundwater, land use, and soil hydrology and can be viewed with your web browser or downloaded for local printing.

*The authors are with the Environmental Data Center at URI's Department of Natural Resources Science.*

### *TNC Research Grants Available*

**The Nature Conservancy-Rhode Island** is pleased to announce the availability of research grants through its John Wald Science Endowment. We anticipate awarding five grants of $3,000 each commencing 1 March 2000 on topics that will support TNC Science programs.

For application instructions or additional information, contact Ginger Carpenter at (401) 331-7110 or visit our web site at www.tnc.org/rhodeisland.

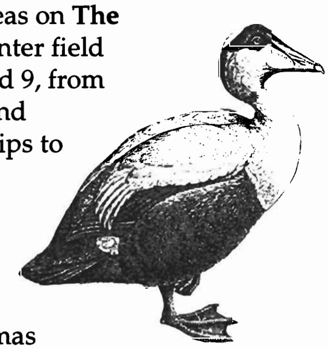
### *Lose the Winter Blues at the Winter Lecture Series at Roger Williams Park Zoo*

**The Roger Williams Park Zoo** is offering a series of free lectures this winter, held at the Meller-Danforth Education center at 2:00 p.m. They include *One Zoo, Two Islands, and a Beetle,* a presentation about the Zoo's work on the American Burying Beetle (January 16); *Banding Together,* a look at RWP Zoo's involvement in neotropical migratory songbird banding and conservation efforts in the Bay of Fundy (January 23); *The Cuban Parrot Project* (January 30); plus other topics, to be determined, on February 6, 13, and 20.

The RWP Zoo is also sponsoring an evening Conservation Lecture Series, to be held at 7:00 p.m., with *Wolves of Yellowstone and the Northeast* (February 17), *Amazon River Dolphins* (March 23), and *Swift as a Shadow, Extinct and Endangered Animals* (April 20). $7/zoo & museum members; $9/non-members. To register, or for more information, call (401) 785-3510 ext. 358.

### *Winter Walking with TNC*

Dress warmly and enjoy exploring Rhode Island's natural areas on **The Nature Conservancy**'s winter field programs. December 2 and 9, from 9-11 a.m., Rachel Farrell and Todd McLeish will lead trips to Sachuest Point National Wildlife Refuge, Middletown, a wonderful site for winter waterfowl. December 9, 7-10 a.m., there will be a pre-Christmas bird count at Queen's River Preserve, Exeter, led by Mike Tucker and Rachel Farrell. And on January 22, 2000, Keith Killingbeck and Chris Nerone will lead a woody plant ID session at Grass Pond Preserve, Richmond, from 10 a.m.-noon. To register, call (401) 331-7110.



### *Have a Wild Winter Time with the RI Wild Plant Society*

**The Rhode Island Wild Plant Society** offers lectures, workshops, and walks throughout the year. Winter 1999-2000 events include a New Year's Day walk at Sachuest Point, a botanical illustration workshop series, talks on natural landscaping, a tour of the URI Herbarium, a winter walk with writer Ken Weber, vernal pool exploring, and walks at Caratunk Wildlife Refuge and the Great Swamp. Contact the RIWPS office at (401) 783-7895 for the complete calendar and registration information.

## *Opportunities for Volunteers & Students*

***Audubon Society of Rhode Island*** (12 Sanderson Road, Smithfield RI 02917) welcomes volunteers to help with property surveys and inventories, checking property bounds, doing trail maintenance, and serving as trail wardens. Contact Larry Taft, Director of Properties & Acquisitions at (401) 949-5454.

***Center for Field Research*** (680 Mt. Auburn Street, Watertown, MA 02172) is inviting proposals for 2000 field research grants and Student Challenge Awards Contact David Lowe at (617) 926-8200; email: dlowe@earthwatch.org or visit the CFR website at http://www.earthwatch.org/cfr/cfr.html

***The Nature Conservancy*** (Rhode Island Field Office, 159 Waterman Street, Providence, RI 02906) is looking for volunteers to monitor Piping Plover and Least Tern sites in Rhode Island; a minimum commitment of a half-day training session and 2 days of monitoring is expected. Unique opportunity to help endangered species! Call G. Venator at (401) 331-7110.

TNC would also like volunteers to help with field, lab, and clerical work for the Odonata atlas being compiled by Virginia Carpenter, and Jane Jackson is seeking volunteers to help inventory TNC properties for birds, herptiles, invertebrates, etc. Contact Ginger and Jane at (401) 331-7110.

***Rhode Island's National Wildlife Refuges:*** Ninigret, Trustom Pond, Pettaquamscutt Cove, Sachuest Point, and Block Island Refuges need your help counting wildlife, banding birds, constructing nesting boxes, maintaining trails, leading nature walks, and assisting refuge visitors. The program offers you several areas of opportunity; these include biological, visitor interpretation, education and orientation, maintenance, and miscellaneous skills. For more information contact Norma Klein at (401) 364-9124.

***Roger Williams Park Museum of Natural History*** (Elmwood Avenue, Providence, RI 02905) has several curatorial projects for knowledgeable volunteers or student interns including taxonomic updating, identification, cataloging, and organizing the herbarium and mollusk collections. Opportunities to work with other collections exist as well. Student research or internships that earn academic credit are encouraged and welcomed. For information contact: Marilyn Massaro, Curator, (401) 785-9457 ext. 248.

***Roger Williams Park Zoo*** (1000 Elmwood Avenue, Providence, RI 02907) hosts monthly volunteer information seminars. At this program, you will learn where your time, talent, and interests may lead you in your quest to serve the zoo. These programs are offered every second Friday OR Saturday of the month from 9:45 a.m. to noon in the Education Center. There are many types of volunteer positions available including clerical, docents (who educate the public as they tour the zoo), PR ambassadors in the community, public programs, and many other positions. For information call Anna Linville at (401) 785-3510 ext. 356.

***Rose Island Lighthouse Foundation*** (P. O. Box 1419, Newport, RI 02840) needs volunteers and interns for spring and summer work to help develop school curriculum for grades K-5, and to guide at the lighthouse in the summer. Interest in education, lighthouses, history, birds, native plants, and/or marine biology is helpful. Enthusiasm and reliability are required. For information contact: Charlotte Johnson, Executive Director, at (401) 847-4242.

***South Kingstown Land Trust*** (66 Main Street, Unit 3, Wakefield, RI 02879) seeks volunteers to monitor and maintain existing SKLT properties and trails, conduct scientific inventories for plants and animals on existing and potential sites, contribute to the development of management plans for SKLT properties, and assist with research on potential funding sources. Contact the SKLT office at (401) 789-0962.

***URI Watershed Watch Program*** (Room 210B Woodward Hall, URI, Kingston, RI 02881) invites volunteers to become part of Rhode Island's largest volunteer water-quality monitoring program. Volunteers monitor one of more than 100 available sites statewide (see www.edc.uri.edu/uriww for a list of monitoring locations) on a weekly basis from April to November. The program strives to have more than one volunteer per site so that teams can share monitoring efforts as suits them best. Volunteers must provide enthusiasm, a way to get out on their monitoring locations (i.e., canoe, kayak, boat), a personal flotation device, and be available for about 1 hour between the hours of 10 a.m. and 2 p.m. on the weekly monitoring day. The Program will provide all training, monitoring equipment, and program support. Volunteers and sponsors for new locations are also sought. Contact Linda Green or Elizabeth Herron at (401) 874-2905 or email uriww@etal.uri.edu *(see p. 12 of this newsletter for more information about the program).*

## *Upcoming Conferences & Seminars*

December 7. *Take A Gander at Goosefish,* a Friends of Oceanography Breakfast Series lecture by Catalina Martinez at URI's Coastal Institute, Narragansett Bay Campus. 9 a.m. Free. (401) 874-6602.

December 11. *Introducing the Water-dwelling Macroinvertebrates,* a field trip led by George Christie for high school students and adults, Tri-Pond Park, South Kingstown, RI. Sponsored by the Environmental Education Program of the S. K. Parks & Recreation Department.

$15 SK residents/$20 nonresidents. (401) 885-7055.

January 12, 19, 26, 2000; February 2, 9, 16; March 1 and 8 (Wednesdays), 3:30-6 p.m, plus April 29 and May 6 (Saturdays, 8:30-3:30), *Oceanography for Educators.* Office of Marine Programs, URI Narragansett Bay Campus. $495; preregistration required. CCE graduate credits available, $75 additional fee. (401) 874-6211.

February 10. ***Mussels and Macrophytes in the Maelstrom: Mechanical Design for Life on Shore,*** **an RINHS lecture** by Emily C. Bell (URI Department of Biological Sciences), 7:30 p.m., URI Coastal Institute, Narragansett Bay Campus, Narragansett, RI. Free. (401) 874-5800 for more information.

April 13. ***Nesting Amid the Tides: Songbird Survival in Southern New England Salt Marshes,*** **an RINHS lecture** by Steven Reinert (Freelance Ornithologist), 7:30 p.m., Center for Economic and Environmental Development, Roger Williams University, Bristol, RI. Free. (401) 874-5800 for more information.

April 25-27. *Monitoring for the Millennium: National Water Quality Monitoring Council National Monitoring Conference,* Austin, TX. http://nwqmc.site.net.

April 26; May 3, 10, 17, 24, 31; and June 7 and 14 (Wednesdays, 3:30-6 p.m.), plus May 13 and 20 and June 10 (Saturdays, 8:30-3:30), *Global Change Education.* Office of Marine Programs, URI Narragansett Bay Campus. $495; preregistration required. CCE graduate credits available, $75 additional fee. (401) 874-6211.

August 27-31. *International Conference on Riparian Ecology and Management in Multi-Land Use Watersheds,* Portland, OR. For information: http://www.awra.org/meetings/Portland/Portland.html.

November 2. ***The Ecology of Rhode Island's Islands,*** **the 6th Annual RINHS Conference.** Location TBD.

*See page 17 for other events sponsored by RINHS organizational members.*

## *Benefits of membership in the Rhode Island Natural History Survey*

*For Individual, Family, and Student Members*

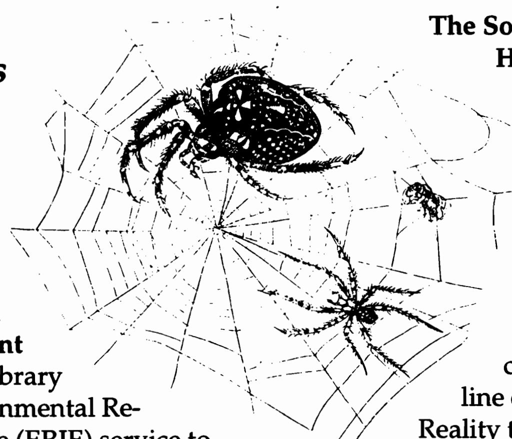
- *RINHewS*, the newsletter
- Free membership list
- 10% discount on all publications
- Discount on annual conference fee
- 20% discount on subscription to the journal *Northeastern Naturalist*

*For Organizational Members*

- *RINHewS*, the newsletter
- 2 free membership lists
- Listing in Program for Annual Conference
- 10% discount on all publications
- 1 free registration at annual conference
- 20% discount on subscription to the journal *Northeastern Naturalist*

***Rhode Island Natural History Survey, Inc.***
c/o Cooperative Extension Education Center
3 East Alumni Ave., URI, Kingston, RI 02881
*Telephone:* (401) 874-5800; Fax 401-874-2259
*Email:* rinhs@etal.uri.edu
*Website:* http://www.edc.uri.edu/rinhs/nathist.htm

## *Weaving the Web: Electronic Resources*



**Audubon Society of Rhode Island (ASRI)** web page has information about ASRI's refuges and programs: http://www.asri.org

**Committee for the National Institute for the Environment (CNIE)'s** on-line National Library has launched its new Environmental Research Information Exchange (ERIE) service to provide a forum for researchers, educators, resource managers, agency decision-makers, foundation representatives, journalists, and others in environmental fields to share information and discuss issues: http://www.cnie.org

**Committee on Recently Extinct Organisms (CREO)** has a mission to foster an improved understanding of species extinctions that have occurred in recent times. It is organizing an international effort to develop a rigorous methodology for surveying and evaluating extinctions across diverse taxonomic groups: http://www.creo.org

**Large marine Ecosystems (LME)** web system, produced by NOAA/NMFS. The 50 LMEs are regions of ocean space encompassing coastal areas from river basins and estuaries to the seaward boundaries of continental shelves and coastal current systems. They are relatively large regions of distinct bathymetry, hydrography, productivity, and trophically dependent populations. The web page contains descriptions of the LMEs, GIS data, maps, and much more: www.edc.uri.edu/lme

**The Society for the Preservation of Natural History Collections (SPNHC)** publishes the journal *Collection Forum* and has several unique publications, including *Managing the Modern Herbarium: An Interdisciplinary Approach.* See the SPNHC web page for ordering information: http://www.spnhc.org .

**URI's Virtual Garden**, URI Agricultural Experiment Station's new online educational project. Using Virtual Reality technology, you can take a 3-dimensional tour of URI's Learning Landscape Garden, obtain information about the flora, and learn how to plant and maintain maintenance- and pesticide-free garden plants: http://www.riaes.org

**U. S. Environmental Protection Agency** web site on fish advisories makes it easier for the public to find out if the fish they catch is safe to eat. Check for local fish consumption warnings on any river, lake, or stream throughout EPA's national list of fish advisories at: http://www.epa.gov/ost/fish

**U. S. Fish & Wildlife Service (USFWS)** web page has information about National Wildlife Refuges, USFWS publications, and much more: http://www/fws/gov

*Illustrations credits:* Photos: p. 3 by C. Deacutis; p. 4 by J. Prezioso, NMFS; p. 6, by R. Casagrande; p. 14, photographer unknown (we'll be glad to give credit in the next *RINHewS*). Illustrations: p. 7 (beetle drawing) from USFWS; other illustrations from *Animals: 1491 Copyright-Free Illustrations*, by Jim Harter, 1979, New York: Dover Publications, Inc.; *Heck's Pictorial Archive of Nature and Science*, J. G. Heck (ed.), 1994, New York: Dover Publications; and *The Plant Kingdom Compendium*, by Jim Harter, 1988, New York: Bonanza Books.

Rhode Island Natural History Survey
c/o Cooperative Extension Education Center
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