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Erik Kiviat

News from Hudsonia

Volume 37, Number 1

Summer 2023

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Photo on front cover: Monarch visiting wild bergamot (*Monarda fistulosa*), our native bee-balm species. Butterflies, bees, and other insects are poisoned by direct applications of herbicides, and by consumption of herbicide-contaminated nectar, pollen, foliage, and fruit. Photo © Erik Kiviat

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Dear Friends of Hudsonia,

Are you managing land, reviewing an application for an environmental permit, or just going for a walk in your neighborhood? Are you wondering what happened to the flowers that once bloomed along the state highway guiderail or the unusual plants in a local wetland preserve?

If you do not have the time or the technical background to review the literature on herbicide toxicology, you're not alone… it can take ten or twenty years for research results to filter down to environmental professionals and others with an interest in conservation. That's why scientists compile and synthesize important information for decision makers.

Contributing to that goal, for decades we have collected research from our own and other scientists into a suite of conservation resources, such as our Biodiversity Assessment Manual for the Hudson River Estuary Corridor*, reviews of the ecology of non-native species including water-chestnut and* Phragmites*, and analysis of the ecological impacts of hydraulic fracturing for natural gas. Such compilations are valuable tools for environmental practitioners as well as students and other researchers.(Please visit our website to access them.)*

The article about herbicide toxicity to wild species in this issue of News from Hudsonia *is intended to raise awareness of the potential consequences of widespread use of synthetic chemicals in agriculture and vegetation management. The article cannot answer all our questions, but perhaps it will set you on a journey to know … the same journey Hudsonia staff takes every day as we work to solve problems of conservation and land use planning.*

You have made our journey possible and, as always, we're here to answer your questions. And we ask you to please make as generous a donation as you can to Hudsonia so we can continue traveling together down the path of knowledge!

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ARE HERBICIDES DANGEROUS?

By Erik Kiviat*

Pressures to grow more food in many parts of the world, and the drive for profits from large-scale farming in others, have led to the continual development of new insecticides, fungicides, and herbicides for agricultural use. Demand also comes from forestry, where herbicides are widely used to suppress other vegetation in favor of timber and pulp trees; from habitat restoration projects where herbicides are used to suppress non-native plants that might compete with natives; from highway departments that use herbicides along roadsides; and from the landscaping industry and homeowners who use herbicides and insecticides in attempts to create perfect lawns and gardens.

Current-generation herbicides are synthetic organic chemicals. The most-used herbicide worldwide is glyphosate, usually in formulations containing other materials (adjuvants) that make the glyphosate more effective at killing target plants. In this article I refer also to glyphosate-based herbicides (GBH).

"Glyphosate was first synthesized in 1950 as a pharmaceutical compound but no pharmaceutical applications were identified. It was reformulated in 1970, tested for its herbicidal activity, and patented for use by Monsanto. The patent has since expired and now glyphosate is produced worldwide by numerous manufacturers….

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glyphosate was registered in over 130 countries as of 2010. Since the introduction of genetically engineered glyphosate-tolerant crops in 1996, the global use of glyphosate has increased 15-fold, making it the most widely used pesticide worldwide."[30]

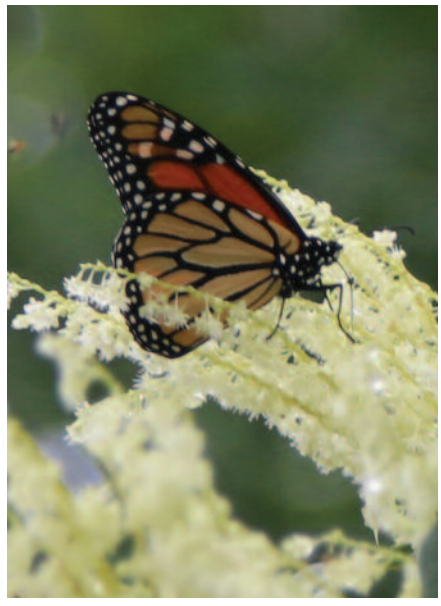
Glyphosate is the main ingredient in Roundup, Rodeo, Ranger, and others that have long been used in agriculture, forestry, and landscaping. In addition to those primary uses, glyphosate and GBH are used for management or restoration in the habitats of waterfowl, the endangered bog turtle, common reed-dominated marshes and wet meadows, habitats colonized by various other environmental weeds, and fallow fields to be planted for insect pollinators.

Application levels of glyphosate recommended by the manufacturers are often many times greater than necessary to control target weeds.[18] Residues of glyphosate or its breakdown product AMPA (aminomethylphosphonic acid) are now widespread in surface water, sediments, and soil, airborne particulates from farmland, harvested crops, processed foods, and human urine, blood, umbilical cord serum, and milk.[31] Cut-stem or injection treatments of environmental weeds such as tree-of-heaven (*Ailanthus altissima*), common reed, and knotweed (*Polygonum cuspidatum*) are more contained than spray treatments. Although it has often been stated that cut-stem and injection techniques require *more* herbicide per acre, some published reports contradict that.[3,4]

TOXICITY TO PLANTS, BACTERIA, FUNGI, LICHENS, AND ANIMALS

One of the important impacts of glyphosate and other herbicides is harm to nontarget plants, such as rare species or the milkweed hosts of the monarch butterfly. All vascular (higher) plants are susceptible to glyphosate to some degree, and bryophytes and algae evidently are also. Glyphosate can persist in soil and inhibit seedling growth of vascular plants.[34]

GBH can be more toxic than pure glyphosate.[26] There are numerous commercial GBH and many of their "inert" ingredients are proprietary or poorly studied toxicologically.[23] Herbicides can also move far from application sites. For example, 2,4-D can disperse directly via spray drift, as well as by evaporation from leaves and soil, and transport on windblown soil particles. The compound has been detected in air distant from treated areas.[17]



Monarch larva feeding on common milkweed (left) and monarch adult visiting knotweed flowers (right). Glyphosate-contaminated foliage, pollen, and nectar are consumed by butterflies, moths, bees, and other insects. Photos © Erik Kiviat

Glyphosate and GBH are toxic to a wide range of unicellular and multicellular animals as well as fungi and microorganisms. Selected effects are summarized in Table 1. In one study, mice developed airway inflammation after laboratory exposure to air from GBH-treated farm fields and to pure glyphosate at similar concentrations.[22] Although this was a lab study, the findings strongly indicate the potential for toxicity to rodents and other mammals in and near crop fields and wild vegetation treated with glyphosate or GBH.

Heart-leaved plantain (*Plantago cordata*) is a rare plant in the Hudson River that could have been affected by herbicide use in the estuary or in corn fields on tributaries. Photo © Erik Kiviat

The phantom crane fly (*Bittacomorpha clavipes*), a habitat specialist, may be at risk from glyphosate used to manage *Phragmites* in bog turtle habitats. Photo © Erik Kiviat

Another study found that glyphosate suppression of symbiotic gut bacteria interfered with formation of the cuticle (outer layer of the exoskeleton) in a laboratory beetle. The authors stated that this pathology could be involved in global declines of insect populations.[19] While much more research is needed on the cuticle phenomenon to implicate glyphosate in insect declines, the large global use of glyphosate also raises questions about its possible roles in declines of other taxa such as amphibians, reptiles, and birds that depend on insects for food or that are themselves poisoned.

REGULATION OF HERBICIDES

Glyphosate has been banned in the European Union as a probable human carcinogen. In 2022, glyphosate use was banned on state lands in New York, but many exceptions are allowed (https://www.dec.ny.gov/press/125533.html). Although it might appear beneficial to substitute another herbicide for the well-studied but toxic glyphosate, we might unwittingly be substituting an even more harmful but less-studied chemical (see Table 2).

ALTERNATIVES TO HERBICIDES

One often-touted weed management method is classical biocontrol which involves testing and importation of "natural enemies" from the native range of the target plant. The biocontrol organism is often an insect, but fungi, nematodes, and others are also used. Despite careful research, the host range (target range) of a biocontrol organism can expand or shift following release in the new environment. After all, future ecological interactions are to a great extent unpredictable, given rapid evolution and a changing environment. For example, there are concerns that two moths proposed for biocontrol of the nonnative subspecies of common reed (*Phragmites*) will also attack the native subspecies.[20] A promising approach to biocontrol, however, involves the use of native microorganisms to tip the competitive balance between a nonnative weed and its native neighbors.[21]

A variety of other techniques has been used to reduce weed populations, including mechanical cultivation, mowing, hand cutting or pulling, covering with plastic or rubber sheeting, electricity,

The non-native purple loosestrife is an important nectar and pollen resource, so should be managed selectively with that in mind. Photo © Erik Kiviat

The native blue iris (*Iris versicolor*) grows on shorelines and in marshes. Photo © Erik Kiviat

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Table 1. Glyphosate and glyphosate-based herbicides, and examples of their nontarget impacts.

Material	Organism affected	Pathology	Potential impact on biodiversity	Source
glyphosate	mouse*	airway inflammation	muskrat decline; other mammals	Kumar et al. 2014
glyphosate or GBH	mouse, rat*	carcinogenicity	decline of rodents; other mammals	Portier 2020
glyphosate, GBH,	mammals	epigenetic changes	diseases	Rossetti et al. 2021
AMPA, GBH	chicken*	genotoxicity, hematological & biochemical changes	declines of many bird species	Hussain et al. 2019
GBH	Amazon River turtle*	embryonic abnormalities	declines of freshwater turtles	dos Santos Mendonça et al. 2022
POEA (adjuvant)	frogs*	developmental abnormalities	frog declines	Howe et al. 2004, Cheron et al. 2020
GBH	lizard*	altered thermoregulatory behavior	suggests fever, a symptom of pathology	Carpenter et al. 2016
GBH	mangrove salt marsh snake**	emigration after GBH reduced cattail cover	plant biomass reduction could harm many animals & benefit others	Ackley & Meylan 2010
GBH (Roundup)	European eel*	DNA damage	could contribute to European & American eel declines	Guilherme et al. 2012
glyphosate	bumble bee*	impaired thermoregulation	decline of bumble bees	Weidenmüller et al. 2022
glyphosate	grain beetle*	interference with cuticle synthesis	insect declines	Kiefer et al. 2021
GBH	freshwater snail*	endocrine disruption	could affect reproduction of many animals	Omran & Salama 2016
GBH (Roundup)	web-spinning spiders**	reduced abundance associated with microhabitat simplification in crop field edges	decline of spiders & their pest management services	Haughton et al. 1999
glyphosate	earthworms*	reduced body weight & lack of reproduction	could affect earthworms in general, including native species	Correia & Moreira 2010
glyphosate or GBH	an oyster, estuarine crab, staghorn coral, polychaete	various physiological changes	could harm marine invertebrates, at least at higher environmental concentrations	Matozzo et al. 2020
GBH	lichens**	species declines in boreal forest experiment	lichen declines	McMullin et al. 2012
GBH	entomopathogenic fungi*	inhibition of mycelial growth & spore production	reduced fungal mass, reduced fungal predation on soil arthropods	Morjan et al. 2002
GBH (Roundup)	stonewort (*Nitella*)**	reduced photosynthesis	decline of stoneworts & other algae	de Campos Oliveira et al. 2016
glyphosate	vascular plants**	resistance	increase of resistant weeds on & near farms	Sammons & Gaines 2014
glyphosate	vascular plants**	milkweed loss near glyphosate-resistant crops	monarch declines	Thogmartin et al. 2017
GBH (effects caused by glyphosate)	vascular plants	promotes microbial diseases of plants	harm to nontarget plant species	Johal & Huber 2009
glyphosate	oligotrophs (species of low-nutrient environments)	phosphorus loading to environment	many aquatic & wetland plants;	Hébert et al. 2019

* Laboratory experiment

** Field study

Table 2. Selected herbicides with examples of nontarget impacts. Glyphosate impacts are outlined in Table 1.

Material	Some trade names	Common uses	Some impacts	Sources
2, 4-D*	Formula 40	cereal crops, pastures, orchards, lawns; formerly military defoliant	amphibians: stops egg development, neurotoxic, damages DNA; harms lady beetles	Correia & Moreira 2010, Islam et al. 2018
Atrazine	AAtrex	corn and other crops	endocrine disruption & other effects on freshwater snail, fishes, frogs, lab rodents	Omran & Salama 2016, Singh et al. 2018
Triclopyr	Garlon, Remedy	silviculture, food crops, poison-ivy	toxic to lichens & bryophytes; one formulation toxic to fish & aquatic invertebrates	Newmaster et al. 1999, McMullin et al. 2012
Dicamba	Diablo, Vanquish	food crops, rangeland weeds	toxic to amphibian larvae	Attademo et al. 2021
Imazapyr	Arsenal, Habitat	environmental weed management (e.g., *Phragmites*, floating aquatic weeds)	toxic to common duckweed, test invertebrates	Cruz et al. 2015
Paraquat*	Gramoxone	agricultural weeds, formerly illegal marijuana	physiological, biochemical, oxidative stress & genetic effects on mouse; acute human toxicity	Onur et al. 2022
Ammonium sulfamate	Ammate	poison-ivy management, other woody plants	widespread in waters; toxicity to aquatic organisms should be studied	Van Stempvoort et al. 2019

* Banned in European Union or other countries.

least toxic materials such as acetic acid, prescribed grazing, removal of plant litter, and fire. Some of these alternatives have only a temporary top-kill function or require repeated treatments, e.g., twice per month for several years, to deplete the underground storage organs of the plant.

The history of pesticides in North America shows that many materials have been approved by regulatory agencies and have come into widespread use, and then were found to be dangerously toxic. DDT is the best example of a pesticide that was ubiquitous in agriculture, mosquito control, and even delousing of humans, until it was proven that DDT and its breakdown products were causing reproductive failure in birds of prey. The same story of wide use followed by discovery of adverse impacts has been repeated with the insecticides chlordane and diazinon, the rodenticide zinc phosphide, and the herbicide-defoliant Agent Orange (2,4-D + 2,4,5-T). The current controversy about glyphosate seems an analog of the same process. It is likely that, if glyphosate use declines in the U.S., farmers and vegetation managers may adopt purportedly less-toxic alternatives that eventually turn out to be ecologically troublesome too.

DISCUSSION

I have selected examples from the toxicology literature that demonstrate significant toxicity of glyphosate, GBH, and other herbicides to diverse wild organisms. Many other examples could be cited. Although some other studies did not find toxicity, what matters is that glyphosate and GBH are toxic to many organisms in at least some situations. These materials may cause dangerous loss of biodiversity and associated ecosystem services such as crop protection without proving toxic in every study.

Although glyphosate and other herbicides are very widely used in agriculture, forestry, landscaping, and in managing wild vegetation, rarely are adverse effects on nontarget organisms measured directly in the field. Many potentially affected taxa are mobile, and move in and out of herbicide-treated areas. And dying or dead small animals are hard to find in dense vegetation, water, or when carcasses are quickly consumed by scavengers. Moreover, besides herbicides, organisms are subject to mixtures of contaminants that may include PCBs, PFAS, heavy metals, pharmaceuticals, microplastics, personal care products, and other pesticides. Hence the importance of controlled experiments to point the way, but lots of uncertainty exists.

Clearly, there is a need to reduce use of glyphosate and other herbicides, and to develop better techniques for field monitoring of lethal and sublethal effects on wild organisms. We can all help reduce the use of toxic herbicides by refusing to use them ourselves or for projects in which we are involved, and by buying organically grown food and fiber.

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HUDSONIA PROJECT UPDATES, SUMMER 2023

Special Species and Habitats

Temporary pools. In collaboration with Emily White of Bard College, our two-year survey of 27 temporary pools, ranging from two square meters to 0.4 hectare (22 square feet to 1 acre), in Ulster and Dutchess counties, has yielded 162 species of aquatic macroinvertebrates. We are analyzing the relationships between invertebrate diversity and environmental chemistry. In addition to amphibians and mosquitoes, temporary pools of many kinds, right down to rain-filled wheel ruts on dirt roads, are important for biodiversity and highly threatened because they are easily filled, drained, or treated with insecticides, and mostly lack legal protection. (Funded by Will Nixon.)

Wood turtle. In collaboration with Jason Tesauro Consulting and the Hawthorne Valley Farmscape Ecology Program, Hudsonia is radiotracking wood turtles for the fifth year on a large agricultural site. This species is vulnerable to injury and mortality from farm equipment, and we are studying the environmental and agronomic factors that contribute to this risk. The wood turtle is a NYS Species of Special Concern and a High Priority Species of Greatest Conservation Need. Wood turtles spend the cool months in streams and the warm season mostly on land basking, foraging, and nesting. We are analyzing weather and streamflow data in search of factors that stimulate turtles to move farther from the stream and closer to actively farmed areas. We will make recommendations for reduction of farming hazards to turtles at our study site and on farms in general. (Funded by the Hudson Valley Farm Hub.)

Bob Schmidt at a temporary pool in the Thompson Pond Preserve, Pine Plains. Photo © Lea Stickle

Lea Stickle radiotracking wood turtles at the research site; Erik Kiviat in the background. Photo © Amy Wu/Hudson Valley Farm Hub

American eel. Hudsonia continues its collaboration with the NYSDEC Hudson River Estuary Program, the Hudson River National Estuarine Research Reserve, and Bard College to monitor an eel fyke net at the tidal mouth of the Saw Kill in Tivoli South Bay. The American eel is a NYS Species of Greatest Conservation Need. Each year, the net is checked daily from mid-March to mid-May for glass eels – the young translucent American eels (*Anguilla rostrata*) that migrate each year from the Sargasso Sea into rivers and streams along the U.S. East Coast. Due to warmer temperatures, the net was installed a bit earlier this year, in early March, and left in for approximately 11 weeks. Three Bard College student interns conducted education outreach and oversaw the daily monitoring of the net alongside Hudsonia staff. Over 100 volunteers came out to help throughout the 2023 season, counting a total of 2,334 eels. Besides eels, other species collected included various invertebrates along with small fishes such as fourspine

sticklebacks, banded killifish, and tessellated darters. (Funded by NYSDEC and Bard College).

Blanding's turtle. We collaborated with Marist College and Arlington High School on a study of the importance of groundwater exchange in Blanding's turtle core wetland habitats. The Blanding's turtle is a Threatened species in New York, and a high priority Species of Greatest Conservation Need.

Knotweed. Two studies of knotweed (*Polygonum cuspidatum*, a non-native species) use by other organisms are nearing completion. In one project, with help from experts, we identified more than 150 species of insects from knotweed flowers and leaves. Analysis addresses the proportion of native species visiting knotweed, the plant parts used (not necessarily eaten), and the kinds of plants these insects are usually associated with. The second project, assisted by community scientists, documents numerous examples of birds nesting in knotweed widely in the U.S. and Canada and across a spectrum of bird species. Knotweed is unquestionably invasive but its trajectory of integration into the North American biota must be considered in policy and management. (Initial field work funded by the Greene County Soil and Water Conservation District and New York City Department of Environmental Protection; analysis and manuscript preparation funded by the DHR Foundation.)

A small, swampy stream in which wood turtles overwinter.
Photo © Lea Stickle

Examining the catch from the eel fyke; from left to right, intern Nique Alladen and volunteers Heather Phelps-Lipton, Carol McLaughlin, and Emily McLaughlin. Photo © Lea Stickle

Phragmites. A manuscript of a review and analysis of ecosystem services provided by common reed (*Phragmites*) in East Coast tidal marshes has been submitted for publication in a scientific journal. The project is a collaboration between Hudsonia, Tom Mozdzer, Judith Weis, and others.

Biodiversity Assessments and Other Technical Assistance

Bontecou Wildlife Preserve. We are delighted to be conducting a biodiversity assessment of the new Jesse and Gayle Bontecou Wildlife Preserve in the towns of Washington and Stanford, Dutchess County, NY. The 1300-acre property, formerly a part of Rally Farms, is owned and managed by the Dutchess Land Conservancy for the primary purpose of wildlife protection and habitat conservation. (The Preserve is not yet open for public use.) In collaboration with Larry Federman, the Hawthorne Valley Farmscape Ecology Program, Bob Schmidt, Jason Tesauro, and Emily White we are conducting exploratory surveys of water quality, plants, butterflies, dragonflies and damselflies, ants, ground beetles, fishes, reptiles, amphibians, breeding birds, winter raptors, and bats and other small mammals. Our findings will help the Dutchess Land Conservancy plan for future land management and public uses. (Funded by the Dutchess Land Conservancy.)

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We performed **biodiversity assessments**, **reviewed environmental documents,** and provided **conservation recommendations** for proposed developments, future parks, energy projects, and private estates in the New York towns of Amenia, Copake, Dover, Highlands, Huntington, Mount Pleasant, Pine Plains, Rhinebeck, Saratoga, and Woodstock, and in the New Jersey towns of North Bergen and Teaneck. Among our interesting finds were the rare fungus "sweet knot" (*Globifomes graveolens*) in a Woodstock forest, and marsh straw sedge (*Carex hormathodes*, NYS Threatened) near the Suffolk County tidal shore.

Biodiversity Education

In collaboration with the Hudson River Estuary Program, we held a webinar in March on the topic of **Habitats and Biodiversity Conservation**, with an introduction to habitats of the Hudson Valley, principles of biodiversity conservation, and how local legislation can protect habitats, plants, and animals of conservation concern. A recording is available at https://www.dec.ny.gov/ lands/120539.html, along with recordings of many other webinars on land use and conservation sponsored by the Estuary Program. We also held in-person workshops in Westchester, Orange, Columbia, and Albany counties on the topic of **Planning for Nature in Your Community**. The programs included an introduction to Natural Resource Inventories and Open Space Plans and discussions of how they can be used in local policy-making, and in environmental reviews of land development projects. Later this year we will hold field workshops on the values of **small wetlands and streams** and how to protect them. (Funded by the NYS Environmental Protection Fund through the Hudson River Estuary Program.)

Assistance to Municipalities

Natural Resource Inventories

We are continuing to work with advisory committees in the **Town of Kent** (Putnam County) and the **Town of Milan** (Dutchess County) on preparation of natural resource inventories (NRIs) for those towns. The NRIs describe the bedrock, soils, groundwater, surface water, habitats, plants and animals of conservation concern, farmland, scenic areas, and resources for public recreation in each town, and provide recommendations for uses and sound stewardship. The purposes of the NRIs are to inform townwide land use planning, environmental reviews of development projects, and land management and conservation initiatives of public agencies, NGOs, and individual landowners. The final documents will be published—printed and online—later this year. (Funded by grants to the towns from the NYS Environmental Protection Fund through the Hudson River Estuary Program.)

Critical Environmental Areas

In partnership with the Hudson River Estuary Program, we have continued assisting a team in the **Town of Olive** (Ulster County) with proposals to establish two Critical Environmental Areas—one in the vicinity of an unusual wetland, and the other along two high-quality trout streams. A Critical Environmental Area is a geographical area formally designated by a municipality to draw attention to exceptional natural or cultural features that deserve special attention during environmental reviews and land use decisions. (Funded by the NYS Environmental Protection Fund through the Hudson River Estuary Program.) ■

Sweet knot (the dark lumps), a rare fungus occurring here with a shelf fungus on sugar maple. Photo © Chris Graham

Herbicides continued from page 5

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WELCOME TO MEG RUMPLICK

This spring, Meg Rumplick joined Hudsonia as a Technician. A recent graduate of Vassar College, Meg came to us with broad experience in herbarium curation, Geographic Information Systems, management of invasive plants, and field biology—plants, birds, large and small mammals, insects—including a 2022 stint with the School for Field Studies in Tanzania. She recently completed a senior thesis on the Beech Leaf Disease that has been spreading rapidly in New York over the last decade. This summer, Meg is tracking wood turtles at a research site in Ulster County to see how the turtles are interacting with farm operations. In addition to turtle data management and analysis, and pressing plants for the Herbarium, Meg will be conducting field and lab work on many other biodiversity assessment projects.

WATERSHED WAVEMAKERS AWARD

Hudsonia's Biodiversity Resource Center (BRC) was honored to be one of four recipients of the 2023 WaveMakers Award from the Hudson River Watershed Alliance. This is an annual award recognizing people and institutions that have contributed to the protection of water resources in the 13,400 square mile watershed of the Hudson River. The BRC was recognized for its Habitat Mapping, Natural Resource Inventories, and Biodiversity Education programs, all of which aim to put scientific information into the hands of local decision-makers for on-the-ground conservation.

Slime mold on rock. Slime molds are a highly diverse group of organisms that share some physical and life history features of plants, animals, and fungi, but are classified separately as protists (Kingdom Protista). Slime molds consume bacteria and play important roles in decomposition ecosystems. Photo © Kristen Bell Travis

Spongy moth caterpillars. The infestations are patchy in the region, but some areas have been hit heavily this spring. By late June the caterpillars start to pupate, and the adults emerge in July to mate and deposit their egg masses on the trunks of trees. Photo © Kristen Bell Travis

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BIODIVERSITY RESOURCE CENTER

Hudsonia seeks to hire a Director of the Biodiversity Resource Center to conduct ecological research, perform biodiversity assessments, speak and write for both scientific and lay audiences, and lead an education program for municipal agencies, land trusts, and others involved in decision-making about land use and conservation. A full description of the position and instructions for applicants are at https://www.hudsonia.org/employment.

UPCOMING EVENTS

Exploring Little Stony Point

Hudsonia biologist Chris Graham will lead a New York Flora Association (NYFA) field trip at Little Stony Point (Cold Spring, Putnam County NY) on 20 August 2023, 9:00am – 12:00pm. Little Stony Point in the Hudson Highlands State Park is a ca. 25-acre (10-hectare) area on the Hudson River shore with a nice variety of habitats, including mature oak forest, mixed-hardwood forest, a rocky summit, dry sandy meadows, and tidal sandy shore. In August there should be good displays of fruiting sedges and flowering forbs, including some uncommon species. For anyone who wants to bring their lunches, the rocky summit has excellent views and is a nice place for a picnic at the conclusion of the walk. The event is free but is limited to 14 participants, and registration is required. For more information and to register, visit the NYFA Events page: https://nyflora.org/events-directory/.

Small Streams and Wetlands

Small streams and small wetlands have outsized importance for ecosystems and ecological services, and are threatened by many of our land uses, but are mostly unprotected by federal and state laws. The workshop will cover the ecological and other values of small streams and wetlands, how to recognize wetlands even when they are dry, some of the threats to wetlands and streams, and how to protect those resources through individual actions, local policy, and local legislation. In collaboration with the Hudson River Estuary Program, we will hold two field workshops in September and October 2023. Check the Hudsonia website in July for information on the dates and places and how to register (https://www.hudsonia.org/events).

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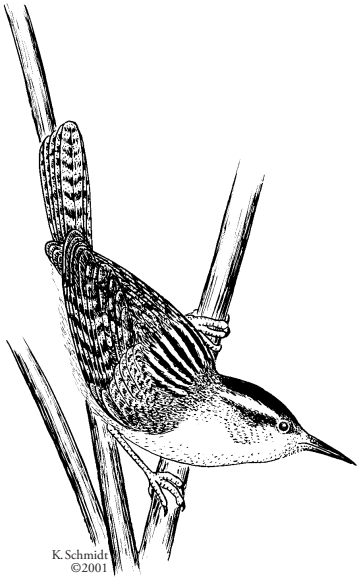

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