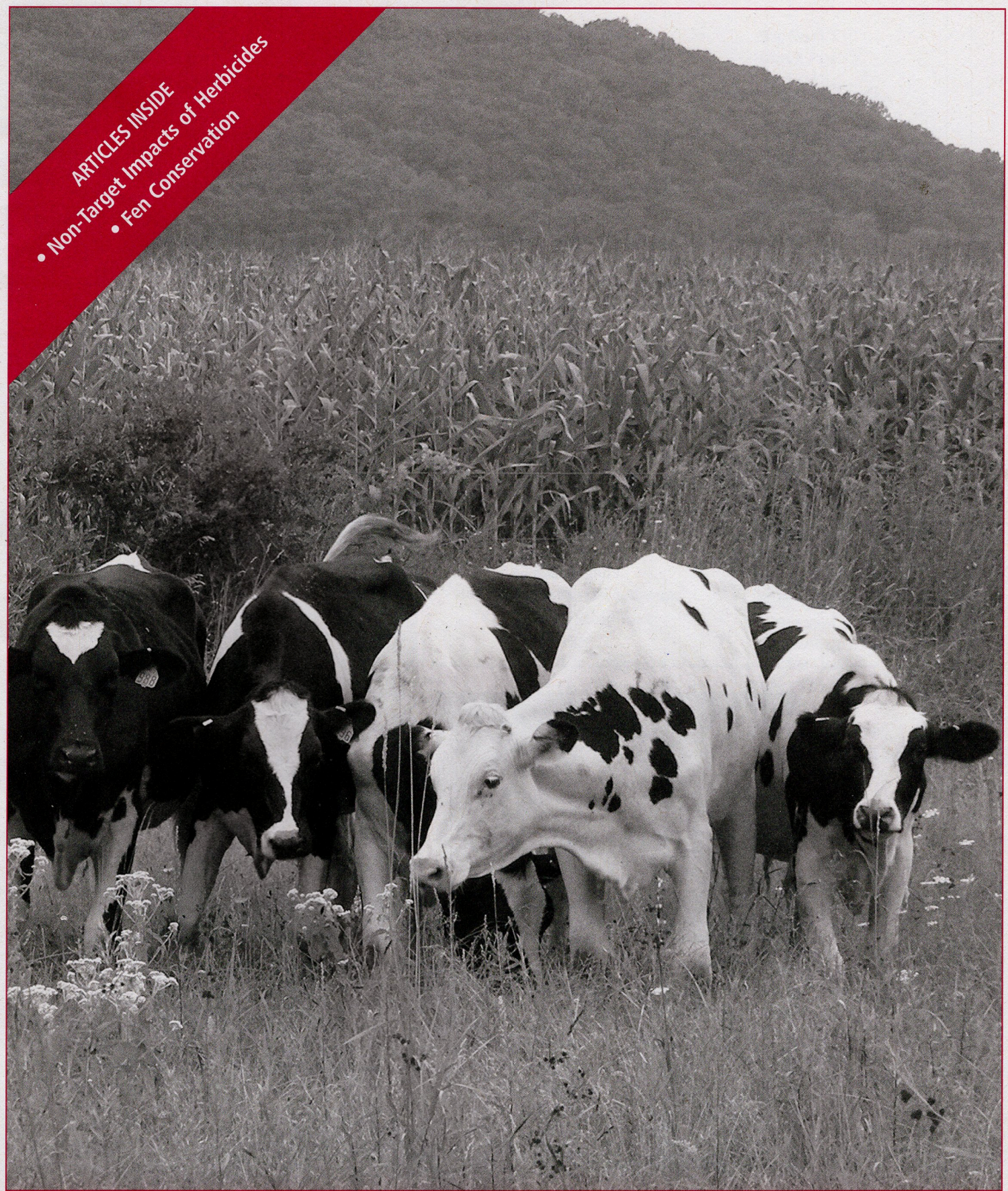
ARTICLES INSIDE
- Non-Target Impacts of Herbicides
- Fen Conservation



Dairy cows in fen.
Photo © Karyn L. Hajek

Environmental Research and Education
Science for Conservation

News from Hudsonia

Volume 23, Number 1 Fall 2009

Inside Hudsonia

Dear Friends of Hudsonia,

Your responses to our funds appeals during the past year have been fabulous—thank you so much for keeping Hudsonia alive!

And please keep donating—it is especially crucial to Hudsonia now, when funds from other sources are flowing very slowly.

With your help, we will continue our research on important natural phenomena that are "under the radar" of most practitioners, our studies of critical issues related to nature management, and our research and education programs for conserving biodiversity in your own communities. This year, as we tighten our belts in the face of the worldwide economic slump, Hudsonia has suspended work on the long term Blanding's turtle research project, skipped the spring issue of *News from Hudsonia*, and left two staff positions temporarily unfilled. But we are carrying on our work to understand the natural world and bring sound science to the conservation actions of other organizations and agencies.

We are confident that, as you read this issue of *News from Hudsonia* and follow our projects and accomplishments in the region, you'll find Hudsonia a vital force in northeastern conservation science worth supporting.

Thank you again, and all our best wishes,

Erik Kiviat
Executive Director

Philippa Dunne
Chair, Board of Directors

ISSN 1072-8244

Environmental Research and Education
Science for Conservation

News from Hudsonia

A journal of natural history and environmental issues

Telephone: (845) 758-0600
Facsimile: (845) 758-0607
Website: www.hudsonia.org

PO Box 5000
Annandale, NY 12504-5000

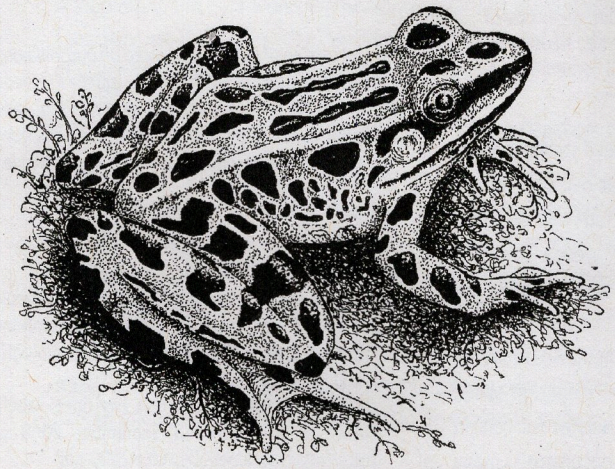
Volume 23, Number 1 Fall 2009

NON-TARGET IMPACTS OF HERBICIDES

By Erik Kiviat*

Some plants compete with our crops or alter the visual appearance and habitat functions of the landscape, so there are places and times where people want to eliminate certain plant species. Nowadays that is usually done with chemical herbicides that interfere with the physiological processes of those plants. Over the last few decades, herbicides have become increasingly sophisticated, more effective for particular purposes, more degradable, less obviously toxic to humans or wildlife, and more heavily used.

But do herbicides just harm weeds? Let's look at glyphosate and its commercial formulations (such as Roundup) to help answer this question. Glyphosate is a systemic herbicide that, when applied to foliage, is translocated into the root systems and is capable of killing the whole plant. Glyphosate is the most widely-used herbicide in the U.S. and worldwide, and has been used for decades on gardens, lawns, and parkland; has been applied to thousands of acres of common reed (*Phragmites*) in Delaware Bay, the Hackensack Meadowlands, Connecticut, and New York; and has been used on hundreds of millions of cropland acres around the world.[13]



Amphibians such as the northern leopard frog may be vulnerable to endocrine disruption from herbicide formulations. © 2001 Kathleen A. Schmidt.

Often a new pesticide is touted as effective and nontoxic and is widely used, but many years later we discover that there are serious human health or wildlife impacts. This occurred, for example, with the insecticides DDT, chlordane, and diazinon, and the herbicide 2,4,5-T. Glyphosate and its formulations are described by manufacturers as virtually harmless to organisms other than the target weeds, safe for humans, and rapidly immobilized in soil. The toxicological and epidemiological research of the last 10-20 years, however, paints a different picture.

Glyphosate can be used diluted with water or mixed with other substances referred to as "adjuvants" that improve the effectiveness, portability, or ease of application. Surfactants, one group of adjuvants, are detergent-like compounds that cause the herbicide to stick to plant surfaces better. Other adjuvants include thickening agents, solvents, and emulsifiers.[4,25] An impurity, N-nitroso-glyphosate, belongs to a group of chemicals that includes many carcinogens.[4] Different commercial formulations of glyphosate (such as Ranger, Rodeo, and Roundup), contain different adjuvants. The "Other ingredients" (59% by weight of Ranger, for example) may be trade secrets.[14]

Continued on page 2

CONTENTS

* Erik Kiviat is Hudsonia's Executive Director.

Herbicides continued from page 1

NON-TARGET IMPACTS

There has been controversy regarding the effects of glyphosate formulations on amphibians. Some formulations do, indeed, affect larval and juvenile frogs and this toxicity may be due more to the surfactant POEA in Roundup than to the glyphosate itself.[18,19] The mechanism of impact on frogs may be endocrine disruption[6]—a common effect of chemical toxicity that results in decrease or increase in the body's production of one or more hormones.

Roundup was genotoxic in an experiment with laboratory mice, indicating that Roundup might cause cancer in other mammals including agricultural workers; the responsible compound was not identified.[17] Roundup was also toxic in human placental cell culture at concentrations much lower than used in agriculture, and was considered a potential endocrine disruptor.[20] Several studies have indicated that glyphosate or Roundup may be carcinogenic and mutagenic.[24] Human toxicity has been attributed to both the surfactant[21] and to the glyphosate itself. The common surfactant POEA and an associated contaminant, 1,4-dioxane, are toxic to humans and other mammals.[16] Glyphosate inhibited steroidogenesis in cultured mammalian cells in the laboratory[23] and therefore could be a reproductive toxin in mammals.

Non-target toxicity is not limited to glyphosate herbicides. For example, imazapyr or its formulations (such as Habitat), also used to control invasive plants in the U.S., can cause irreversible eye damage in humans; is toxic to fish and potentially toxic to rare plants; has produced resistance in several species of vascular plants and an alga; and may be a carcinogen.[2,5]

One of the significant problems associated with pesticides is that they reach non-target habitats by accidental application, wind drift, and runoff.[18] Damage to sensitive plant species from drift of chlorophenoxy herbicides (different from glyphosate) was found to occur as much as several miles from the site of application,[25] presumably by aircraft. In one study, for seven of 14 common non-target plant species tested, the amount of Roundup that caused damage was less than 1 µg (millionth gram) per plant.[3]

Risks of wind drift and contaminated runoff can be reduced by using manual application methods. A backpack sprayer allows the applicator to more accurately direct the herbicide to the target weed, but still results in drift. Herbicide can also be injected into individual weed stems, which works well with thick-stemmed plants such as Japanese knotweed (*Fallopia japonica*). There are also cut-stem treatments, in which an individual weed stem is cut and then herbicide is painted on or dripped into the cut stump. Injection and cut-stem treatments put the herbicide right where it is wanted, and are less likely to expose non-target organisms,[22] although effects on co-occurring rare plants have been seen occasionally with hot-weather cut-stem applications to common reed.[15] Treatments applied to individual stems are labor-intensive and practical only for small stands of a weed.

The ragged fringed orchid (*Platanthera lacera*), shown here among common reed and woody plants at Jamaica Bay Wildlife Refuge, is one of the uncommon plants that could be harmed by herbicide applications to control common reed.
Photo © David Taft, National Park Service.

Herbicide applications to weed stands put elements of native biodiversity at risk both within and outside the stand, but much use of herbicides to kill environmental weeds (invasive plants) as well as agricultural weeds is unnecessary. Not only are there effective and non-toxic alternatives, but the weeds themselves may be less harmful than you think. Although weed stands may indeed be poor habitat for certain desired native species, I have documented many common and rare native species, ranging from liverworts to mammals, using such stands and appearing to benefit from them.[1,7,8,9,10,11,12]

ALTERNATIVES TO HERBICIDES

Many non-chemical treatments work well for weed management, but an effective management strategy must be specific to the weed species, the local situation, and the management goals. Some alternative treatments include frequent cutting or hand-pulling; cutting followed by flooding; burning; livestock grazing; covering with plastic; and, for short-lived weeds or weeds that do not resprout after top-kill, use of agents such as steam or strong vinegar. Another weed management approach is biological control. But biocontrol has its own problems, as the organisms (insects, fungi, and others) used to control weeds can attack non-target plant species. For common reed I have outlined a holistic approach to management decisions that considers the goals of management, the local ecological situation, a variety of detrimental and beneficial relationships of the weed to other species, and the advantages and disadvantages of different management techniques.[11,12] A similar approach may be appropriate for other weed species.

To avoid harming other organisms I recommend that you minimize herbicide use, consider non-chemical alternatives for landscaping, gardening, and invasive plant management, and when feasible eat foods grown without herbicides. If you must apply herbicide, use manual application techniques, careful procedures, and adequate protective gear. These measures will help protect non-target plants and animals (including you), and move our society further towards ecology-based weed management that is effective, practical, and least-toxic. ■

A longer version of this article, posted on hudsonia.org, addresses evolution of glyphosate resistance in weeds, glyphosate toxicity to seedlings and to fungi, and additional issues. The Web article will be amended from time to time as information becomes available.

REFERENCES CITED

1. Barbour, J.G. & E. Kiviat. 1997. Introduced purple loosestrife as host of native Saturniidae (Lepidoptera). Great Lakes Entomologist 30(3):115-122.
2. BASF. 2004. Habitat herbicide [specimen label]. BASF. 13 p. (Viewed 8 September 2009 at http://www.cdms.net/LDat/ld6H2000.pdf)
3. Breeze, V., G. Thomas, and R. Butler. 1992. Use of a model and toxicity data to predict the risks to some wild plant species from drift of four herbicides. Annals of Applied Biology 121:669-677.

CONSERVATION OF FENS IN AGRICULTURAL LANDSCAPES

By Karyn L. Hajek*

Fens are often overlooked—and sometimes purposefully avoided—by both professional ecologists and nature lovers due to their small size and the high probability that you'll end up sinking thigh-deep into black muck! However, a glimpse at these distinctive wetlands is well worth the risk. Fens are extremely interesting ecologically and are valued by conservationists because they harbor diverse and unusual plants and animals. To my eye, they are also some of the most aesthetically pleasing natural areas in the region.

A fen is a specific kind of wetland that is fed by groundwater seepage. In the Hudson Valley, the groundwater that discharges into fens tends to have high mineral concentrations due to the local geology, which is dominated by calcium-rich materials such as limestone or dolomitic marble. For this reason, fen communities have many calcium-loving plant species, including a wide variety of sedges, forbs and low-growing shrubs, such as shrubby cinquefoil. Many fen plants are visually impressive. In late spring, the tufted fruits of cottongrass are striking, with the richly colored blossoms of blue-flag iris and golden ragwort adding a regal flair. Later in the summer, fens are decorated by composites, such as purple-stemmed aster, bog goldenrod, and rough-leaved goldenrod. A blanket of mosses underfoot is often studded with the distinctive white blooms of grass-of-Parnassus and the delicate form of Kalm's lobelia.

Fen plants are not only eye-catching, but are also quite tough; they must survive and reproduce in a stressful hydrological and chemical environment. Because fens receive a steady flow of groundwater, water levels tend to be stable throughout the growing season. So—unlike a riparian wetland where soils are flooded mainly in springtime and after heavy rains—fen soils are continuously saturated, leading to very low oxygen in the soils. These anaerobic conditions reduce the availability of essential nutrients such as nitrogen and phosphorus. Also, the calcium and magnesium compounds in the groundwater bind phosphorus in the soil, further reducing its availability to plants.

Kalm's lobelia (*Lobelia kalmia*) is a plant of limy wetlands, and is often found in fens of southeastern New York. Photo © Kristen Bell.

My graduate research, which concentrates on describing plant diversity patterns in fens, has allowed me the opportunity to make focused observations of plant communities in over two dozen fens in central New York and the Hudson Valley. In these studies I have observed that fen plant communities are not homogeneous. Many environmental factors—moisture, mineral concentrations, pH, and temperature—vary throughout the fen and influence the patterns of biological diversity in complex ways. Generally, peak plant diversity is often observed at intermediate levels of these factors, and low diversity at the extremes. Thus, while environmental conditions in fens are stressful, the moderate infertility is associated with the high plant diversity found in fens.[1]

Environmental gradients in a fen are observable at multiple scales. For instance, fen species composition can vary within a few centimeters of elevation, as moisture levels decrease from hollows to hummock. Also, as you move horizontally away from a spring, or site of groundwater discharge, the influence of the groundwater on the plant community appears to diminish. The spring itself is often marked by very low-growing, herbaceous plants, such as spikerushes. Diversity is low because only a few species are well-adapted to these stressful conditions. Moving away from the spring, plant diversity increases and individual plants grow larger. At even greater distances from the spring, plant diversity starts to decrease, and the community becomes dominated by large herbaceous species such as cattail, or shrubs such as willows, alders, and dogwoods. This spatial heterogeneity is one reason fens are famous for botanical diversity.

Human activities have altered these complex systems in many ways. Many of the fens that have survived our landscape manipulations over the last two centuries exist in agricultural landscapes. Ditching has changed water levels; runoff from adjacent cropland has increased fertility; new species have been introduced from Eurasia; and physical disturbance regimes have been altered. These human-mediated impacts change the nature of fen plant communities and the animal communities that rely on them. The combination of drier conditions (due to ditching) and greater nutrient availability allows shrub cover to increase in these wetlands. Even sites that retain natural hydrologic regimes often become dominated by invasive species, such as reed canary-grass and purple loosestrife, that grow well under fertile conditions. Shrubs and tall herbaceous species tend to shade out the shorter plants that are characteristic of fens. Also, the tremendous amounts of leaf litter produced by species such as reed canary-grass can nearly eliminate the moss community. These changes result in the dis-

* Kay Hajek is a Ph.D. candidate at SUNY College of Environmental Science and Forestry.

Blue flag (*Iris versicolor*), the native wild iris found in many of our freshwater wetlands, lends its spectacular bloom to the fen landscape. Photo © Karyn L. Hajek.

appearance of the signature plant community of fens, and likely alter nutrient cycling.

I am interested in studying practical ways to manage fens to resemble their natural state. Sustaining or restoring the moderate infertility that is so important for maintaining the fen communities can be accomplished by altering some of the human land use practices around fens to maintain or restore the fen hydrology, reduce the nutrient inputs, and control invasive plants. For example, when shrubby buffers are established between croplands and wetlands, the shrubs take up water and nutrients, reducing the amount of nutrient-rich agricultural runoff entering the wetlands.

Once nutrient inputs are reduced, however, invasive species must be controlled to allow native fen plants to reestablish. Although mechanical removal and herbicide treatments can effectively reduce the cover of many invasive plants, these actions are expensive and time consuming, and are likely to harm non-target species.

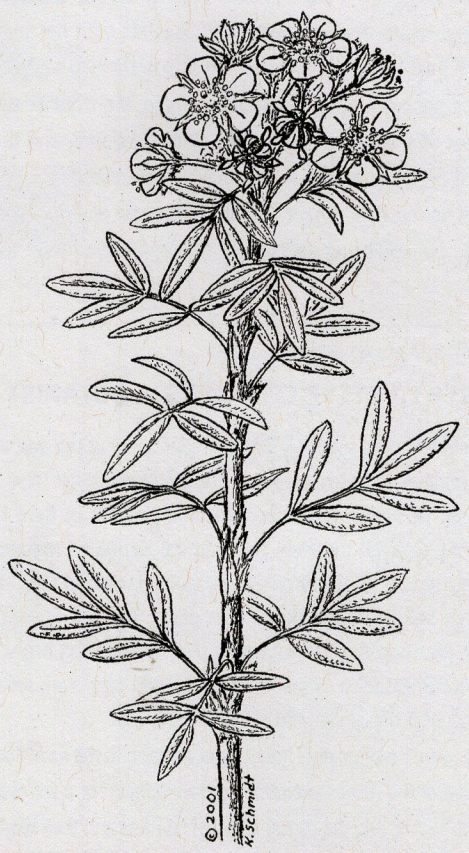
Although they do not perfectly mimic the natural disturbances that historically occurred in fens, traditional agricultural practices may be a realistic option for land managers wishing to restore fen ecology.[3] Historically, the many fens that occurred on working farms were regularly mowed or were grazed by livestock, but abandonment of mowing and grazing has allowed shrubs and invasive plants to expand in fens.[2] I have compared grazed and ungrazed fens, and found that diversity is somewhat higher in grazed sites, and the cover of invasive species is lower.

Livestock grazing, however, affects plant communities by at least three major mechanisms: consumption of plants, trampling of plants and soil, and nutrient inputs from animal waste. The exact impacts depend on the kinds of livestock and the timing and intensity of uses. For instance, goats consume woody plants and may be a good option in formerly drained wetlands where shrub cover is high. When cattle are stocked at moderate rates and ample upland areas are incorporated into the pasture, consumption of fen plants is minimal. But even at low stocking rates, cattle can affect the fen just by walking through it. Trampling of above-ground and below-ground plant parts may favor some fen plants by reducing competition for light, and creating refugia for smaller, less competitive fen plant species.

Moderate grazing may be a viable management option, but our knowledge of grazing impacts remains incomplete. For instance, how does trampling affect soil structure, and how does this action combined with nutrient inputs affect long-term nutrient cycling and plant growth? What is the impact of trampling and grazing on fen moss communities? Though we still need to answer such questions and refine our management techniques, I believe that these traditional agricultural practices will encourage the coexistence of agriculture and native biodiversity. Managed fens may not perfectly resemble historical natural communities, but they will continue to harbor many native plants, including some of the rare and uncommon species for which fens are renowned. ■

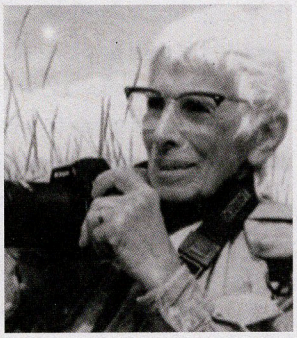
REFERENCES CITED

1. Bedford, B. L., M. R. Walbridge, and A. Aldous. 1999. Patterns in nutrient availability and plant diversity of temperate North American wetlands. Ecology 80:2151-2169.
2. Middleton, B. A., B. Holsten, R. van Diggelen. 2006. Biodiversity management of fens and fen meadows by grazing, cutting and burning. Applied Vegetation Science 9:307-316.
3. Motzkin, G. and D. Foster. 2002. Grasslands, heathlands, and shrublands in coastal New England: Historical interpretations and approaches to conservation. Journal of Biogeography 29:1569-1590.



Shrubby cinquefoil (*Potentilla fruticosa)* is one of the signature species of fens in southeastern New York. © 2001 Kathleen A. Schmidt.

REMEMBERING ESTHER



One of the noblest words in our American lexicon is "commonwealth." From our earliest efforts at community-building on what at first seemed to be an inhospitable shore—and indeed for millennia before that in the societies established by Native Americans—the wellbeing of all depended on the goodwill and contributions of each toward the common good. We all believe it to be as true today as it was in former times, but how many put that belief into practice?

Esther Kiviat did exactly that for most of her 93 years. Perhaps in part because of her parents' experience as Jewish immigrants from Poland, but surely also because her native deep intelligence guided her there, Esther sought out ways in which she could, quietly but steadily, strengthen and improve the community for all. Professional photographer, nursery and primary school teacher and administrator, proprietor of a children's summer camp, environmental and nature educator, writer—the particularities of her long life blend into one word: citizen.

And what a useful citizen Esther was! I came especially to know her a dozen years ago when she was a vibrant 80 and asked me to read and comment on the chapters of her book "Changing Tides," a natural history of the Tivoli Bays. The joyful diligence with which she undertook, over a number of years, to research, write, and illustrate with her stunning photography this exceptional volume left me with nothing to say but Wow! Still in print, the book continues to introduce young and old alike to the magic of our great tidal wetland and its adjoining shorelands, and to an understanding of their importance to the health of the planet.

She and her husband Charles made another, far more momentous, contribution to our wellbeing and quality of life in raising their son Erik and encouraging him on his way as he became the region's preeminent ecologist and scholar of natural communities and endangered habitat. Needless-to-say, the non-profit, civic mission of Hudsonia and its success were a source of immense and justified pride for Esther.

At the end she was still teaching and inspiring us with her nature photography and with her eagerness to master the new technologies of the desktop computer era in order to deliver more effectively still that ancient message of the commonwealth.

—Wint Aldrich
Deputy Commissioner for Historic Preservation
NYS Office of Parks, Recreation, and Historic Preservation
Town Historian, Red Hook

Donations in memory of Esther Kiviat may be made to Hudsonia Ltd.

Spatterdock and clouds, late afternoon, Tivoli North Bay. Photo © 1999 Esther Kiviat.

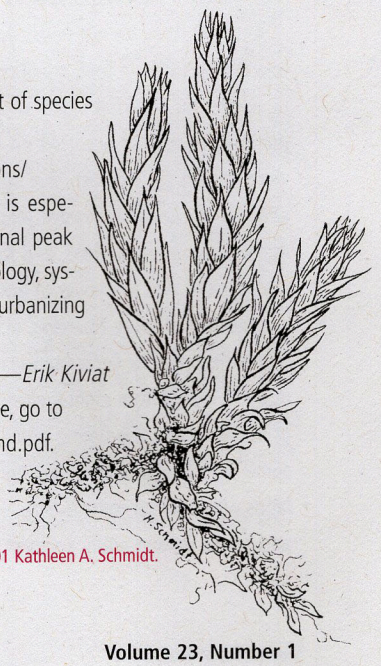
GOODBYE TO STEVE CLEMANTS, A BOTANIST FRIEND

Steven Clemants died suddenly in November 2008 at the age of 54. Steve was a Hudsonia Research Associate for many years. We first met in the 1980s when he held a temporary teaching position at Bard College. He subsequently directed the New York Natural Heritage Program, and then had a long tenure at the Brooklyn Botanic Garden where he was Vice President of Science at the time of his death. At BBG, Steve created the New York Metropolitan Flora Project (http://www.bbg.org/sci/nymf/), a valuable documentation of plants in the greater New York area built by a large group of professional and amateur botanists.

Among Steve's professional interests, in addition to the local flora, were the classification of the rushes (*Juncus*), the development of a list of rare mosses for New York State, and the conservation of habitats and their biodiversity. The umbrella group Nature Network benefited greatly from his patience and organizational work. Steve gave generously of his time to Hudsonia, identifying plants and providing data (notably the list of species of the Hackensack Meadowlands; see hudsonia.org/wp-content/files/Publications/NJ%20 Meadowlands/r-hmtabp.pdf). It is especially tragic to lose a person at professional peak and a good scientist who blended field biology, systematics, and conservation in the great urbanizing core of the Northeast.

—Erik Kiviat

To contribute to a living memorial for Steve, go to bbg.org/sci/staff/clemants_wildflowerfund.pdf.



Brachythecium turgidum, a rare moss. © 2001 Kathleen A. Schmidt.

WISH LIST

File cabinets
Digital camera
Folding chairs
Office chairs
Easels
Library shelving or bookshelves
Natural history and field science books and journals (but inquire first, please)
"Rite in the Rain" paper, 8.5x11
Photocopier
Area rugs
Conference table
Large folding table

THE OSI CITIZEN ACTION PROGRAM

- **Do you have an idea and seed money but need help with organization?**
- **Are you involved with a small start-up that wants to become more established?**
- **Would you like to receive tax deductible donations but do not have 501(c)(3) status?**

The Citizen Action Program of the Open Space Institute can help with legal and financial aspects of managing your project; attracting more donors; and making your work more effective. The CAP provides fiscal sponsorship and administrative support to grassroots community groups whose programs and activities are aligned with OSI's central mission to protect scenic, natural, and historic landscapes. CAP can help groups that work on land use planning issues take advantage of Hudsonia's scientific expertise. For more information, please contact Antonia Bowring—abowring@osiny.org.

DONORS OF GOODS AND SERVICES

DONORS OF FIELD AND LABORATORY ASSISTANCE

Clare Churchill-Seder
Gabriella DiGiovanni
Lizbeth MacQuarrie
Matthew Pomerantz
Samantha Root
Anne Liljedahl Schock
Greg Shaheen
John Thompson

DONORS OF TAXONOMIC SERVICES

Richard Harris
C. Barre Hellquist
Ken Hotopp
Ken Karol
John Mickel
Paula M. Mikkelsen
Tim Pearce
Ken Soltesz

DONORS OF BOOKS AND JOURNALS

Jim Beemer
Lin Fagan
Joan Dye Gussow
IAMSLIC member libraries
Peter Rose

DONORS OF OTHER GOODS AND SERVICES

Bard Free Store
Joe Bridges
Megan Callus
Gina Walker Fox
John Hoyt
Russ Immarigeon
Estate of Esther Kiviat
Omega Institute

ANNOUNCEMENTS

The **Harlem Valley and Ridges Supplement** (to the Biodiversity Assessment Manual for the Hudson River Estuary Corridor) is now available at hudsonia.org/current-projects/harlem-valley-ridges-supplement. The Supplement has profiles of habitats and species that occur along the eastern edge of Westchester, Putnam, Dutchess, and Columbia counties that were not covered in the Biodiversity Assessment Manual. Preparation of the Supplement was funded by Sweet Water Trust, the Northeast Dutchess Fund of the Berkshire Taconic Community Foundation, and Belinda and Stephen Kaye.

The Biodiversity Education page of Hudsonia's website (hudsonia.org/education/) now has several documents available for viewing or downloading that may be of interest to land use decision-makers throughout the Hudson Valley: **Habitat Fact Sheets**, that describe ecological values and offer conservation recommendation for some of the special habitats in the region. **LEED Certification and Local Biodiversity**, a brief paper explaining the limitations of the LEED program for addressing impacts to local biological resources. A brief introduction to **Transfer of Development Rights** programs, explaining some of the what, why, and how-tos for communities considering establishing a TDR program to protect their natural or cultural assets.

Goodsearch web browser
Goodsearch allows Web users to raise funds for Hudsonia while shopping online. Just go to goodsearch.com and follow the directions.

SPECIAL THANKS

To the **Hudson River National Estuarine Research Reserve**, for making the Norrie Point Environmental Center available for Hudsonia educational programs.

To **Cliff Schwark** for his invaluable help with contacting Beekman landowners, and to **all the landowners** in Beekman, Hyde Park, and Pine Plains for giving us access to their properties for the habitat mapping projects.

To the **Norcross Wildlife Foundation** for a special grant to help cover the publication costs of this issue of *News from Hudsonia*.

To **Terrapin Catering** for donating a catered lunch to our workshop on reptile and amphibian survey methods, and to **Mother Earth's Storehouse** for donating other refreshments for the workshop.

News from Hudsonia is printed with soy ink on 100% post-consumer recycled paper.