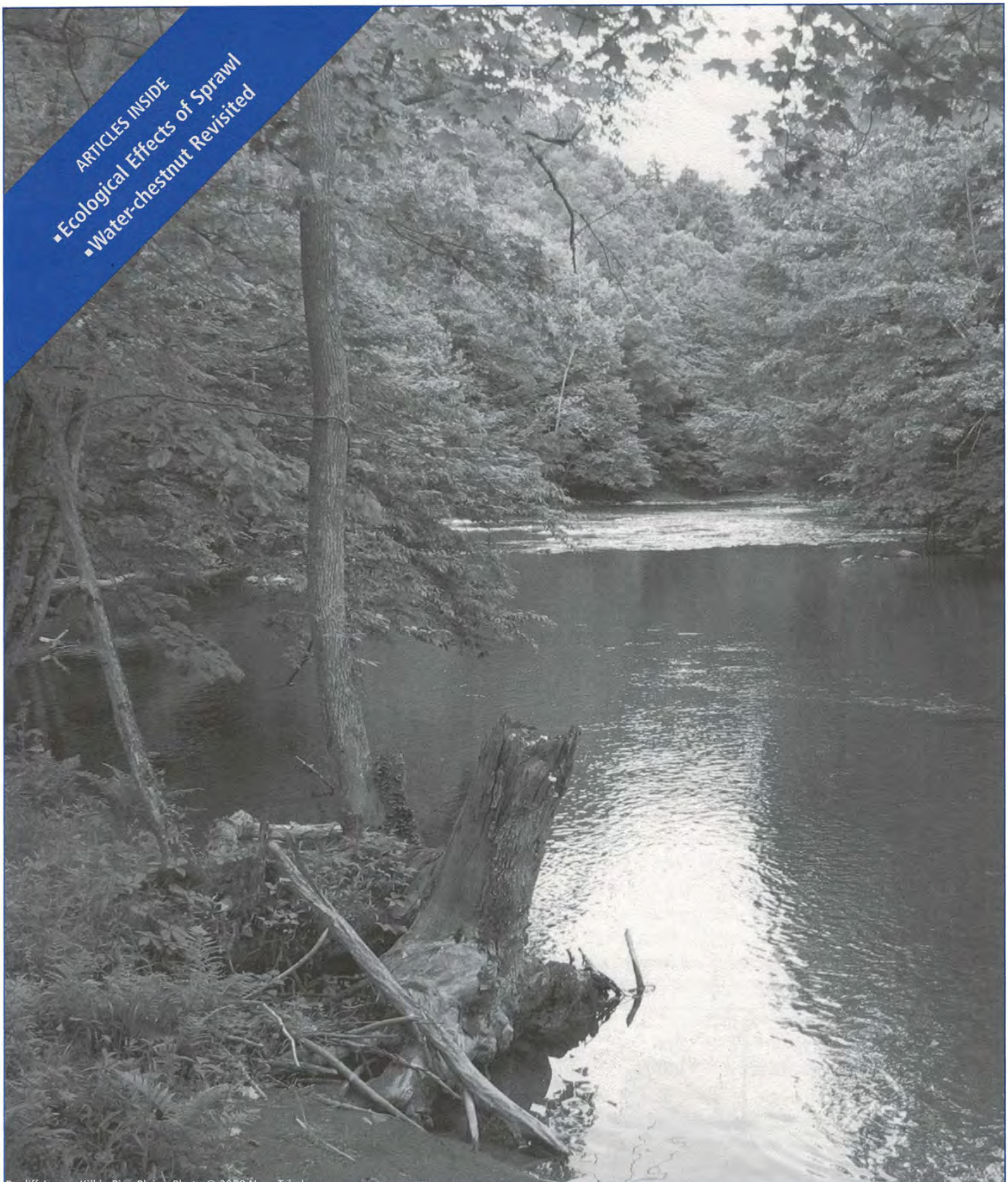

Roeliff-Jansen Kill in Pine Plains. Photo © 2008 Nava Tabak

News from Hudsonia

Volume 22, Number 2
Fall 2008

INSIDE HUDSONIA

Dear Friends of Hudsonia,

It's no secret that this has been a tough year in the financial markets, and many of our funders are working with diminished resources. Even so, here at Hudsonia we are working with the same commitment as ever to providing first-rate scientific information to those who need it most.

In fact, **the breadth and scope of our work continues to expand**, and we are reaching important new audiences—all of this accomplished by our small staff working with barebones funding. Now with Governor Paterson's recently proposed cuts in state programs, some of which support our projects, we need your help more than ever to continue our crucial work. And, with public resources fading, we will need to shoulder a greater share of the effort to identify, understand, and protect critical biological resources.

We are **mapping ecologically significant habitats** throughout whole towns, and instructing planning boards, conservation commissions, and land trusts in ways **to recognize and protect biodiversity resources**. We are applying our longterm research on the Blanding's turtle to issues of **freshwater turtle conservation** throughout New York and in other states, and consulting on bog turtle conservation in Connecticut and New York.

We are studying habitats of **cerulean warbler, eastern prickly-pear, Virginia snakeroot, and other rare species** to better inform conservation efforts. We are **analyzing ecological restoration projects in urban wetlands** to help practitioners improve the benefits of restoration to a wide range of animal and plant species as well as to nature's ecosystem services. Page 6 of this issue lists some of our other projects involving **rare species, significant habitats, biological surveys, biodiversity education, and environmental reviews.**

> ***No one else is doing this work the way that Hudsonia does, with the collective experience of our scientific staff, and with the neutrality and non-advocacy we ferociously maintain. But we need your assistance to continue.***

We sincerely thank those of you who have contributed recently, including all those who helped us meet the challenge posed in our last issue. We encourage others to donate too! Donations in any amount are welcome; your gift is tax deductible.

You can donate via PayPal by visiting www.hudsonia.org, OR you can call the Hudsonia office (845-758-0600) during business hours and give us your credit card information, OR you can send a good old paper check to Hudsonia, PO Box 66, Red Hook, NY 12571.

Thank you very much for helping!

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Chair, Board of Directors

Erik Kiviat, PhD
Executive Director

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Volume 22, Number 2 — Fall 2008

QUANTIFYING THE ECOLOGICAL EFFECTS OF HUDSON VALLEY SPRAWL

By Karin E. Limburg*

It won't be news to those who live here that the Hudson River Valley, renowned as a region of scenic beauty, is suffering from sprawl development and loss of open space. Much of this is driven by economics: agriculture declined from its peak in the 1880s, and industry has grown dramatically since the Second World War. Although one result of the decline in agriculture has been a re-growth of forests in the Northeast,[7] in recent decades an upsurge in housing construction, retail development, and intensification of roadways (more and larger roads) has produced some subtle and not-so-subtle changes to the character of much of the Valley.

Researchers Lisa Vasilako and Karen Stainbrook sampling in Hunter Brook.
Photo © Karin Limburg

In 2001–2004 a group of economists from Rensselaer Polytechnic Institute (RPI) and ecologists from the College of Environmental Science and Forestry (ESF) of SUNY, funded by a grant from the Hudson River Foundation, studied the process of economic development and its effects on land use and, in turn, on changes in the "ecosystem health" of two adjacent watersheds in the mid-Hudson Valley: Wappinger Creek (546 km^2; 213 mi^2) and Fishkill Creek (521 km^2; 203 mi^2) watersheds in Dutchess County. The Fishkill watershed appeared to be more developed and potentially under greater ecological stress. Thus, a working hypothesis was that ecological insults would be more obvious there.

Doctoral student Audra Nowosielski, advised by RPI professors Jon Erickson and John Gowdy, developed an economic model—called a social accounting matrix—to describe the flows of money into, out of, and within Dutchess County. The ponderous model, which tracked 284 economic sectors as well as households and government, produces a static picture of the economy. Nevertheless, it can be used to generate "what if" scenarios to study how changes in one sector create ripple effects throughout the regional economy. Thus, we could generate scenarios—such as increasing the number

Continued on page 2

CONTENTS

* Associate Professor, College of Environmental Science and Forestry at the State University of New York, Syracuse, 13210.

Hudson Valley Sprawl continued from page 1

of jobs in the semiconductor industry, or increasing agriculture—and study the impacts.

In an economic impact scenario, new jobs create new demands for housing. Using GIS, tax parcel maps, and a variety of other demographic and physiographic data, RPI doctoral student John Polimeni developed a land use change model to examine the driving causes behind new housing starts. His binary logit model predicted the most likely places to be developed within the Wappinger Creek watershed.

The most important factors turned out to be income-related, along with topographic slope and soil moisture characteristics. Later this model was extrapolated to all of Dutchess County by ESF post-doctoral researcher Bongghi Hong.

The third piece in this study was an ecological assessment of the two watersheds, conducted by ESF Master's student Karen Stainbrook and me. Over the course of two years we sampled thirty-three sites in the Fishkill and Wappinger creeks. We studied water chemistry (to assess stream water quality) and habitat characteristics, and sampled the fish and aquatic invertebrate communities to study their responses to urbanization. This set of metrics allowed us to characterize the "ecological integrity" of each sampling site, and relate this information to geographic and demographic indicators of sprawl. In the remainder of this article I will focus on the ecological results, and conclude with a discussion of current and follow-up research.

RESULTS

Using GIS land use and land cover data sets, Karen quantified land use change in the Wappinger and Fishkill creek watersheds between 1991 and 2001. Most of the change was conversion of forested to urban/suburban uses, and much of this change occurred near the Taconic Parkway.

Using impervious surface area (ISA), a chief characteristic of urbanization, we quantified land use change at three scales: the whole catchment upstream of a sampling site, the sub-catchment, and the local area defined as a 1-km^2 zone just upstream of a sampling site. The ISA in both watersheds was highest at the local scale, suggesting a tendency to build near water (waterways are generally at lower elevations and thus serve as natural corridors along which to build roads). At that scale, the ISA exceeded 10% of the land area, on average, at Fishkill Creek sites, and was significantly higher than the local ISA in the Wappinger Creek (Figure 1). Ten percent ISA is broadly recognized as a threshold above which stream degradation becomes markedly worse.[2]

Water quality was consistently lower in Fishkill Creek, but not dramatically so. Dissolved oxygen, necessary for aquatic life, was somewhat depressed in Fishkill Creek and water temperatures were somewhat higher. Such parameters as total nitrogen, percent inorganic nitrogen (ammonia, nitrite, and nitrate, which largely derive from fertilizers, municipal sewage, and septic systems), total phosphorus, and conductivity all correlated with urbanization. Conductivity, which is a measure of the total dissolved salts in water, was particularly interesting. Not only was it strongly correlated with urbanization and estimated percent impervious surface, but the highest conductivities were measured in August, when water flows were lowest and we were sampling pure "base flow" coming from the groundwater. Given that most road salt is applied in the winter, this was a surprising result, but one that has been subsequently confirmed by researchers at

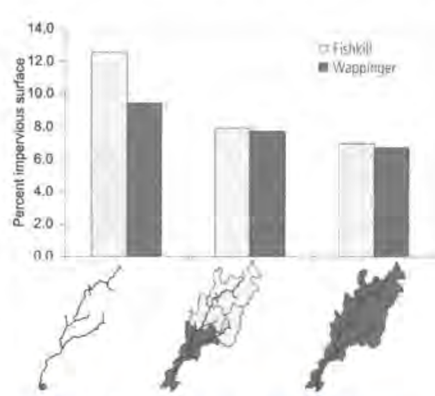

Figure 1. Effect of scale of observation on the amount of impervious surface in the Wappinger and Fishkill creek watersheds in 2001. Diagrams below the chart indicate the scale (local, sub-catchment, and whole catchment above the sampling site). Modified from Limburg and Stainbrook (2007).

the Cary Institute of Ecosystem Studies (CIES) and elsewhere in the Northeast. A summertime peak in riverine saltiness suggests a time lag between winter application and emergence in the creek. Further, we and others have documented increases in streamwater saltiness over time (e.g., Figure 2) in northeastern watersheds, and a consensus is that road salt is a significant contributor.[4,5]

Our biotic assessments included the Fish Index of Biotic Integrity (IBI)[3] and similar measures for stream macroinvertebrates.[1] Fish IBI values did not vary dramatically between watersheds, although on average the Fishkill IBIs indicated slightly worse condition than did Wappinger IBIs. Stream invertebrate communities showed a stronger response, however. On reflection, this is not so surprising because fish are more mobile, and can move among a greater number of habitats or leave if conditions become unfavorable. One surprise—and a good one at that—was that stream invertebrate communities in Fishkill Creek had become healthier by 2001 when compared to macroinvertebrate data collected by Hudsonia in 1988.[6] We attribute this to some cleanup efforts that occurred in the interim, perhaps spurred by the Hudsonia study.

With the fish data in hand, and with the help of Hudsonia researcher Bob Schmidt and New York State Museum ichthyologist Bob Daniels, we were also able to do a unique comparison of fish community changes since the 1930s. New York's Conservation Department undertook an extensive survey of its water resources in the 1920s and 1930s, watershed by watershed. Fish populations in the lower Hudson were surveyed in the mid 1930s. Using both qualitative and quantitative data from that study, and also fish data collected in the late 1980s – early 1990s in the Fishkill and Wappinger creeks, respectively, we calculated IBIs and compared them over time. The results? Fishkill Creek went from moderate condition in the 1930s to poor condition in the 1980s, and has improved a bit since then (Figure 3). In contrast, Wappinger, whose condition was similar to Fishkill's in the 1930s, has declined through time. This suggests that urbanization of the Wappinger Creek watershed, although slower to get started, has advanced and is causing noticeable impacts to the stream.

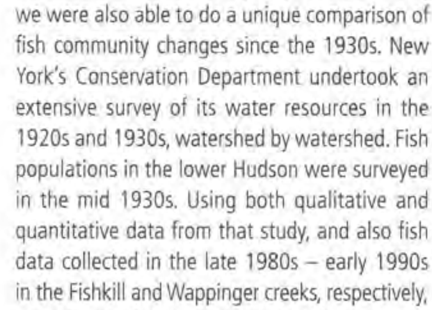

Figure 2. Trends in streamwater conductivity in the Fishkill and Wappinger creeks over time. Source: Stainbrook et al. (2006).

FOLLOW-ON AND CURRENT WORK

Following the construction and collection of these tools and data sets, Bongghi Hong developed an integrated modeling framework to "connect the dots" between economic activity on the landscape, land use change (new housing), and ecological impacts. For example, in a scenario where the semiconductor industry creates 1000 new jobs (such as at IBM's chip factory in the Fishkill watershed), an additional 1200 jobs were created, not only in related fields, but even such sectors as health care and restaurants. If all these represented new families moving into the area, it means the addition of 2200 new households. Computing their impact resulted in declines in water quality and loss of some biodiversity. Of course, this is a marginal analysis, and does not represent the overall ecological impact of all changes in the local economy and resultant construction for residences, services, and infrastructure. But it does show us the logical results of development.

A further refinement of this work is to include closer integration of tools used to determine environmental quality impacts. These include impervious surface estimation, water quality monitoring, and hydrologically based watershed runoff modeling. In a project sponsored by the Syracuse Center of Excellence in Environmental and Energy Systems, we are collaborating with Peter Groffman of CIES to apply this new model to the Wappinger Creek watershed, and to compare it to the Onondaga Creek watershed near Syracuse, New York. We have adapted simpler methods to relate economic indices to development, and find that sprawl is caused by different drivers in these two systems.

Overall, we have learned a great deal about the economy – land use – ecology connections, even if we could not include all the factors we'd have liked (for example, we did not include transportation issues, even though these are critical in many ways). Further, our modeling framework is of necessity a "one-way" flow of cause and effect, when in reality there are feedbacks that may either amplify or reduce some of the impacts. These remain topics for future research. In the meantime, one of our goals, ultimately, is to make our integrated modeling framework available to planners and others who wish to assess the impacts of development on watershed health. ■

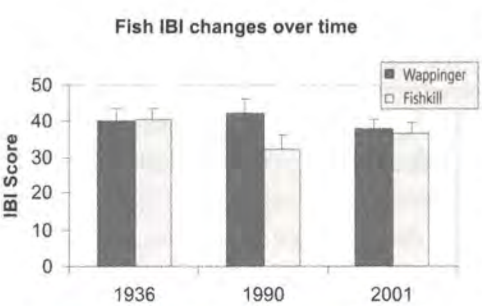

Figure 3. Changes in mean values (± 95% confidence intervals) in fish Index of Biotic Integrity (IBI) values for sites in the Fishkill and Wappinger creek watersheds. Higher IBI scores indicate better environmental quality.

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SPREADING (WATER-) CHESTNUT REVISITED

By Erik Kiviat*

Introduced plant species sometimes become so abundant that they alter habitats, ecosystems, and the human environment in ways we consider undesirable. Once a species has progressed to that stage of impact, it is hard to reduce its population substantially without great cost in dollars and ecological side effects. Very abundant and widespread invasive plants cannot be eradicated. At best they can be managed to reduce the negative impacts and promote the positive, using techniques designed according to the goals for a particular site.[7]

A principal of invasive plant management is that a newly-arrived species that occurs as a few individuals in a few areas should be eradicated promptly unless it can be proven that the species will not spread widely and become harmful. This is known as "Early Detection, Rapid Response" (EDRR). EDRR applies at various spatial scales, such as the first occurrence of variable flatsedge (*Cyperus difformis*) in New York State, or the first stems of common reed (*Phragmites australis*) at a wetland restoration site.

Water-chestnut (*Trapa natans*) is a rooted aquatic plant with floating leaves that is native to Europe, Asia, and Africa. Water-chestnut plants are anchored in the sediment by the "horned" fruit hull, and have several-meter-long stems with submerged leaves and water roots, and multiple floating rosettes of bright green leaves. The leaves are rhombic, about 4-5 cm (1.6-2 in) long, and emerge from a central succulent "core" which also bears the above-water, small, white flowers, and underwater fruits. Each fruit is about 3 cm (1.2 in) wide, not counting the four long barbed spines. Although the nut is edible and has been heavily used for thousands of years, *Trapa natans* is not related to the familiar "water-chestnut" (*Eleocharis dulcis*) of Chinese-American cuisine.

Hulls of the nut-like water-chestnut fruit (posed). Photo © Gretchen Stevens

Trapa natans was introduced to the northeastern states as an ornamental planting in ponds in the late 1800s, and has since spread widely in freshwater tidal rivers, sluggish nontidal streams, lakes, and ponds from Virginia to Québec.[9] More than 800 hectares (2000 acres) of the freshwater tidal and slightly brackish tidal Hudson River shallows are dominated by water-chestnut,[8] with more in the nontidal river north of the Troy Dam and in many, mostly smaller, infestations in nontidal ponds, lakes, and sluggish streams of the Hudson Valley region. Extensive dense water-chestnut beds in the Hudson, and presumably elsewhere, cause oxygen depletion during summer that interferes with the ability of fish to consume the aquatic invertebrates that are abundant on and beneath the water-chestnut plants.[3] These large beds also interfere with fishing, boating, and swimming in some areas. Apart from the dense carpets of leaves on the water surface, many people know water-chestnut by the windrows of empty blackish spiny fruit hulls at the high tide line.

Hand-pulling of water-chestnut can be an effective control method where infestations are small, such as at Kingston Point and at the Beacon dock, but hand-pulling is not practical where water-chestnut covers immense areas of marshes and shallows. Attempting to control water-chestnut with herbicide would almost certainly lead to nontarget impacts on plants, fishes, and other organisms. Research is being conducted to develop a classical biocontrol program that would probably use insects from the native range of water-chestnut. If approved by the U.S. Department of Agriculture, it would take many years to find out if classical biocontrol is effective and if it has serious nontarget impacts on related or unrelated plants.

Water-chestnut researchers have suggested that the extensive water-chestnut beds in the tidal Hudson River could be thinned or broken into small patches to reduce their negative impacts on dissolved oxygen, fish, and other aquatic plants.[4] This could be done by selective mechanical harvesting of water-chestnut, with the harvested material used for generating methane or making compost, depending on contaminant contents. Water-chestnut seeds might also be harvested for human food, again depending on contaminants and pathogens.

But what about the ponds and lakes in the Hudson Valley? During the past 25 years I have noticed that water-chestnut has gradually colonized many water bodies distant from the Hudson River, ranging in size from a 10 x 30 m (33 x 100 ft) pond in the Town of Milan to the 36-ha (88-ac) Wappinger Lake, for example. Canada geese and mute swans have been observed with water-chestnuts clinging to their

* Executive Director, Hudsonia

plumage, and it is thought that water birds are the principal vector of the heavy nuts from the Hudson to inland waters; boats, nets, and other equipment could also play a role. Most of the small water bodies have but a few water-chestnut plants, and it is not known if and how rapidly water-chestnut will consolidate and cover these waters. Having witnessed, however, the extensive nuisance-level infestations in the Hudson River and in several inland waters of Westchester, Dutchess, and Columbia counties, we must assume that many other ponds and lakes will eventually be covered with dense water-chestnut beds.

There is a simple and prudent solution: EDRR. Watch for water-chestnut in your pond or other body of quiet water. The photographs accompanying this article, and many more on readily accessible websites, will help with identification. If in doubt, ask a botanist for help; a photograph or specimen of a leaf rosette should allow definitive identification. Then pull the water-chestnut out, tugging gently to remove the entire stem and anchor, and as many of the leaf rosettes as possible. (Try not to damage or remove other plants unless you are sure they are harmful.) Wear gloves, and sneakers or boots, to protect yourself from the barbed spines on the nuts. Dispose of the harvested material at an upland location well away from the pond so that nutrients from the decomposing plants won't leach back into the pond. Pull the water-chestnut before the end of July when seeds begin to mature and fall. Then you will need to monitor the pond for several years, and may need to hand-pull for several years, because seeds can remain viable in the sediments for five years or more.

Fifteen years ago I wrote about water-chestnut in *News from Hudsonia*,[5] and in 2008 the plant maintains about the same dominance of sheltered freshwater tidal shallows on the Hudson River. But this troublesome and successful plant has spread into many nontidal water bodies where it is forging unpredictable ecological relationships with other plants, invertebrates, fish, and people.

Floating water-chestnut rosettes. Photo © Erik Kiviat

If you find a water-chestnut infestation near where you live, do not rush to use herbicides—they are toxic to other plants and animals, including humans, and pose unnecessary risks to the environment.[1,6] Grass carp—another popular treatment for aquatic weed problems—probably do not eat water-chestnut. Moreover, because they graze selectively, eating certain weeds and allowing other weeds and algae to flourish, grass carp may exacerbate instead of eliminate aquatic weed problems in some cases.[2] Hand-pulling, on the other hand, is an elegant, effective, and easy remedy for small water-chestnut infestations, and will cause little damage to the aquatic ecosystem. ■

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FYI

A FEW OF HUDSONIA'S PROJECTS THIS YEAR

- **Flora survey** of a circumneutral bog lake in Dutchess Co.
- **Exploratory surveys for rare plants, dragonflies, damselflies, reptiles, amphibians, birds, and mammals** at a post-industrial site on the Hudson River in Columbia Co.
- **Surveys for rare plants, reptiles, amphibians, and birds** at a post-industrial site on the Hudson River in Dutchess Co.
- Habitat studies to inform **wetland and rare plant mitigation planning** and **pond management** at sites in Westchester Co.
- **Bog turtle surveys** at a proposed golf club development site and a **bog turtle habitat assessment** at a proposed retirement community expansion site, both in Litchfield County, Connecticut.
- **Review of biological impacts** of several proposed development projects in Dutchess, Rockland, and Ulster counties.
- Ongoing **studies of biodiversity and its management** in the Hackensack Meadowlands, New Jersey.
- Ongoing **monitoring of turtles and habitats** at our long-term Blanding's turtle habitat restoration site in Dutchess Co.
- **Identification and mapping of known and potential Blanding's turtle habitats** in six Dutchess County towns.
- **Fish surveys** on the Saw Mill River, Westchester County.
- **Identification and mapping of ecologically significant habitats** in three Dutchess County towns.
- **Workshops with town agencies** to help them interpret habitat information for town planning and environmental reviews.
- Preparation of papers on the **importance of forests** for sustaining water resources, **breeding of cerulean warbler** on a dredged material disposal area, **bird use of common reed and cattail stands** in a freshwater tidal marsh, an **urban frog survey**, vegetation and soils in **Japanese knotweed** stands, and the vegetation, soils, and land use in **fens** in southeastern New York.
- Working with municipal agencies, land trusts and others in Albany, Columbia, Dutchess, Orange, Putnam, Ulster, and Westchester counties in our **Biodiversity Assessment Training** program and **Biodiversity Assessment Short Course**.
- Work on a **biodiversity assessment handbook** for New York City, and a **Harlem Valley and Ridges** supplement to the Biodiversity Assessment Manual for the Hudson River Estuary Corridor.
- Observations on **common reed** in California to better understand its impacts on biodiversity in the northeastern states.

HUDSONIA T-SHIRTS FOR SALE

Short- and long-sleeved shirts in white or beige with small Hudsonia logo on the front, large green and yellow Blanding's turtle on the back. Limited quantities available—get them while they last! For adults S, M, L, XL ($18, long sleeve only) and children S, M, L ($10, short sleeve only). Price includes tax; shipping $4.80 ($2 for each extra shirt).

Contact Linda Spiciarich at 845-758-0600 or spiciari@bard.edu. Credit card payments accepted.

HUDSONIA'S TECHNICAL ASSISTANCE PROGRAM

Hudsonia routinely conducts biodiversity assessments and provides other technical assistance on a fee basis to municipalities, consulting firms, NGOs, and individuals on the bog turtle and Blanding's turtle, other rare animals and plants, wetland ecology, stream ecology, and invasive plants. Contact Erik Kiviat at 845-758-7273 or kiviat@bard.edu to make arrangements for these services.

Operation Habitat

The Philip and Amanda Duff Dunne Fund

We regularly receive inquiries from people who want to support our efforts to identify and protect the habitats of rare and endangered species.

In response to these inquiries, and to honor her parents and their enthusiasm for protection of imperiled wildlife, Hudsonia Board Chair Philippa Dunne established **Operation Habitat,** a designated fund within Hudsonia to support our conservation science work.

Please visit our website to make your tax-deductible contribution to Operation Habitat.

www.hudsonia.org

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for Environmental Professionals
2009

- Herpetological Field Methods, 21–22 May 2009
- Biodiversity Conservation and Site Plan Design, 21 July 2009
- Wetland Habitat Creation and Turtle Conservation, 1 September 2009

See our website (www.hudsonia.org), or contact Linda Spiciarich (spiciari@bard.edu; 845-758-0600) to register or to obtain further information.

SPECIAL THANKS

- To everyone who responded to the fundraising challenge described in the summer issue of *News from Hudsonia*
- To all the landowners in the towns of Beekman, Hyde Park, and Pine Plains who have given us walking access to their property for our habitat mapping projects
- To Natalie Kelly, who donated her layout services for the summer issue of *News from Hudsonia*
- To Elaine Colandrea, who hosted a meeting of the Hudsonia Board of Directors and staff
- To the Cary Institute of Ecosystem Studies, the Hudson River National Estuarine Research Reserve, and Cornell IRIS for donation of GPS units

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Natural history and field science books and journals (but inquire first, please)
"Rite in the Rain" paper, 8.5x11
Photocopier
Area rugs
Conference table
Folding table

2009 BIODIVERSITY ASSESSMENT TRAINING

Hudsonia is now accepting applications for the 2009 Biodiversity Assessment Training program offered to land use decision-makers in the Hudson Valley. This ten-month program is offered to a 5–10 member community group interested in identifying and protecting biodiversity resources in their own community. The program is free-of-charge, and is especially designed for members of municipal planning boards, conservation commissions, the staff of land trusts, and others who are routinely engaged in land use planning, environmental reviews, and the design of conservation easements.

See the Biodiversity Education page of our website (www.hudsonia.org) or contact Andrew Meyer (ameyer@bard.edu or 845-758-0600) for the program application and further information.

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