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News from.... Hudsonia

Environmental Research and Education Technology for Conservation

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NEARSHORE ENVIRONMENTS OF THE HUDSON:
THE STATE OF OUR KNOWLEDGE OF THE SHALLOWS, WETLANDS, AND SHORELINES

by Erik Kiviat

Least bittern in tidal marsh

In the 1970s, many ecologists asserted that tidal marshes improve the quality of the water flowing through them by removing nutrients and toxicants. Much recent research has shown these processes to be highly variable in eastern estuaries, and information about the Hudson is not definitive.

Phragmites (common reed) is generally considered a pest by marsh managers and conservationists in the eastern U.S. The data supporting or contradicting this opinion are scant, but scientists are beginning to discover how reed interacts with its environment and other organisms.

In the 1970s we never saw blue crabs at Tivoli Bays (river kilometer 160). Beginning in 1982, we found immature male crabs common in summer in the fresh-tidal river, and in 1995 large numbers of crabs moved into the tidal mouths of tributaries.

How much do we really know about the "nearshore environments" of the Hudson? What needs to be studied further? How will the results affect you?

Since the late 1960s the Hudson River has been studied intensively but most of the effort has been focused on deep waters. There is relatively little information on habitat characteristics, ecosystem processes, plants, fish, and other organisms of the shallows, wetlands, tributary mouths, and shorelines. The same time period has seen the burgeoning of research on brackish and freshwater-tidal nearshore environments in other eastern estuaries as well as an explosion of knowledge of the salt marshes of the outer coast. In 1982, the Hudson River National Estuarine Research Reserve (HRNERR) was created to manage four tidal wetland complexes on the Hudson River, and to conduct and sponsor research and public education on estuaries. HRNERR is part of the New York State Department of Environmental Conservation (DEC) and is a unit of the federal system of National Estuarine Research

ALSO IN THIS ISSUE: *New Staff, Book Reviews, Biodiversity Manual Workshops p. 7, Sponsor & Donor Lists p. 8.*

Reserves. By protecting study areas and facilitating research on Piermont Marsh, Iona Island, Tivoli Bays, and Stockport Flats, HRNERR has helped build a clearer picture of nearshore ecology.

Nearshore areas of the tidal Hudson, from New York City to Troy, account for a significant portion of the estuary's interaction with human society, including scenery and recreational areas, bird watching and nature study, fish spawning habitats and fishing areas, hunting and trapping areas, probable influences on water quality, and habitats for many of the rare species[12] that society increasingly values. Fig. 1 illustrates a classification of nearshore environments by elevation; salinity, soil, and vegetation can also be used as classifiers.

Salinity decreases from the "mouth" of the river (between the southern tip of Manhattan and the New Jersey shoreline) northward through the Tappan Zee - Haverstraw Bay and the Hudson Highlands. Slightly brackish water reaches Poughkeepsie during extended dry periods but for practical purposes the river is fresh above the Highlands. In the most saline reaches during the driest season (late summer and early fall), salinity is still considerably less than "full-strength" seawater. The most southerly major wetland, for example, Piermont Marsh, is flooded by river water reaching a maximum of 14 parts-per-thousand salinity, whereas the Atlantic Ocean has a salinity of 35 ppt. The wetland soils are silty, organic, or sandy. Lower elevation areas are silty, higher elevation areas organic, and some areas (especially northward) are sandy from the dumping of dredged material.

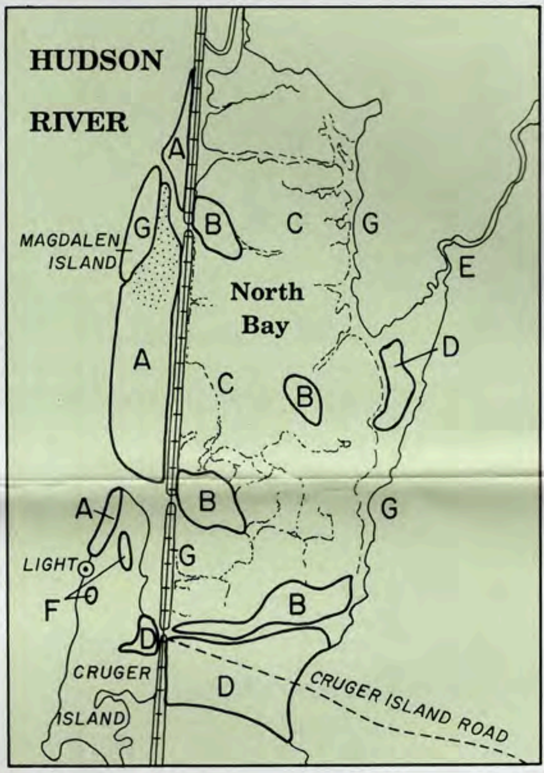
Below I outline several recent nearshore studies; many have been supported by grants or fellowships from the Hudson River Foundation (HRF).

Drift of Fish Eggs and Larvae from Tributary Mouths

Alewife, blueback herring, rainbow smelt, white sucker, spottail shiner, smallmouth bass, and white perch are fishes of the ocean or estuary that swim "upstream" into the mouths of tributaries to spawn in winter or spring. Several years ago, Bob Schmidt and Karin Limburg studied the drift of fish eggs and larvae from the nontidal lower reaches of 16 Hudson River tributaries. They documented the importance of these streams as spawning habitats for migratory fishes, and discovered that the greater the degree of urbanization of a tributary watershed, the less its production of fish eggs and larvae.[16] Most of the spawning takes place in streams with less than 10% of the watershed area urbanized. Last year, Bob Schmidt and Theresa Stillman[19] sampled the drift of fish eggs and larvae more intensively in the mouth of Stockport Creek (Columbia County). And this year Bob is assessing the potential for installing fishways (structures that will allow migrating herring to ascend dams or natural bedrock barriers) in the mouths of Hudson River tributaries.

The lower ends of the tributaries are significant to several of the Hudson's ecologically and recreationally important fish species. Striped bass swim at least 11 km up the Roeliff Jansen Kill to Blue Store. River herring are major users of the tributary mouths but our data do not allow us

Fig. 1 Nearshore environments in the Tivoli Bays area of the Hudson River.



KEY:

- **A.** Open shallows (to -2 m below Mean Low Water) with or without vascular vegetation
- **B.** Semi-enclosed subtidal and intertidal pools
- **C.** Marshes, lower and upper intertidal zone (herb dominated)
- **D.** Intertidal and supratidal swamps (tree or shrub dominated)
- **E.** Tributary mouths, tidal and nontidal reaches up to the first barrier to upstream-migrating fish
- **F.** Supratidal pools (0-1 m above Mean High Water)
- **G.** Other shoreline environments, including railroad fill, dredge spoil, natural islands, and natural mainland shorelines

to assess the relative abundance of alewife vs. blueback herring, or the importance of spawning areas in the tributaries compared to spawning areas in the tidal shallows. It is possible that all the white suckers in the Hudson estuary are spawned in the tributaries, because no one has found sucker eggs or yolk-sac larvae (young larvae) in the tidal waters. There may also be smallmouth bass runs from the estuary up the tributaries. Our current knowledge of the movement of fishes between the estuary and its tributaries may be only the "tip of the iceberg."

Water-chestnut and Fish

The European water-chestnut (*Trapa natans*) was introduced to the Hudson River system in the late 1800s and now covers large expanses of sheltered shallows, excluding other plants from those habitats.[14] Water-chestnut and another introduced "submerged" aquatic vegetation (SAV) species, Eurasian watermilfoil (*Myriophyllum spicatum*), evidently replaced many stands of wild-celery, pondweeds, and other native species. In 1987, Bob Schmidt and I compared the vegetation and fish communities of wild-celery, watermilfoil, and water-chestnut beds in the Tivoli Bays, and subsequent research by Bob and Polgar Fellows Barth Anderson, Nick Hankin, Keith Pelczarski, and MariLynn Sidari further examined the fish-plant interactions.[1,8,17,20]

Although boaters, hunters, fishers, and naturalists condemn water-chestnut as a pest, documentation of its ecological characteristics is needed to formulate a sound management strategy. Fishes that use water-chestnut beds are sparse and the bulk of the community is composed of European carp, an introduced species that stirs up the bottom sediments and competes with native fishes for food. Two North American fishes with broad ecological tolerances, the golden shiner and fourspine stickleback, are also common in water-chestnut. Three species of small native fishes - the banded killifish, spottail shiner, and tessellated darter - are typical inhabitants of Hudson River shallows but may have declined in recent years; none of the three occurs as adults in water-chestnut beds.[14] Water-chestnut supports substantial populations of invertebrates that are potential food for small fishes. Nonetheless, dissolved oxygen is low in the dense masses of water-chestnut, and this may inhibit fish use of the habitat.

Largemouth bass and certain other fishes favor the edges of water-chestnut beds; much of the fishing for largemouth in the Hudson seems to take place around water-chestnut edges. We do not know, however, whether water-chestnut edges are better for fish than the edges of wild-celery beds or those of other SAV species. Many aspects of the fish-plant relationships need additional study, including the "edge effects," the role of different plants in supporting a food base for fish, and the way in which water quality or other factors affect fish use of water-chestnut beds.

Where are the Amphibians and Reptiles?

Although many northeastern frogs, salamanders, turtles, and snakes are closely associated with water, of about 50 species found in the Hudson Valley, only 14 have been recorded in the freshwater-tidal wetlands at Tivoli Bays. And only 1 of these 14 is common (the snapping turtle), whereas 13 are rare in freshwater tidal habitats. The Jug Bay fresh-tidal wetlands of the Patuxent River in Maryland, in contrast, have 20 species of which about 10 appear to be rare.[22] The Patuxent is similar to the Hudson except smaller, not PCB-contaminated, and of course more southerly. I have found no survey data from the tidal Housatonic or Connecticut rivers which are climatically similar to the Hudson.

Another Bard graduate student Christine Rozycki supported by a fellowship from HRF and HRNERR, is studying the painted turtle population in Tivoli North Bay. The painted turtle is frequently the most abundant turtle in nontidal ponds of the Hudson Valley, but it is very sparse in North Bay. Chris's 1995 data indicate painteds may be even fewer than they were 20 years ago, when I collected data on the species incidental to snapping turtle research. Analysis of the condition of individual painted turtles, the proportions of females, males, and juveniles in the population, and characteristics of the habitats used in North Bay should provide insight into environmental factors limiting or stressing this population. These factors could include tidal fluctuation, vegetation, food supply, predators, and PCBs.

Why are we interested in animals that are rarely used for human food and have little other economic value? Worldwide and in our region, many reptile and amphibian species are declining. These animals are sensitive to human alterations of the environment and are thought to be indicators of environmental quality. Whether human impacts on the chemical and physical characteristics of the nearshore environment are impoverishing the amphibian and reptile community, or natural factors such as tides and predators are limiting this fauna, the knowledge gained will help us understand threats to wildlife everywhere as well as the dynamics of nearshore ecosystems in the Hudson.

Water snake

Insects in the Marsh

Insects graze the productive marsh vegetation and are eaten by predators such as dragonflies, spiders, fish, and birds. We do not know how important this energy pathway is compared to the detritus pathway (animals and microbes consuming dead, rather than live, plant material). Nonetheless, there is evidence that redbreast sunfish, juvenile American shad, and other estuarine fishes feed on non-aquatic insects that fall on the water surface and become "drift." And birds, including the least bittern, wood duck, marsh wren, cedar waxwing, red-winged blackbird, and sparrows, probably also harvest insects from the above-ground vegetation during the spring and summer. For example, both wetland and land birds prey on the water-lily leaf beetle which is abundant on water-chestnut, spatterdock, and purple loosestrife in summer. Red-wings, black-capped chickadees, and downy woodpeckers continue to forage for insects in the winter marsh, picking at the spikes of cattail and the stalks of loosestrife and reed.

There have been few surveys of insects in fresh-tidal and brackish environments.[3,4,18,21] Preliminary estimates of overwintering insect density and biomass in the three most important species of upper-intertidal plants are shown in Fig. 2. Reed in North Bay apparently supports far more overwintering insects than cattail or loosestrife. The apparently widespread opinion that North American common reed has few associated insects thus needs to be reconsid-

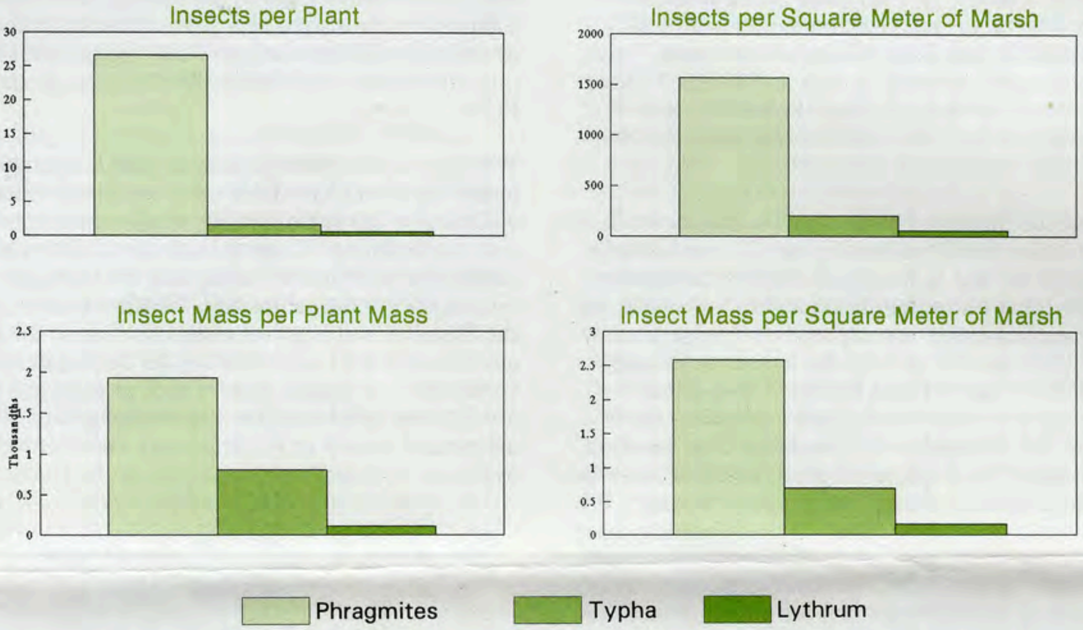


Fig. 2. Insect density and biomass in cattail, reed, and purple loosestrife in Tivoli North Bay, early spring, 1995.[10] (Based on five 0.25 square meter plots per plant species.)

ered. Further research is needed on insects associated with emergent marsh plants in the Hudson, the aquatic insects of the nearshore zone, and the origins of the insects consumed by shad and other fishes.

Vegetation Patterns in Shallows, Marshes, and Swamps

Fresh and brackish tidal wetlands are widely known as ecosystems capable of producing large amounts of vegetation biomass (i.e., weight of plants per square meter). How do the Hudson's wetlands measure up, what factors control production, and how is the vegetation changing?

The "high marsh" (approximately the upper intertidal zone) habitats in the Hudson support peak summer biomass of cattail, reed, purple loosestrife, cordgrasses, or mixtures of these and other plants similar to other East Coast estuarine marshes.[5,11] The "low marsh" (lower intertidal zone) spatterdock stands of the Hudson, however, seem less productive than elsewhere. Possibly the water-lily leaf beetles that attack Hudson River spatterdock in summer are responsible for the lower peak biomass; this beetle has not been reported in more southerly estuaries.

In Tivoli North Bay, the higher marsh surface elevations have higher soil organic matter, plant litter mass, and plant biomass. Qualitative observations of vegetation change in North Bay since 1971 indicate that marsh pools are filling in slowly and plant communities are progressing gradually but irregularly from spatterdock, to pickerelweed and wild-rice, to cattail mixed with other species of the middle and upper intertidal zone. In some of the higher areas, cattail is being replaced by purple loosestrife or reed. HRNERR vegetation maps provide a baseline for detecting vegetation changes when mapping is repeated at several-year inter vals. Variations in the population density of muskrats and their grazing, rooting, burrowing, and lodge-building activ ities also affect vegetation and soil.[13] Another Bard College student, Lisa Connors, is writing her Master's thesis on these processes in Tivoli North Bay.

In the SAV, wild-celery and clasping pondweed have increased, and watermilfoil has decreased, at least at Tivoli, over the last 20 years. Water-chestnut rebounded from low levels when the DEC terminated its control program in 1976, to dominate shallows that are sheltered from the strongest currents and winds. Stuart Findlay of the Institute of Ecosystem Studies, with Chuck Nieder of HRNERR and Jeannie Barnaba of Cornell University, are mapping SAV from Castleton (just south of Albany) to Poughkeepsie in 1995-96.

Vegetation composition, biomass, and change are important information for assessing the ecological integrity and function of nearshore habitats, and the needs for and effects of management and restoration activities. If we can better understand the factors that shape vegetation we may be able to manipulate it where desired. Marsh restoration, for example, requires knowledge of existing and former vegetation. I believe our knowledge of vegetation patterns in space and time has to catch up with the widespread interest in habitat restoration and enhancement if these activities are to achieve well-defined and measurable goals.

Biogeochemistry

IES ecologists Stuart Findlay, Cathy Wigand, and Peter Groffman are examining the relationships between marsh plants and the belowground processes associated with nutrient cycling. Different plants, such as cattail, purple loosestrife, and reed, may produce litter with different sediments, and may affect the retention or release of nutrients and the subsequent growth of vegetation.

Lawrence Fernberg, a Fordham University graduate student, is studying purple loosestrife effects on decomposition of plant matter in a fresh and a brackish marsh, and Lisamarie Windham, a Rutgers University grad student supported by New York Sea Grant and HRNERR, is examining nitrogen availability and uptake by reed and saltmeadow cordgrass at Piermont Marsh. Higher levels of nitrogen from sewage and other sources may be facilitating the spread of reed at the expense of other plants. The proportions of cattail, loosestrife, and reed in the high marsh vegetation are changing on a large scale, and it is important to discover the causes as well as the effects vegetation change will have on nutrient cycling.

Water Quality

Chuck Nieder of HRNERR has been studying water quality in the five streams that flow into the Reserve sites: Stockport Creek, Stony Creek, Saw Kill, Doodletown Brook, and Sparkill Creek. The Sparkill has the most urban watershed, and the stream has a high chloride level which is likely from deicing salts. The Saw Kill has consistently had the highest nitrate levels for three years, and sampling of sub-watersheds suggests that septic systems in residential areas are the principal source of nitrogen. Stony Creek has an extremely high phosphorus level, which is believed to originate from a sewage treatment plant. A Hudsonia study of three other Hudson River tributaries,[23,24] Moodna, Quassaic, and Fishkill creeks, also found high levels of nutrients and chloride. Pollution loads were correlated with loss of diversity in the communities of aquatic insects and diatoms (a group of algae).

Although the Hudson is a large waterbody with considerable capacity to assimilate nutrients, enriched stream waters affect nearshore systems. A recent model of sediment and carbon inputs from tributaries[9] suggests that urban-suburban areas and agricultural areas are contributing disproportionately to nutrient loading of the entire freshwater tidal Hudson. Increased nutrient levels, in turn, may be stimulating changes in biological communities such as the dominance of reed, loosestrife, and water-chestnut.

Environmental Issues

* Much of the wanton dredge spoil deposition, channelization, municipal dumping, and other gross alteration of Hudson River shallows and wetlands has stopped. Surreptitious filling and disposal of old railroad ties, brush, and garbage still occur.

* There is siltation from vista clearing and other upland soil disturbances adjoining the river, and from construction and agriculture along tributaries. Deforestation of patches of shore for vistas and the restoration of historic landscapes repeat the ecological errors of the last century.

* Diesel smoke and herbicides from the railroads have not been studied but probably have substantial impacts on adjoining wetlands. These could be factors contributory to, for instance, the low lichen diversity in the tidal swamp at Cruger Island.[6]

* The accumulation of PCB and other toxicants in wetlands and shallows has caused extreme contamination of snapping turtles.[25] Total PCB levels in fish have generally declined since the 1970s, but the more-chlorinated, more toxic PCB compounds have not disappeared from fish as rapidly as the less-chlorinated PCBs. The current concern among some toxicologists about the "estrogenic" effects of PCB and many other environmental contaminants on the reproductive systems of humans and other vertebrates[7] causes us to reexamine our thinking about the impacts of PCB in the Hudson. Are estrogenics responsible for the apparent declines, low densities, or reproductive anomalies in Hudson River fauna such as the muskrat, mink, river otter, harbor porpoise, harbor seal, osprey, snapping turtle, and painted turtle?

* Tidal marshes trap floating debris of both natural and human origin, including a lot of plastic and wood garbage. Do animals become ensnared in these materials, or are toxicants released into the marsh environment?

* Since the 1970s, there has been intermittent debate about the impacts on the exposed shallows caused by the wakes of ships plying the narrow reaches of the upper estuary (about Saugerties to Albany). Do these disturbances cause significant mortality or displacement of fish eggs, benthic invertebrates, or rooted plants? Would slower ship speeds reduce the problem? Recreational boating also affects the sediments and vegetation through the disturbances caused by anchors in the shallows and boat hulls on the shorelines. And the noise from speed boats and "jet skis" disturbs water birds and other animals. The importance of these impacts needs assessment.

* Do Hudson River wetlands lose their ecological functions and values to society at later stages of sediment deposition? Or do they just shift from one group of species (with associated functions and values) to another? Does the disturbance of soil, vegetation, and wildlife caused by duck blinds, recreational boating, and researchers significantly affect species composition or ecological processes in nearshore areas? Do we understand "pest" species (water-chestnut, purple loosestrife, common reed, yellow iris, Eurasian watermilfoil, false-indigo, mute swan, European carp, Norway rat) well enough to make management decisions? If not, what critical information should we be gathering?

Conclusions

Research of the past two decades has provided many answers, but many basic questions remain about Hudson River nearshore environments. The great majority of public and private research funding is still spent on the "main river" (the deeper, open waters) and on fish. How will we acquire information on basic natural history, species biology, and nearshore ecosystem processes that is needed to assess environmental problems and design appropriate management and restoration actions? Can we predict the impacts of changing land use and of restoration activities on the ecosystems and species of the river? What will be the roles of HRF, HRNERR, DEC, New York Sea Grant, IES, Hudsonia, and other institutions in coordinating, funding, or conducting research?

As both funding for research and biological resources decline, we must all learn how to use our dollars and efforts more efficiently to solve problems in basic and applied science. I believe it would serve researchers, the environment, and the public if there were a "clearinghouse" for information about nearshore research planned, in progress, and completed. This will require a bigger commitment from both institutions and scientists. Components of a strategy may include:

-A conference summarizing and integrating research results every other year;

-Innovative analysis of the observations of naturalists and sportspeople to provide information to scientists and the public (*a la* the *Hudson River Almanac* and the *New York Breeding Bird Atlas*.[2,15]

-Cross-listing the collections of major Hudson River libraries for remote access;

-A comprehensive technical guide to the biota and habitats of the Hudson.

If we can gain new knowledge of certain phenomena, and better organize existing science and natural history, we will be better prepared for the challenges of planning, management, and restoration.

* * *

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Donors of Goods and Services

Sumru Aricanli, books; Steven Clemants, identifying specimens; Denise Edelson, field assistance; Lin Fagan, herbarium work, periodicals; Katherine Gould-Martin, herbarium work; Russell Immarigeon, library advice; Jesse Ivan, field assistance; Jerry Jenkins, loan of computer; Jug Bay Wetlands Sanctuary, books; Esther Kiviat, periodicals; Martin Kunitz, computer assistance; Barbara Maple, grants information; Heinz Meng, identifying specimens; John Porcella, computer assistance; Tom Schaefer, PVC pipe; Kathleen A. Schmidt, use of drawings; Jim Stapleton, printing labels; Dusan Tynek, herbarium work; Hans Weber, books; Mary-Alice White, periodicals.

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Hudsonia News

After nine and a half years of dedicated service, Kathy Anne Schmidt is retiring from her position as Administrative Director to attend the Florida School of Massage. We wish Kathy success in her future.

Hudsonia's new Administrative Director is Patti Kelly. Patti worked for twelve years as a television and radio casting director in New York City before leaving that position to serve as legislative director to former Assemblyman Kevin Cahill.

Marine Mammals:

Since the article on marine mammals appeared in *News from Hudsonia* 10(2), we have received several additional reports of harbor seals. Even more interesting was a series of sightings of two probable harbor porpoises which were seen in 1995 off Staten Island, Brooklyn, the west side of Manhattan, and finally in the Hudson near Ossining. If these unverified reports actually represented harbor porpoises, it may be the first record of this species in the Hudson in more than a century.

Book Reviews

Laubach, Rene. 1992. A guide to natural places in the Berkshire Hills. Berkshire House, Stockbridge, MA. 260 p. Replete with information about the rare (e.g. peregrine falcon) and the commonplace (yellow birch), this pocket guide profiles 29 public-use areas in detail. The book is readable, practical, and carefully produced. A "Seasonal Highlights" section notes natural and recreational attractions and conditions for visitors.

Mitsch, W.J. & J.G. Gosselink. 1994. Wetlands. 2nd edition. Van Nostrand Reinhold, New York. 722 p. As a textbook or reference, there is still no serious challenge to the broad perspective of this book. There is a new chapter on wetland restoration and creation, and expanded consideration of economics, fauna, vegetation development, biogeochemistry, hydrology, and foreign wetlands. The chapter on freshwater tidal marshes could be improved by additional information from the Hudson River and New England.

Turner, J.L. 1994. Exploring the other island; A seasonal guide to nature on Long Island. Waterline Books, Great Falls, VA. 194 p. This is a good, practical guide, covering a wide variety of topics, with adequate text and clearly reproduced black-and-white photos. The 32 chapters end in directories of sites where the reader may go to seek the species or phenomena discussed (sadly, one is "Where to See the Night Sky"). A longer bibliography of the local natural history literature would be welcome.

Recent Reports Available from Hudsonia
(postage included in prices)

Reference Wetlands in Eastern New York. 94 p. $20

Millbrook Marsh Watershed: Conservation of Biological Resources. 75 p. $10

Environmental Quality of the Wallkill River in Orange County, New York. 44 p. $10

Bronx River Reservation Environmental Studies for the Woodlands Viaduct Reconstruction. 44 p. $10

Baseline Assessment of Tributaries to the Hudson: Water Quality, Fishes, Macroinvertebrates, and Diatoms in Fishkill, Quassaic, and Moodna Creeks. Vol. 1 (text), Vol. 2 (data). $30 (both volumes) or $15 (Vol. 1 only).

Offered

Hudsonia has a large collection of duplicates of books and journals for trade. Call our office for lists.

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We have tentatively scheduled two workshops on the use of Hudsonia's *Manual for the Identification of Biodiversity Resources in the Hudson River Greenway Corridor*. Team-taught by Erik Kiviat and Gretchen Stevens, these training sessions will be on Wednesday 9 and Saturday 18 November (please call about dates, fees, and reservations). A pre-publication draft of the *Manual* will be available at that time for testing and comment.

Dear Friend of Hudsonia,

During this period of political and regulatory change, we urge you to remember the importance of accurate information for environmental decision-making. Now more than ever, Hudsonia needs your support. Your tax-deductible donation will go a long way towards insuring that those who seek reliable scientific data to make sound environmental decisions will always be afforded that opportunity.

***Please* take the time to make a contribution today.**

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