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News from....

Hudsonia

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MUSKRAT: MANAGER OF THE MARSH

by Erik Kiviat

On a pleasant June day, as I rested by a muddy stream, I was astonished to see a bunch of blue forget-me-nots and other small wildflowers seem to swim across a pool in front of me. Soon a muskrat appeared, swimming behind the flowers - a muskrat with a bouquet in its mouth! The muskrat dove into its burrow to eat its pretty lunch in underground seclusion. Muskrats are relatively approachable and leave obvious signs of their presence, suitable for study by naturalists and casual observers alike. Yet most interest in muskrats has focused on fur, trapping, crop depredation, and damage to dikes and ditches. Animals affect their environments via feeding, trampling, building, and excreting,[1,2] but little has been written about how the feeding and building activities of muskrats influence other biota and the marsh ecosystem.

An adult muskrat is about 50 cm long including its nearly hairless and vertically flattened tail, and weighs about 1 kg. Native in much of the United States and Canada, the muskrat was introduced to other parts of North America as well as to Europe, and northern Asia.[8] Within their North American range, muskrats inhabit almost every pond, lake, ditch, stream, and wetland, including rather brackish tidal marshes. Muskrats are active all year. They breed from April to August in the northern U.S.,[5] and year round on the Gulf Coast.[15]

Where there are banks with cohesive soil, muskrats live in burrows. These are 10-15 cm in diameter and may be many meters long, with one or more underwater entrances and nest chambers above the water table. Away from suitable banks, muskrats build lodges of plants and sediment in the shallow water or on floating mats. Lodges are 50-450 cm wide at the base and 30-150 cm tall.[12,21] Young are raised in lodges, burrows, or open nests. Muskrats also make feeding stations that resemble small lodges.

Cattails, bulrushes, arrowheads, wild-rice, wild-celery, and sweetflag are favored foods. Muskrats also eat other sedges, grasses, smartweeds, iris, duckweed, pickerelweed, common reed, water-lilies, willow bark, horsetail, green algae, maize, apples, and many other wild and cultivated plants.[4,7,22] Animals, especially freshwater mussels, are sometimes eaten. Foraging takes place within 30 m of the dens in dense muskrat populations in marshes, or as far as several hundred meters in sparse lakeshore populations.[5] Food may be eaten where found or brought to dens or feeding stations. Muskrats may disperse (move to a new area) in spring and fall when they are often found in intermittent streams, culverts, new ponds or ditches, and dead on the roads.

One to 6 or more muskrats may inhabit a lodge or burrow. In studies of large areas, marsh populations ranged from 0.03 to 86 muskrats per hectare, and stream populations 0.06 to 0.23 per hectare.[5,6,16] Marsh populations fluctuate greatly depending on weather, water levels, ice, food supply, predation, trapping, and pollution. Population changes mean that muskrats affect their marsh and waterside habitats with varying intensity, altering soils, flora, vegetation, fauna, decomposition, and nutrient cycling.

Grass-like (graminoid) marsh plants such as cattails, bulrushes, and common reed, are fibrous and tough. Insects, birds, deer, and muskrats favor the young shoots, seeds, or underground parts which are more tender and nutritious.

ALSO IN THIS ISSUE: *Phragmites p. 4; Project Notes p. 7; Sponsor & Donor Lists p. 8*

Although production of plant material in cattail marshes is comparable to that of grain on good farmland, usually little of the marsh plant biomass is eaten while still alive. For food and lodge material, muskrats typically harvest about 5% of a marsh's living plant biomass in a year,[16] but under exceptional conditions called "eat-out," muskrats may destroy nearly 100% of the vegetation.[13,9,15] The ability of muskrats to dig up underground plant parts, gain nutrition from fibrous materials, eat a variety of plants, and also feed on animal matter allows efficient exploitation of the high productivity of marshes.

Muskrats consume about one-third their body weight daily in fresh plant matter,[15] and produce feces containing large amounts of finely ground fiber. Muskrats harvest 2-3 times more than they eat,[16] storing some material temporarily in lodges and feeding stations. The "wasted" plant material from lodges and feces contributes to the stock of dead plant material (detritus) that is colonized by microorganisms and eaten by a variety of invertebrates and a few fishes. Muskrat pre-processing of detritus presumably alters detritus-based food chains. Abandoned, rotting lodges, enriched by feces of muskrats and raccoons, and by mussel shells, are the compost heaps of the marsh.

Muskrats, young and adult, are eaten by northern pike, snapping turtles, snakes, birds of prey, foxes, dogs, and especially mink.[5] Many predators are part-time users of the marsh; they thus link marsh production with the nearby upland and aquatic environments.

Selective feeding by muskrats on favored food plants reduces dominance by cattail, bulrushes, and other aggressive species, creating space for many small plants.[6,13,15] Muskrats noticeably thin the vegetation in a 5-8+ m radius of the lodge when building and feeding. Lodges are abandoned after 6 months to several years, and the clearings subsequently support developmental plant communities. Ducks, rails, and sparrows are attracted to seeds and insects in muskrat clearings. When muskrat populations are moderate, shifting lodge sites maintain a mosaic of vegetation and increase the diversity of plant and animal species and communities in the marsh. Sometimes these disturbed areas are more vulnerable to invasion by introduced weeds like purple loosestrife and common reed.

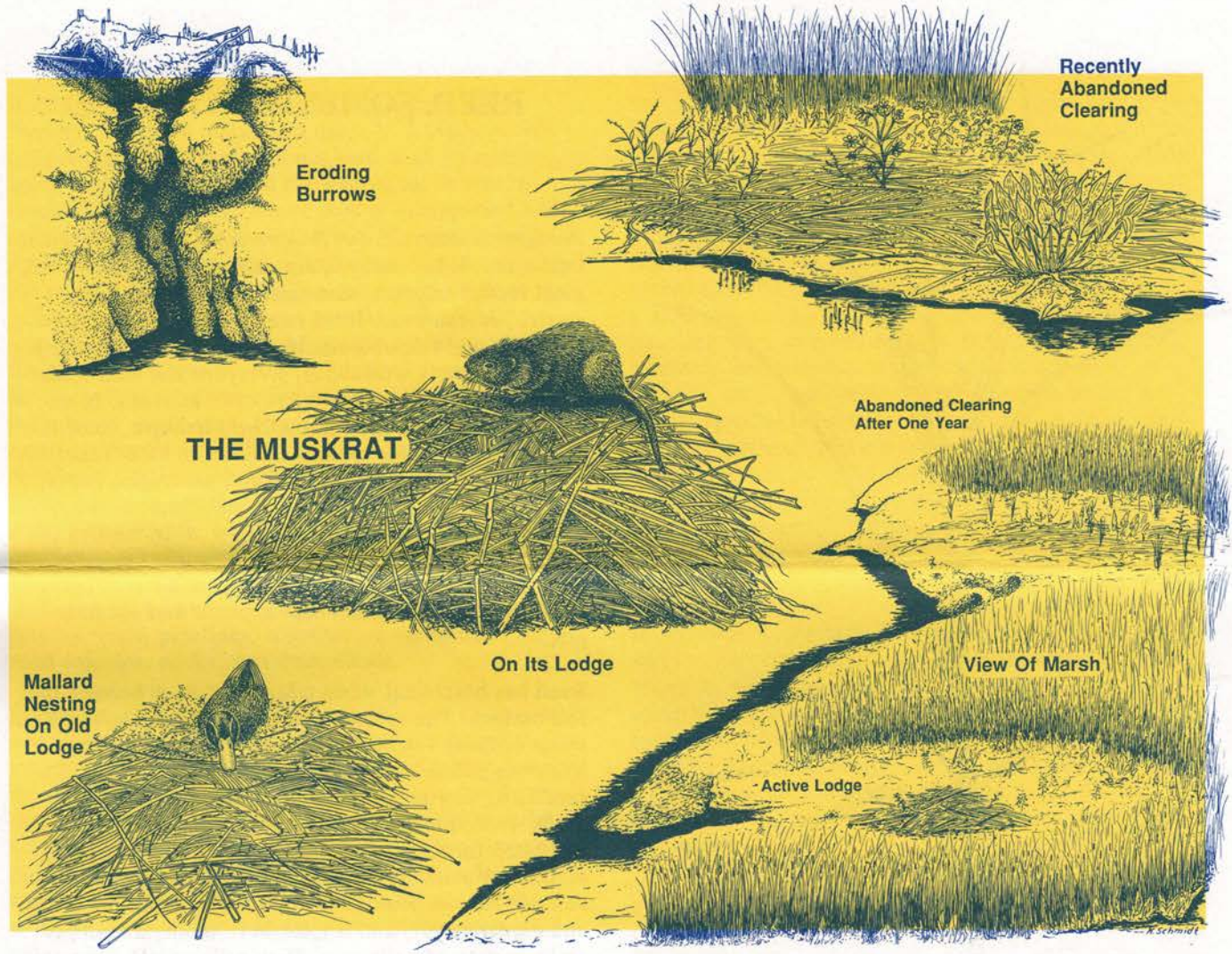
Burrowing animals aerate, mix, and otherwise alter the soil.[2] Collapsed and eroding muskrat burrows create hummocky surfaces along waterway banks, and form varied sites for plant growth. Abandoned lodges and excavated areas in the marsh also provide high and low spots for different kinds of plants. The rooting, probing, digging, and trampling of muskrats, birds, snapping turtles, alligators, and bottom feeding fishes resuspend sediments and help keep marsh pools and channels from filling in.[11]

Many marsh and aquatic plants can become established in new locations by means of the rooting of tubers, stem fragments, or other vegetative propagules.[18] This capacity avoids the difficulty of seed germination and establishment on flooded, oxygen-poor, and often unstable soil. Muskrats leave pieces of cattail and sweetflag rhizomes, smartweed stem bases, and broadleaf arrowhead tubers on lodges and feeding stations, and floating in quiet waters, thus contributing to plant dispersal.

Any animal that makes burrows in the soil, cavities in tree trunks, pools in the marsh, clearings in dense vegetation, or nests of plant matter or soil is host to other animals seeking shelter, foraging areas, and nesting sites. Natural or human-caused changes in host populations also affect the guests. The relatively dry, raised structures of muskrat lodges and burrow chambers are especially attractive places in the wet marsh. Perhaps 100 species of vertebrates use muskrat burrows and lodges.[10,12] Prominent guests include small fish hiding in burrow entrances; turtles laying eggs in the outside of, basking on, and hibernating beneath, lodges; waterfowl and terns resting and nesting atop lodges; and carnivores and rodents sleeping, rearing young, scent marking, and foraging for non-muskrat food. As many as 26 snapping turtles have been reported from a single muskrat burrow,[3] and up to 8 Forster's tern nests on one muskrat lodge.[14] Other animals are frequently caught in traps set for muskrats in their burrows and runways. Some animals are greatly benefitted by their use of muskrat architecture, and little harm is caused to the muskrats. Nonetheless, no other animal is known to require muskrat lodges or burrows. Manipulation of muskrat populations for fur or to protect crops and dikes, however, also affects symbiotic species.

Muskrat populations in Hudson River tidal marshes have been abnormally low since about the mid-1970s, with apparently different trends in different marshes. Toxic substances (e.g. cadmium,[17] herbicides, fungicides, dioxin), disease, raccoon predation, and vegetation change could be factors contributing to the declines. Additionally, muskrats can be vulnerable to overtrapping in tidal marshes.[19,20] At Tivoli Bays, the population crashed ca 1974 and has increased only modestly in the last several years. Sweetflag and hybrid cattail, both preferred muskrat foods, increased in the late 1970s and early 1980s, as did common reed. Muskrat clearings in the cattail, supporting secondary plants such as smartweeds, bur-marigolds, and mid-sized grasses, all but disappeared until recently. Two large intertidal pools have gradually silted in, perhaps partly due to lack of muskrat harvesting of the cattail and other plants. Common moorhen and sora disappeared from the breeding bird community, possibly due to the loss of pool and clearing habitat.

We do not know what muskrat densities or fluctuations are optimum in northeastern tidal and nontidal marshes, but we believe muskrat influences are important to the maintenance of native biological diversity in marshes. Furthermore, a normal muskrat population is one of many indicators of the ecological integrity of a marsh. Biologists interested in the conservation, management, and restoration of marshes should look for ecological information in the past and present activities of muskrats.



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REED, SOMETIMES A WEED

Erik Kiviat

Phragmites australis (= *P. communis*) is a giant wetland grass. It has many common names: common reed, giant reed, reedgrass, savannah grass, mares' tails, carrizo, roseau cane. Reed ranges widely in North America, and this or a similar species of *Phragmites* is important nearly worldwide. Everyone has seen reeds along highways, on lakeshores, or in marshes. In nature, one person's trash is another's treasure. Reed is often despised in the eastern U.S. but in other countries it is a resource for thatch, food and beverages, paper, fuel, fodder, crafts, fencing, soil stabilization, sewage treatment, and construction.[3,6,8,9,10,17,20] In the U.S., reed thrives on wetland fill and in disturbed marshes, invades from highway ditches and pipeline corridors, and colonizes abandoned beaver ponds and old mine pits.

Reed has horizontal stems (rhizomes) at or beneath the soil surface. The rhizomes send up vertical aboveground stems (culms) 1-4 m tall with many narrow leaves. Vigorous culms have flowering tassels capable of producing tiny seeds. In addition to reproduction by seeds, reed spreads vegetatively by rhizome extension and often forms new colonies when rhizomes are fragmented by animals, ice, or machinery and carried to a suitable habitat. Reed is favored by high nutrient levels and moderate pH, and is tolerant of moderate salinity and a variety of pollutants. High salinity, pH extremes, strong currents, heavy grazing, and possibly high soil organic matter inhibit reed.[8,10] Density of reedbeds varies, and secondary plants such as sedges, jewelweed, and bugleweed may be rare or common among reeds. Production of reed is high, and peak aboveground biomass is about 700-4000 dry grams per square meter,[21] comparable to maize. Mature, living culm and leaf tissues are protected from most grazing by tough cellulose fibers and glassy silica deposits. Cut or broken reeds may be knife-sharp. Dead reed material is eaten by mollusks, crustaceans and insects,[16] and these invertebrates are potential food for larger invertebrates, birds, and fish.

Living reeds in the Northeast have few associated insects, and those do little harm to the plant. European reed has a rich insect fauna that is capable of severe damage.[2,7,8,15,18,19] Reed seems more heavily used by nesting and foraging birds and by muskrats in Europe[10] than here, although our reedbeds are far from being biological deserts. There is debate about whether reed is native, introduced, or both in the U.S.[14] Reed material has been found in prehistoric sediments and archeological contexts,[1] but in some areas (including the Hudson Valley) modern reed behaves much like an introduced species that has left its ecological controls home in Europe.

Reed, purple loosestrife, and water-chestnut are "weeds" at certain places and times.[11,12] Many people believe that these plants are not used at all by native animals. But black-capped chickadees eat insects in reedbeds; ducks forage where reed is interspersed with open pools; many birds nest or roost in reed; muskrat, nutria, and geese eat reed. The real question is whether the more specialized (and often more vulnerable or rare) native animals and plants can coexist with aquatic weeds, or if the expansion of aquatic weeds results in the decline and loss of native biological diversity. We have insufficient information to answer this question definitively about reed. Reed does threaten some tidal marshes, nontidal marshes, and fens in portions of the Northeast, yet in other habitats or areas the plant may be harmless or even beneficial. I believe that reed (like many other aquatic weeds) is a symptom of deeper problems: siltation, pervasive nutrient enrichment of waters and wetlands, alteration of hydrology, chemical pollution, and disturbance of wetland soils and vegetation by roads, pipelines, construction equipment, off-road vehicles, docks, and duck blinds.

Whenever people think "the sky is falling," ecologists and managers should weigh the potentially harmful longterm consequences of control before taking drastic measures. For instance, panic over an introduced species, the gypsy moth, resulted in the late 1950s aerial spraying of DDT in fuel oil which had little effect on the moth while harming many other animals. Introduced species that spread aggressively *are* a threat, but the solution is not widespread use of broad-spectrum pesticides.

Common reed has been controlled by repeated cutting, deep flooding with or without cutting, burning, plowing, grazing, spraying of herbicides, hand-cutting and hand-application of herbicide, and covering with plastic.[4,5,8,10] Handpulling or suffocating with plastic are practical only where a small infestation in an otherwise weed-free area can be eliminated before spreading. As far as I know, research and development of biological control has not begun. Biocontrol of weeds is slow and costly to develop, but the success rate is high. Proper research begins with studies of pathogens and grazers in the native and introduced ranges of the species, followed by exhaustive laboratory testing to demonstrate that candidate control organisms will not damage other plants or animals, and finally field experiments. A program of purple loosestrife biocontrol developed by the U.S. Department of Agriculture and Cornell University shows promising results after early field trials.[13] Why not reed? Except in a few instances of urgent threat to rare plants or animals, we might be better off putting efforts into biocontrol R & D, than lots of small experiments with chemical and mechanical control. If reed is, indeed, partly native, we would need a biological control that affected the introduced form or that could be applied locally where it is determined that reed invasion cannot be tolerated. With any control technology, it will be necessary to correct underlying problems of pollution and habitat damage to reduce the rate of invasion and the likelihood that reed or other weeds will reinvade after control.

"Controlling" pests is expensive and difficult. Eliminating the factors that encourage their invasion and spread, where possible, is the best approach. For reed, this means minimizing soil disturbance on and around construction sites, minimizing erosion and siltation into wetlands, and preventing nutrient enrichment of streams, lakes, and wetlands. This may seem like a simple agenda, but neglect on construction sites, and abuse of wetlands and streams are widespread. We need to not only educate land owners and construction engineers about the importance of careful soil management and the conservation of native biological communities, but also to overcome regulatory indifference and ineffectuality.

In some cases, we may discover environmentally benign ways to harvest and use reed and other weeds.[10] For example, young reed growth is eaten by horses and other livestock, and possibly could be harvested for hay. Innovative uses might help reduce populations without harming the native plants, insects, and vertebrates that contribute to the biological diversity and ecological integrity of our tidal and nontidal marshes, fens, and wet meadows.

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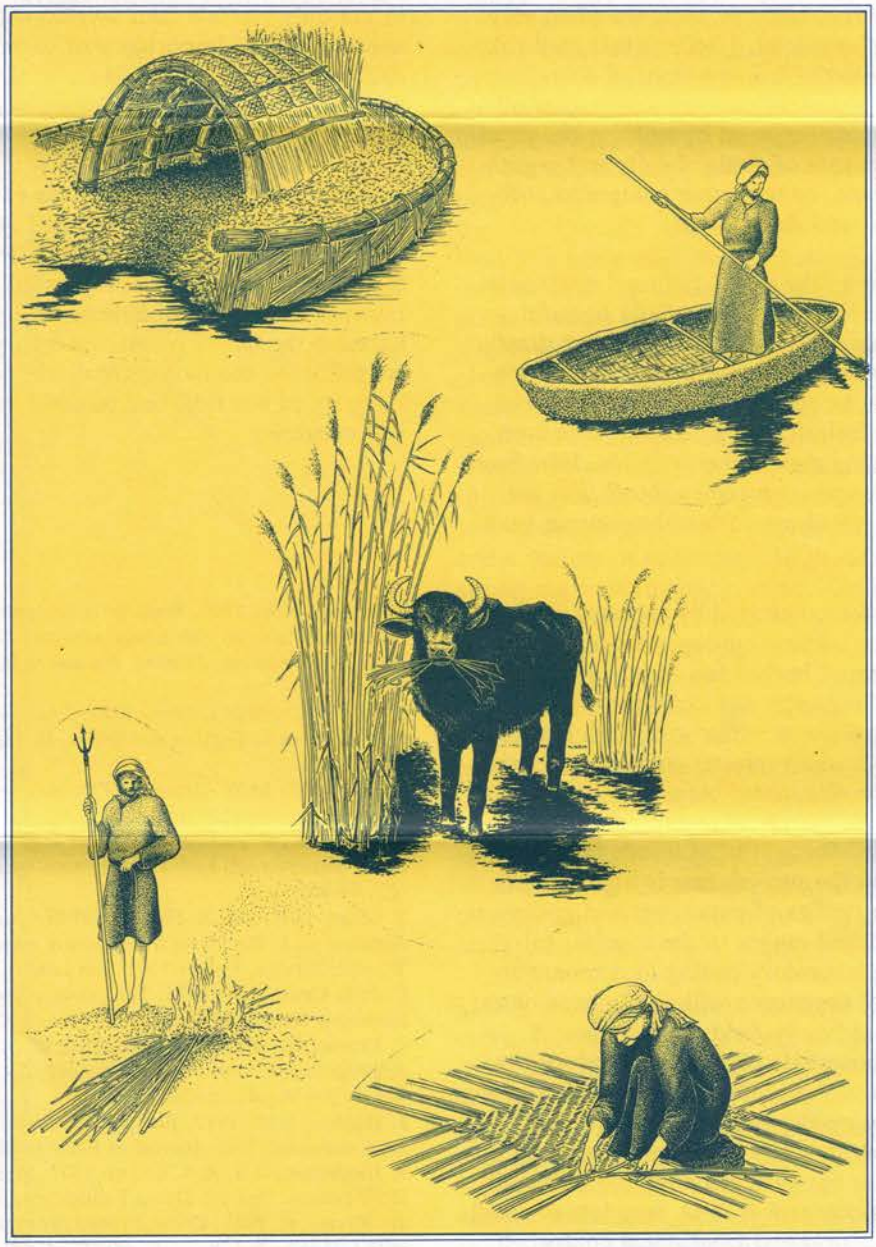

Reed culture of the Madan of the Tigris-Euphrates delta marshes. ***Center***, reeds grazed by domestic water buffalo; ***top left***, reed fence on mound of reeds and sediment supporting shelter of reed-bundle arches covered with reed matting; ***top right***, reed pole and bitumen-coated reed canoe; ***bottom right***, weaving mat of split reed culms; ***bottom left***, reed fuel and reed shaft of fishing spear. Drawn by Kathleen A. Schmidt for E. Kiviat, 1979, Wetland Human Ecology, Ph.D. Thesis, Union Institute, Cincinnati, OH.

Design and production by Kathy Anne Schmidt. Drawings Copyright c Kathleen A. Schmidt 1994. Special thanks to the Bard College Library and the Hudson River National Estuarine Research Reserve. Gretchen Stevens and Laura Pilkington commented on drafts. Donors, organizations, and individuals acknowledged do not necessarily agree with the concepts and opinions expressed in *News from Hudsonia*.

* * *

Hudsonia News

Hudsonia has received the **Researchers of the Year** award from the Hudson River Environmental Society.

We are drafting the text for the ***Manual for the Identification of Biodiversity Resources in the Hudson River Greenway Corridor.*** Inquiries and comments may be addressed to Erik Kiviat or Gretchen Stevens at our office.

Report Available

Baseline Assessment of Tributaries to the Hudson: *Water Quality, Fishes, Macroinvertebrates, and Diatoms in Fishkill, Quassaic, and Moodna Creeks. 2 volumes.* $25 from Hudsonia.

Equipment and Literature Available.

Our old chest freezer; works fine but door needs repair of gasket and insulation. Ask us for a list of books and periodicals available for trade, or donation to nonprofits.

* * *

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Who is that voice on the phone? Laura Pilkington, Administrative Assistant, came to Hudsonia last January. Her responsibilities include handling course reservations and arrangements, communicating with Sponsors, supervising student assistants, purchasing, and managing Hudsonia's library. Laura grew up on Long Island, and has a Bachelor's degree in geography and a Master's of Library Science from SUNY Albany.

Office and Herbarium Assistants: Patti Austin, Flavia deJesus, Dwayne Linville, Naomi Yoder.

* * *

Appeals for Information

Prickly-pear. Hudsonia and Bard graduate students are analyzing data on the distribution of prickly-pear cactus in the Hudson Valley. Please contact us if you have information on locations or status of prickly-pear (exact locations of this vulnerable plant will not be revealed to the public).

Wood turtles rarely enter tide-affected habitats. We have only 5 records of wood turtles in Hudson River habitats during the past 20 years. Have you found a wood turtle in tidal habitat in the Hudson or another estuary?

American goldfinch. We are completing a study of goldfinch nesting in purple loosestrife. Please call if you have found an active or abandoned goldfinch nest in this plant.

Osage-orange is an introduced tree from the Southwest which has large fibrous fruits. Last winter, Don Ferlow (Stearns and Wheler Engineers) and Erik Kiviat observed gray squirrels carrying and eating osage-oranges in Westchester. Have you seen animals feeding on these fruits?

Wish List

An electronic typewriter; C. Schuberth, *Geology of New York City and environs*; New York State Conservation Department, *A biological survey of the lower Hudson watershed*; Litchfield Co., CT, soil survey; Putnam Co., NY, soil maps; *Biosis list of serials*.

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