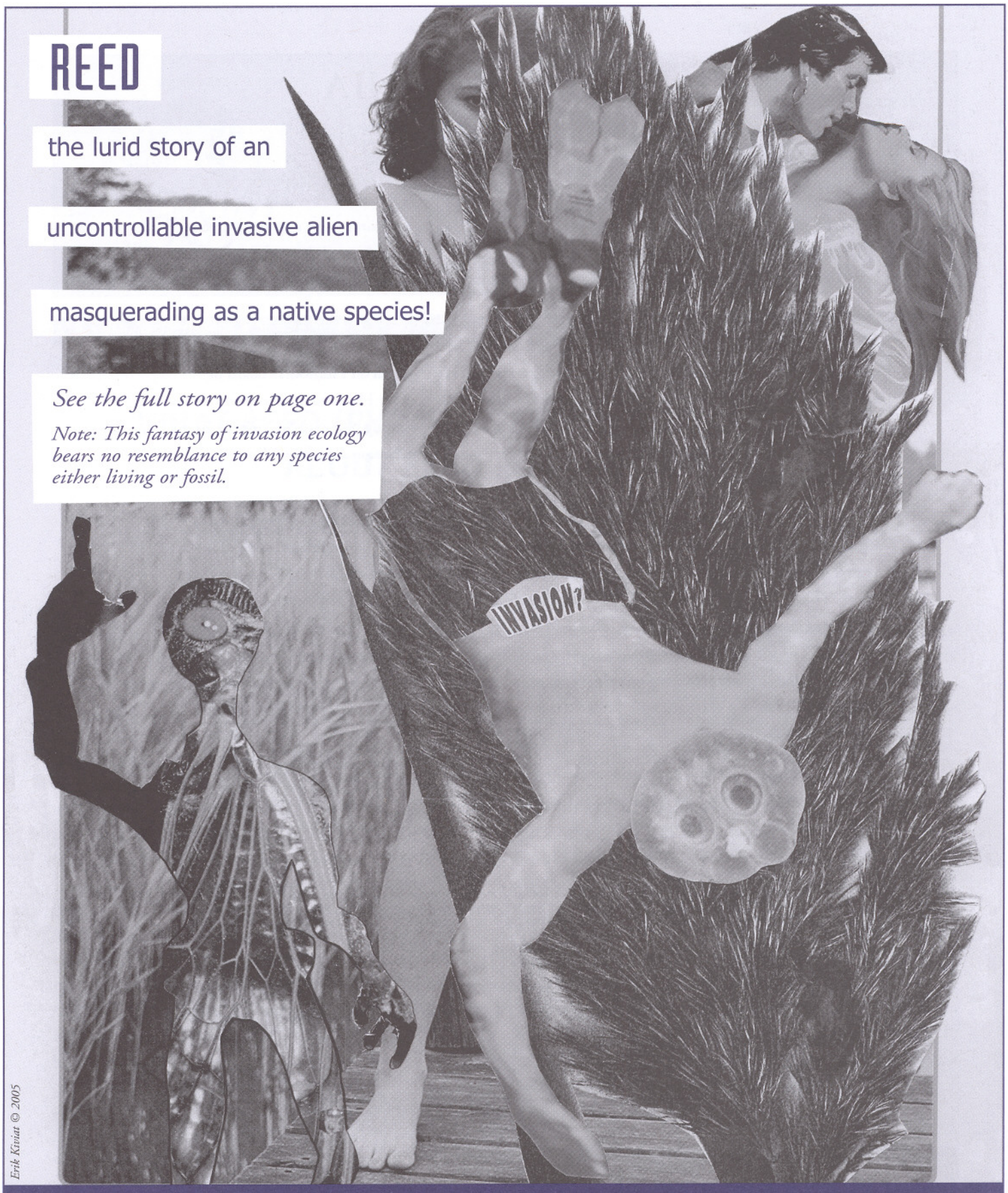

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Environmental Research and Education
Science for Conservation

News from Hudsonia

Volume 20, Number 1 Spring 2005

Environmental Research and Education
Science for Conservation

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Volume 20, Number 1 Spring 2005

WHAT REED (*PHRAGMITES*) ECOLOGY TELLS US ABOUT REED MANAGEMENT

PART 1. CONFRONTING REED'S LURID REPUTATION

By Erik Kiviat*

Common reed (*Phragmites australis*) is a giant grass—as widespread in the world as any plant, represented in an Egyptian hieroglyph and the Hudsonia logo, habitat for more than 100 species of North American birds, managed in England for roof thatch that lasts 70 years, once cut for arrowshafts and dozens of other products by Native Americans, and controversial among U.S. ecologists and wetland managers. Reed is a fascinating case study in wetland and wildlife ecology, the impacts of human activities, and the importance of detailed, objective scientific inquiry prior to expensive and sometimes destructive management actions.

Invasive plants such as common reed are of concern to ecologists because of their ability to dramatically alter biological communities. Reed often takes over marshes and wet meadows, displacing other wetland plants. The belief is widespread that reed provides little food or shelter for native species, and many wetland managers try to eradicate reed wherever it occurs. Yet the scientific basis for these beliefs and actions is weak, and the results often damaging to biological diversity.

An "invasive" plant is a native or introduced plant that displaces native species in natural communities. The "invasiveness" of a plant is a function of its ability to compete for water, light, and nutrients, resist damage by herbivores or pollutants, and tolerate bare soil or other harsh environments. The "invasibility" of the local environment[17] is increased by human activities that have raised or lowered water levels, disturbed soils, increased nutrient (e.g., nitrogen, phosphorus) availability, altered salinity levels, or that have added or removed competing plant species, wild herbivores, or livestock. Reed invasion is most often related to human or natural (e.g., beaver) disturbance to soils and vegetation; once established at the site of disturbance, reed may spread into surrounding undisturbed areas.

REED IN NORTH AMERICA

Native forms of common reed have been in the northeastern U.S. for perhaps 10,000 years,[10] and in the southwestern states for more than 40,000 years.[8] An introduced form apparently arrived from Eurasia a century or more ago and became invasive.[26] The Eurasian form is prevalent in the Northeast and may be the only form found in the Hudson Valley; native forms are more frequent in the Middle Atlantic states and the Midwest, and predominate in the West. Researchers are still sorting out the morphological and ecological differences between native and introduced reed.[27] Although the Eurasian form is more competitive in laboratory experiments (K. Saltonstall, unpublished), a native form can also be invasive in the wild.[14]

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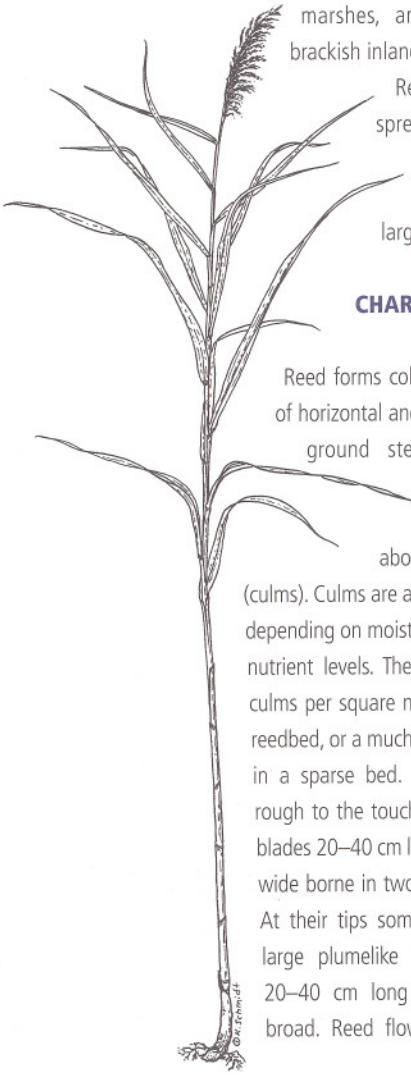
Reed habitats range from deeply flooded to very dry soils of almost any texture, from fresh water to one-third seawater salinity, from full sun to half shade, from sea level to hundreds of meters elevation, and occur from southern Florida to California, and from northern Canada to South America. In New York, Connecticut, Massachusetts, and New Jersey, reed thrives in the shallows of natural and artificial lakes and ponds, active and abandoned beaver ponds, swamps where trees have died, mine pits, freshwater tidal and brackish tidal marshes, dry landfill cover and dredged material, roadside ditches and seepy roadcuts, sluggish streams and rivers, fens, and varied nontidal marshes and wet meadows both "natural" and altered. Reed does poorly in closed-canopy forested wetlands, acidic bogs, high salinity tidal marshes, and actively grazed pastures. In prehistoric North America, reed occurred in upper edges of saline tidal marshes, and alkaline or brackish inland wetlands.[18,10] Reed was widespread before the 1900s, but probably not in large dense stands.



CHARACTERISTICS OF REED

Reed forms colonies by means of horizontal and vertical underground stems (rhizomes) that give rise to vertical aboveground stems (culms). Culms are about 1–4 m tall, depending on moisture, salinity, and nutrient levels. There may be 100 culms per square meter in a dense reedbed, or a much smaller number in a sparse bed. Culms are stiff, rough to the touch, and have leaf blades 20–40 cm long and 1–3 cm wide borne in two vertical planes. At their tips some culms bear a large plumelike flower "tassel" 20–40 cm long and 5–10 cm broad. Reed flowers and seeds are tiny, but the tassel overall is conspicuous, brown, gray or purple when in flower, and becoming tan or gray when in fruit in fall and as it weathers during the winter. There are measurable external differences between the Eurasian form and the native American forms, and botanists are learning the best characters for discrimination without recourse to DNA technology.[27]

1 kilometer (km) = 0.62 mile
1 meter (m) = 3.28 feet
1 centimeter (cm) = 0.39 inch
1 hectare (ha) = 2.47 acres

Reed culms die in fall but the dead culms stand erect through the winter, or they lean or flatten ("lodge") under the influence of wind and snow. Reedbeds may be dense, with only a few stunted stems of other plants, or may be sparse and intermingled with sedges, forbs, woody plants, or mosses. At wetland-upland edges, reedbed margins sometimes support a variety of vines, which may be so lush as to render the reeds almost unrecognizable. Commonly there is an admixture of other plants in the outer meter of the reedbed, and reed is dense in the interior. Reedbeds occur in all sizes from a square meter to hundreds of hectares, and in shape from linear fringes to large round or irregular patches. The beds may be continuous, or broken by creeks, pools, and clearings. Reedbeds may cover large areas with few or no patches of other vegetation, or may be interspersed with patches of other marsh plants, shrubs, trees, or submergent aquatic plants. In many places, reedbeds spread and consolidate by means of lateral extension on or below ground. Yet reedbeds may also remain stable for decades, thin out, shrink, or disappear due to livestock or muskrat grazing or increased water levels. Long-distance dispersal of reed occurs when rhizomes are severed by animals, ice, or human activities and fragments are moved to a new site by water or construction equipment. Occasionally reed grows from seed.

FIRES, NUTRIENTS, SOILS

Reedbeds burn readily, especially in early spring when the previous year's material is very dry and new aboveground growth is just beginning. Methane emitted from organic soils (Ellen Hartig, personal communication, 2002), and seasonal or aperiodic drought, make reedbeds more combustible. It is unclear whether reeds are inherently more fireprone than certain other types of weedy vegetation, but reedbeds are considered a fire hazard in developed areas. Reed fires in spring, when wetland soils are saturated, do little if any damage to reed rhizomes and reed typically sprouts with vigor shortly after burning. In summer or during drought, when surface layers of soils are dry, reed fires may burn into organic soils, killing patches of rhizomes and burning away soil materials which can result in the death of reed patches and the creation of shallow pools.[31,29]

Where humans have fertilized waters and wetlands via sewage disposal, runoff from agricultural and developed areas, or atmospheric deposition from industrial emissions, reed tends to invade and actively displace other marsh plants, including cattails in freshwater and cordgrasses in brackish water[28] habitats. Reedbeds can remove nutrients and metals from waters,[6,3,4,36] either in the wild or in constructed wetland systems designed to treat wastewater. Nitrogen entering reedbeds may end up in soil organic matter, in the atmosphere (via denitrification), or in harvested plant material, or may be regenerated into surface waters. Reedbeds can thus be helpful in improving water quality in some situations.

Reed leaves fall from the culms in winter and decompose within about a year. The culms die in autumn but remain standing for a year or two, then lodge and break into pieces. These pieces may wash or blow around, accumulating in wrack deposits in marshes and lakes, or become incorporated into soil organic matter beneath the reedbed. At the same time, suspended organic and inorganic particles settle from surface waters moving through reedbeds, because the dense vegetation slows currents and reduces their ability to carry sediment. Soil elevation may build up rapidly in a reedbed. Like many aspects of reed ecology, this soil building is a double-edged sword for environmental managers. Soils sometimes build up in reed-dominated tidal marshes to the point where tidal rivulets and pools in the reedbeds are filled in[35] and there is a loss of habitat for small fishes and crustaceans.[1] But, reed's effective anchoring of soils may also reduce erosion in coastal

marshes[24] where sea level is predicted to rise about 20 cm in the next 20 years.[25]

IS "REED HABITAT" AN OXYMORON?

Many managers and biologists think reedbeds are always poor habitats for other species, and there are many published statements to the effect that reed is good habitat only for other pests. Although most reedbeds are poor habitat for other plants, uncommon or rare plant species sometimes appear to thrive in sparse reedbeds or in the shelter of reedbed edges. In the Croton Point Marsh on the tidal Hudson River, for example, the rare mudwort (*Limosella subulata*) grows where reed anchors the lower margin of peat. At Jamaica Bay Wildlife Refuge in New York City, the ragged fringed orchid (*Habenaria lacera*) is found only among sparse reed culms.

A few examples will show that reedbeds can be important to animals, and that these values may be widespread. About 85 species of birds have been reported breeding in reed habitat in the U.S. or Canada.[12] Some birds build nests attached to reed culms or on the ground beneath a reed canopy, and other species occupy territories that include substantial areas of reed, or nest in isolated plants of other species within buffering reedbeds. The most commonly reported reed-breeding birds are red-winged blackbird and marsh wren. Interesting cases include the ruddy duck and American coot which in New Jersey are known to breed only in reed-dominated marshes,[9] and the Belding's yellowthroat, an endangered species restricted to small reedbeds in oases of arid Baja California.[23]

In 2001–2002, Hudsonia studied three small (0.3–0.5 hectare) reedbeds in the interior of the large freshwater tidal marsh at Tivoli North Bay on the Hudson River.[11] There was less singing (i.e., breeding activity) of birds in the reedbeds compared to equal areas of narrowleaf cattail, *Typha angustifolia*, surrounding the reedbeds. However, nonbreeding use of the reedbeds was greater than cattail, due to flocks roosting at night in the reedbeds. These birds (tree swallow, bank swallow, barn swallow, eastern kingbird, red-winged blackbird, common grackle, rusty blackbird, bobolink, brown-headed cowbird, and European starling) came from outside North Bay and zeroed in on the reedbeds—which constituted only about 1% of the tidal marsh; the

Marsh wren is one of the birds most often found nesting in reedbeds.

birds showed no evidence of roosting in other plants (although in the early 1970s, when there were only a few square meters of reedbed in North Bay, roosting songbirds used cattail, purple loosestrife, and woody plants). Bobolink and rusty blackbird are declining rangewide, and the apparent role of reedbeds in protecting roosting birds such as these from predators, human intrusion, and bad weather needs to be elucidated. Roosting of swallows, blackbirds, and starling in reedbeds has been reported widely in the eastern states.[21,15,13] Another nonbreeding use we observed in North Bay in August of both years was ruby-throated hummingbird foraging for insects or spiders in the edges of reedbeds.

There are also well-documented examples of negative influences of reed on certain animals. Three species of habitat-limited, high salt marsh nesting birds in southern New England, the willet, saltmarsh sharp-tailed sparrow, and seaside sparrow, do not nest in dense reedbeds[2] although the sharp-tailed sparrow nests in short sparse reed with an understory of short grasses.[5] A number of studies have compared use by nekton (free-swimming animals, in these cases fishes, blue crab, and grass shrimp) in reed-dominated areas and other plant communities, usually saltmarsh cordgrass (*Spartina alterniflora*), in the northeastern and Middle Atlantic states.[7,33,16,19] Generally these studies have found about equal activity in reed vs. nonreed, provided the reedbeds flooded at high tide, with variation according to different nekton species. One fish, however, is common in both reed and cordgrass

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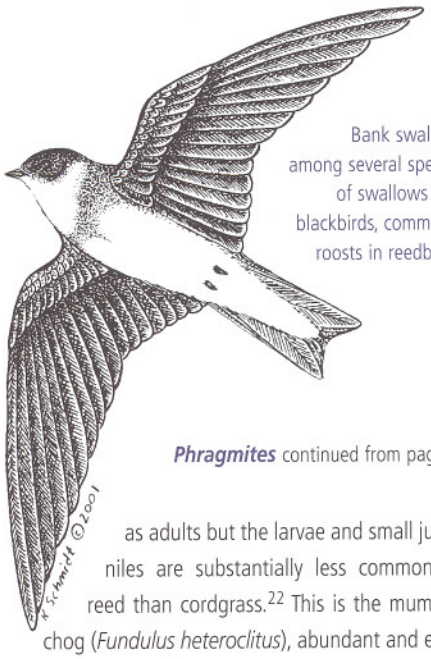


Bank swallow, among several species of swallows and blackbirds, commonly roosts in reedbeds.

Phragmites continued from page 3

as adults but the larvae and small juveniles are substantially less common in reed than cordgrass.[22] This is the mummichog (*Fundulus heteroclitus*), abundant and ecologically important as an intermediate link in the salt marsh food web. The food supply for mummichog early life stages may be inadequate in the reedbeds that have been studied.

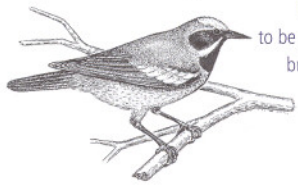
Reeds are used by muskrat (*Ondatra zibethicus*) for food, shelter, and lodge-building, and white-tailed deer (*Odocoileus virginianus*) for shelter and sleeping. White-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), and mink (*Mustela vison*) use reedbeds intermittently, or potentially for sustained periods. Several species of frogs breed in pools in reedbeds. At least three insects eat reed leaves in the Hackensack Meadowlands of New Jersey: the common meadow katydid (*Orchelimum vulgare*), the larva of Henry's marsh moth (*Simyra henrici*), and the larva of broad-winged skipper (*Poanes viator,* a butterfly). The mealy plum aphid (*Hyalopterus pruni*) sucks sap from reed leaves, and its relative, the reed scale (*Chaetococcus phragmitis*), also a sap-feeder, lives between the culm and leaf sheath. Black-capped chickadees venture well out on herbaceous marshes in winter and spring to forage on reed scale. Other insects inside the culm attract downy woodpeckers. Tree sparrows, and other sparrows, eat the tiny reed seeds. Northern harrier, a hawk of conservation concern, selects extensive reedbeds for nesting, deriving a buffer against human intrusion. Increasingly, several species of herons on the Atlantic Coast breed in reedbeds rather than in woody vegetation (David Jenkins, personal communication, 2005).[20] In most cases there are no data comparing population density, food habits, behavior, production of offspring, health, or other measures of "success" in reedbeds vs. alternate plant communities. This limits informed judgments about managing reedbeds for wildlife. As to the question whether animal use of reedbeds is a last resort where better habitat has disappeared, the examples I have given of roosting birds, foraging tree sparrows and black-capped chickadees, and nesting herons indicate this explanation is invalid in at least some cases, whereas in other cases reedbeds indeed seem inferior habitat. Much more research is needed to explain animal "selection" of reedbeds and whether it is favorable or not, compared to alternate habitats. It is important to recognize that reedbeds vary in many ways that may make one marsh better or worse habitat for a particular animal species.

Reed detritus (dead plant material) is eaten by various invertebrates (e.g., grass shrimp, fiddler crabs[34]). Although still little studied, the detritus appears to be a good base for portions of estuarine food webs. In Delaware Bay, reed, cordgrass, mud algae, and plankton algae contributed equally to food chains supporting open water fishes.[30,32] Given the prodigious production of reeds, they may nourish a variety of small animals and their larger predators meters and even kilometers away from the reeds.

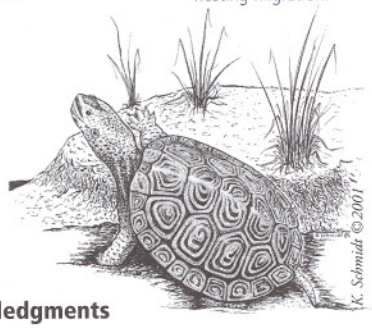
WHY VILIFY REED?

Why are the habitat functions of reed so often underestimated, and the plant so often considered a pest in wildlife marshes? Reed has recently spread in many wetlands and rapid, visible change in vegetation makes people uneasy. Some large, dense reedbeds have few breeding birds, and this may be particularly true of ducks, the management of which traditionally has shaped many ideas about wetland ecology. Little objective, quantitative research on animal-reed interactions (or other aspects of reed ecology) was performed before the 1980s; good scientific data have only recently become available and this new knowledge has not yet been widely adopted by managers. Management decisions must be made, nonetheless, and if accurate scientific information is not available, decisions often follow precedents. Many reed management projects lack quantitative monitoring and lack research designed to accurately measure reed-animal relationships. Permit-issuing agencies commonly require several years of simple vegetation monitoring in reed removal projects, to ensure that the soil is covered by vegetation other than reed. Birds and fishes are usually not monitored in these projects, however, even though improving habitat for these groups is often a goal of management.

Most aspects of reed ecology remain poorly understood. I encourage you to make your own observations on common reed and its associated organisms. You might watch how birds use reedbeds at different places and times; look for other vascular plants, mosses, fungi, invertebrates, or mammal sign within reedbeds; see how people use reeds and reedbeds; and see whether the beds expand, contract, open, close, or develop to woody vegetation, and under what human or nonhuman influences. Almost any observation of reed and wildlife is likely to add to sparse knowledge. I invite you to submit observations by email to kiviat@bard.edu or via www.hudsonia.org. In the second part of this article (fall 2005) I will analyze reed management methods and propose a new approach to managing this misunderstood species. ■



Reedbeds are reported to be unfavorable habitat for breeding golden-winged warbler and are thought to impede diamondback terrapin nesting migration.



Acknowledgments

Many colleagues, collaborators, and confidants have provided information and assistance, and librarians at Bard College and elsewhere have been especially helpful. Preparation of this article was supported by a grant from the Westchester Community Foundation. Hudsonia's work on Phragmites *has also been funded by the Geraldine R. Dodge Foundation, Hudson River Foundation, Geoffrey C. Hughes Foundation, New York City Environmental Fund, New York State Department of Environmental Conservation Hudson River Estuary Program, Salisbury Association, and Wildlife Conservation Society.*

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Timberdoodle

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