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

PART 2. OPTIMIZING REED VALUES

By Erik Kiviat*

Common reed (*Phragmites australis*) is both an invasive pest—capable of overwhelming native plant communities in certain settings—and a valuable resource, providing ecosystem services, products for human use, and habitat for animals and plants (see *News from Hudsonia* 20[1]). Reedbeds vary in their habitat functions, depending on a number of intrinsic characteristics, environmental factors, and management. In this second part of a two-part article, I review the ways that people use, perceive, and manage reed, and offer an approach to making management decisions that can optimize the benefits of this controversial plant.

CONTEMPORARY AND EARLIER USES OF REED

The principal contemporary use of reed in the U.S. is in constructed wetlands for wastewater treatment,[13] a cost-effective technology for nutrient removal or sludge dewatering in use at hundreds of sites around the country. People use reed in dried plant arrangements and occasionally in gardens, and ornamental fencing made of reed culms (aerial stems) is imported from Europe and sold in nurseries. A few artisans practice European-style reed thatching in North America (two examples may be seen on the south side of Route 23 east of Windham in Greene County, New York). Fishing poles are made from reed culms in Florida. Occasionally reed is planted in restoration projects and there is interest in using native genotypes for this purpose.

Reed was prominent among herbaceous (non-woody) plants used by North American Indians, especially in the western states.[10] Reed use was common during the period of contact with Europeans and reed artifacts are abundant in many southwestern prehistori archaeological sites where dry, cool conditions have preserve organic materials in caves. The most common reed products wer arrowshafts, pipestems, "cigarettes" (culm sections containin smoking mixtures), sugar, medicines, and boats. Some Nativ American groups managed reedbeds for harvest.

Europe has traditional and modern reed harvest for thatch, wal construction, paperboard, fuel, fencing, mats, and livestock fodde Complex systems of reed management maximize quality for thatc or other products while improving habitats for biodiversity.[5] Ree is also used in many other areas of the world.

THE COMMON AND LITTLE-KNOWN COMMON REED

Many managers, researchers, sportspeople, and naturalists tend t overlook the ecological values of reed because they have bee taught that reedbeds support little biological diversity.[4] Also, fiel workers who look at reedbeds usually do so during the day, in th springtime, and from outside the bed, because they assume that th

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bed is uniform and uninteresting. Furthermore, the noise from human movement through reeds often changes the behavior of the animals under observation. One must spend large amounts of time in the interiors of reedbeds, in different places and different habitats, at all seasons of the year and times of day, to find animals and their sign. Most researchers have studied reed in a single geographic area and worked with a single group of organisms and a small set of reedbeds and wetland sites, and the findings are often assumed typical of other reedbeds and other organisms. Most reed workers do not perform extensive literature searches, and most information from reed studies is never disseminated to other workers. Vegetation management in wetlands is expensive, however, and can have undesirable ecological side-effects, so it is advisable to base management decisions on good basic science and natural history.[17]

REED MANAGEMENT

In the northeastern U.S., reed is often perceived as having (and sometimes does have) negative impacts: providing poor habitat for ducks, breeding birds, and the bog turtle; excluding rare native plants and common native plant communities, and reducing marsh diversity; building up soil levels in tidal marshes thus reducing exchange of water between marshes and estuary and inhibiting use of the marshes by estuarine fishes and crustaceans; producing mosquitoes; creating a fire hazard in developed areas; blocking views of open water and other landscape features; and concealing undesirable human activities.

Robust rhizomes (underground stems) of common reed allow formation of dense colonies. Photo © 2007 Erik Kiviat

Where management of reed is deemed necessary, different management techniques, singly or in combination, may be used on reedbeds depending on environment, bed size, associated biota, and management goals. Techniques include herbicide application, prescribed fire, frequent cutting, cutting under water, "mulching" (i.e., destruction of rhizomes and buds), livestock grazing, raising water levels, lowering bed (soil) levels, increasing tidal flushing by saline water, covering with plastic, and (potentially in the future) biological control.

Reed roof thatching on house in Greene County, New York. Photo © 2007 Erik Kiviat

Herbicides

Thousands of hectares (1 hectare = 2.47 acres) of reedbeds have been or are being controlled with herbicides or combinations of herbicides and other techniques, in tidal and nontidal marshes of Massachusetts, Connecticut, New York, New Jersey, and Delaware. The herbicide most often used is glyphosate in various formulations (e.g., Roundup® or Rodeo®). Glyphosate, applied properly, kills the underground as well as aboveground parts of reed. Glyphosate is more-or-less toxic to all vascular plants as well as mosses, thus valuable native species or rarities of conservation concern are at risk where they occur in and downwind or down-current of reedbeds being treated. Although glyphosate is reportedly inactivated by binding to soil particles, the toxicity of glyphosate to many common and rare wetland animals has not been investigated. Glyphosate was an endocrine disruptor in cultured mouse cells,[18] thus has the potential to cause reproductive disorders and other hormone-related problems in wild mammals and humans (see additional toxicology information in the *Phragmites Management Sourcebook*[9]). I have seen no data addressing the actual on-site toxicology of glyphosate where used in reed management projects. Because of water movement and the occurrence of many rare plants and animals in tidal wetlands, herbicide may be particularly hazardous there.

Instead of spraying, herbicides can be applied by cutting reed culms and wiping or dripping herbicide onto or into the culm stumps. I will refer to these techniques loosely as "clip-and-drip" to distinguish them from spray application. Clip-and-drip is labor-intensive and can only be used on small reedbeds or small patches of large reedbeds. This approach, however, can greatly reduce the potential to harm non-target organisms because less herbicide is lost into soil, water, or other organisms. Clip-and-drip may be suitable for situations where rare plants are intermingled with reeds. Caution is advised, however, due to reports of clip-and-drip damage to other plants during hot weather.

Burning, Cutting, Grazing

Cutting or burning common reed during the dormant season produces a temporary "short grass" habitat in spring that attracts migrant birds such as American woodcock and common nighthawk, and breeding birds including certain ducks and shorebirds. Fire also removes the abundant and persistent litter thus opening up space for other organisms and reducing soil build-up. Burning reed on organic soils when water levels are low in summer or during drought can burn off patches of soil and reed rhizomes, creating openings or pools in reedbeds. Frequent cutting reduces the vigor of reedbeds; two or more cuts annually during the growing season for several years may be required. Cut material should be removed from the beds if possible and either used or disposed of where it cannot root. Most livestock readily eat reed, especially the young shoots in spring. Grazing and trampling inhibit or even kill reedbeds but the grazing intensity must be designed to affect the reed without unwanted impacts to soil or other plants. Details on these and other management techniques and

information sources are cited in the *Phragmites Management Sourcebook*.[9] There are many opportunities for innovation and experiments to adapt reed management techniques to the goals and conditions of northeastern sites.

Classical Biocontrol: A Risky Solution

"Classical" biological control involves importing to the introduced range of a species those insects, fungi, or other organisms that seem to regulate an invasive species in its native range. In theory, many invasive plants become invasive in their introduced ranges because they escape these "natural enemies." These enemies can be identified, tested for their potential to harm nontarget plants (e.g., crop plants or rare native species), and released to control the invasive species; this process is intended to reduce the invasive to levels at which it is no longer a pest. Despite these pre-release precautions, however, imported natural enemies sometimes switch hosts and attack rare native plants or other nontarget species.[12]

Research and development are underway for classical biocontrol of reed in North America.[2] Unfortunately, imported natural enemies are unlikely to stay in a geographic region such as the Northeast, and will not limit their activities to undesirable reedbeds and leave valuable reedbeds alone. It is possible that natural enemies would be found that would attack only the Eurasian form of reed but it cannot be guaranteed that those organisms will not adapt to feeding on native forms of reed. Reedbeds in the northeastern states, many of which are the introduced form, often support rare and uncommon breeding or nonbreeding birds.[7,8] Elsewhere in North America reedbeds support other birds of conservation concern, including several species of nesting ducks in the Delta Marshes of Manitoba[19] and an endangered bird, the Belding's yellowthroat, in Baja California.[14] A common butterfly, the broad-winged skipper (*Poanes viator*), depends largely on reed in the Northeast, and an uncommon and local butterfly, the Yuma skipper (*Ochlodes yuma*), is absolutely dependent on reed in the West. No surveys for reed-dependent invertebrates have been conducted in the West (or on the Gulf Coast, México, etc.). The Seri in Sonora, México, formerly made 25 different products from reed which has a limited occurrence there,[3] and at least two Native American groups still use reed.[1,11] Reed biocontrol could also harm reedbeds constructed for nutrient removal or sludge dewatering in sewage treatment, where many small communities may be unable to afford other techniques.[13] There are treatment reedbeds in the Hudson Valley in Highland, New Paltz, and Tivoli.

AN APPROACH FOR DECISION-MAKING

The habitats and the surrounding landscapes of reedbeds vary greatly; if we are to manage reedbeds scientifically we have to learn to "read the reeds." To the careful observer, variations in the reedbed and its surroundings will suggest particular management strategies to attain particular goals. For example, if foraging habitat for certain ducks is desired, an extensive dense reedbed might be treated to create large shallow pools within the bed[5] or to reduce culm density.[19] If a small reedbed in a large tidal marsh is important to roosting songbirds, but extensive spread of reed is unwanted, ditches might be dug around the reedbed to contain vegetative extension, or the bed can be allowed to expand until contained by existing tidal creeks. If northern harrier nesting habitat is wanted, extensive reedbeds can be preserved, or moderate-size beds can be expanded, with protection from human intrusion. Impounded or tide-gated, formerly saline, tidal marshes where reed has displaced cordgrasses can be re-opened to saline tides. Prior to embarking on any reed management project, managers should predict the positive and negative ecological effects of the management, design the project to secure the greatest net benefit, and carefully monitor the results. Managers and researchers need a detailed and accurate reedbed taxonomy and language so that reedbed characteristics pertinent to management can be recognized and considered.

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Beaver lodge in common reed stand in a Hudson River freshwater tidal marsh.

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TABLE 1. Site-specific decision process for common reed (*Phragmites australis*) management.

STEP	INFORMATION NEEDED	INFORMATION SOURCE
1. Clarify management goals	Desired outcomes of management	Management plan or guidance, scientist opinions, public opinion
2. Observe environment	Soil, hydrology, vegetation, landscape; invasibility factors	Published information, extant data, new observations, new data collection
3. Determine status of reed population	Increasing, stable, or decreasing on site	Historic observations, ground or aerial photos, remnants in soil
4. Observe characteristics of reedbeds	Size, number, shape, proximity, interspersion, density, height, fertility, dominance or admixture (including woody plants) in bed interiors, admixture (including vines) in bed edges, internal waterways & clearings, grazing by muskrat, insects, or livestock, past & present management	Field observations (outside and within beds), etc.
5. Survey associated biota	Presence of other organisms including keystone, rare, economic, or amenity species	Field observations, etc. (skilled volunteer observers may be used)
6. Decide if scientific information supports the combination of goals, environment, and methods	Analysis of existing data on reed habitat functions and other ecosystem services	Literature and researchers analyzing data from research, natural history, and monitoring studies
7. Identify management options (techniques)	Techniques that may be used at site	Financial, regulatory (permits), ethical constraints, public relations, available skills, equipment, funding, nontarget risks
8. Select taxa and abiotic features to monitor, and design monitoring program	Data to assess outcomes specific to management goals, site character, and treatment types	Scientific advice often needed
9. Select and perform management treatments (supervised)	Permits, public announcements, signs, or other arrangements may be needed	
10. Monitor results of treatments	Before and after treatments; adequate sampling procedures	Original data collection and analysis
11. Adapt treatment program to achieve goals ("adaptive management")	Monitoring data	From #10
12. Perform maintenance as needed to sustain desired conditions (reedbed character or alternate community, associated biota)	Observations on managed area to determine status of desired character	Original observations and data collection
13. Disseminate monitoring data with information on goals, techniques, and outcomes		

Management of reedbeds for particular goals can be planned according to a logical process (Table 1). Goal-directed and effective site-specific management depends on clear articulation of goals, conditions, treatments, and outcomes. Interim and final results should be made readily available to practitioners and the public, so that others can learn from each management project. More detail on decision-making and techniques is in the *Phragmites Management Sourcebook*.[9]

PROSPECT FOR SENSIBLE REED MANAGEMENT

Introduced and invasive plants are almost everywhere; we cannot set the biogeographic clock back 500 years to a world where the only plant introductions were accomplished by indigenous peoples or migratory animals. We have to choose the "battles" that will yield the best results in biodiversity conservation and maintenance of ecosystem services and amenities, at an affordable cost in dollars and nontarget impacts. Reed is super-successful because it can tolerate human-altered environments with lowered water tables, increased fertility, and disturbed or contaminated soils. Some reed habitats are in environments that have been so severely degraded by urban or industrial activities that they will not support viable populations of non-invasive native plants such as cattail, cordgrass, or sedge. Some reed-invaded habitats can sustain restoration to native, non-reed vegetation, but many such projects will require expensive maintenance. At some sites, it may be possible to correct underlying ecological problems that have increased invasi-

bility—e.g., altered hydrology, nutrient loading, or population levels of herbivores—and potentially re-create an ecosystem and native plant community that will require minimal maintenance.

Because native forms of reed have been in North America for many thousands of years, both native forms and the similar introduced reed form should be "acceptable" habitat or food to many native organisms that have adapted to reed genetically or otherwise. Such adaptations are not guaranteed, but in some cases appear to be occurring: heron use of reedbeds for nesting is on the increase,[6] and broad-winged skipper is believed to have switched hosts from the declining wild-rice to reed.[16] Well-designed management can make reedbeds better habitat for organisms we wish to foster, and simultaneously conserve the capability of reedbeds to provide ecosystem services such as water quality maintenance and flood buffering. If processes and markets are developed for reed products (thatch, livestock bedding and fodder, biomass energy, industrial feedstocks, medicines, foods), reedbeds can be thinned or fragmented for habitat and the harvested material used. Impacts of harvesting on wetlands would need assessment. Some practitioners argue that non-native stands should be eradicated and native forms should be preserved. This might be beneficial in some areas. However, many thousands of hectares of introduced reed, e.g., in the New York City region, support mammals, birds, insects, human activities (e.g., birdwatching), and even plants that would not thrive otherwise (that is, where native plant communities cannnot tolerate the harsh urban conditions). Native reed may be less competitive than introduced reed,[15] thus native reedbeds may be more invasible by introduced reed or other invasive plants.

Are concepts of reed management applicable to other invasive plants? Recently established species should typically be eradicated from a site or region before they become abundant, but long-established and abundant introduced invasive plants and native invasives are better candidates for containment, alteration of stands to optimize impacts, or harvest. A containment, alteration, and harvest strategy should work for purple loosestrife or water-chestnut, with species-specific modifications, but may not be right for Japanese stilt-grass, garlic-mustard, or tree-of-heaven.

Hudsonia is always interested in learning about invasive plant management projects, successful or not. Please send your stories of successes or failures, and your observations of invasive plant interactions with other organisms. ■

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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.