

Cattle Grazing and Its Long-term Effects on Sedge Meadows

Most people think that wetlands are temporary, that they fill in by natural processes, and eventually become dry land. Some of these outdated ideas have come from the way that this subject has been covered in introductory textbooks in schools (Gibson, 1996). From these texts, we learned incorrectly that over time a lake fills with sediment or organic matter to become a wetland, which dries out to support shrubs and trees, and eventually it is no longer a wetland (Middleton, 1999; Middleton and others, 2004).

These old ideas of how vegetation changes (succession) are no longer accepted. Wetland succession should be thought of as a cycle, with natural disturbance driving the changes, depending

on the needs of the species. Succession is not something that changes a wetland into something that is not a wetland (Egler, 1978; van der Valk, 1981; Middleton and others, 1991; Klinger, 1996; Middleton, 1999).

As an example of how disturbance changes wetlands, I have studied sedge meadows that have become invaded by shrubs after cattle (*Bos* sp.) have grazed them, in the Lodi Marsh State Natural Area, Wisconsin. Cattle disturbances allowed shrubs to invade sedge meadows, but the cattle also grazed on the shrubs, which kept them small. After the cows were removed, the plant species changed in the sedge meadow from the original sedges (fig. 1), to sedges mixed with growing small shrubs,

Figure 1. Cattle damage sedge tussocks with their hooves and eat the sedges. Sedge tussocks, which are lumpy masses of roots and partially decomposed plant material, are broken partially when the massive animals step on them. Nonetheless, the tussocks are remarkably solid because they are composed of two types of roots, which track seasonal changes in water levels. Horizontal roots lie near the surface of the peat while vertical roots access moisture during the recession of groundwater in the summer. *Carex stricta* dominates tussocks and these sedges create an umbrella-like canopy about 1 m over the tussock. Other species either emerge from this canopy (e.g., joe-pye weed; *Eupatorium maculatum*) or cling to the sides of the tussock in the shade (e.g., clear weed, *Pilea fontana*; Middleton, 1978). Because tussocks are the basis of the ecosystem, the key to understanding long-term effects of grazing is to study how cattle affect the sedges (photo by Beth Middleton).



and eventually to tall shrubs with very small amounts of sedge, called “shrub carr” (Middleton, 2002a). Even though there has been a succession of plant types, the meadows, which began as wetlands, have remained wetlands. The settlers originally found the sedge meadows to be open “sedge” lands and not shrubby. The settlers cut the sedges by hand to feed the cattle. White-tailed deer (*Odocoileus virginianus*), though probably not bison (*Bison bison*), grazed these sedge meadows (Middleton 2002a).

Subsequent studies have explored methods to control invasive shrubs to restore the biodiversity of formerly grazed sedge meadows (Middleton, 2002b).

Shrub Invasion in Formerly Grazed Sedge Meadows

While it was once thought that the invasion of shrubs in sedge meadows was an automatic process, this long-term study showed that shrub invasion can be due to cattle grazing. Over this 20-year study, shrub dominance did not change in a sedge meadow that had never been grazed. However, in a formerly grazed sedge meadow, after 20 years, the site had become a shrub carr. The vegetation changes in the formerly grazed versus ungrazed site are a direct result of the disturbance of cattle grazing. Similar sweeping changes in vegetation following cattle grazing have been noted in world wetlands including sedge

meadows, fens, and salt marshes (Middleton 1999; Middleton 2002a).

In grazed sedge meadows, cows break tussocks with their hooves (fig. 1) and allow invasion sites for shrubs. Tussocks are masses of roots and peat shaped like a pedestal, typically 10-60 cm tall (fig. 1). At the same time, cattle browse shrub seedlings (*Cornus sericea*) so that these never get over a few inches in height. If cattle are removed from the sedge meadows, the shrub seedlings can grow to several meters (fig. 2). In the Lodi Marsh State Natural Area, sedge meadows were open sedge meadows during and for a few years after cattle grazing (fig. 3a), but 20 years later, shrubs dominated the sedge meadow and a shrub carr had formed (fig. 3b).

Cows change sedge meadows in subtle ways even while they graze. Pastures have large amounts of plant species that cows do not eat (for example, mountain mint, *Pycnanthemum virginianum* and thistle, *Cirsium vulgare*; Middleton, 2002a), and exotic species that may originate from hay that is fed to dairy cattle (for example, red clover, *Trifolium hybridum*; Mt. Pleasant and Schlather, 1994). While exotic species eventually disappear from the standing vegetation, they can remain in the seed bank for decades waiting to reinvade after the next disturbance, even though these species are never dominant (Middleton, 2002a).

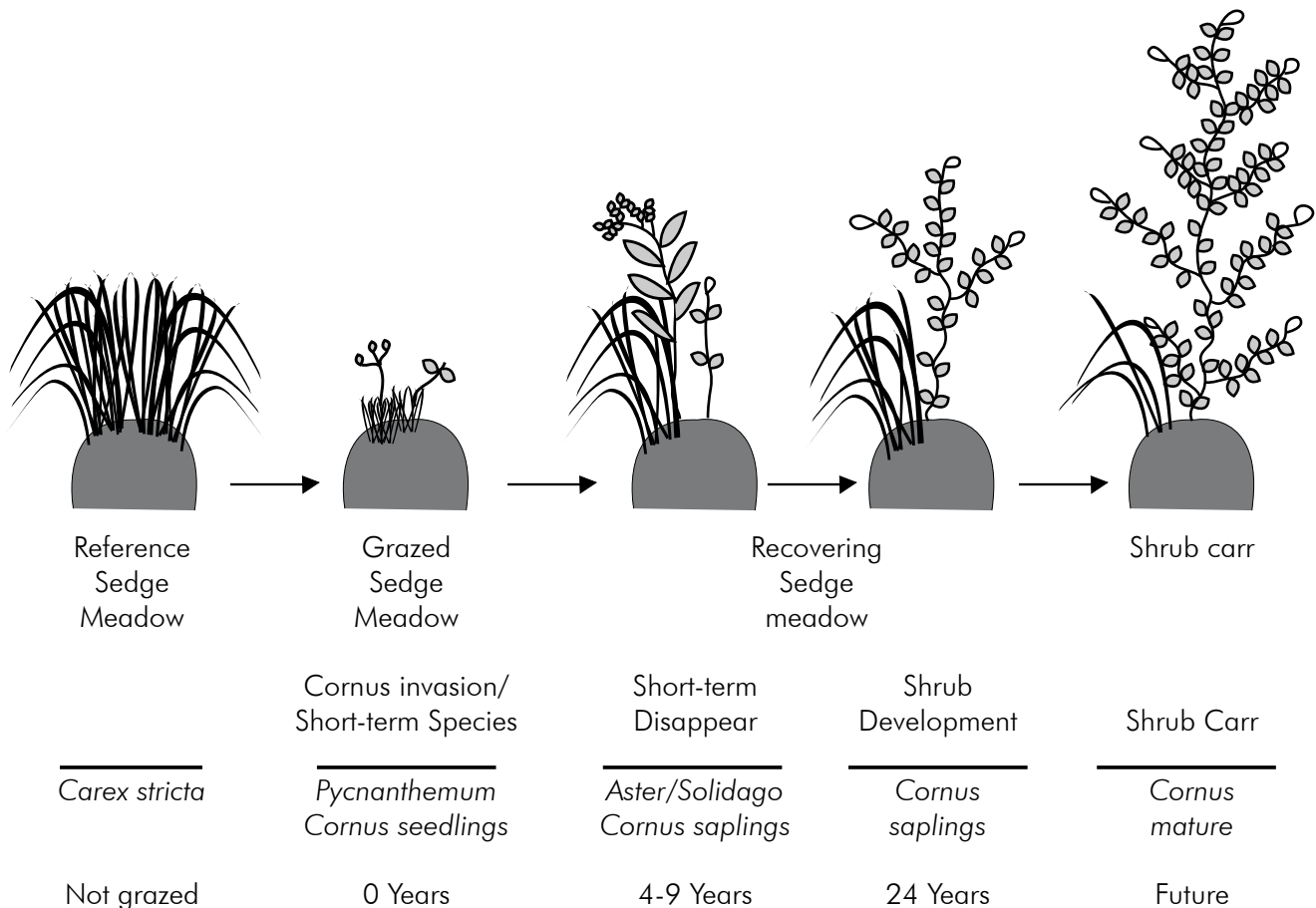


Figure 2. Tussocks damaged by cattle allow an invasion pathway for woody species such as red-osier dogwood (*Cornus sericea*). While cattle use the sedge meadow as a pasture, they continuously browse the dogwood, so that the sedge meadow appears unchanged (Middleton, 1978). Fifteen to twenty years after cattle grazing stops, the dogwood grows to several meters tall, so that the sedge meadow reverts to a shrub carr. The overall process is not an inevitable part of succession, but rather related to the disturbance of cattle grazing (Middleton, 2002 a, b; reprinted with kind permission of Kluwer Academic Publisher).



Figure 3a. Sedge meadow in 1978 shortly after cattle grazing stopped. Note the lack of shrubs.



Figure 3b. Sedge meadow in 2001, 24 years after cattle grazing stopped and shrubs invaded (Lodi Marsh State Natural Area: photo by Beth Middleton).

Winter Burning and Control of Invasive Shrubs

Researchers in both North America and Europe have explored restoration techniques to reduce shrubs and/or increase native biodiversity in formerly grazed wetlands. Shifts in vegetation have been startling in regions of the world where farmers no longer graze cattle or cut forage in wetlands with small hand tools (van der Valk and Verhoeven, 1988; Middleton and others, 1991; Jutila, 1997; Middleton, 2002a). The need for restoration can be great, particularly in situations where the wetlands have been seriously damaged from past grazing activities.

In Wisconsin, some formerly grazed sedge meadows have changed into shrub carrs of low biodiversity, and much of this land has reverted to public ownership. The Wisconsin Department of Natural Resources and the USGS National Wetlands Research Center are engaged in joint research projects to find better ways to restore sedge meadows that were damaged by cattle grazing several decades ago. In the Lodi Marsh State Natural Area, some of the techniques that require further study to control shrub dominance and increase biodiversity are seasonal burning, cutting, herbicide treatments, and selective reseeding of forbs (native flowering herbs).

Winter fire is an attractive management tool because it minimizes the danger of wildfire; however, it is an ineffective tool for reducing shrub dominance. Shrubs did not decrease with winter burning in either formerly grazed or ungrazed experimental plots in the Lodi Marsh State Natural Area. Unfortunately, burning increased the number of exotic species in the formerly grazed plots (Middleton, 2002b), demonstrating that seed banks have a long memory of past disturbances. Exotic plant species likely entered these wetlands decades ago in manure from cows that were fed hay in dairy barns (Middleton, 2002a).

Unlike the grazed site, the effects of winter burning in the ungrazed site were beneficial. Desirable forbs that had been absent from the vegetation for at least a decade flowered and set seed the following year. This flush of forbs lasted only for a year or two; however, the long-term result of winter fire may be that these species are retained as seeds in the seed bank, and this is valuable in preserving long-term biodiversity of these species. The forb species that disappeared from vegetation and then flourished after winter fire included marsh bellflower (*Campanula aparinoides*), turtlehead (*Chelone glabra*), marsh pea (*Lathyrus palustris*), gentian (*Gentiana puberulenta*), iris (*Iris virginica*) and Michigan lily (*Lilium michiganense*; fig. 4).



Figure 4. Winter burning stimulated the flowering and occurrence of desirable forbs in the ungrazed sedge meadow, including *Lilium michiganense*. The same burn treatment did not increase forbs in the formerly grazed sedge meadow, nor did it decrease the amount of dogwood (Middleton, 2002b). Further studies are exploring ways to restore the diversity of formerly grazed sedge meadows (photo by Beth Middleton).

Sedge dominance also increased after winter fire in both the formerly grazed and ungrazed sites (Middleton, 2002b). Damaged tussocks could benefit from sedge stimulation after fire.

Fire suppression and grazing in sedge meadows have gradually caused a loss of biodiversity of plant species. Without burning, ungrazed sedge meadows eventually lose biodiversity because of reduced flowering and growth (Bowles and others, 1996; Kost and DeSteven, 2000; Middleton, 2002b). Grazed sedge meadows lose biodiversity over time because these plant species do not grow in the shady conditions of the shrub carrs that develop after grazing stops. Over time, the seed banks of these flowering species may not survive in formerly grazed sedge meadows, so burning may not solve the problem (Middleton, 2002a). Further studies are exploring ways to restore the diversity of sedge meadows, but the restoration of grazed sedge meadows that have changed into shrub carrs will be difficult.

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