

CREATING HETEROGENEOUS TOPOGRAPHY TO RESTORE SEDE MEADOW DIVERSITY



Michelle Peach and volunteers created mounds in spring 2003.

Can heterogeneous topography enhance diversity?

Small-scale topographic heterogeneity seems to increase plant species richness and influence community composition (see leaflet 2 in this series). Theoretically, such variations in habitat characteristics as exposure to light, water inundation, litter accumulation, nutrient availability, and soil redox potential can provide habitat for the germination and survival of many species with different environmental requirements. In mesocosms, differences of 1–3 cm increased species richness relative to level substrate (Vivian-Smith 1997). In Wisconsin sedge meadows, Michelle Peach (2004) compared different microsites on tussocks formed by *Carex stricta*. Several species had preferences for either the top, sides, or areas adjacent to the tussock. Also, the tussocks increased species richness beyond that expected by increased surface area, suggesting that microsite diversity played a role in supporting more plant species (illustrated in leaflet 2). Thus, bumpy topography could enhance diversity in restoration projects (above figures).

We created mounds to test their ability to support more species.

To see if we could mimic the beneficial effects of sedge tussocks on species richness, we created mounds at a bare wetland restoration site, where a drainage ditch had been filled and the soil graded smooth. In spring 2003, Michelle Peach and several volunteers constructed more than 100 mounds of soil by hand and shovel in a recently filled drainage ditch at Pheasant Branch Conservancy near Madison, WI. Mounds initially averaged 0.5 m in height and 1.5 m in circumference and were arranged in 5 treatment blocks. Three seeding treatments were applied within each block: a “diverse” species mix, a “cover” mix, and an unseeded control treatment. The diverse mix included *Baptisia alba*, *Carex vulpinoidea*, *Desmodium canadense*, *Eryngium yuccifolium*, *Eupatorium maculatum*, *Monarda fistulosa*, *Rudbeckia subtomentosa*, *Scirpus atrovirens*, *Scirpus cyperinus*, *Spartina pectinata*, *Silphium perfoliatum*, *Silphium terebinthinaceum*, *Vernonia fasciculata*, *Verbena hastata*, and *Veronicastrum virginicum*. The cover mix included *Rudbeckia subtomentosa*, *Scirpus cyperinus*, *Spartina pectinata*, and *Verbena hastata*.

Quadrats with mounds recruited twice as many species as flat plots.

In August 2004, Hall (2004) randomly sampled the species present by placing 0.5 x 0.5 m plots around 30 unseeded mounds and 10 diverse-seeded mounds. For each mound, we also sampled an adjoining “flat” plot without a mound. Adding seeds did not affect species richness of either mound or flat plots, but reasons are unclear. Either seeds moved between treatments as water flowed, or the seed bank provided all the

Table 1. Species with topographic preferences. Data are number of plots (out of 35) in which each species was found.

Species that preferred plots with a mound	Plots with a mound	Flat plots
<i>Carex</i> sp.	12	3
<i>Epilobium coloratum</i>	11	2
<i>Eupatorium perfoliatum</i> *	20	11
<i>Silphium terebinthinaceum</i> *	16	2
<i>Solidago gigantea</i>	10	1
<i>Verbena hastata</i> *	17	6
<i>Cornus stolonifera</i>	17	5
<i>Populus deltoides</i>	35	26
<i>Salix bebbiana</i>	32	13
Species that preferred flat plots		
<i>Scirpus atrovirens</i>	27	35
<i>Lemna</i> sp.	8	15

* Sown

plants that established. The latter is more likely, given that most (9 of 15) of the species that were sown did not establish.

Combining data from both seeding treatments, mound plots averaged 13.1 species while flat plots averaged 8.3 species (Figure 2). For each pair of mound and flat plots, we calculated the difference in species richness. Overall, plots with mounds had from 3.6 to 6.0 more species than flat plots, with 95% confidence. Sampling different microsites (top, north side, south side) on the mounds with 0.1 x 0.1-m plots showed no effect of microsite location on species richness.

Many native species preferred plots with mounds.

Eleven species had topographic preferences, and all were native to Wisconsin (Figure 3). Three of them (*Scirpus atrovirens*, *Populus deltoides*, and *Salix bebbiana*) were present in more than 50% of all plots sampled. Nine species (1 graminoid, 5 forbs, and 3 shrubs; see Table 1) preferred mound over flat plots, as measured by a chi-squared goodness of fit test. Only two species preferred flat plots.

Because quadrats with mounds had greater surface area than flat quadrats, we cannot specifically attribute the increased species richness in mound quadrats to an increase in microhabitat types on mounds. However, the preference of many species for mounds even when taking into account the increased species richness found there suggests that mounds may provide beneficial environmental conditions not found in flat areas.

Moisture levels that vary from the top to the bottom of the mound could strongly influence the preference of species for mound plots, and



Figure 2, above left: View of the filled ditch with constructed mounds. Flags indicate those that were studied.

Figure 3, left: Flat plots favored a few marsh plants, while mounds supported many more.

Figure 4, above right: Close-up of constructed mound with graminoids on top and forbs on the side.

Figure 5, right: Mounds as short as a foot create a range of moisture conditions that favor different plant species.

Photos by S. Hall.

drier conditions may have allowed the establishment of species often found in non-inundated communities (Figure 4). For instance, *Cornus stolonifera* and *Salix bebbiana*, two shrubs that preferred mounds, are major dominants in shrub-carr communities. Shrub-carr communities form where sedge meadows are drained or accumulate enough peat to form mounds (Curtis, 1959).

Applications for restoration

Three species that preferred plots with mounds are desirable restoration species because of their high fidelity to pre-settlement native plant communities according to the Wisconsin “coefficient of conservatism” index (UW–Madison Herbarium 2004). These were *Eupatorium perfoliatum*, *Silphium terebinthinaceum* and *Salix bebbiana*.

Creating topographic heterogeneity using soil mounds could prove a cost-effective method for establishing a diversity of plants in wetland restorations, especially for species that cannot tolerate extended inundation and for species with varying germination and establishment requirements. Further tests of the role of topographic heterogeneity and seeding treatments in restoring biodiversity could be accomplished at the Arboretum, for example, where soil will be graded to repair Pond 4 in Southeast Marsh. We suggest varying the topography in different ways (e.g., rough surfaces as well as mounds), testing the effect of mound size (e.g., comparing mounds of 30, 50 and 70 cm tall), and developing new ways to create mounds.

References

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