Seed Bank Dynamics of an Urban Retention Wetland

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Abstract

Few studies compare the characteristics of seed banks and standing vegetation of urban wetlands, yet this information may have important implications for management practices. The seed bank of a constructed retention wetland located on the Binghamton University campus (Vestal, NY, USA; 0.15 ha) was examined to determine its potential use to revegetate the wetland in the future. We then compared the seed bank and standing vegetation. We found that the species richness of the seed bank does not vary across the wetland, and that the similarity between the seed bank and standing vegetation is relatively low at the site scale, but variable at the plot level. The seed bank has a very low percentage of identifiable invasive species, suggesting that the seed bank should be used as donor soil to revegetate the wetland.

Introduction

Providing wetland "donor" sediment harboring seed banks may be an effective alternative to planting for the revegetation of created or restored wetlands. While the use of seed banks in some natural wetlands has led to successful restoration, donor sediment from urban wetlands may not have the same potential, or may contain undesirable species (e.g., invasive species).

Lake Lieberman is an urban retention wetland located on the Binghamton University campus in upstate New York. The site is currently undergoing reconstruction to accommodate a greater volume of runoff. This study examines the potential of the Lake Lieberman seed bank to revegetate the wetland without promoting the dominance of invasive species present in the area.

Several processes may influence the dynamics of seed banks (Fig. 1; also see Middleton 1999), and result in patchy seed distributions of importance to the restoration ecologist. We examined patterns of spatial variation in the Lake Lieberman seed bank to test the following hypotheses:

1. The species richness in the seed bank and number of seeds declines with increasing distance from the influent stream. If so, this would suggest that the stream is an important source of seeds.

2. The similarity between the seed bank and the standing vegetation is greater at the plot scale than for the wetland as a whole. If so, this would suggest that localized *in situ* seed dispersal helps account for patchiness.

3. An additional objective was to test for the relative abundance of invasive species in the seed bank. If high, this could be a drawback to the use of seed banks.

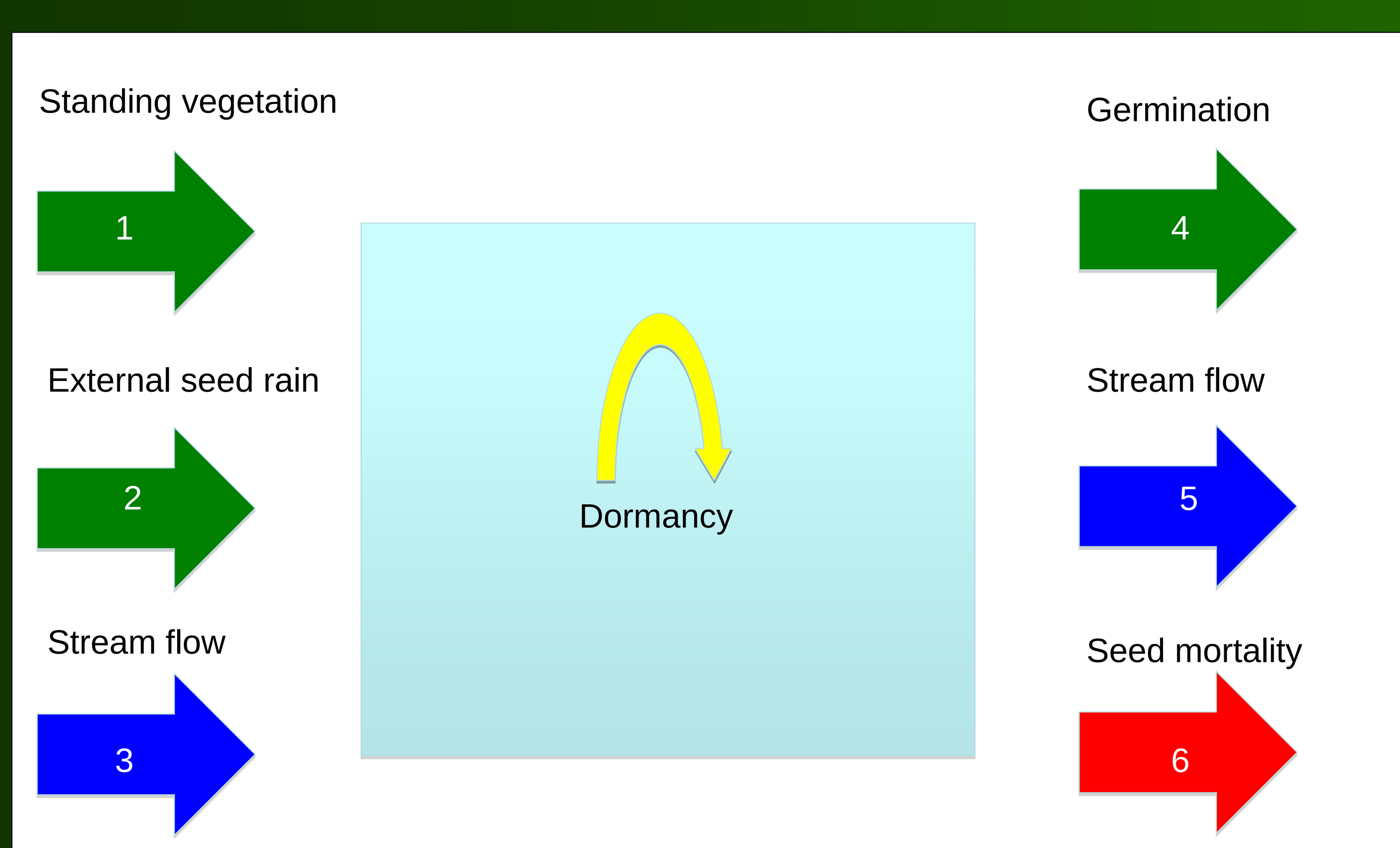

Figure 1: "Seed banks: gains and losses." Seed banks accumulate with deposition from *in situ* vegetation (1) and from afar (arrows 2 & 3), and are depleted by germination (4), erosion (5), and mortality (6).

Figure 2: Map of Lake Lieberman wetland on Binghamton University campus (altered from Google Image, 2009).

Methods

Seed Bank Collection

We collected soil cores (15.2 cm diameter, 5 cm depth) in May 2011 from five 1 m^2 quadrats on each of three equally spaced transects perpendicular to the main axis of the wetland (Fig. 2). The sediment cores were homogenized and evenly spread about 1 cm thick on top of sterilized sand, and placed in tanks in our Research Greenhouse. There were two treatments for each core: flooded and draw-down. We collected data on seedling community composition to the species level when possible for eight months.

Vegetation Sampling and Analysis

Vegetation was sampled in the same 1 m^2 quadrats in June 2011. Percent cover was recorded for each taxon to the nearest 5%. We used Sørenson's similarity index to compare (1) the flora of the seed bank between transects, and (2) the seed bank vs. the standing vegetation at two spatial scales.

Results

Objective 1: Species richness of the seed bank across the wetland:

Species richness:
- T1: 30 species
- T2: 32 species
- T3: 30 species

Sørenson's similarity index between transects:
- T1 and T2: 0.706
- T1 and T3: 0.736
- T2 and T3: 0.789

Number of seedlings:
- T1: 3268 seedlings
- T2: 4178 seedlings
- T3: 3548 seedlings

Objective 2: Seed Bank and Standing Vegetation Comparison:

Sørenson's similarity index
- Site scale- 0.317
- Plot scale: Range: 0 - 0.533, Mean: 0.235

Plots with low similarity indices were often dominated by *Typha* spp.

Objective 3: Presence of invasive species

Table 1: Percent of native vs. nonnative species in the standing vegetation (based on relative percent cover) and in the seed bank (based on relative density).

	Standing vegetation	Seed Bank
Total number of species	24	57
Relative importance of native species (%)	72.2	95.1
Relative importance of nonnative species (%)	27.8	4.9

Conclusions

1. Species richness in the seed bank is quite similar across the wetland. Also, a majority of the species found in the seed bank across the wetland are the same. In addition, the number of seedlings from the seed bank does not decrease. Stream flow may not be an important source of seeds, or at least the seeds are equally deposited along the wetland.

2. At the site-scale, the similarity between the seed bank and the standing vegetation is relatively low (0.317), but varies greatly at the plot scale. Clearly, processes other than simply seed rain from the standing vegetation shape seed bank composition.

3. As the relative percent cover of *Typha* spp. in the standing vegetation increases, the similarity between the seed bank and the standing vegetation decreases.

4. The proportion of native species emergent from the seed bank is far higher than in the standing vegetation, while the proportion of invasive species is much lower. We conclude that the donor sediment from Lake Lieberman has promise for revegetating the wetland.

Reference

Middleton, B. Wetland Restoration: Flood Pulsing and Disturbance Dynamics. 1999. John Wiley & Sons, Inc. New York, NY, USA

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