Ecological restoration of a minerotrophic peatland in Canada

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Introduction

Restoration methods for Sphagnum-dominated peatlands have been successfully developed (Rochefort et al. 2003); however, in practice, peat extraction can lead to the exposure of the underlying minerotrophic peat and mineral deposits. As these sites are richer in minerals and less acidic than the pre-existing bogs (Wind-Mulder et al. 1996), the restoration efforts should focus toward minerotrophic peatlands (fen).

Because of different historical land uses and restoration goals, much of the European fen restoration research is not directly transferable to North America. Until now, we mostly worked at the plot scale on fen restoration in North America (Cooper & MacDonald 2000; Cobbaert et al. 2004, Graf et al. 2008). Therefore, we still ignore which techniques are suitable to re-establish natural fen conditions at the ecosystem level.

To get some answers, a brand new project was initiated in 2008 to restore the primary carbon accumulating function of a minerotrophic peatland after peat extraction. A multidisciplinary team of researchers from the Peatland Ecology Research Group (PERG) of Canada is studying the ecology of target plant assemblages to be reintroduced, the hydrology of the cutover peatland and diverse techniques for successful establishment of key peat accumulating species.

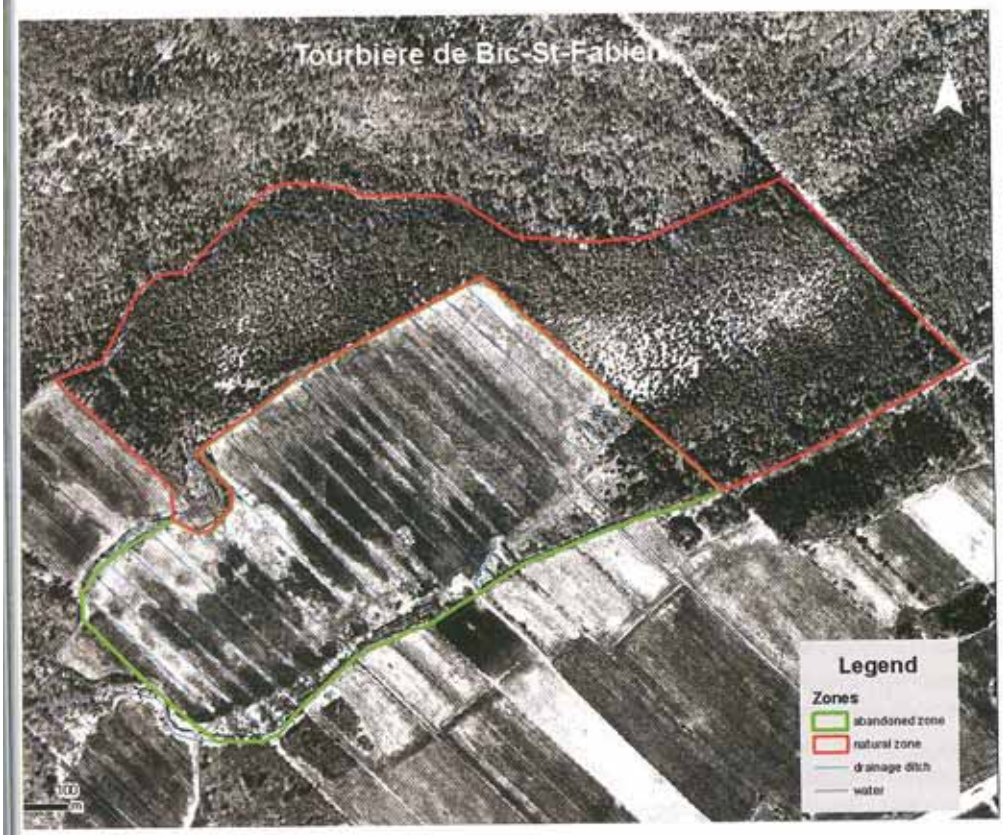

Figure 1. The Bic Saint-Fabien peatland, Québec, Canada.

The site is located at the Bic-Saint-Fabien peatland in eastern Québec, Canada (Figure 1). This site has been used for the extraction of horticultural peat since 1946, but the work has ceased in recent decades.

The ecological work follows a framework for restoration projects inspired by assembly rule approach (Figure 2), which is a helpful tool in restoration ecology. Indeed, if the constraints of a system are defined, restoration efforts can focus on manipulating these constraints to steer succession towards the desired community (Temperton et al. 2004).

Determining the reference ecosystem

In 2008, the first objectives of the project were to define the reference ecosystem and to identify the plant assemblages that should be reintroduced to form the new pool community (see Figure 2c). A paleoecological study and historical documents helped to understand the dynamic of the system through time. Vegetation surveys of surrounding regional fens (Figure 2b) were also used to estimate the range of variation in plant communities.

Vegetation surveys in the abandoned peatland

Other tools were utilised to define the spontaneous species pools (Figure 2a). To test the relationships between various community structures and the prevailing abiotic conditions, vegetation relevés and

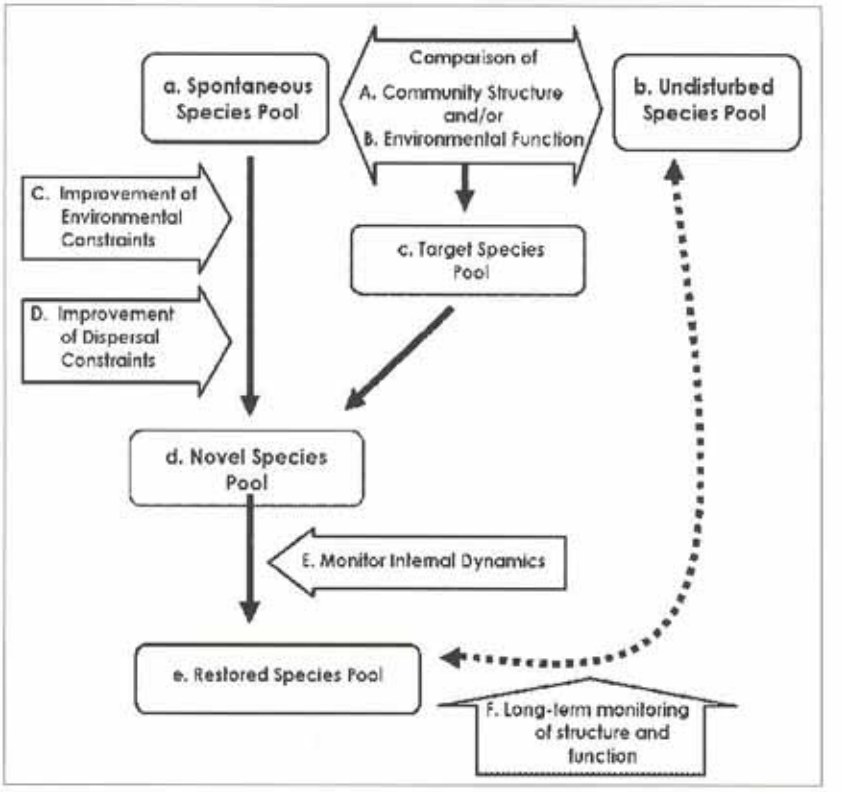

Figure 2 a-f. Framework of the research program to gain knowledge on the restoration of fens and wet meadows. The rectangles represent "species pools" which are pertinent for restoration. Open arrows represent active measures which should be explored to develop strategies for restoring a degraded system. Solid arrows represent the direction of the "species pool" development during restoration and the dashed arrow represents similarity between "species pools" (Graf 2008).

peat and water physico-chemistry samplings were made within a systematic sampling design.

Carbon cycling of abandoned peatland ecosystem

Other objectives of the project were to establish the net carbon fluxes (CO_2 and CH_4) of different plant communities growing in the abandoned area (Figure 3) in comparison to the natural area (Figure 4), and to determine the potential for peat accumulation of several spontaneously recolonised plant communities. Closed chambers were installed in the field to measure carbon fluxes. This data will continue to be recorded during the following years.

Hydrological assessment of post-harvested minerotrophic peatland

To characterise water inflows and outflows of the disturbed peatland, and to improve the hydrological major constraint (Figure 2c), an ecosystemic approach for rewetting was designed. A meteorological station, piezometer nests, water wells, lysimeters, a tensiometer, and a potentiometer will be used to collect data.

Trials of restoration techniques

During 2009, we will have begun the reintroduction of a target species pool (Figure 2c) and the restoration of the fen's hydrological conditions (by rewetting). We will try to reintroduce the vegetation by hay transfer and moss layer transfer techniques. The creation of pools is scheduled as well.

Success monitoring

During the coming years, we will have to monitor the internal dynamics between the reintroduced species (Figure 2e) to ensure that the target species can persist on the restoration site. We will also check if the ecosystem functions tend towards the reference ecosystem.

Figure 3a. The west side of the abandonned area is wetter and well re-vegetated. The peat depth varies between 1.6 to 3.5 m.

These objectives will be achieved by vegetation and macrofauna surveys, microbiological assays, productivity assessments, water balance and carbon cycle measures.

Conclusion

This is a first attempt of fen restoration at the whole-ecosystem level in eastern Canada. We hope to develop suitable techniques to re-establish natural conditions of a carbon accumulating fen.

Acknowledgements

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References

Cobbaert, D., L. Rochefort & J. S. Price. (2004). App Veg Sc 7: 209-220.

Cooper, D. & L. MacDonald. (2000). Restoration Ecology 8:103-111.

Graf, M., L. (2008) Thesis (Ph.D.), FSAA, Université Laval, Québec.

Graf, M., L. Rochefort & M. Poulin. (2008). Wetlands 28(2): 28-39.

Rochefort, L., F. Quinty, S. Campeau, K. W. Johnson & T. J. Malterer. 2003. Wetlands Ecology and Management 11: 3-20.

Temperton, V. M., R. J. Hobbs, T. Nuttle, M. Fattorini & S. Halle. 2004. Pages 1-8 in Temperton, V. M., R. J. Hobbs, T. Nuttle, M. Fattorini & S. Halle (eds.). Island Press, Washington, DC, USA.

Wind-Mulder, H. L., L. Rochefort & D. H. Vitt. 1996. Ecol. Eng, 7: 161-181.

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Figure 3b: The the east side of the abandonned peatland is drier and still shows bare peat.

Figure 4. left (a) Open moderately-rich fen that has never been mined but is still under the influence of the former drainage system. It may be used as a reference system. Peat thickness averages 5 m. It is the habitat of several rare plants like, above (b) *Amerorchis rotundifolia*, (c) *Arethusa bulbosa*, (d) *Cypripedium reginae* and (e) *Valeriana uliginosa*. The moss layer is composed of (f) *Tomenthypnum nitens*, (g) *Sphagnum warnstorfii* and (h) a mixed community of *Scorpidium cossonii* and *Campylium stellatum*.