FIELD EXPERIMENT OF SPHAGNUM REINTRODUCTION ON A DRY ABANDONED PEATLAND IN EASTERN CANADA

Jean-Luc Bugnon1, Line Rochefort1,3 and Jonathan S. Price2
1 Université Laval
Centre d’Études Nordiques and
Département de Phytologie
Faculté des Sciences de l’Agriculture et de l’Alimentation
Ste-Foy, Québec, Canada G1K 7P4
E-mail: Line.Rochefort@plg.ulaval.ca

2 University of Waterloo
Department of Geography
Wetlands Research Center
Waterloo, Ontario Canada N2L 3G1

3 Author to whom correspondence should be addressed.

Abstract: Early attempts at peatland restoration have been aimed mostly at rewetting the peat, which alone has proven inadequate to ensure good regeneration of Sphagnum mosses. Sphagnum mosses can be actively reintroduced by scattering Sphagnum fragments (diaspores) on bare peat surfaces and by sheltering them against desiccation. The present study aims at refining the restoration techniques to reintroduce Sphagnum where the surface conditions of cutover peatlands are too harsh for natural Sphagnum establishment. The objective is to increase local moisture conditions of the peat by reprofiling the surface to invert the camber created during drainage operations. Sphagnum diaspores were spread in the concavity. Reprofiling fields increased Sphagnum establishment compared to control sites. The addition of two plastic sheets on the edge of the field reduced evaporation and directed precipitation towards the middle of the field. When they were combined with reprofiling, there was a further increase in the establishment success of Sphagnum.

Key Words: reprofiling, restoration techniques, rewetting, Sphagnum establishment, water management

INTRODUCTION

The natural revegetation of abandoned peatlands does not have the attributes of natural bog vegetation and sometimes does not occur at all (Salonen 1987, Famous et al. 1991, Lavoie and Rochefort 1996). Natural revegetation of Sphagnum, the dominant peat-forming vegetation in bogs, has rarely been observed in rewetted bogs (Poschlod 1992) due to persistantly harsh hydrologic and microclimatic conditions (Price 1996). Early attempts at peatland restoration have focused on restoring the wet conditions typical of undisturbed peatlands by damming the drainage ditches, building embankments, and creating water reservoirs (Nick 1984, Eggelssmann 1988, Schouwenaars 1988, Meade 1992, Roderfeld 1993, Wheeler and Shaw 1995, LaRose et al. 1997). Until recently, peatland restoration has relied mostly on active water management practices but little on plant reintroduction (Wheeler and Shaw 1995). As natural regeneration of the moss layer in peat-harvested sites does not occur readily (at least in the time range of 25 years; Famous et al. 1991), attempts to actively reintroduce Sphagnum are warranted. Sphagna have a great power of regeneration and are able to reproduce vegetatively from almost any distinct part of the plant (including leaf, branch, and stem fragments; Poschlod and Pfadenhauer 1989, Rochefort et al. 1995). Subsequent studies demonstrated that a moss cover can be re-established by scattering such Sphagnum parts (diaspores) onto a peat surface (Rochefort and Campeau 1997). However, moss establishment is significantly better if a protective cover, such as a straw mulch, is applied on top of the diaspores (Quinty and Rochefort 1997, Rochefort and Campeau 1997). Alternatively, Sphagnum establishment success can also be improved by reintroducing Sphagna in association with shelter plants (Ferland and Rochefort 1997). These methods of plant reintroduction reduce evaporation from Sphagnum diaspores and
the peat substrate and result in more favorable, humid, growing conditions at the air-peat interface (J.Price pers. com.). In a similar way, irrigation systems have been tested to increase humidity at the diaspore level (Rochefort and Bastien 1998). Irrigation favored Sphagnum establishment but to a lesser extent than the two previous methods. The impact of water droplets on the peat substrate displaced and/or buried the newly introduced Sphagnum diaspores.

Generally, Sphagnum regeneration/restoration success is related to the depth of the water table below the peat surface (Money 1995, Rochefort et al. 1995, Rochefort and Bastien 1998, Campeau and Rochefort 1996). Schouwenaars (1988) suggested that the water table should be no more than 40 cm below the peat surface if good Sphagnum regeneration is to be attained. However, Price (1996) indicated that soil moisture and soil tension conditions are more relevant for Sphagnum establishment than the water-table position. This is partly confirmed by Quinty and Rochefort (1997), who succeeded in re-establishing a Sphagnum cover when the water table fluctuated between −50 and −70 cm over several summers. Success here was attributed to the presence of a mulch that increased surface soil moisture. The long-term viability of the newly formed moss layer, however, remains to be seen for time spans greater than four years.

In this study, we attempted to reintroduce common peat-accumulating Sphagnum species on a very dry abandoned peatland where former drainage ditches had been filled three years before the experiment. Given that the only input of water to a bog is by direct precipitation, we needed to find ways to concentrate the rain water into local zones where Sphagnum diaspores could be reintroduced. In the peat industry, particularly when peat is harvested by the vacuum technique, the fields are shaped in a convex cross-sectional form to promote drainage toward the ditches. We hypothesized that if the convex form was inverted to produce a V shape, like a funnel, the peat substrate in the center of the field would be at a lower elevation with respect to the water table and would become relatively more humid than the surrounding areas. Furthermore, higher humidity of the peat substrate in the middle of the field could be attained if evaporation from the peat was reduced. This reduction can be achieved by adding an evaporation barrier (plastic sheets) on the elevated sections on the V shapes reprofiled fields. Additionally, this design will concentrate runoff from the plastic sheets toward the middle of the field.

METHODS

Study Site

The experiment was conducted at the St-Modeste peatland near Rivière-du-Loup, Québec, Canada (48°51'42"N, 69°27'12"W). Mean January and July temperatures are −12.1°C and 17.8°C, respectively, with mean total annual precipitation of 924 mm, of which 672 mm fall as rain (Environment Canada 1993). The peatland is located in the low boreal wetland zone and can be classified as a raised bog (NWWG 1987). The site was harvested for horticultural peat moss by the vacuum harvesting technique. An area of 16 fields (30-m wide by 350-m long) were exploited for approximately 25 years and then abandoned in 1987. The thickness of the residual organic layer is over 1 m deep. Drainage ditches were filled in 1992. Eight years after harvesting operations ceased, the vegetation cover is still very poor. Bare peat has been colonized only by a few shrubs (Vaccinium sp., Kalmia angustifolia L., Chamaedaphne calyculata (L.) Moench) and a few Betula alleghaniensis Britton and B. papyrifera Marsh., which together represent less than a 1% cover over the total abandoned area.

Rewetting Strategy

To create a peat substrate with better local moisture conditions, the exploited fields were re-shaped with a bulldozer to invert the cambered form into a wide V shape. After reprofiling the fields, the height difference from the edge to the middle of the field was approximately 1 m, representing a local slope of 0.03%. A second treatment consisted of adding a polyethylene sheet 10-m long and 5-m wide, on each external edge of the V, parallel to the ditch relics. Each treatment was compared to a control site that was only flattened to reproduce the effect of the bulldozer passage (Figure 1).