

RESTORATION PEATLANDS AFTER WHITE PEAT SELECTIVE EXCAVATION

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SUMMARY

This pilot project developed on cutaway bog on one of the Ecology Peat Centre production complexes in Russia, from which peat was harvested for environmental purposes. This paper provides an overview of the current research specifically aimed at the regeneration of cut-over bog through revegetation with appropriate *Sphagnum* species. The aim of this small scale experiment is to assess the peatland can be restored by natural colonization of *Sphagnum* mosses. Preliminary results indicate that plant establishment at the cutover peatland by natural colonization only is relatively fast.

KEYWORDS: harvesting, cutaway peatland, restoration, monitoring of success

INTRODUCTION

A raised bog in its mature state is defined on two levels: a) its location and appearance in the landscape, b) its species composition. *Sphagnum* species are well suited to this environment and continue to dominate in a self-perpetuating system (McQueen, 1990). This paper explores issues dealing with the feasibility of restoration of a bog utilized for 'raw peat' production. The product is a raw peat excavated for peat filters production (Mikhailov *et al.*, 2000) and the production capacity at the bog site is 1500 m³/season.

The method of extraction of the raw peat is 'Lagoons Cutting' - a method of peat extraction carried out by specialized machinery that cuts peat from trenches and puts it into a tractor and semitrailer for transporting. In this method the surface layer (less decomposed 'white' peat layer) is removed to a depth of approximately 0.5 m. This method is used primarily in shallow peat deposits and small bogs and essentially the acrotelm peat to a depth of 0.5 m is removed. The depth of excavation, in particular, the depth of white peat remaining at the bottom of the bog after extraction is completed, has been shown to be critical to the restoration process (Roderfeld, 1993). Immediately following peat extraction the peat surface is bare and re-colonisation is generally slow due to lack of nearby seed source.

While attempting to return a site to its immediate previous state is the most desirable approach, in considering the restoration of damaged sites, it has been argued that it must be realized and accepted that returning a site to a somewhat earlier developmental stage is all that in some cases can be practically and economically achieved (Wheeler, 1995). The aim of this work is to assess the restoration potential of these raw peat excavation sites and inform how to reduce the overall. Assessing the feasibility of which approach to take depends on the degree of damage to the site's hydrology, and residual propagule material. These issues are site dependent and must be evaluated on that basis.

MATERIALS AND METHODS

The bog site is located 80-km southwest of Novgorod city (58°08'15,89" N, 30°14'24,20" E). The site is a natural bog with *Sphagnum* peat; Peat thickness is 2.0 m. and degree of decomposition (von Post scale) is H1-H2. Climate is damp, moderate-continental with an average yearly precipitation of 700 mm, 210 mm of which falls as snow. Average January temperature is 8 °C and average July temperature is 17 °C. The vegetative period is 175 days. The bog is located in a wood zone (southern taiga and mixed forests). Mostly the water depth averaged from 0.4 m to 0.6 m below the peat surface.

The study site is a cut-over bog of 0.4 ha. The restoration approach was to allow natural colonization to occur on site. Peat excavation was conducted using a systematic grid (lagoons) of approximately (2 m × 2 m) with depth of excavation – 0.5 m. Permanent quadrats have been established and have been surveying every year since 2009.

Post peat cutting, best practice is to block the lagoons by peripheral berms. The width of berms between lagoons is 0.5 m which is sufficient in our opinion for the subsequent restoration of vegetation across the site. Berms can play many roles in peat bog restoration; their main purpose is to limit water movement and to keep water as long as possible on the site rather than retaining large masses of water. The lagoons can be likened to a chessboard or small basins which improve conditions for plant establishment (Quinty and Rochefort, 2003).

A total of 23 permanent plots were installed at the site in the restored zone (Fig. 1). Each plot is measured as 2 by 2 m. Vegetation cover in the plots was derived from mean vegetated cover in the sub-plots. Permanent plots were surveyed every year since 2009.

RESULTS

Damage assessment

The first step in the restoration process is the assessment of the extent of damage to the hydrology, topography and vegetation of a site. The damage was not severe (i.e. excavation was fairly shallow) and it was therefore considered that it may be possible to repair the area. For those sites which are not extensively damaged, revegetation rates can be impressive.

Site Hydrology. –The peat excavation process resulted in a reduction of the level of the peat surface and the formation of lagoons. Water is the single most important factor in the raised bog environment playing a critical role in its formation (Heathwaite *et al*, 1993).

Acrotelm

The functions of the acrotelm play an essential role in the restoration process. Therefore, the extent of peat mining has a significant impact on the potential for restoration success in any site. The requirements of the white peat acrotelm to be present can be met when the top spit is protected from decomposition by maintaining its moisture content and by returning it to the bog surface to a depth of at least 30 cm (Roderfeld, 1993).

Re-establishing Appropriate Bog Vegetation

Restoration of an ombrogenous raised bog cannot be considered successful unless a *Sphagnum* based plant community is re-established on the site. The importance of the acrotelm regarding water management has been demonstrated as having the benefits of surface topography manipulation to create micro environments appropriate for *Sphagnum* establishment. An immediate source of propagule material, both vegetative and in the seed/spore bank, is an obvious advantage. Under such favorable conditions, the rate of revegetation can be impressive, with pioneer vegetation cover, including *Sphagnum* species, quickly achieved (Wheeler, 1995; Joosten, 1995). Vegetation establishment was relatively fast on the study site and conditions have been relatively stable up to 2010. The establishment of *Sphagnum* diaspores by natural colonization has been remarkable. *Sphagnum* cover in the cut-over zone reached a maximum of 30% two years after restoration. The *Sphagnum* cover is steadily expanding and is up to 45% to 60% in places. The cover of *Sphagnum* was essentially dominated by *Sphagnum magellanicum* which represented nearly three-quarters of the total cover. *Sphagnum balticum* was the second most abundant species with 10% and 40% of the *Sphagnum* cover.

Cover of ericaceous species has steadily increased in the restored area over the three years of monitoring (from 15% to 35%) with a clear dominance of *Chamaedaphne calyculata* (L.) Moench noted and *Vaccinium oxycoccos* L., *Andromeda polifolia* and *Ledum palustre* L. The cover of the herbaceous layer, including species of grasses, sedges was greater in the restored zone compared to the regional reference ecosystems. This abundance is mostly driven by the flourishing development of *Caltha palustris* up to three years post-restoration. Trees and shrubs are still lagging behind in their development. It should be noted that the obtained results are preliminary because of the short period of monitoring so far. No biomass measurements have been taken yet. However, it has been found that the complete recovery of mosses on separate kinds of peat is observed in general in 5-6 years (Prjanishnikov, 1954).



Fig. 1a – natural bog before excavation



Fig. 1b – after excavation (June 2009)



Fig. 1c – revegetation process (August 2009)



Fig. 1d – revegetation process (May 2010)



Fig. 1e – revegetation process (August 2011)

CONCLUSION

Plant establishment by natural colonization at the restored peatland was relatively fast and complete plant cover was restored after 3 years. Most species colonizing the restored areas were typical peatland species. Herbs quickly invaded restored sites but their cover decreased with

time. Although moss establishment was quite variable between the restored areas, *Sphagnum* mosses were **domain**. Conclusions will be more exact in a few years, when species interactions and flora composition are more stable and the production of seedlings, biomass and species cover will be measured. Nevertheless, even preliminary results show that there is a good chance for the degraded peatland to be restored by selective peat excavation followed by natural **colonization**. The restoration procedure should drive this mined peatland towards a functional and 'typical' peatland ecosystem. Thus, on the majority of moss bogs of wood zone it is possible to carry out small scale extraction of upper peat layers without serious damage to the peatland ecosystem.

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