NATURAL REVEGETATION OF AN ALBERTA PEATLAND AFTER HORTICULTURAL PEAT EXTRACTION

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INTRODUCTION

Natural revegetation of peatlands after horticultural peat extraction, which hasn't been previously documented in Alberta, is described herein in relation to feasibility as a reclamation option. A peatland of several hundred hectares, located 100 km west of Edmonton, Alberta, was harvested and then abandoned in several stages between 1970 and 1980. No reclamation was initiated and the drainage network was left partially functional. The cutover bog is characterized by a variety of site types with differences in peat thickness, water table regime, peat botanical composition, peat chemistry and topography, and it has since been colonized by differing vegetation associations.

Colonization of abandoned, cutover bogs has been described elsewhere (Elling and Knight 1984; Famous et al., 1991; Jonsson-Ninniss and Middleton 1991; Salonen and Setala 1992), and research is underway at the University of Alberta and at Laval University to establish *Sphagnum* and other native peatland species. Knowledge of critical site environmental parameters will help land managers anticipate the direction of revegetation and evaluate feasibility of natural revegetation as a reclamation option. A two year study was initiated in 1994 to investigate the ecosite characteristics of five site types approximately 14 years after abandonment.

METHODOLOGY

Preliminary ecosite mapping and soil and water chemistry data for this project was available from a broader reclamation project involving development of a protocol for soil inventory of cutover peatlands (Turchenek et al. 1993). Five site types were selected, subjectively based on observable differences in vegetation composition. Four replicate plots of each site type were established.

Each 25 m^2 plot was centered on a capped, slotted, 5 cm I.D. groundwater monitoring tube. Water table levels were measured bi-monthly from May to October in 1994 and 1995. Vegetation species were identified and percent cover for each species was estimated. Soils were sampled with a MacCauley corer at 1-10 cm and 10-25 cm intervals from 10 sample points within each plot and then composited for analysis. Soils were analyzed for pH, weak acid extractable Ca, Mg, K, and P, and for KCl extractable NO_3 and NH_4. The degree of decomposition was estimated using the von Post index and rubbed fibre measurements, bulk density was determined by volumetric sampling, and botanical composition was estimated visually.

RESULTS

Vegetation

An adjacent undisturbed site was characterized by typical bog species (*Picea mariana/Ledum groenlandicum/ Sphagnum spp.* site type) . The site is dominated by hummock-forming *Sphagnum spp.* and *Ledum groenlandicum* accompanied by several lichen species and an open overstory of stunted *Picea mariana*. Few other non-*Sphagnum* mosses or sedges were present and brown mosses were absent.

The five study site types were designated as: i) barren peat, ii) *Betula/Eriophorum*, iii) *Eriophorum*/moss, iv) *Betula/Ledum/Polytrichum*, and v) *Carex*/moss. A component of bare peat was present in all disturbed sites, ranging from a mean low of 2% in the *Carex*/moss site type to 100% in the barren peat site type. Species numbers ranged from 9 to 23 in the replicate plots while the undisturbed site had a similarly low number of 20 species. However, the disturbed sites differed considerably from the undisturbed site in species composition. For example, *Picea mariana* and *Smilacina trifolia* had not yet become established on any disturbed sites and the variety of

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lichens was less on any given plot. *Sphagnum* spp. mosses were neither widespread nor present in the same percentage as in the undisturbed site.

Sphagnum spp. and brown mosses were nearly absent from the relatively dry *Betula/Eriophorum* and *Betula/ Ledum/Polytrichum* sites. The relatively wetter *Carex*/moss and *Eriophorum*/moss site types were colonized by a variety of brown (e.g., *Polytrichum strictum* and *Aulacomnium palustre*) and *Sphagnum* species but lacked lichens. Species common to most of the disturbed site types included *Betula neoalaskana*, *Salix maccaliana*, *Calamagrostis canadensis*, *Eriophorum vaginatum* and *Polytrichum strictum*.

In general, a wider variety of trees, shrubs, herbs, graminoids and moss species have become established in the cutover peatland sites as compared to the undisturbed peatland. The presence of a variety of brown mosses in the *Carex*/moss and *Eriophorum*/moss site types suggests a nutrient regime that differs from the original bog peatland.

Peat Chemistry and Composition

pH levels were typical of native bog and poor fen systems, although the barren peat and *Betula/Eriophorum* pH values were significantly lower than in the *Carex/*moss sites. Extractable nutrient levels in the peat soils at all sites were low and were comparable to low values reported previously (Turchenek et al 1993). The barren peat site type had the lowest levels of P, Ca, Mg and K, while the peat substrate in the *Carex*/moss site type had the highest levels of these nutrients. Contents of NO_3 and NH_4 were highest in the barren peat and the *Betula/ Eriophorum* peat soils.

The degree of decomposition and the botanical composition of the peat materials at the five sites were similar. Nutrient contents between some of the site types were significantly different. The most common occurrences of differences in nutrient contents occurred between the barren peat site type and one or more of the other types.

Water Table Levels

There was considerable variation within and between some sites at any given time. Heavy precipitation during July 1994 and August 1995 produced significant short-term rises in water level at all site types. The barren peat site type had the greatest variability, ranging from -126 to -11 cm with a mean of -60 cm. The *Betula/Ledum/ Polytrichum* site type was less variable and had a mean of -36 cm for two replicates and -60 cm for the other two. The wettest site types, *Carex*/moss and *Eriophorum*/moss, had mean water levels within 10 cm of the surface and had relatively low temporal variability. The *Carex*/moss site type was flooded for an extended period in 1994.

DISCUSSION

The barren peat, *Betula/Eriophorum* and two of the *Betula/Ledum/Polytrichum* replicates had water table levels that averaged -40 cm or less. This depth is considered the minimum for survival of *Sphagnum* mosses. The barren peat surface can become very dry and subject to wind erosion with excessively low water table levels. In contrast, the *Eriophorum*/moss site type had consistently high water levels, at or slightly above the peat surface, as well as the greatest *Sphagnum* moss component with hummock formation. The *Carex*/moss site type, being flooded for long periods with water depths up to 20 cm, was too wet for many of the species present in the other site types. The *Betula/Eriophorum* site type was very similar to the barren peat site type except for a higher mean water level of 40 cm. The two *Betula/Ledum/ Polytrichum* replicates, with a mean -36 cm water table level, had a dense *Polytrichum* cover in which *Sphagnum fuscum* was becoming established.

The five site types were similar in terms of composition and degree of humification of the peat. The peat substrates among the sites differed to some extent. The barren peat and two of the *Betula/Ledum/Polytrichum* site types were most similar with regard to water table levels, however, P, Ca, Mg and K were higher in the latter site type. Thus, substrate fertility appears to be a factor in the development of different site types. The relatively high NO_3 and NH_4 of the barren peat and *Betula/Eriophorum* site types was likely attributable to accumulation as a consequence of absence of vegetation that would normally utilize these nutrients. The dominance of *Eriophorum vaginatum* in the *Betula/Eriophorum* site type may be related to the relatively high NH_4 in the peat as this species has been shown to favour NH_4-N in its nitrogen uptake (Salonen and Setala 1992).

The slightly higher pH levels in the *Betula/Ledum/Polytrichum*, *Carex*/moss and *Eriophorum*/moss site types suggest that they are richer in nutrients than the barren peat and *Betula/Eriophorum* site types. The differences in nutrient contents, however, may be attributable to replenishment arising from higher water tables in some of the site types.

CONCLUSIONS

1. The rate of natural revegetation on cutover peatlands depends on the site conditions, in particular, the water table level. Adverse site conditions can prevent any revegetation for at least 15 years.
2. *Sphagnum* moss development appears to be limited to sites with a mean water table level higher than -40 cm and preferably within -20 cm.
3. Lichen, *Betula*, *Ledum* and *Picea* species were most prevalent in sites where the mean water table level was between -30 and -60 cm.
4. Dry, nutrient-poor sites are the slowest to revegetate. Mean water table levels of -60 cm result in a peat surface that is too dry for plant establishment. Reclamation assistance is required for such sites.
5. *Carex spp.* can become well established in less than 10 years and will tend to be dominant in areas subject to long term inundation.
6. The number of species that become established in a site type is similar to that of a typical bog; however, the species are different. Diversity in post-harvest site types leads to relatively high diversity in species composition.
7. It appears that the current stage of revegetation and sequence of colonization is similar to that noted by researchers in Eastern Canada. For example, bog species such as *Picea mariana* and *Smilacina trifolia* are very slow to return to a disturbed peatland.
8. The success of natural revegetation depends on the time horizon acceptable to the land manager. Five to ten years is likely required to colonize and stabilize most peatlands assuming site conditions are suitable. The return to the original bog species composition may require many decades.
9. Water table management is essential to ensure successful revegetation and to guide the direction of revegetation. Soil chemistry adjustment may be required for problem soils.

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