ACTA SOCIETATIS
BOTANICORUM POLONIAE
Vol. 61; nr 1: 37-43
1992

Soil and vegetation characteristics of a peatland near Lake Édouard in Mauricie National Park, Québec, Canada

PIERRE MILETTE, DENIS FONTAINE, MIROSLAV V. GRANDTNER

Laboratoire d'écologie forestières, Département des sciences forestières, Faculté de foresterie et de géomatique, Université Laval, Québec, Canada G1K 7P4

(Received: January 19, 1990. Accepted: February 14, 1990)

Abstract

The majority of plant communities within the peatland near Lake Édouard belongs to the poor fen group. They are containing poor fen species such as *Myrica gale, Carex rostrata, Glyceria canadensis, Calamagrostis canadensis, Carex canescens, Carex stricta, Alnus rugosa* and *Sphagnum subsecundum*. Members of these taxa grow in association with a group of marsh species and with *Chamaedaphne calyculata* and *Sphagnum majus*, species characteristic of bogs. The soil are of the humisol great group, being well decomposed and relatively rich in nutrient elements but ranging from extremely to strongly acidic. Four new associations are noted: *Sphagno-Juncetum brevicaudati, Sphagno-Hypericetum boreale, Sphagno-Glycerietum canadensis* and *Carici canescenti-Sphagnetum majï*. The distribution of vegetation appears dependent on ground relief and, consequently, on the level and quality of water in the peatland.

Keywords: phyto-ecology, peatland, fen, plant community, organic soil, Mauricie National Park, Québec

INTRODUCTION

Mauricie National Park is located on the north shore of the Saint-Lawrence River, approximately 65 km north of Trois-Rivières. A general phytoecological survey of the southern third of the park has already been carried out mainly concerned with forest vegetation (Grandtner et al. 1975) and with six peatlands (Millette and Fontaine 1975). To our knowledge, these are the only phyto-ecological surveys of this region. The forest vegetation was the subject of a previous publication (Lalumière and Thibault 1988). In this

contribution we consider the vegetation and soils of one of the peatlands surveyed, namely the one situated northwest of Lake Édouard at 46°45'N and 72°57'W. This peatland, part of the Saint-Maurice River watershed, has an altitude of 325 m and a surface area of approximately 9 ha.

METHODS

VEGETATION STUDY

Aerial photographs (1:20 000) were used to delineate two transects (A and B) from the center of the peatland. These transects served as the base for sampling, along which square sample plots (4 m in width) were located. Within each sample plot and each stratum (as defined by Payette and Gauthier 1972), species abundance-dominance and species sociability were determined using the scale of Braun-Blanquet (1932) as it was slightly modified by Grandtner (1974). The nomenclature for vascular plants followed Fernald (1970), that for mosses followed Crum et al. (1973), and that for liverworts followed Schuster (1953).

SOIL STUDY

A comprehensive soil study was conducted at each phytosociological plot. The variables examined included: drainage (according to CCP (1972); with 'class 7' added to indicate the presence of 15 cm or more of standing water above the soil surface), soil humus (according to Bernier (without date)), depth of the water table, soil pH (using the colorimetric method of Hellige-Truog) and soil color (according to Munsell 1973). Samples, collected with the aid of a Hiller borer, were air dried and then ground to pass through a 2 mm sieve. The texture of the mineral soil was determined by sieving 10 g samples through a series of five sieves with gauges of 1.000, 0.500, 0.250, 0.105 and 0.044 mm, respectively. The pH of dried samples was measured in water using a Beckman Zeromatic pH meter.Nitrogen contents were determined using the Kjeldahl method (Cole and Parks 1946) and organic carbon contents using ignition (Amiot and Bernier 1962) with a conversion factor of 1.732.

RESULTS

SOILS

All soils studied belonged to the order of organic soils, in the great group of humisol. Four subgroups were observed: typic, terric, lithic and hydric.

The **typic humisol** had a top layer (15 cm) of extremely acidic (pH 3.6) humus belonging to the type known as fibric peat mor. The remaining profile, to a depth

of 160 cm, was composed of relatively well decomposed (91% O.M. (organic matter), 1.7% N, C/N 31) and black (10 YR 2/1 h) humic peat. Drainage was imperfect to poor (classes 4 and 5, respectively) with the water table at a depth of approximately 20 cm. The cation exchange capacity, of approximately 20 meq/100 g, decreased with depth.

In the **terric humisol**, a sandy mineral horizon was located at a depth of 65 cm, being grey (10 YR 6/1) in color when dry and very strongly acidic (pH 5.0). The remaining profile consisted of a very well decomposed (40% O.M., 1.7% N, C/N 13) and black (10 YR 2/1 h) humic peat which was strongly acidic (pH 5.4) and had a much higher cation exchange capacity (15 meq/100 g) than the mineral horizon (2 meq/100 g) underneath. Drainage in this soil was generally very poor (class 6).

The **hydric humisol** was distinguished by a layer of free water between the depth of 40 to 80 cm. The surface horizon, comprised of 50 cm of fibric peat mor, was extremely acidic (pH 3.0). The underlying horizon Of, comprised of fibric peat, was also extremely acidic (pH 3.8). Further below was the horizon Oh which was humic, black (10 YR 2/1 h), very strongly acidic (pH 4.9), very well decomposed (60% O.M.,1.9% N, C/N 18) and relatively rich in nutrient elements (17 meq/100 g). This soil was very poorly drained and even flooded (classes 6 and 7) , the water level varying between a groundwater table at 10 cm depth to a surface layer of free water of 15 cm deep.

In the case of the **lithic humisol**, rock was found at a depth of 40–60 cm. An extremely acidic (pH 3.1–3.3) fibric peat mor was again found at the surface. The underlying Oh horizon of humic peat was less acidic (pH 4.0–5.0), very dark grey (10 YR 3/1) when moist and very well decomposed (52% O.M., 2.0% N, C/N 15) and has a relatively high cation exchange capacity (16 meq/100 g). Drainage ranged from imperfect (class 4) to very poor (class 6), the water table being found at a depth of 15–60 cm.

VEGETATION

Figures 1 and 2 illustrate the distribution of plant communities along the two transects and their corresponding soil types. One end of both transects was in contact with an unnamed lake northwest of Lake Édouard. The following text in this section describes the plant communities as they changed progressively from the lakeshore.

At the edge of the lake on the first transect (Fig. 1), a leather leaf-bog myrtle--peat moss subassociation (*Myrico galis-Chamaedaphnetum calyculatae sphagnetosum* G a u d r e a u 1979) was found on an hydric humisol. This initial shrub community, comprising of peat mosses usually associated with the richer peat such as *Sphagnum russowii*, was subsequently replaced by a series of herbaceous associations in the wetter depression. The first two of these associations, lacking

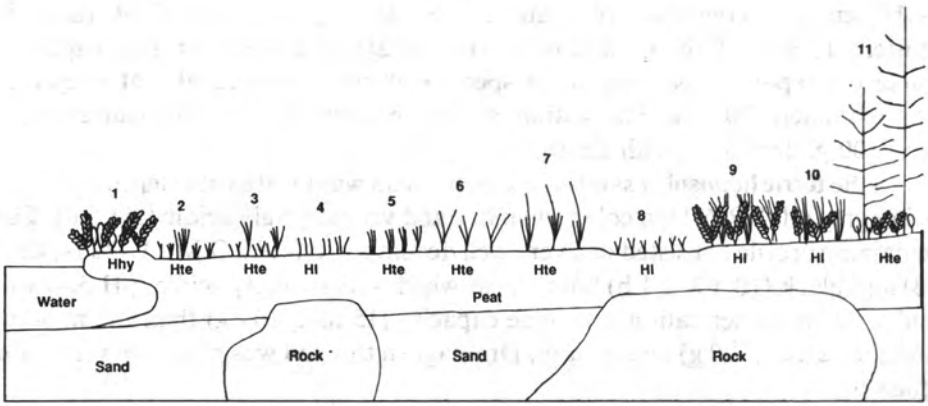

Fig. 1. Schematic diagram of the topographical sequence of the peatland near Lake Édouar. Plant community: 1 — *Myrico galis-Chamaedaphentum calycalatae sphagnetosum*, 2 — *Scirpetum atrocincti*, 3 — *Caricetum rostratae*, 4 — *Sphagno-Juncetum brevicaudati*, 5 — *Sphagno-Hypericetum boreale*, 6 — *Sphagno-Glycerietum canadensis*, 7 — *Sphagno-Calamagrostidetum canadensis*, 8 — *Carici canescenti-Sphagnetum maji*, 9 — *Sphagno-Chamaedaphnetum calycalatae caricetosum strictae*, 10 — *Caricetum strictae*, 11 — *Sphagno-Laricetum laricinae myricetosum galis*; soil: Hhy—hydric humisol, Hl—lithic humisol, Hte — terric humisol

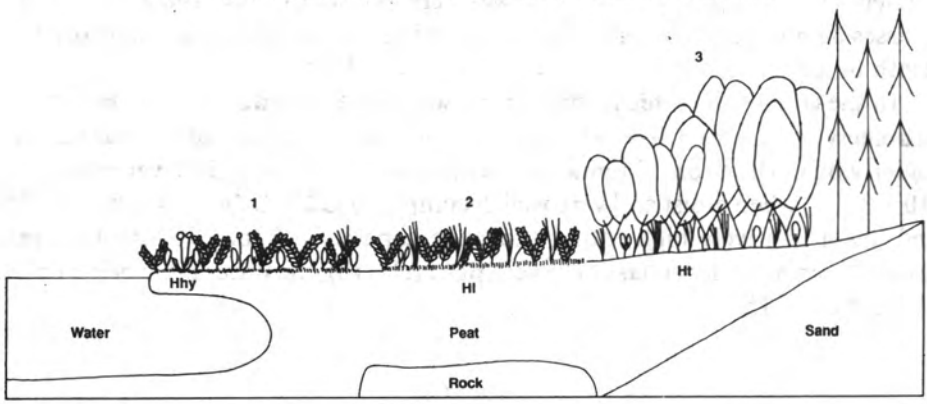

Fig. 2. Schematic diagram of the topographical sequence of the peatland near Lake Édouard. Plant community: 1 — *Myrico galis-Chamaedaphnetum calyculatae sphagnetosum*, 2 — *Sphagno-Chamaedaphnetum calyculatae caricetosum strictae*, 3 — *Sphagno-Alnetum rugosae myricetosum galis*; soil: Hhy—hydric humisol, Hl—lithic humisol, Ht—typic humisol

peat mosses and found on the terric humisol, were respectively dominated by blackish bulrush (*Scirpetum atrocincti* Grandtner 1960) and beaked sedge (*Caricetum rostratae* Dansereau 1959). The subsequent association was short caudate rush-peat moss (*Sphagno-Juncetum brevicaudati* Milette and Fontaine 1975) on a lithic humisol and then there was northern St. John's worts-peat moss (*Sphagno-Hypericetum boreale* Milette and Fontaine 1975), Canada manna grass-peat moss (*Sphagno-Glycerietum canadensis* Mi-

lette and Fontaine 1975) and Canada reed grass-peat moss (*Sphagno-Calamagrostidetum canadensis* Gaudreau 1979), respectively, on a terric humisol. These last four associations were characterized by an abundance of *Sphagnum majus*.

In the subsequent water saturated depression on lithic humisol, *Sphagnum majus* and silvery sedge formed a distinct species-poor association (*Carci canescenti-Sphagnetum maji* Milette and Fontaine 1975). On drier lithic humisol, this association was replaced by a leather leaf-peat moss-stiff sedge subassociation (*Sphagno-Chamaedaphnetum calyculatae* (Anctil 1956) Grandtner 1960 *caricetosum strictae* Milette and Fontaine 1975) and by a stiff sedge association (*Caricetum strictae* Gauthier 1980). Finally, on the even drier terric humisol, the first stage of forestation of the peatland was indicated by the presence of a tamarack-peat moss-bog myrtle subassociation (*Sphagno-Laricetum laricinae* Gauthier 1967 *myricetosum galis* Milette and Fontaine 1975).

The second transect (Fig. 2), an uniform slope without depressions, consisted of typic humisol colonized by shrub communities found a both ends of the first transect (Fig. 1). Further up the slope, these communities were replaced by a grey alder-peat moss-bog myrtle subassociation (*Sphagno-Alnetum rugosae* Grandtner 1960 *myricetosum galis* Gaudreau 1979) on typic humisol and it was in turn replaced by forest vegetation on mineral soil.

DISCUSSION

The Lake Édouard peatland is characterized by minerotrophic organic soils belonging to the great group of humisols. The organic matter is generally well decomposed (C/N 13–18, exceptionally 31) and relatively rich in nutrient elements (15-20 meq/100 g) and it ranges from being extremely to strongly acidic (pH 3.0-5.4). These conditions favor the presene of *Myrica gale, Carex rostrata, Glyceria canadensis, Calamagrostis candensis, Carex canescens, Carex stricta, Alnus rugosa* and *Sphagnum subsecundum*; species commonly found in poor fens (Sjörs 1961b, 1963 in Gauthier 1980). The poor fen designation for most of the plant communities of this peatland is substantiate by the absence of species characteristic of a rich fen and by the presence of those that normally grow in ombrothrophic peatland, such as *Chamanedaphne calyculata* and *Sphagnum majus*. Furthermore, the minerotrophic status of the peatland is underlined by the presence, in the *Scirpus atrocinctus* and the *Carex rostrata* associations, of marsh species such as *Sagitaria latifolia, Eleocharis obtusa, E. acicularis, Lycopus uniflorus, Spargenium chlorocarpum* and *Hypericum virginicum*.

The distribution of plant communities seems to depend on ground relief and thus the level and quality of groundwater. The hummocks and depressions at the interior of the peatland, progressively removed from the influence of moving minerotrophic water are primarily colonized by species associated with ombro-

trophic peatlands. This is the case with the two leather leaf-peat moss associations and with the association of *Sphagnum majus* with silvery sedge.

In contrast, minerotrophic associations (*Scirpetum atricincti, Carictum rostratae, Spagno-Juncetum brevicaudati, Sphagno-Alnetum rugosae*) are found in the depressions at the edge of the lake and at the periphery of the peatland where the soil is fed by circulating water which has been in contact with the mineral soil. These communities are dominated by the fen or marsh species whereas bog species such as *Sphagnum majus* are facultative.

The peatland described here differs from the bogs described to date in Québec (Grandtner 1960, Gauthier and Grandtner 1975, Gauthier 1980) as well as the fens described in the Québec Laurentians (Gauthier 1980). The former lacks most of the ombrotrophic peatland species whereas the latter lacks the newly noted plant communities (*Sphagno-Juncetum brevicaudati, Sphagno-Hypericetum boreale, Sphagno-Glycerietum canadensis, Carici canescenti-Sphagnetum maji*). Certain herbaceous plant communities in the Lake Édouard peatland are also rich in marsh species. Finally, the shrub communities of this peatland show the greatest similarity with those of the peatland at Lake Chicobi described by Gaudreau (1979) and that in Forillon National Park described by Grandtner et al. (1973), particularly with respect to the important role played by *Myrica gale*.

Acknowledgements

The authors thank the following persons for the identification or verification of specimens: Ernest Lapage and Galles Lemieux (vascular plants), Robert Gauthier and Gilles Robitaille (mosses and liverworts). Thanks are also extended to Yvon Laflamme for his assistance in the soil analyses, to Tadeusz Rycabel for preparing the Polish abstract, and to David Boyle, Paul de la Bastide, Lynn Moore and Ken Wong for preparing the English text. This study was financed by the Canadian Park Service of Environment Canada.

REFERENCES

Amiot L.P., Bernier B., 1962. Méthodes d'analyse chimique usuelles des soils et tissus végétaux. Presses Univ. Laval, Québec.

Anctil L., 1956. Reboisement des tourbières brûlées ou partiellement drainées. Mém. B.Sc., Fac. Forest Géod., Univ. Laval, Québec.

Bernier B., without date. Esquisse descriptive de la classification des humus forestiers. Fac. Forest Géod., Univ. Laval, Québec.

Braun-Blanquet J., 1932. Plant sociology. McGraw-Hill, New York.

CCP, 1972. Classification canadienne des sols. Min. Agric. Canada, Ottawa.

Cole J.O., Parks C.P., 1946. Semimicro-Kjeldahl procedure for control laboratories. Analyt. Chem. 18: 61–62.

Crum H.A., Streere W.C., Anderson L.E., 1973. A new list of mosses of North America north of Mexico. The Bryologist 76: 85-130.

Dansereau P., 1959. *Phytogeographia laurentiana II.* The principal plant associations of the St. Lawrence Valley. Contr. Inst. Bot. Univ. Montréal, 75: 1-147.

Fernald M.L., 1970. Gray's manual of botany. 8th ed., American Book, New York.
Gaudreau L., 1979. La végétation et les sols des collines Taraginan, Abitibi-Quest, Québec. Études écologiques 1, Lab. Écol. For., Univ. Laval, Québec.
Gauthier R., 1967. Étude écologique de cinq tourbières du Bas-Saint-Laurent. Thèse M.Sc., Fac. Forest Géod., Univ. Laval, Québec.
Gauthier R., 1980. La Végétation des tourbières et les sphaignes du parac des Laurentides, Québec. Études écologiques 3, Lab. Écol. For., Univ. Laval, Québec.
Gauthier R., Grandtner M.M., 1975. Étude phytosociologique des tourbières du Bas-Saint-Laurent, Québec. Naturalise Can. 102: 109-153.
Grandtner M.M., 1960. La forêt de Bausejour, comté de Lévis (Québec). Étude phytosociologique. Fonds Rech. Forest. Univ. Laval, Contr. 7: 1-62.
Grandtner M.M., 1974. Le *Cakiletum edentulae* des Îles-de-la-Madeleine. Doc. Phytosoc. 1974(7-8): 35-44.
Grandtner M.M., Majcen Z., Ruffignat J., 1973. Analyse et cartographie de la végétation du parc national Forillon, Québec. Dir. Parcs Nat. Lieux His., Min. Aff. Ind. Nord Can., Ottawa.
Grandtner M.M., Thibault M., Majcen Z., Milette P., Fontaine D., 1975. Analyse et cartographie de la végétation du parc national de la Mauricie, I. Rég. Qué., Parcs Can., Min. Aff. Ind. Nord Can., Québec.
Lalumière R., Thibault M., 1988. Les forêts du parc national de la Mauricie, au Québec. Études écologiques 11, Presses Univ. Laval, Québec.
Milette P., Fontaine D., 1975. Étude phyto-écologique de six tourbières du tiers inférieur du parc national de la Mauricie, Québec. Mémoire B.Sc., Fa. Forest Géod., Univ. Laval, Québec.
Munsell, 1973. Munsell soil color charts. Munsell products, Macbeth color and photometry division of Kollmorgen Corporation, Baltimore.
Payette S., Gauthier B., 1972. Les structures de végétation: interprétation gégraphique et écologique, classification et application. Naturaliste Can. 99: 1-26.
Schuster R.M., 1953. Boreal *Hepaticae*. A manual of the liverworts of Minnesota and adjacent regions. Amer. Midl. Nat. 49: 258-684.

Gleby i roślinność torfowiska położonego w pobliżu jeziora Édouard w Parku Narodowym Mauricie w prowincji Québec w Kanadzie

Streszczenie

Większość zbiorowisk roślinnych pokrywających torfowisko jeziora Édourad należy do fenów ubogich. Spośród gatunków spotykanych w fenach ubogich, występują tu: *Myrica gale, Carex rostrata, Glyceria canadensis, Calamagrostis canadensis, Carex canescens, Carex stricta, Alnus rugosa* oraz *Sphagnum subsecundum*. Te taksony rosną w towarzystwie gatunków moczarowych oraz *Chamaedaphne calculata* i *Sphagnum majus* charakterystycznych dla bogów. Występujące tu gleby należą do humisolów. Są one dobrze rozłożone, relatywnie zasobne w składniki pokarmowe, lecz ekstremalnie lub bardzo kwaśne. Cztery nowe zbiorowiska roślinne zostały tu opisane: *Sphagno-Juncetum brevicaudati, Sphagno-Hypericetum boreale, Sphagno-Glycerietum canadensis* oraz *Carici canescenti-Sphagnetum maji*. Rozmieszczenie roślinności zależy prawdopodobnie od rzeźby terenu, a w konsekwencji od poziomu oraz jakości wody obecnej w torfowisku.