THE VEGETATION, SURFACE WATER CHEMISTRY
AND PEAT CHEMISTRY OF MODERATE-RICH FENS
IN CENTRAL ALBERTA, CANADA

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Abstract: The non-forested fens of the Athabasca area in central Alberta, Canada are characterized by their surface water and peat chemistry. Correlations between vegetation and chemical gradients are examined. The primary vegetation gradient is from stands dominated by Drepanocladus vernicosus, Meesiatriquetra, Menyanthes trifoliata, and Carex chordorrhiza to those dominated by Brachythecium mildeanum, Drepanocladus aduncus, Carex aquatilis, and Drepanocladus polycarpus. This vegetation gradient reflects a chemical gradient of increasing pH, magnesium, sodium, sulphur, organic nitrogen, and phosphorus in the fen water and increasing magnesium, iron, and phosphorus in the fen peats. Potassium and sodium in the fen peats show a decreasing trend along the vegetation gradient. A second gradient from shrub-moss vegetation to sedge-moss vegetation is significantly correlated with microtopography and an increase in nitrate content in the spring (May) waters. The fen waters in this study are in the 5.3-7.1 pH range, with specific conductance of 18-240 μS. The calcium content of the waters averages 19.5 - 22.1 mg/l and that of magnesium averages 4.3 - 5.3 mg/l in spring and fall, respectively. The subsurface fen peats are characterized by mean calcium contents of 17,426 mg/kg and magnesium contents of 1,719 mg/kg. Organic nitrogen, nitrate, and ammonium content in the spring and fall waters average 1,967-2,395 μg/l, 3.1-9.8 μg/l, and 16.8-88.9 μg/l, respectively.

A review of peatland literature suggests that the Athabasca fens are classified as moderate-rich fens. The chemical contents of the fen waters and fen peats are intermediate between those of poor fens and extreme-rich fens that previously have been described. Common rich fen species, such as Tomentypnum nitens, Bryum pseudotriquetrum Campylium stellatum, and Calliergon giganteum, are present. In addition, characteristic species of these moderate-rich fens include Drepanocladus vernicosus, D. aduncus, D. polycarpus, and Brachythecium mildeanum. These species are believed to be characteristic of moderate-rich fens in continental, boreal areas.

Key Words: fen, peat chemistry, nutrients, Drepanocladus, peatlands, vegetation analysis, elemental chemistry, Alberta, boreal forest.
INTRODUCTION

Much of the northern two-thirds of Alberta lies in the Boreal Forest Zone (Rowe 1972). Within the province, peatlands cover 12.7 million hectares or 21% of the land area (Zoltai 1988). In the southeastern part of the Province, warm, dry prairie conditions with excessive evapotranspiration limit the distribution of peatlands. To the southwest, steep slopes and the higher elevations of the Rocky Mountains restrict peatlands to late snowmelt areas and to the lowest valleys.

Within the Boreal Forest Zone of Alberta, Zoltai et al. (1988) recognized two major wetland regions. The Continental Mid-Boreal Wetland Region across the central part of the province is characterized by forested flat bogs and basin bogs associated with patterned fens, as well as flat fens and basin fens in the absence of permafrost. The Continental High Boreal Wetland Region in the northern part of the province is colder and characterized by patterned fens, small wooded peat plateaus and palsas, flat bogs, and fens (Zoltai and Pollett 1983).

Peatland classifications in Canada have been devised for specific practical purposes, as well as for general use in broad-based studies. Most of them have borrowed ideas from Fennoscandia and central Europe. Radforth's (1952) Muskeg Classification, which stressed the appearance of the peatland from the air, was devised for engineering purposes. More recently, there has been interest in peatlands as potential forestry sites in Canada, and a site classification for drainage and growth potential has been proposed by Häkkinen (1985) and Mäktitalo (1985), following the ideas of Finnish researchers (Cajander 1913, Heikurainen 1979). Other studies have stressed the vegetation component (Dansereau and Segadas-Vianna 1952, Segadas-Vianna 1955, Railton and Sparling 1973, Gauthier and Grandtner 1975). The site-type concept (Cajander 1913), which combines aspects of hydrotopography with physiognomy of the vegetation has been found to be practical for broad-based studies and non-specialists (Allington 1961, Tarnocai 1970, Jeglum et al. 1974, Wells 1981). Finally, the Zoltai et al. (1973) wetland classification includes the concepts of bog and fen, but is based on vegetation physiognomy. It is hierarchical in structure, with the early divisions based on the hydrotopography and physiognomy of the vegetation, while the lower levels are flexible and subject to modification depending on the purpose of the study.

Peatland studies in Alberta have been conducted in forested peatlands or muskegs because they are most abundant. Black spruce (Picea mariana) bogs have been described in the Caribou Mountains of northern Alberta (Horton et al. 1979) and in central Alberta (Nicholson 1987, Zoltai and Johnson 1987). These are often dominated by Picea mariana, Sphagnum fuscum, S. magellanicum, S. angustifolium, and lichens in the genera Cetraria, Cladina, and Cladonia, and have low surface water pH (3.3-4.1 at Mariana Lakes). Many of these bogs compare favorably to ombrotrophic bogs described by Swedish researchers (Tables 1 and 2). Few studies have been done on open, non-forested peatlands. Non-forested poor