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ABSTRACT

This paper discusses the string bog portion of Cedarburg Bog and the origin of string bogs in general. String bog or "strangmoor" is found in Cedarburg Bog, which is about 200 miles south of the southernmost string bog location previously reported. The string bog is deep within the bog, remote from both the periphery of the bog and the open lakes within it. This vegetational pattern consists of slightly raised ridges and islands with woody vegetation, alternating with flat sedge mat areas. This string bog, like others of North America and Eurasia, is found on a slightly sloping surface; the alternating ridges and flats are at right angles to the slope of the peat surface and the apparent direction of water flow. This orientation has given rise to various explanations concerning the origin of these patterns.

INTRODUCTION

String bog, often called "strangmoor" in the literature, in Cedarburg Bog is of interest because of its unusual appearance, its location this far south, and the controversy regarding its mode of formation. From the ground these patterns are seen as open field-like sedge areas surrounded by hedgerows of woody vegetation. This woody vegetation is picturesque and often stunted, especially when found on islands within the open sedge mat. The unique character of the string bog is even more apparent when seen from aerial photographs or from an airplane. String bogs were considered to be restricted to the far north (Auer 1920 and Troll 1944). Later they were identified and described in Minnesota (Heinselman 1963) and in Michigan (Heinselman 1965), with the southernmost string bog previously reported being near Seney, Upper Michigan. Identification of the string bog in Cedarburg Bog was confirmed by Dr. M. L. Heinselman (personal communcation) from an examination of an aerial photograph and a description of the area.

METHODS

The string bog was studied by stereoscopic examination of aerial photographs taken by the U. S. Government, by observations made from an airplane, and by ground reconnaissance.

A limited topographic survey was conducted during the winter, using a Dumpy level and rod (W. and L. E. Gurley, Engineering Instruments, Troy, New York). The survey established two east-west lines and two north-south lines intersecting

them (Fig. 1); the elevation was measured at 30.5 m (100 ft.) intervals along each of these survey lines. The measurements were made on the relatively flat areas to avoid any ridges or islands and thus insure a degree of uniformity.

The depth of the basin (peat and marl depth) was measured by means of an Eberbach peat and marl sampler (Eberbach Corporation, Ann Arbor, Michigan) at 30.5 m intervals; these measurements were made along the east-west survey lines.

RESULTS

The string bog is found deep within the bog, though not along the lakes within the bog (Fig. 1). The dark, coarse-textured, parallel ridges or "strange" and islands lie on a lighter toned and finer textured matrix. Closer observations reveal ridges covered with woody vegetation forming hedgerow-like patterns separating open sedge mat areas or "flarks". The smaller ridges and islands are covered with bog birch (Betula pumila var. glandulifera), leatherleaf (Chamaedaphne calyculata var. angustifolia) and sometimes stunted cedar (Thuja occidentalis) and stunted tamarack (Larix laricina). Dense stands of taller cedar and tamarack cover the larger ridges and islands; various shrubs are found here, especially along the edges of these elevations (Table 1). On the higher ridges and islands, Sphagnum spp., cranberry (Vaccinium Oxycoccos), and sundew (Drosera rotundifolia) sometime grow beneath the shrubs and trees. On the more shaded ridges and islands, velvet-leaf-bilberry (Vaccinium myrtilloides) and winterberry (Ilex verticillata) may be found.

The open, relatively flat sedge mat is dominated by beak sedge (Rhynchospora alba), sedge (Carex lasiocarpa), reed (Phragmites communis), and bladderwort (Utricularia spp.). Other species are listed on Table 1. This area is especially colorful in spring with the yellow flowers of the bladderwort and the pink colors of the various orchids. In contrast to the firmer ridges and islands, which are elevated above the surrounding mat, the sedge mat is very soft, even semi-fluid in places, with the water table normally at or just below the surface.

The topographic survey elevations are indicative of levels relative to the first point surveyed on each east-west line. The two east-west lines, each with a north-south appendage (Fig. 1), are independent of each other, and no attempt was made to link the two lines separated by one-half mile of bog. Along line 1, the slope rises from west to east at 0.29-0.47 m/km and drops slightly again near the lake, whereas along line 2 it rises from south to north at 0-0.12 m/km. In the southern portion, along line 3, the slope rises from west to east at 0.60-0.89 m/km and along line 4 from south to north at 0.34-0.48 m/km.

The string bog is underlain by Houghton peat, which is poorly drained brown peat greater than 1.07 m in depth; beneath this, there is more peat and finally marl. Basin depths at 37 points along sampling lines in the string bog ranged from 2.36 to 8.91 m, with a mean depth of 4.85 m.

Fig. 1. Aerial photograph of Cedarburg Bog with string bog area outlined. Location of topographic survey lines is shown in the string bog.

Table 1. String bog plants.

Ridges and islands:

- Andromeda glaucophylla (bog-rosemary)
- Aronia melanocarpa (black chokeberry)
- Betula pumila var. glandulifera (bog birch)
- Chamaedaphne calyculata var. angustifolia (leatherleaf)
- Cornus stolonifera (red osier dogwood)
- Drosera rotundifolia (round-leaved sundew)
- Habenaria dilatata (bog-candle)
- Ilex verticillata (winterberry)
- Juniperus communis var. depressa (juniper)
- Larix laricina (tamarack)
- Lonicera villosa (mountain-fly-honeysuckle)
- Rhamnus alnifolia (dwarf alder)
- Rhus vernix (poison sumac)
- Sarracenia purpurea (pitcher plant)
- Sphagnum spp. (sphagnum moss)
- Thuja occidentalis (cedar)
- Vaccinium myrtilloides (velvet-leaf bilberry)
- Vaccinium Oxycoccos (cranberry)

Sedge mat:

- Andromeda glaucophylla (bog-rosemary)
- Calopogon pulchellus (swamp-pink)
- Campanula aparinoides (marsh-bluebell)
- Carex chordorrhiza (sedge)
- Carex lasiocarpa (sedge)
- Carex limosa (sedge)
- Carex tetanica (sedge)
- Drosera linearis (linear-leaved sundew)
- Eleocharis sp. (spike-rush)
- Equisetum fluviatile (water horsetail)
- Lobelia Kalmii (lobelia)
- Menyanthes trifoliata (bogbean)
- Phragmites communis (reed)
- Pogonia ophioglossoides (pogonia)
- Rhynchospora alba (beak-sedge)
- Sarracenia purpurea (pitcher plant)
- Solidago uliginosa (goldenrod)
- Triglochin maritima (arrowgrass)
- Typha angustifolia (narrow-leaved cat-tail)
- Typha latifolia (broad-leaved or common cat-tail)
- Utricularia cornuta (bladderwort)
- Utricularia intermedia (bladderwort)
- Utricularia vulgaris (bladderwort)

DISCUSSION

Since bog patterns typically lie at right angles to the angle of slope or direction of water flow (Auer 1920, Troll 1944, Sjörs 1948, 1959, and 1961, Drury 1956, and Heinselman 1963 and 1965), explanations concerning the origin of the string bog are related to this slope. A general southwestern flow of water within the bog is suggested by the topographic survey and by the presence of the outlet for the entire basin being in the southwestern corner of the bog. Where the rise is gentle, as near survey lines 1 and 2 (Fig. 1), the patterns are more scattered and the open mat areas are large. The more abrupt rise found near lines 3 and 4 have prominent serpent-like ridges and islands and smaller open sedge mat areas.

Heinselman (1963) reported slopes of 2-10 ft/mile (0.38-1.89 m/km) in patterned bogs. Troll (1944) noted that horizontal or very slightly sloping bog surfaces produce isodiametric islands, but steeper slopes form elongated stränge perpendicular to the slope direction. Sjörs (1961) pointed out that these patterns are limited to parts of the peatland where most of the water movement occurs.

Though no completely adequate explanation of their development is yet available (Drury 1956 and Sjörs 1961), four mechanisms have been suggested as being important in string bogs. These include: (1) downslope sagging, (2) the flow of water and debris over frozen peat, (3) frost action, and (4) biotic effects.

Downslope gliding or sagging may occur in a pliable medium such as a sedge carpet in loose growing Sphagnum. Downslope sagging of the entire sodden surface will occur, resulting in wave-like elevations that dry out; the elevations are then colonized by less hydrophytic Sphagnum species (Drury 1956). However, Sjörs (1961) holds that downhill movements or soil-creep are not likely the cause, since the flarks are most conspicuous on slopes too small to allow any peat-flow at all.

Drury (1956) thinks that a more important mechanism involves sheets or torrents of water from sudden thawing of ice and snow or from a downpour of rain. Here a sheet of water flows over a firmer frozen surface and riffles are formed, leaving festoon-like ridges of debris after the water has subsided.

Frost action, though not considered adequate to initiate string bog patterns by Drury (1956), is one of the oldest explanations offered (Auer 1920 and Troll 1944). Here freezing in the autumn forms ice first in the bog hollows (flats), then later in the ridges due to the poorer heat conductivity of the drier hummock peat. This squeezes the peat in the ridges. In mid-winter, the ridges freeze more solidly, since they have a thinner snow cover, which produces further vaulting. Uneven thawing in the spring is also critical. It appears that frost action helps exaggerate surface differences started by other mechanisms.

Vegetation also capitalizes on and emphasizes microtopographic features formed by other factors. The ridges and islands with woody vegetation and the hollows with sedges and aquatics permit organic residue accumulation at different rates, which accentuates the ridges and hollow pattern (Heinselman 1963).

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