Productivity and $\Delta^{13}C$ in Sphagnum mosses across climatic and nitrogen deposition gradients

Steven K. Rice$^{1}$, Kyle Pilkington$^{1}$ and Sean Robinson$^{2}$

$^1$Department of Biology, Union College, Schenectady, NY
$^2$Department of Biology, SUNY-Oneonta, Oneonta, NY

Research Objectives:

- To determine whether Sphagnum productivity varies between regions that differ in climate and N deposition.
- To explore the relationships among productivity, microhabitat characteristics and $\Delta^{13}C$ values.

Introduction:

Sphagnum mosses are important peatland species, yet we understand little about the mechanisms that underlie differences in their productivity. Meta-analyses using studies from north temperate, boreal and Arctic locations indicate strong associations between long-term climate and light availability with productivity$^4$. Unfortunately, these results rely on different species, various methodologies and historical climate patterns. Consequently, it is difficult to draw robust conclusions or to address how recent changes like increased N climate patterns. Consequently, it is difficult to draw robust conclusions or to address how recent changes like increased N climate patterns.

The Global Sphagnum Productivity (GSP) Project, a consortium of over 35 research groups across the northern temperate to subarctic regions, seeks to refine our understanding of Sphagnum productivity and its relationships to environmental drivers. This effort focuses on two peat-forming species (S. magellanicum and S. fuscum) over two growing seasons (2013-14). The GSP Project is organized by Gustaf Granath (McMaster University, Canada) and Håkan Rydin (Uppsala University, Sweden). We report on part of this work by comparing growth, productivity, $\Delta^{13}C$ and microhabitat characteristics between field sites in New York and Maine that differ in climate and N distribution.

Field Sites

![Distribution of sites containing S. fuscum and S. magellanicum. Each of the ADK sites includes only one species.](image)

Table 1. Climate and N deposition for New York (top 3) and Maine (bottom 3) sites. May-Oct 2013 values except for N, which is annual avg. from 2010-12.

<table>
<thead>
<tr>
<th>Site</th>
<th>Precipitation (cm/season)$^2$</th>
<th>Temperature (C, avg)$^3$</th>
<th>N Deposition (kg/ha/yr)$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRW</td>
<td>88</td>
<td>17</td>
<td>4.3</td>
</tr>
<tr>
<td>LKD</td>
<td>58</td>
<td>16</td>
<td>3.8</td>
</tr>
<tr>
<td>ADK</td>
<td>76</td>
<td>13</td>
<td>3.8</td>
</tr>
<tr>
<td>SAC</td>
<td>37</td>
<td>16</td>
<td>3.6</td>
</tr>
<tr>
<td>GWI</td>
<td>88</td>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>ORB</td>
<td>68</td>
<td>15</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Field Sampling

- Productivity measured using vertical growth and bulk density (normally n=4 plots per species per site).
- Brush wires (n=3) installed at each plot early in growing season 2013. Growth increment was measured at end of growing season and bulk density obtained from 10 cm cores.
- Microhabitat characteristics measured: height above water table, vegetation cover.

![S. fuscum hummock with three brush wires installed. Straws allow for easy relocation.](image)

Laboratory Analyses

- Productivity calculated as g/m$^2$/yr.
- $\Delta^{13}C$ of plant tissue measured following gridding on a Thermo Delta Advantage ratio mass spectrometer.

![Distribution of sites containing S. fuscum and S. magellanicum. Each of the ADK sites includes only one species.](image)

Productivity

![Graph showing productivity for New York and Maine.](image)

$\Delta^{13}C$ of Plant Tissue

![Graph showing $\Delta^{13}C$ of plant tissue for New York and Maine.](image)

Summary

- Within similar latitudes, regional variation in climate and N deposition does not affect Sphagnum productivity as much as site variation within regions; climate, but not N, was also more variable within regions.
- Microsite variation along hummock-hollow gradients affects $\Delta^{13}C$ ratios of Sphagnum tissue more than environmental or physiological factors that control productivity.

Acknowledgements

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Footnotes

2National Climate Data Center
3National Atmospheric Deposition Program