St. Olaf College

Local Ecology Research Papers

A survey of mosses present along a south-facing dry run in a maple-basswood forest at St. Olaf College, Northfield, MN

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Susan Adolphson
Field Ecology
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Abstract:

The objectives of this study were to determine which families of moss are present in the study site, and whether or not there is a significant difference in maturity and area covered between different families of mosses and between the three substrates on which moss is found: rocks, soil, and fallen trees. I photographed all of the different types of moss present on each substrate, and plotted two random lines along which eight samples of area covered by the two families of moss present were taken. ANOVA tests indicated a significant difference in area covered between mosses in the *Hypnaceae* and *Orthotrichaceae* families: *Orthotrichaceae* covered a larger area on logs than *Hypnaceae*. However, there was no significant difference between the area samples taken from the two different lines. No statistical tests were needed to determine a significance in maturity between the three substrates; logs were the only substrate on which I found moss with fruiting bodies present. Fruiting bodies were only found on *Orthotrichaceae*. Therefore, I concluded that there is a significant difference in both maturity and area covered by moss between the different substrates on which moss is found along this dry run at St. Olaf College.

Introduction:

In this study I investigated patterns of moss growth and abundance on three substrates: rocks, logs, and soil. As the simplest of land plants, mosses are central to the study of plant evolution, particularly in shedding light on how their aquatic predecessors evolved to survive on land (Cove et. al., 1997). In addition, mosses have been shown to contain highly variable concentrations of heavy metals as indicators of pollution in the substrate on which they are growing (Bargagli et. al., 1995).

Other valuable aspects of mosses include their ability to break down rocks into soil material, either through the dissolving action of chemicals secreted from their rhizoids or their growth into tiny cracks already existing in the rock (Hugo, 1995), and their ability to recover quickly from disturbances; mosses are often among the first plants to recolonize in burned-out or clear-cut areas (Hugo, 1995). In addition, Johnsgard and Birks (1995) found that mosses played a critical role in colonization of land in western Norway as the glaciers retreated from the last ice age.

With regard to the interactions of moss with other organisms, many birds use moss as one of their nesting materials, and moss is also used by larger mammals (such as bears) as bedding (Hugo, 1995).

Mosses in the *Hypnaceae* family are usually found on soil and rotting wood, as well as on stones and trunks of trees. The plants are slender to robust and usually woody in texture; often they form stolons or slender creeping stems. The branching is usually irregularly pinnate, although often regularly so. The leaves of the members are commonly thin and membranous, sometimes scaly and glossy (Bodenberg, 1954).

Mosses in the *Orthotrichaceae* family usually grow in short tufts or cushions on trees or rocks; they are light green to yellowish green on the outside of the tufts and brown or blackish inside. The family name is derived from "ortho" (upright) and "tricho" (hair) from the erect hairs on the calyptra, which is the thin hood or cap on top of the capsule (Bodenberg, 1954).

According to Parker et al (1997), these hair cap mosses play a significant role in natural regeneration of white spruce; a higher rate of seedling survival after a short drought stress treatment was found in seedlings that were growing in moss, and seedlings grown on moss were taller and had higher root shoot ratios than seedlings grown in other substrates.

My objectives in this study will be to determine if there are significant differences in surface area covered, species of moss present, and maturity of plants growing on the three different substrates of rocks, logs, and soil.

Methods:

First, I visually examined and photographed mosses present on all three substrates and collected samples from each patch. Through the use of Bodenberg's moss ID guide, I identified each of my moss samples as belonging to either the *Hypnaceae* or *Orthotrichaceae* family. Identification to the genus or species level required observation of differences in mature capsules, of which there were none present on any of my samples. To determine my sampling areas, I used a tape measure to mark off a plot area stretching out 30 meters from the concrete wall south of the Science Center and running parallel to the wall for 100 meters. I then used a random numbers table to generate the points at which I stretched a line perpendicular to the wall. Since the majority of mosses were growing on rotting logs, I traced the areas covered by *Hypnaceae* and *Orthotrichaceae* within the range of a 215 mm x 279 mm overhead transparency on the first four logs which intersected this line. I did this with two lines, for a total of eight sample area tracings.

Next, I cut each overhead transparency into the separate pieces which represented the area covered by *Hypnaceae* or *Orthotrichaceae*. I weighed the pieces for each area from each tracing separately on a scientific balance which was accurate to one ten-thousandth of a gram. Then, I used the equation of (family area)/(total area) = (overhead family area mass)/(total overhead mass) to determine areas covered by *Hypnaceae* or *Orthotrichaceae*.

I then statistically analyzed these areas through an ANOVA test, in order to determine if there was a statistically significant difference in area covered on logs between *Hypnaceae* and *Orthotrichaceae* mosses.

Results:

I found *Hypnaceae* moss to be present on all three substrates, while *Orthotrichaceae* moss was only present on some of the logs sampled. With regard to area covered, the ANOVA results indicated a significant difference ($P = 0.0053$) in mean areas covered on logs between

Hypnaceae and *Orthotrichaceae* mosses (see Table 1). While *Orthotrichaceae* covered a larger area than *Hypnaceae* on logs, *Hypnaceae* covered a larger total area on all three substrates.

With regard to comparison of the areas covered by each moss family along the two sample collection lines, the ANOVA results ($P = 0.9996$) indicated no significant difference (see Table 2). This supports the accuracy of my sampling methods.

No statistical tests were necessary to determine the significance of my results regarding maturity of the moss as determined by the presence or absence of fruiting bodies. I found no fruiting bodies present on mosses growing on rocks or soil anywhere within my study site. However, there were fruiting bodies present on some *Orthotrichaceae* moss growing on logs.

Discussion:

The fact that I found *Hypnaceae* to be present on all three substrates and *Orthotrichaceae* to be present only on logs indicates that *Hypnaceae* is more tolerant with regard to the variety in substrates on which it will grow. In addition, *Hypnaceae* covered a larger total area on all three substrates than *Orthotrichaceae*. According to Cove et al (1997), this would suggest that *Hypnaceae* evolved to become one of the first mosses present at a location where disturbance has recently occurred. Therefore, I would recommend that *Hypnaceae* mosses be planted first in a newly disturbed area in which ecosystem restoration is desired. This recommendation is supported by Jonsgard and Birks (1995) in their analysis of environmental reconstructions since the end of the last ice age. They concluded that ground-cover mosses colonize newly available habitats at least as quickly as vascular plants, and play an important role in the successful reintroduction of other returning plants.

However, as indicated by the amount of area covered on logs by *Orthotrichaceae* and the observed maturity of this family, *Orthotrichaceae* seems to be more capable of reaching a level of maturity at which reproduction through capsule formation is possible. This may be beneficial in situations where the wind would distribute the capsules' seeds farther from the parent plant than the growth of the parent plant would reach in the same period of time. However, successful germination of these seeds would require a substrate fertile enough to support their growth. This may be an indication that the rotting logs contain the nutrients necessary for the development of new *Orthotrichaceae* plants, while soil and rocks do not. Further study and analysis of nutrient content of these substrates would be appropriate.

As there were no white spruce present in the location of my tests, I was unable to support or contradict the results of Parker et al (1997) with regard to the effects of *Orthotrichaceae* mosses on seedling growth.

In conclusion, I found a significant difference to be present between *Hypnaceae* and *Orthotrichaceae* mosses which were growing in my sample site. *Hypnaceae* mosses covered a larger overall area on all three substrates which were present (rocks, logs, and soil), but did not reach a level of maturity capable of producing capsules. *Orthotrichaceae* mosses covered a significantly larger area on logs and reached a level of maturity capable of producing capsules, but did not grow on all three substrates. Therefore, *Hypnaceae* are more well-suited to quick growth after disturbances and *Orthotrichaceae* are more well-suited to covering larger areas of logs which provide the nutrients necessary for capsule development.

Literature Cited:

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Cove DJ, Knight CD, Lamparter T. 1997 March. Mosses as model systems. Trends in Plant Science vol. 2, no. 3, pp. 99-105.

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Jonsgard B, Birks HH. 1995. Late-glacial mosses and environmental reconstructions at Krakenes, western Norway. Lindbergia, 20 (2-3) pp. 64-82.

Parker WC, Watson SR, Cairns DW. 1997. The role of hair-cap mosses (Polytrichum spp.) in natural regeneration of white spruce (Picea glauca (Moench) Voss). Forest Ecology and Management, 92 (1-3), pp. 19-28.

Table 1: ANOVA results for comparison of area covered by Orthotrichaceae (O) with area covered by Hypnaceae (H). P= 0.0053

ANOVA Table for Areas of both families O & H

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Moss Family	1	282051.086	282051.086	12.582	.0053
Residual	10	224167.694	22416.769		

Model II estimate of between component variance: 44508.74

Means Table for Areas of both families O & H
Effect: Moss Family

	Count	Mean	Std. Dev.	Std. Err.
Family O	7	536.371	75.089	28.381
Family H	5	225.400	218.138	97.554

Fisher's PLSD for Areas of both families O & H
Effect: Moss Family
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
Family O, Family H	310.971	195.337	.0053	S

Interaction Bar Plot for Areas of both families O & H
Effect: Moss Family
Error Bars: 95% Confidence Interval

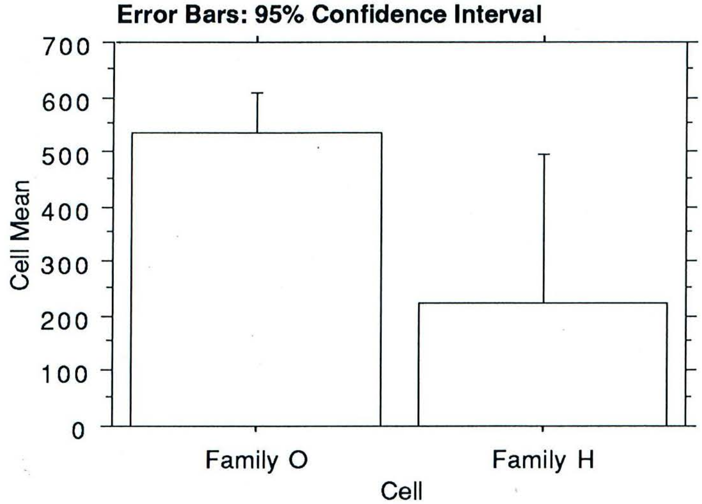


Table 2: Anova results for comparison between two sample lines (1 + 2) of total area sampled.

P = 0.9996

ANOVA Table for Areas of both families O & H

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Sample line	1	.013	.013	2.634E-7	.9996
Residual	10	506218.767	50621.877		

Model II estimate of between component variance: •

Means Table for Areas of both families O & H
Effect: Sample line

	Count	Mean	Std. Dev.	Std. Err.
1	6	406.767	232.220	94.804
2	6	406.833	217.526	88.804

Fisher's PLSD for Areas of both families O & H
Effect: Sample line
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value
1, 2	-.067	289.435	.9996

Interaction Bar Plot for Areas of both families O & H
Effect: Sample line
Error Bars: 95% Confidence Interval

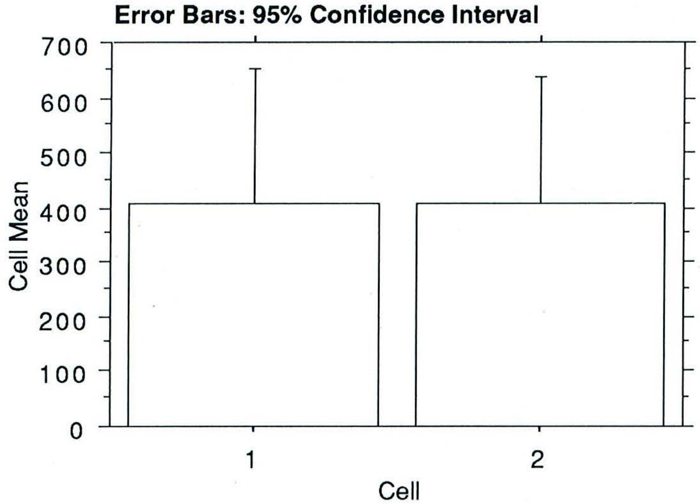
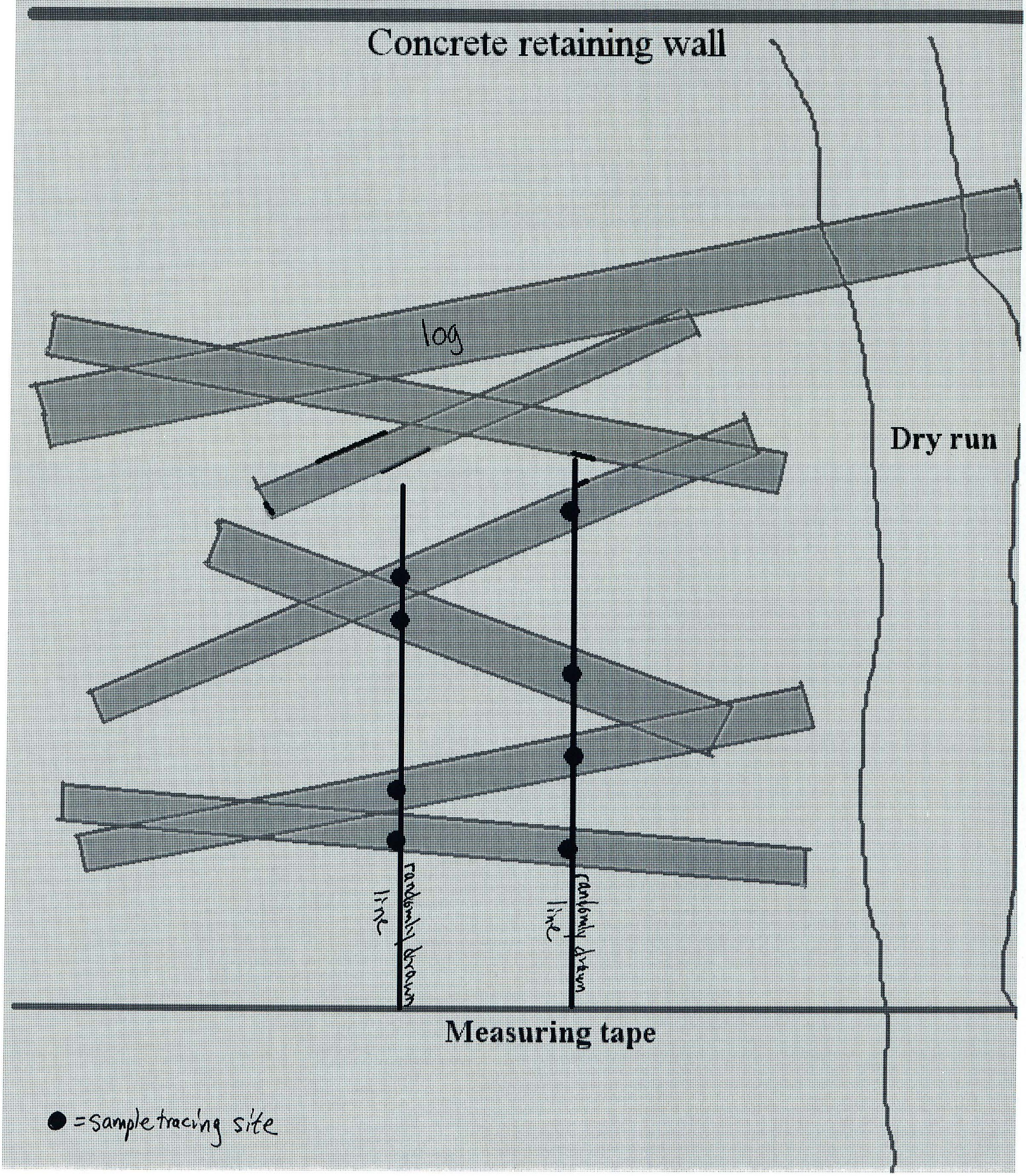


Diagram of study site and sampling methods



Study site in Norway Valley. St. Olaf College, Northfield, MN


Hypnaceae
Orthotrichaceae

Hypnaceae on soil in Norway Valley.

Hypnaceae on rocks in Norway Valley

Hypnaceae & Orthotrichaceae on log in Norway Valley

Hypnaceae & Orthotrichaceae on log in Norway Valley

Hypnaceae on log in Norway Valley

Hypnaceae + _Orthotrichaceae_ with mushroom on log in Norway Valley