Fundy Model Forest

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Report Title: Effects of Forestry Practices on Bryophyte Diversity 95-96 report

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Year of project: 1995

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EFFECTS OF FORESTRY PRACTICES ON BRYOPHYTE DIVERSITY

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FUNDY MODEL FOREST
Year-end report

APPLICANT: **PROJECT #**

Family Name:	Given name:	Position:	Date:
FREGO	**Katherine A.**	**Assistant Professor**	**November 1, 1995**

Institution:	Address:	Postal code:
UNIVERSITY OF NEW BRUNSWICK (SAINT JOHN)	**Biology Dept., UNBSJ P.O. Box #5050 Saint John, NB**	**E2L 4L5**

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Research:	Individual (X)	Team ( )	Length of study (years): **5**

Funding ($) Requested:	1st Year:	2nd Year:	3rd Year:	4th Year:	5th Year:
	$11,000	**$12,000**	**$12,000**	**$12,000**	**$12,000**

Research Partners:

Research Topic:

Short Title:
Effects of forestry practices on bryophyte diversity

10 Key Words:
bryophyte, moss, diversity, disturbance, regeneration, forest floor, recovery

Summary:
Bryophytes are an important part of mixed and coniferous forest ecosystems, with great impact on water and nutrient budgets. Their biodiversity is poorly documented in mature forests, and their recovery after anthropogenic disturbances is even less known. If bryophyte species distribution is determined by microhabitat, forest management practices which alter the microhabitat would be expected to strongly influence bryophyte diversity. Alternatively, bryophyte distribution may be controlled primarily by dissemination of propagation units. Regeneration would then be encouraged by management practices that retain scattered patches of viable plants. This project is designed (a) to document the diversity of bryophytes in mature mixed forests, (b) to document the changes in diversity after a variety of forestry practices, and (c) to determine which practices minimize reduction in diversity.

GOALS:

1. Improve the quantitative understanding of the bryophyte component of forest ecosystem structure and function, by:
   (a) contributing to the knowledge of native biodiversity of these species, and
   (b) contributing to the knowledge of the ecological processes involved in re-establishment of bryophyte communities after various levels of disturbance.

2. Relate changes in bryophyte diversity to operational forest management procedures.

3. Fill information gaps in terms of ecological data on these ecologically important but poorly understood plant species.

OBJECTIVES and PROGRESS TO DATE:

1. Document the diversity of forest floor bryophytes in mature mixed forests in the Hayward Brook Watershed. (YEAR 1)

   Beginning in May 1995, a series of transects were laid out in the Hayward Brook watershed, and 155 permanent quadrats were established. Bryophyte diversity and abundance was determined during the growing season, before forest harvest. Because bryophytes cannot be identified to species without a microscope, the specimens were transported to the lab for identification.

   A species list (Table 1) and descriptive statistics have been generated. The cryptogam flora consisted of 76 bryophyte species (53 mosses, 23 liverworts), and 3 lichen types. Approximately 75% of the quadrats contained 7-18 species, with a mean of 10.37 ± 0.398 and a mode of 7-9 species. The species were heterogeneously distributed, with 49% of the species occurring in $\leq$ 5% of the quadrats. Seven species were common, i.e. they occurred in 60-80% of the quadrats: *Ptilidium pulcherimum, Pleurozium schreberi, Dicranum scoparium, D. polysetum,*

Brachythecium starkei, Lophocolea heterophylla and *Jamesoniella autumnalis*.

The forest floor varies in bryophyte cover, from 0% in dry balsam fir thickets to 100% under open spruce canopy. Most individual species (87%) averaged $\leq$0.25% cover, equivalent to approx 30cm^2. Two quadrats contained the rare species, *Cirriphylum piliferum*, previously reported only in Victoria and Queen's counties in New Brunswick.

Partial canonical correspondence analysis (PCCA), a multivariate statistical technique, was used to summarize the characteristics of the bryophyte community and estimate the relative influence of three environmental features: canopy, topography and litter (Table 2). Canopy accounted for only 1.71% of the community pattern, topography contributed 7.77%, and litter contributed 13.64%. The chemical aspects of litter, such as pH and nutrient contents, were most strongly related with community composition. However, canopy is the direct contributor to litter, hence changes in canopy are expected to have a profound influence on the bryophyte community.

To date, this study documents the pre-harvest bryoflora in the Hayward Brook Watershed (see attached thesis). In doing so, it allows for detection of changes in biodiversity and various community characteristics following harvest practices. Based on the relationship between bryophytes and the selected environmental features, we predict that biodiversity will initially decline following canopy removal. However continued study is essential to determine (a) the relative impact of different harvest practices, and (b) the patterns, conditions and degree of recovery of the bryophyte community.

2. Compare the immediate effects of human disturbances on bryophyte community composition, alpha diversity and structural diversity.

The effects of disturbance will be determined in spring 1996. Delays in site preparation prevented evaluation in the 1995 growing season. However, the spring assessment will be equally valid and valuable.

3. Determine changes in composition and diversity of bryophytes with successional time in response to human disturbance. (YEARS 2-5)
Sampling of the permanent quadrats will continue annually, beginning in 1996 as planned.

Table 1: Species frequency and mean cover values, ordered by descending frequency of occurence in 155 quadrats. Nomenclature follows Ireland 1982, and Ireland and Bellolio-Trucco 1987.

Species	species #	% Frequency	Mean % cover when present	Total mean % cover
Ptilidium pulcherinum (G. Web.) Hampe	72	79.35	0.69	0.55
Pleurozium schreberi (Brid.) Mitt.	41	76.13	7.74	5.89
Dicranum scoparium Hedw.	20	68.39	1.31	0.89
Dicranum polysetum Sw.	19	67.74	3.25	2.20
Lophocolea heterophylla (Schrad.) Dum.	66	56.77	0.18	0.10
Brachythecium starkei (Brid.) B.S.G.	5	55.48	0.72	0.40
Jamesoniella autumnalis (DC.) Steph.	64	51.61	0.38	0.20
Fruticose lichen	75	38.06	0.99	0.38
Herzogiella turfacea (Lindb.) Iwats.	24	37.42	0.56	0.21
Hypnum pallescens (Hedw.) P.Beauv.	28	35.48	0.26	0.09
Dicranum flagellare Hedw.	14	31.61	0.53	0.17
Drepanocladus uncinnatus (Hedw.) Warnst.	21	29.68	0.40	0.12
Dicranum fuscescens Turn.	15	28.39	1.00	0.28
Plagiomnium cuspidatum (Hedw.) Kop.	36	23.23	0.87	0.20
Callicladium haldanianum (Grev.) Crum	9	22.58	0.96	0.22
Ptilium crista-castrensis (Hedw.) De Not.	45	18.06	1.01	0.18

Species	species #	% Frequency	Mean % cover when present	Total mean % cover
Geocalyx graveolens (Schrad.) Nees	63	18.06	0.13	0.02
Tetraphis pellucida Hedw.	52	17.42	0.50	0.09
Plagiothecium laetum B.S.G.	39	16.77	0.13	0.02
Dicranum montanum Hedw.	17	16.77	0.28	0.05
Bazzania trilobata (L.) S. Gray	54	14.84	3.57	0.53
Nowellia curvifolia (Dicks.) Mitt.	69	12.90	0.10	0.01
Brachythecium rutabulum (Hedw.) B.S.G.	*6*	*12.90*	*0.66*	*0.09*
Campylium hispidulum (Brid.) Mitt.	10	12.26	0.33	0.04
Polytrichum commune Hedw.	43	12.26	1.41	0.17
Brachythecium salebrosum (Web. & Mohr) B.S.G.	4	10.97	0.76	0.08
Hylocomium splendens (Hedw.) B.S.G.	25	9.68	5.65	0.55
Hypnum imponens Hedw.	27	9.03	2.21	0.20
Lepidozia reptans (L.) Dum.	65	9.03	0.44	0.04
Herzogiella striatella (Brids.) Iwats.	23	8.39	1.25	0.10
Ptilidium ciliare (L.) Hampe	71	7.74	0.72	0.06
Plagiomnium ciliare (C. Müll.) Kop.	35	7.74	3.32	0.26
Aulocomnium palustre (Hedw.) Schwaegr.	2	7.74	1.57	0.12

Species	species #	% Frequency	Mean % cover when present	Total mean % cover
Amblystegium serpens (Hedw.) B.S.G.	1	7.74	0.07	0.01
Foliose lichen	76	7.74	0.36	0.03
Blepharostoma tricophyllum (L.) Dum.	55	7.10	0.10	0.01
Cephalozia lunnifolia (Dum.) Dum.	59	7.10	0.60	0
Polytrichum juniperinum Hedw.	44	6.45	1.36	0.09
Bryhnia novae-angliae (Sull & Lesq. *ex.* Sull.) Grout	8	5.81	0.92	0.05
Dicranum ontariense Peters.	18	5.16	3.21	0.17
Campylium stellatum (Hedw.) C. Jens.	12	3.87	0.16	0.01
Brachythecium velutinum (Hedw.) B.S.G.	92	3.87	0.57	0.02
Brachythecium campstre (C. Müll.) B.S.G.	3	3.87	0.48	0.02
Thuidium recognitum (Hedw.) Lindb.	78	3.87	0.89	0.03
Brachythecium populeum (Hedw.) B.S.G.	86	3.23	1.49	0.05
Brotherella recurvans (Michx.) Fleisch.	88	3.23	1.43	0.05
Hypnum pallescens var. *protruberans* (Brid.) Aust.	29	3.23	0.09	0
Cephalozia bicuspidata (L.) Dum.	60	3.23	0.50	0
Rhytidiadelphus triquetrus (Hedw.) Warnst.	48	2.58	2.15	0.06

Species	species #	% Frequency	Mean % cover when present	Total mean % cover
Plagiomnium medium (B.S.G.) Kop.	38	2.58	1.78	0.05
Plagiothecium cavifolium (Brids.) Iwats.	37	1.94	4.83	0.09
Scapania nemerosa (L.) Dum.	73	1.94	0.05	0.
Lophozia heterocolpos (Thed.) M.A. Howe	68	1.94	0.07	0
Dicranum viride (Sull & Lesq. *ex.* Sull) Lindb.	80	1.94	0.07	0
Plagiochila porelloides (Torrey *ex.* Nees) Lindenb.	70	1.29	1.65	0.02
Thuidium delicatulum (Hedw.) B.S.G.	53	1.29	0.85	0.01
Platygyrium repens (Brid.) B.S.G.	30	1.29	0.18	0
Cirriphyllum piliferum (Hedw.) Grout	95	1.29	3.55	0.05
Pohlia nutans (Hedw.) Lindb.	42	1.29	0.05	0
Calypogeia muelleriana (Schiffn.) K. Müll.	58	1.29	0.05	0
Riccardia latifrons	82	1.29	0.05	0
Frullania eborascensis Gott.	84	1.29	0.05	0
Sphagnum girgensohnii Russ.	49	1.29	0.30	0
Sphagnum squarrosum Crome	51	1.29	5.20	0.07
Trichocolea tomentalla (Ehrh.) Dum.	74	0.65	0.05	0
Mnium sp.	32	0.65	0.05	0
Cephalozia sp.	89	0.65	0.05	0

Species	species #	% Frequency	Mean % cover when present	Total mean % cover
Frullania oaksiana Aust.	62	0.65	0.05	0
Ceratodon purpureus (Hedw.) Brid.	91	0.65	0.05	0
Brachythecium reflexum (Starke & Web. *ex.* Mohr.) B.S.G.	94	0.65	0.05	0
Frullania brittoniae Evans	61	0.65	0.10	0
Eurynchium pulchellum (Hedw.) Jenn.	85	0.65	1.20	0.1
Crustose lichen	77	0.65	0.70	0
Sphagnum nemoreum Scop.	90	0.65	14.00	0.09
Climacium dendroides (Hedw.) Web. & Mohr	13	0.65	3.70	0.02
Calypogeia integristipula Steph.	56	0.65	0.40	0
Diphyscium foliosum (Hedw.) Mohr	87	0.65	0.20	0
Gymnocolea inflata (Huds.) Buch	83	0.65	0.50	0
Oncophorus wahlenbergii Brid.	34	0.65	0.40	0
Mean	-	13.11	1.23	0.20
standard deviation	-	18.85	2.05	0.70
n	-	79	79	79
standard error	-	2.12	0.23	0.08

March 14, 1996

Peter Etheridge, Manager
Fundy Model Forest
R.R. #4, Aiton Road
Sussex, NB E0E 1P0

Dear Peter:

Enclosed is the year-end report for my project, "Effects of forestry practices on bryophyte diversity". I have incorporated a summary of our progress with the objectives (p. 2). The two foci for this season were (a) to establish the permanent quadrats in such a way that they could be relocated after harvest, and (b) to collect baseline data on bryophyte diversity. Both were accomplished as planned. Bryophyte identification is always time-consuming, but the species list and descriptive statistics are now complete, and form the basis for a fourth-year honours thesis (enclosed) by my student, Mary Sims.

We were not able to collect data on the immediate effects of harvest disturbance because site preparation was not completed in time. However, equally valid data on disturbance will be collected in spring 1996. This is an inconvenience but does not affect the project's outcome.

With continued funding from the Fundy Model Forest, we will be able to track bryophyte recovery and make recommendations on forest management practices to maintain bryodiversity within 5 years.

If you require more detailed information, please do not hesitate to ask.

Sincerely,

Kate

Dr. Katherine A. Frego

Table 2. PCCA results, showing unique and shared influences of canopy, litter and topography on bryophyte species pattern. Litter showed the highest unique correlation with the species pattern, followed by topography. The three-way overlap showed the lowest correlation.

Contribution to species pattern	Environmental variables	Sum of canonical eigenvalues	% of total inertia (species pattern)
Unique	litter	1.957	13.64
	topography	1.060	7.77
	canopy	0.233	1.71
Shared	topography and litter	0.176	1.29
	topography and canopy	0.051	0.37
	litter and canopy	0.046	0.34
	litter and canopy and topography	0.041	0.30
Total		3.564	25.12