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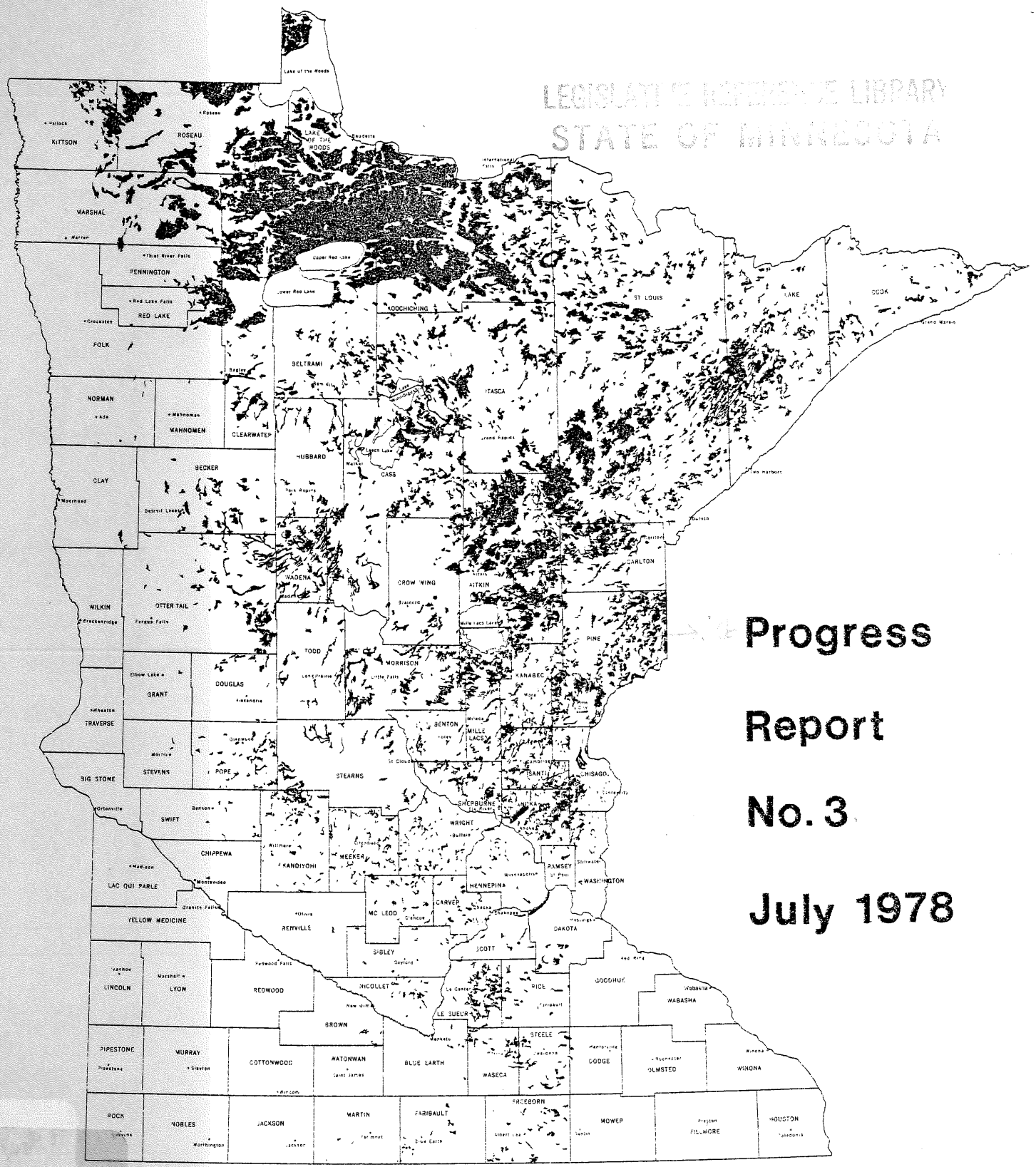

Progress Report No. 3

July 1978

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

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245 MINNESOTA PEAT PROGRAM PROGRESS REPORT, JULY 1978

Submitted by the

Minnesota Department of Natural Resources

Funded by the

Minnesota State Legislature

(1978 - 1979 Biennium)

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PEAT PROGRAM PROGRESS REPORT
1978 - 1979 Biennium Legislative Appropriation

FOREWORD

The studies in this part of the Peat Program are complementary, as well as supplementary, to those funded by the Upper Great Lakes Regional Commission in the Phase II -- Peat Program.

These studies cover such areas as water resources of peatlands, the importance of peatland habitat to wildlife, forest and agriculture reclamation of peatlands, and the potential impact of peat development or non-development on, or adjacent to, the Red Lake Indian Reservation. The results of these studies will provide information necessary for the formulation of a policy governing the management of state peatlands.

Water Resources of Peatlands (Dr. Ken Brooks, University of Minnesota)

TASK 1: SELECT STUDY AREAS

The four field study areas that have been previously selected are:

Corona Bog -- Harvesting Operation
Fens Bog -- Reclamation
Toivola Bog -- Natural Peatland N.E. Minnesota
Red Lake Bog -- Natural Peatland N.W. Minnesota

TASK 2 and 3: FIELD INSTRUMENTATION

A summary of the field instrumentation installed at each study area is provided in the table below. Numbers in parenthesis indicate instruments that are not yet installed. In addition suction lysimeters will be installed in the forestry plots at Fens to evaluate fertilizer movement in peat. Additional wells and staff gauges will be installed at Fens as the reclamation plots are prepared.

	Toivola	Corona	Fens	Red Lake	Total
Water table wells	20	18	25(25)		63(25)
Piezometers	60				60
Recording wells	1	1	1		3
Recording precip.	1	1	1	1	4
Non-recording precip.	11	3	2	1	17
Outlet gauging station	1	2	2	1	6
Staff gauges	1	2	2(6)	1	6(6)
Weather shelter	1	1	1	1	4
Recording temperature	1	1	1	1	4
Lysimeters	(1)	(1)	2		2(2)
Evaporation pan			1		1
Evaporometer			1		1
Bench marks	12(8)	1	1		14(8)

Levels have been run at Corona, Fens, and Toivola that tie the wells into a common datum. At the 20 ground water stations located throughout the Toivola bog, wells and piezometers have been tied into station benchmarks but only 3 miles of levels have been run due to wet conditions.

TASK 4: REVIEW LITERATURE

Literature pertaining to peatland hydrology and water quality is being continually collected and reviewed. Efforts in the last quarter were concentrated on components of the water balance equation, especially for Minnesota.

TASK 5: COLLECT FIELD DATA

Water Quality

Preliminary water quality results are provided in the table below. Only data for the ice-free period to present is given. The locations for these water quality stations are as follows:

Toivola Outlet -- Jula Creek at the outlet of the Toivola Bog draining 16 sq. mi. in St. Louis County. This is the natural bog.

Corona south -- The ditch outlet of the Corona bog near Cromwell draining approximately 900 acres. This site is an existing milled peat harvesting operation.

Corona north -- Located also at the Corona bog, this station represents about one-half the watershed of Corona south.

Red Lake -- The Tamarack River east of Red Lake draining a natural peatland of over 100 sq. mi.

Range in Water Quality Values for Select Peatlands in Northern Minnesota for the Period March 31 to June 21, 1978

(Values in mg/l except where noted)

Parameter	Toivola Outlet	Corona South	Corona North	Red Lake
Temperature ^{o}C	0 - 19	1 - 21	1 - 25	17 - 21
pH	5.3 - 6.1	4.9 - 5.8	4.4 - 5.2	7.2
spec. cond. µmhos/cm	31 - 40	38 - 110	48 - 81	89 - 90
Dis. oxygen	4.4 - 11.3	1.8 - 9.8	4.3 - 11.6	8.1 - 8.3
Color Plt. units	65 - 225	150 - 670	125 - 450	110 - 200
Acidity	7.9 - 21.3	16.6 - 63.5	16.3 - 55.5	12.4
Alkalinity	7.5 - 14.5	0.5 - 33.0	0.0 - 7.0	
Sus. sediment	1.1 - 2.6	3.0 - 28.7	2.9 - 37.3	2.9
% volatile	100	≈100	100	
Total P	<.01 - .03	.02 - .20	.03 - .10	.02
Total N	.4 - 1.1	2.2 - 4.2	1.6 - 2.6	.06
Ammonia - N	<.01 - .27	1.21 - 2.80	.70 - 1.62	.05
Nitrate + Nitrite - N	<.01 - .08	<.01 - .43	<.01 - .37	<.01
Potassium	.44 - 2.41	<.25 - 2.08	.81 - 5.78	1.05
Calcium	2.40 - 7.25	1.32 - 12.85	1.17 - 4.19	16.26
Magnesium	.80 - 1.91	.27 - 3.62	.52 - 1.75	5.51
Iron	.34 - .85	1.43 - 10.39	.69 - 3.32	.16
Sodium	<.12 - 1.32	<.12 - 4.02	2.36 - 5.83	.76
Manganese	.03 - 1.8	.05 - .26	.05 - .13	.05
Zinc	<.01 - 0.5	<.01 - .03	<.01 - .03	<.006
Copper	<.01 - .01	<.01 - .07	<.01 - .04	<.006
Boron	<.006	<.006	<.006	<.006
Lead	<.006	<.006	<.01 - .11	<.006
Nickel	<.025	<.025	<.02 - .03	<.025
Chronium	<.01 - .04	<.01 - .03	<.03 - .05	< .01
Cadium	<.006	<.006	<.006	<.006
Cobalt	<.12 - .19	<.12 - .25	<.12 - .27	<.12
Aluminum	<.06 - .12	.10 - .64	.34 - 1.17	<.06

Water quality values vary on both a seasonal and storm-related basis. Interpretations of this information cannot be made at this time. Water quality analysis for mercury, selenium, and arsenic have not been returned from the laboratory. During the next quarter, water quality samples will be obtained from ground water wells and Biological Oxygen Demand (BOD) and downstream assimilation studies will be made.

Measurements of various components of the water balance equation are being coded for computer analysis and results will be reported in the following progress report.

TASK 6 - 9: HYDROLOGIC MODELING

These tasks have not been initiated at this time.

The Importance of Peatland Habitats to Small Mammals in Minnesota
(Dr. Elmer Birney, University of Minnesota)

PROGRESS OF STUDY:

Preparations for the coming field season have been the primary concern this quarter (March - June, 1978). Work was directed toward organization of a second survey of peatland small mammals and the study of small mammal populations in a single region.

SECOND SURVEY:

A second survey will be conducted from June 26 to September 16. Each of the sites sampled during the first survey (August 30 - November 15, 1977) will be trapped again. Repetition of the survey will strengthen our knowledge of the small mammals found in peatlands by providing additional distribution records, by indicating whether any major changes have occurred in species distributions or abundance since the first survey, and by increasing the chance of capturing species missed during the first

survey. This is particularly important with respect to hibernating species, which were largely absent from the first survey because of the late trapping date.

Procurement of equipment, refinement of field techniques, and hiring of personnel for the survey has been completed at this time.

PERMANENT STUDY:

Work on this aspect of the study has involved analysis and refinement of study objectives. procurement of necessary equipment, designing and testing of traps, review of site choice, and hiring of personnel. The permanent study will examine small mammal populations found on a variety of peatland habitats within a single region. These populations will be monitored throughout the year to provide information concerning community structure and stability, and the degree of dependence by small mammal populations on particular aspects of the peatland environment. The permanent study will provide a temporal approach to the understanding of peatland mammals whereas the survey is a geographic or spacial approach to the problem. Data for the permanent study will be gathered by means of mark-recapture and removal trapping techniques. In addition, analysis of habitat structure and diversity and abiotic paramters will be conducted.

Lake Agassiz Peatlands Natural Area had been tentatively chosen as the permanent study site because it offered a variety of contiguous peatland habitats within relatively close proximity. A reconnaissance of the area, conducted May 9 to May 12, showed that access to this area would be extremely difficult during portions of the year. Because access to the trapsites at all times is essential, this area is no longer considered suitable. All roads in the vicinity of Big Falls that are open throughout the year were surveyed for potential peatland sites. Although Waskish is a potential location for the study, habitat variety,

year-round accessibility to sites, and lodging considerations make Big Falls the best choice for the permanent study.

The selection of suitable live traps for the study brought about an unanticipated situation involving added expense, time, and work. The wet conditions of the peatland habitats present unique problems in capturing small mammals and keeping them alive until the traps are checked. Most commercially-produced live traps become flooded, and few traps exist that will capture and keep living trap-shy species such as shrews and bog lemmings. As a result, new traps had to be designed. For mice and squirrels, the Sherman live-trap has been modified by adding a large, water-tight nest box. For shrews and bog lemmings, a water-tight pitfall trap with a floating nest box has been designed.

Assistants for the permanent study have been hired through September. Work currently is being done to construct 500 modified Sherman traps and 500 pitfall traps. Completion of the trap construction is expected by the end of June. Field work for the permanent study is expected to begin the first week of July.

Bird Population Structure and Seasonal Habitat Use as Indicators of Environmental Quality of Peatlands (Dr. Dwain Warner, University of Minnesota)

PROJECT NATURE AND OBJECTIVES:

This study is designed to obtain quantitative data on bird species that utilize resources of the various vegetation types growing on major peat deposits in Minnesota. The period from 15 April through 15 June, 1978 constitutes this reporting period.

The winter studies, which were based at Norris Camp, were terminated in late March. On April 1, field studies began in Beltrami County with the base in Waskish.

Living quarters were at the Cove Resort until personnel moved to the DNR Fish Hatchery after the walleye spawning run and hatch.

An office-laboratory is also maintained in another DNR cabin.

The field personnel total ten persons (plus most of the time of the principal investigator) for the bird studies and the vegetation analyses that will begin in late June.

Additional funding from the DNR has provided an entomologist to this project for the period 1 June through 30 September of this year. This will provide some quantitative information on insect species composition and numbers (biomass) by habitat type. These data will be related to the bird species, their numbers and their use of insect food resources. The entomologist has begun his survey.

TYPES OF BIRD DATA COLLECTION:

There are four methods of data collection as follows:

1. Transect censuses

During a major part of April and early May, a total of 25 census transects were selected, measured, marked and a walking trail was cut through each. These census transects are located near Minnesota Highway 72 from about ten miles south of Waskish to near the Beltrami-Lake of the Woods County line. Their habitat type and lengths are as follows:

Transect No.	Habitat Type	Length (in ft.)	Direction (from 0' to end)
*MP 1	scrub fen	4000	E to W
MP 2	scrub fen	3500	W to E
MP 3	open fen	4000	W to E
MP 4	open fen	3500	E to W
MP 5	muskeg	4000	E to W
MP 6	muskeg	3500	W to E

Transect No.	Habitat Type	Length (in ft.)	Direction (from 0' to end)
MP 7	open bog	4000	E to W
MP 8	open bog	3500	W to E
MP 9	intermed. spruce	2500	S to N
MP 10	intermed. spruce	2500	W to E
MP 11	intermed. spruce	2500	E to W
MP 12	stunted tamarack	3000	S to N
MP 13	stunted tamarack	4000	S to N
MP 14	swamp thicket	6000	S to N
MP 15	swamp thicket	3000	S to N
MP 16	tamarack (intermed.)	3000	S to N
MP 17	spruce-feathermoss	5500	S to N
MP 18	spruce-feathermoss	2500	S to N
MP 19	white cedar	2500	E to W
MP 20	white cedar	2500	S to N
MP 21	white cedar	2500	W to E
MP 22	upland	3500	S to N
MP 23	upland	4000	N to S
MP 24	tamarack (mature)	4500	N to S
MP 25	cut-over spruce	2000	N to S

*MP = Minnesota Peatland

By 13 June, a total of 142 censuses had been made on these transects. Three, possibly four, additional census transects will be established:

Tamarac River (ca. ten miles)
Rapid River (ca. two miles)
Raised Bog
Cut-over white cedar (possibly)

2. Road censuses--by car

Four census routes of ten miles each were established and run during April and May for woodcock, snipe, grouse, and owls (dusk) and for sharptailed grouse and ruffed and spruce grouse and snipe (dawn).

3. Netting plots

Four netting plots were established with 35 to 60 nets placed 50 meters apart in:

white cedar
intermed. black spruce
tamarack
smaller black spruce

Birds captured are banded with numbered bands and they are also color banded. These birds are under intensive study for territory size, movements, reproduction, feeding behavior, etc.

4. Daily summary of all bird observations

Each day a total list is compiled of all birds observed by all personnel. This list includes all habitat types, including Red Lake, rice paddies, etc.

SIGNIFICANT FINDINGS TO DATE:

A few special, and partly unexpected, findings to date are as follows:

(a) Sharp-tailed grouse that were present in the bog habitats in winter have maintained numerous well-defined leks in ribbed fen and scrub fen areas all spring. As of 10 June as many as 20 birds are still on one lek in the early morning. Woodcock are common; snipe are abundant.

(b) Bird populations in the various plant associations on peatlands are much lower than expected and species diversity is not great.

(c) Among the passerine birds (song birds) there are striking differences in reproductive periods in peatland habitats. For example, as of 13 June, the Palm Warbler has had young out of the nest for many days and yet among a very substantial number of Yellow-bellied Flycatchers that have been examined none has yet reached breeding condition.

(d) Individuals of several species are still arriving as new occupants of several habitat types. For the moment we are assuming that these birds are late spring migrants.

The above statements are only interim reporting and should not be interpreted as final conclusions of any kind.

During the next three months, the censuses and netting will continue. A major new phase of the study will be the vegetation analysis that will be done in late June and early July.

Utilization of Minnesota Peatland Habitats by Large Mammals and Birds (Dr. John Tester, University of Minnesota)

From 1 April to 27 June 1978, field work in the Hubbard County study area included regular monitoring of radio-tagged animals, continued trapping and tagging efforts, and additional vegetational mapping. Newly initiated projects included a pellet count survey and weekly track surveys.

Trapping efforts have continued in an attempt to replace animals that are lost to the monitoring system due to emigration, predation, or transmitter failure. Since 1 April, 74 trap nights for hare have resulted in four newly radio-collared animals. Fifty-two mirror trap nights have led to the radio-tagging of four male ruffed grouse. In addition two incubating ruffed grouse hens have been captured and radio-marked-these with the aid of a nest trap and a landing net. In April 33 deer trap nights, using food bait, yielded one recapture and one casualty. Since the snow melt, salt bait sites were established and checked for activity. In late June deer trapping efforts resumed using a salt-soil mixture as bait. Twelve trap nights have been logged thus far - with no captures.

As a result of these and earlier trapping efforts, 17 animals are currently being monitored on a regular basis. These include six ruffed grouse, six hares, two deer, and three spruce grouse. Deer are located an average of once every 24 hours; hare and grouse are generally located once every 48 hours. In addition two radio-tagged spruce grouse that have left the study area are monitored irregularly, when their signals can be picked up. Four other

radio-tagged hares were monitored for various time periods during the quarter until one shed its collar, one was eaten by a predator, and two could no longer be found.

In addition to routine animal locating, four attempts have been made in this quarter to collect data serially. At these times a set of animals are monitored as often as possible through several consecutive hours. These data have aided in determining the extent of the animals' home ranges, the patterns of day/night movements, and the extent to which various habitats are utilized.

Additional information on the activity patterns of radio-marked animals was gathered using the rustrak recording device described in Progress Report No. 1. As intended, several days of continuous data were collected using one animal or combinations of several animals. Unfortunately, the lack of precedence for this work using pulsing signal transmitters has led to difficulties in interpreting the strip charts. While advice on the interpretation of these charts is sought, further use of the rustrak recorder has been indefinitely postponed.

In addition to data on transmittered animals, much effort has been made to record sightings and sign of unmarked animals. Sighting records for this quarter include 25 of deer, 19 of ruffed grouse, three of spruce grouse, and 44 of hare. Among these sightings were four of fawns, one of ruffed grouse brood, and five of leverets. There are also records of two spruce grouse broods, a ruffed grouse brood, and a late ruffed grouse nest belonging to hens that are radio-marked.

Animal sign records consist primarily of notes on tracks, droppings, and sounds. For example, the drumming activities of several ruffed grouse were recorded; and more than seven drumming areas (with one or more logs) were investigated.

Observations of deer tracks have become so numerous in recent weeks that a regular road tracking survey has been initiated. Notes are taken on the habitat types from which tracks emerge onto the roads, the habitat types into which the tracks disappear, and the types that are bypassed by utilizing the road. A drag is used to obliterate old tracks after each recording session.

Sighting and sign records have been kept for many species other than those in the telemetry program. Among the mammals observed are coyote, weasel, skunk, woodchuck, porcupine, gopher, and raccoon. Avian species noted this quarter include barred owl, red-tailed hawk, mallard, woodcock, snipe, nighthawk, and numerous passerines.

Another project of the spring quarter was the sampling of major habitat types for deer, hare, and grouse droppings. Between 24 May and 4 June 1978, pellet count surveys were made in eight peatland habitats in the Hubbard County study area. These were compared to pellet surveys that were done in similar types of habitat to Beltrami County between 17 and 23 May 1978.

The results showed that deer and hare densities are fairly similar in comparable habitat types. However, an additional four habitats were sampled that occurred in only one of the two areas, thus making complete comparisons impossible. These types were white cedar swamp and tamarack with white cedar understory in Beltrami County, and jack pine forest and upland deciduous forest in Hubbard County. Over 90% of the deer pellets recorded in each of the two study areas were found in these unique habitats.

Grouse data collected during the survey were too limited to allow any generalizations to be made. However, information gathered in the two areas by visual census, drumming counts, and nest location will be compared in the near future.

Another major project in the Hubbard County area this quarter was map work. Field reconnaissance, ground measurements, and aerial photograph interpretation were used in an effort to complete the vegetational coding of the study area base map. Although that project appears to be finished, occasional refinements of detail continue.

The Relationship of Amphibians and Reptiles to Peatland Habitats in Minnesota (Dr. Philip Regal, University of Minnesota)

The first field season of the amphibian and reptile peatlands project has been successfully initiated and is now underway. Personnel are housed at the Big Falls Forestry Station, Koochiching County. The work is centered within a fifteen mile radius of Big Falls in the Koochiching and Pine Island State Forests. The Big Falls station has worked out very well. Acknowledgment is gratefully extended for the cooperation of Ben Petz, Les Blakely, Chuck Spoden and Milt Stenlund of the DNR for use of the station and for general assistance without which the work would be severely hampered.

A calendar of events will summarize the major activities to date:

April 10-21: Arrival and initial reconnaissance of general area; selection of trapping sites.

April 22-May 5: Drift fence traps installed in selected habitat types.

April 29: Participation in Minnesota Peat Symposium.

May 10-12: Western Koochiching County and Upper Red Lake peatland collecting trip.

May 13-present: Experiments involving effects of bog water on egg masses and tadpoles of various anuran (frog and toad) species.

In addition to these major events there has been an ongoing program of frog call surveys, water chemistry sampling, plant and insect collecting, and general reconnaissance.

The field season is still in progress, hence detailed analysis of data is not yet available but the following general assessment can be made at this time:

1. Drift fence trapping program.
   Drift fences are 50 foot by 24 inch strips of aluminum which are buried 6 inches - 1 foot deep in the substrate. One funnel trap and four pitfall traps are buried along each side of the fence. Animals hit the fence, follow it, and may fall into one of the traps. The traps collect amphibians, reptiles, small mammals, and insects. Seven such fences have been installed. Distinct peatland habitat types as defined by Fox, Malterer and Zarth in the Minnesota Peat Inventory were chosen as trapping sites. A typical non-peatland upland site was also chosen. Approximate location of the sites is given in Table 1. The trap sites fall into three distinct clumps to the north, south and west. This was done to insure familiarity with several peatland localities, thus providing a wider perspective. The drift fences have worked out very well. To date almost 350 specimens have been obtained from the traps alone. This is much better than anticipated. Initial results (in terms of species presence/absence) are given in Table 2. Most specimens from the traps and those caught by hand have been preserved for later analysis. No detailed analysis of the drift fence trapping is possible at this time but several very noticeable phenomena have been observed. For example, calling frogs were first heard on April 16 from upland pools and reproductive adults were being caught as soon as the first drift fence was installed (April 22). It was not until May 15 that the traps in the open bog and muskeg sites began to catch animals and these have all been small, apparently pre-reproductive individuals.

This suggests interesting variation in peatland habitat utilization and seasonal movements correlated with age/sex differences. More information on this and other observations must await later analysis.

The drift fences have proven to be invaluable but they are not without their problems. They are extremely difficult to set up in some habitats, involving cutting a trench through a tangle of roots, etc. In saturated soils the cans must be weighted down and may fill completely with water. Also they are somewhat biased in sampling since larger forms (turtles, larger snakes and arboreal forms such as tree frogs) tend to be under sampled. In spite of these difficulties, they are the best technique currently available in this type of terrain.

2. Experiments with breeding ecology.

In certain bogs and drains the water is notable for its unique chemistry (low pH, low ionic content and color). It was suggested in the project proposal that such characteristics might impose severe constraints on amphibian breeding whereas minerotrophic sites would offer no such chemical constraints. Observations indicate that bog drains (sensu Fox et al.) are a rather dramatic test of this idea. At certain localities (along Porter Ridge Road, south of Big Falls; the northern edge of Lake Agassiz Natural Peatlands Area), bog drains and sandy highland ridges abut bringing into close proximity two distinct potential breeding habitats (i. e. upland pools, marshes and bog drain pools). It was noticed that the Wood Frog (Rana sylvatica), Chorus Frog (Pseudacris triseriata), Grey Treefrog (Hyla versicolor), and American Toad (Bufo americanus) seemed to exclude themselves from these bog drains although both sites offered shallow pools with similar physical characteristics. The Spring Peeper (Hyla crucifer) is the only frog that was heard calling from the bog drains, but only an occasional individual and never

the concentrated activity heard elsewhere.

The effects of bog drain water on eggs and tadpoles of three species were investigated. Eggs were obtained from the field or from frogs which copulated in the lab. Water treatments used were:

a. Upland Pool (pH=6.5-7.0)
b. Bog Drain (from Porter Ridge Road; pH=4.0-4.2)
c. Adjusted Bog Drain (NaOH used to buffer water; pH=7.0)
d. Tap Water (from well; pH=7.0-8.0)
e. Adjusted Tap (acidified with H_2SO; pH=4.0-4.2)

Two sets of eggs or tadpoles were run for each treatment. The data has not been statistically analyzed but the results were clear enough that the following observations could be made:

i. Wood Frog (Rana sylvatica) Experiment. Advanced egg masses were taken from the field. They did well (in terms of hatching) in all treatments except the Bog Drain water and Adjusted Tap. In the Bog Drain treatment they had difficulty in breaking out of their egg jelly coats. Tadpoles that did hatch in the Bog Drain water were smaller and less robust when compared to upland pool tadpoles. Tadpole mortality in the Bog Drain was much higher than in the Upland Pool. Only 4 Bog Drain tadpoles were left after several days whereas none had died in the Upland Pool.

ii. American Toad (Bufo americanus) Experiment. Eggs were taken from toads which copulated in the lab. Large numbers of tadpoles hatched in all treatments except Bog Drain and Adjusted Tap.

No hatching at all occurred in these treatments.

iii. Spring Peeper (Hyla crucifer) Experiment.
Same as for the American Toad.

These results clearly show that bog drain water has a significant effect on egg masses and tadpoles of these three species. It is predicted if the egg masses of the Wood Frog had been freshly laid rather than advanced, they also would have shown no hatching. Acidity seems to be a major factor since the buffered Bog Drain treatment permits seemingly normal hatching; however, other factors associated with the bog drain water (e.g. plant secondary compounds) cannot be ruled out at this time. The areas where such bog drain pools are found are not rare. These results suggest a very strong selective pressure against frogs utilizing these bog drain sites for breeding. As noted the observations indicate that frogs and toads do seem to actively avoid these areas as breeding sites. Further investigation of this phenomenon is planned.

3. Other Activities.

Water chemistry. pH and dissolved oxygen is taken in the field at the trap sites and other sites of interest on a regular basis. Bottled samples are taken for ion (Mg and Ca) analysis.

Frog call surveys. Evening frog call surveys are periodically made along the roads near the drift fence sites. Tape recordings are made for later analysis.

Collecting surveys. To gain a wider perspective on the herpetofaunal-peatlands relationship, monthly collecting trips to the western Koochiching County - Upper Red Lake Peatland area are planned. As noted, one such trip has been made. This allows assessment of very large fens which are

not found on an extensive scale in the Big Falls area.

Table 1. Approximate locations of drift fence trap sites. Nomenclature for vegetation follows the Fox et al., Minnesota Peat Inventory scheme. Locations refer to U. S. Geological Survey 1:24000 orthophoto quadrangle maps.

A. Upland Pool (mixed conifer-hardwood forest bordering on upland ridge marsh; this is the non-peatland site sampled).
Johnson Landing NE, Minn: T66N, R25W, Sect. 20, SW quarter.

B. Swamp Conifer: Cedar-Spruce (SCC)
Johnson Landing NW, T66N, R26W, Sect. 27, NE quarter.

C. Swamp Conifer: Spruce (SCS)
Johnson Landing NE, Minn: T66N, R25W, Sect. 29, NW quarter.

D. Swamp Conifer-Tamarack (SCT)
Johnson Landing NE, Minn: T66N, R25W, Sect. 29, SW quarter.

E. Open Bog (BO)
Littlefork SW, Minn: T67N, R27W, Sect. 15, NE quarter.

F. Muskeg/Swamp Conifer:Spruce (BM/SCS) (This is a small dense black spruce island which grades off into surrounding muskeg)
Littlefork SW, Minn: T67N, R27W, Sect. 15, NE quarter.

G. Open Fen/Swamp Thicket (FO/ST) (This site has extensive areas of open sedge interspersed with large clumps of shrubs.)
Bog Falls SE, Minn: T154N, R25W, Sect. 33, SE quarter.

Table 2. Species Recorded from Drift Fence Trapping Sites (April 15-June 5). I have not delineated subspecies since in some cases positive identification has not been made.

AMPHIBIA	Upland Pool	Open Bog	Muskeg/Swamp Conifer Spruce	Open Fen/ Swamp Thicket	Swamp Conifer: Tamarack	Swamp Conifer: Spruce	Swamp Conifer: Cedar-Spruce
Frogs and Toads							
Hylidae							
Hyla crucifer (Spring Peeper)	X			X	X[1]	X[1]	X[1]
Hyla versicolor (Grey Treefrog)	X[1]			X[1]			
Pseudacris triseriata (Chorus Frog)	X			X			X
Ranidae							
Rana sylvatica (Wood Frog)	X	X	X	X	X	X	X
Rana pipiens (Northern Leopard Frog)				X			
Bufonidae							
Bufo americanus (American Toad)	X	X	X	X	X	X	X
Salamanders							
Ambystomatidae							
Ambystoma laterale (Blue-spotted Salamander)	X			X		X	
REPTILIA							
Snakes							
Colubridae							
Thamnophis sirtalis (Eastern Garter Snake)	X[1]						
Storeria occipitomaculata (Red-bellied snake)	X						
Turtles							
Chrysemys picta belli (Western Painted Turtle)	X[1]						

[1] Species not caught in trap but seen, heard, or caught by hand at that site.

Agricultural Reclamation of Peatlands (Dr. Rouse Farnham, University of Minnesota)

This progress report covers the period from April through June 1978. It includes a report of the progress of both the greenhouse growth trials at the University and the establishment of vegetable and field crops at the Wilderness Valley Peat Research facility of Iron Range Resources in St. Louis County, Minnesota.

I. GREENHOUSE GROWTH TRIALS

Uniform tomato and mum plants were obtained from local florists. They were transplanted when about 6 inches high to pots and placed on a moist sand bed which was constructed as an automatic watering facility to eliminate moisture stress as a factor in plant growth. Plants were potted March 20, 1978.

A. PEAT TYPES AND SOILS

1. W.V.F. Field 8 surface peat.
2. W.V.F. Field 8 bottom peat (near substrate).
3. W.V.F. Field 8 mineral substrate.
4. St. Louis Co. SAPRIC peat (decomposed).
5. ARLBERG SPHAGNUM peat (v. acid).
6. AITKIN CO. HEMIC - Surface, acid peat.
7. ROSEAU CO. HEMIC-FIBRIC, non acid peat.

B. FERTILIZER TREATMENTS

1. 5.0 grams 10-10-10 fertilizer plus an all purpose minor element mix per pot.
2. Unfertilized - no additions per check.

C. ASSAY PLANTS

1. TOMATOES - HYBRID PATIO variety.
2. MUMS - NEPTUNE variety.

D. REPLICATIONS

3 replicates (3 plants each treatment except where noted) The seven peat types and substrate soils were used in order to assay the relative growth of these two types of

plants on a variety of Minnesota peats. Relative comparisons are then possible in evaluating the W.V.F. peat where field trials are being conducted this summer on both surface and excavated (bottoms) peats.

Tables 1 and 2 show the results of the evaluations of the relative growth rates of tomatoes and mums grown under greenhouse conditions using an automatic watering system to nearly simulate actual peatland conditions.

TOMATO EVALUATIONS:

Table 1 shows the data evaluating the relative growth of tomatoes after 8 weeks for the various peat types both with and without fertilizers.

These data show that under these conditions bottom peat was not as good for tomatoes as the surface peat. This was the case whether fertilized or not. The W.V.F. mineral substrate which was a highly reduced sandy clay material was a very poor medium for growth of tomatoes. Plants were very stunted during entire growth period.

The Sphagnum peat from Arlberg which is extremely acid (pH 3.4) did very poorly and tomato plants were very stunted. The Aitkin County hemic peat and the Roseau non acid hemic peat were better soils for tomatoes under these trials than the W.V.F. surface and bottom peats. One more evaluation of these plants will be made late this summer.

MUM EVALUATIONS:

Table 2 shows the data for evaluation of mum plants under the various treatments and peat types. This data shows the same trends as with the tomato trials. The W.V.F. surface peat showed slightly better results using mums than the bottom peat. The W.V.F. sandy clay substrate produced very poor growth and the plants were stunted from the start. The Sphagnum peat

produced poor growth using mums and showed minor element deficiencies. The best peats for mums appears to be the St. Louis Sapric peat and the Roseau non-acid hemic type.

Another evaluation of these trials will be made in late summer.

II. W.V.F FIELD TRIALS

Work was delayed on excavated plots because of late spring-ice in the peat. Contractors did not complete excavation plots on schedule so planting of vegetable and field crops (grain-grass) will be delayed. Area is presently excavated and is being pumped to dry out soil for planting.

Surface plots in field 7 W adjacent the excavated area have been planted and following tasks completed.

A. June 1-2. Plots delineated in N. part of field 7 W (W.V.F.), staked 150' x 100' with center aisle 10' and E-W aisles 10'. Two replicates for vegetable crops (2 rates of fertilizer) on plots 60' x 100' were extablished.

B. June 5-9. Because of a vigorous growth of quack grass on peat areas, the herbicide "Round Up", which is chemically GYLPHOSATE, was used to eliminate this grass before seeding crops. 2 applications were used in order to adequately kill the quack grass.

C. June 12-14. Vegetable plot areas were rotovated to 8" and were raked to remove dead quack grass rhizomes and other weeds. Rows were planted for the vegetable crops and fertilizer applied. Fertilizer applied at two rates - 300 lbs/acre rate of 6-24-24 and 200 lbs./acre rate of 6-24-24. This provides two treatments for fertilizer response evaluations.

D. June 20-23. All vegetable seeds were planted. Figure 1 shows the plot layout including 10 kinds of vegetables under two fertilizer rates.

E. June 26-30. Transplanted onions, cabbage, cauliflower and planted seed potatoes.

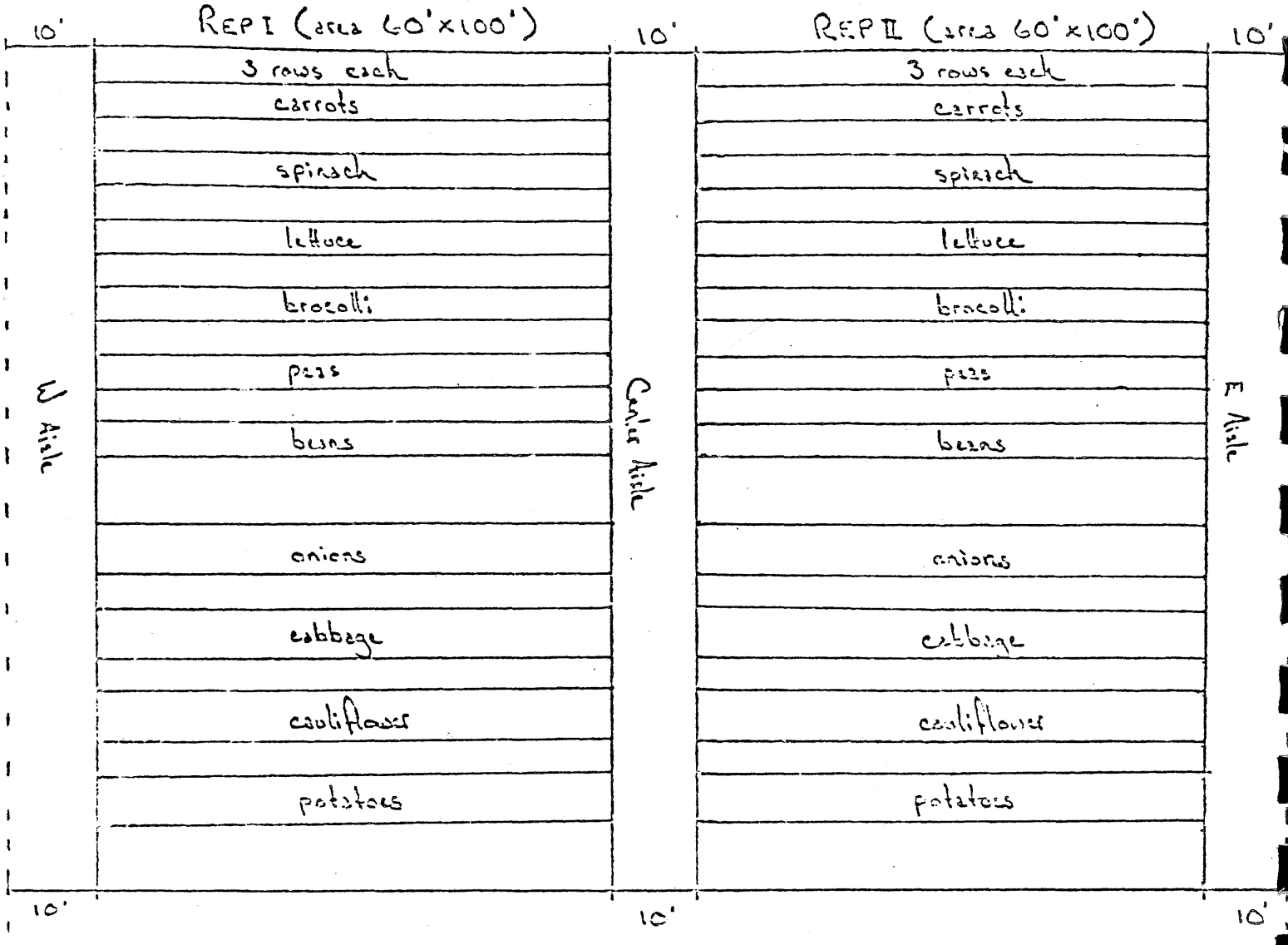
Applied "Round Up" herbicide to kill quackgrass and weeds in adjacent area south of vegetables which is to be planted to several grass, grain and forage crop varieties as soon as possible.

Excavated area has been dug and ditched and presently is being pumped prior to planting. These plots will be late this year due to contractors delay in excavating peat.

VEGETABLE PLOTS

ROAD

FIELD 7W W.V.F.



South adjacent area (similar to above)
to be planted to Grass-Grain
following quackgrass eradication
with denoted herbicide

TABLE 1. GREENHOUSE TOMATO EVALUATIONS - 8 WEEKS GROWTH

POTTED PATIO HYBRID TOMATOES

PEAT TYPE	HEIGHTH (cm) AVE. (3 PLANTS)	STEM DIAMETER (cm) AVE. (3PLANTS)	VIGOR RATING AVE.	COMMENTS
W.V.F. Bottom Peat (+)*	39	1.0	2.8	-
" " " (0)	25	1.-	1.0	Poor growth
W.V.F. Surface Peat(+)	49	1.0+	4.0	Good growth
" " " (0)	48	1.-	3.8	Ave.growth
W.V.F. Min. Sub. (+)	21	1.-	1.0	Plants stunted
" " " (0)	24	1.-	1.0	" "
St Louis Co. Sapric(+)	48	1.-	3.6	Good color
" " " (0)	38	1.0	2.0	-
Arlberg Sphagnum (+)	21	1.-	1.0	Stunted
" " (0)	24	1.-	1.0	"
Aitkin Co. Hemic (+)	47	1.0	4.5	V. good growth
" " " (0)	49	1.0	3.0	Ave. growth
Roseau Co. Hemic (+)	50	1.5	4.0	V. good growth
" " " (0)	40	1.0	3.8	Good growth

* + = Fertilized
0 = No Fertilizer

Table 2. GREENHOUSE MUM EVALUATIONS - 8 WEEKS GROWTH

POTTED MUM PLANTS

PEAT TYPE		HEIGHTH (cm)	VIGOR RATING (SCALE 1-5)	COMMENTS
W.V.F. Bottom Peat	(+)*	25	2.5	Below ave.
" " "	(0)	20	2.0	" "
W.V.F. Surface Peat	(+)	32	2.8	Good color
" " "	(0)	32	2.8	- -
W.V.F. Min. Sub.	(+)	12	1.0	V. Poor growth
- - -				
St Louis Co. Sapric	(+)	33	4.0	V. good growth
" " "	(0)	31	3.0	Ave. growth
Arlberg Sphagnum	(+)	19	1.9	Some dificiencies
" "	(0)	18	2.0	Short
Aitkin Co. Hemic	(+)	34	3.0	Good growth
" " "	(0)	29	2.8	- -
Roseau Co. Hemic	(+)	33	3.5	Tip burn
" " "	(0)	39	3.0	Slightly stunted

* + = Fertilized
  0 = No Fertilizer

Forestry Reclamation of Peatlands (Dr. Edwin White, University of Minnesota)

UNMINED PEATLANDS:

Two sets of tree plantings were established at Wilderness Farms, Zim, Minnesota. Experimental design was a randomized complete block with three replications of five tree species and eight fertilizer treatments. Tree species being tested are white spruce, black spruce, Scots pine, hybrid poplar and Norway spruce. Fertilizer treatments are:

TREATMENT NUMBER	FERTILIZER RATE AND SOURCE
1	0, Control, no fertilizer
2	(N) Nitrogren at 300 pounds per acre from ammonium nitrate
3	(P) Phosphorus at 150 pounds per acre from triple superphosphate
4	(K) Potassium at 200 pounds per acre from potassium chloride
5	(NP) Nitrogen at 300 pounds per acre from ammonium nitrate plus phosphorus at 150 pounds per acre from triple superphosphate
6	(NK) Nitrogen at 300 pounds per acre from ammonium nitrate plus potassium at 200 pounds per acre from potassium chloride
7	(PK) Phosphorus at 150 pounds per acre plus potassium at 200 pounds per acre from potassium chloride
8	(NPK) Nitrogen at 300 pounds per acre from ammonium nitrate plus phosphorus at 150 pounds per acre from triple superphosphate plus potassium at 200 pounds per acre from potassium chloride

Tree seedlings on the north block were hand planted on May 23, 1978 and on the south block on May 25, 1978 in sixteen tree plots of four rows of four trees per row at a spacing of three by three feet. Individual tree plots have a spacing of four feet between plots with an eight foot spacing between replications. Double isolation ditches have been constructed around and between the north and south blocks of tree plantings in order to allow other researchers to ascertain the impact of the fertilization treatments on water quality. Only the north block (three replications) has been fertilized.

All individual tree plots are staked on the northwest corner and identified with coded tag. For example, RIWSP refers to replication 1, white spruce, phosphorus fertilizer treatment.

The week of June 19, 1978 an application of the herbicide Roundup at the rate of 4 ounces of roundup per 1½ gallons of water was hand applied to all plots to control quack grass. Trees were protected from the herbicide by placing plastic containers over the seedlings.

All fertilizer treatments were hand broadcast uniformly on the appropriate treatment plots on June 26, 1978.

On June 27 and 28, 1978 survival and height of all trees by plots was tallied using a serpentine tally system so that each individual tree's location is mapped and can be remeasured in the future. This early tally has indicated excellent survival of the seedlings. Maps of the study are attached.

MINED PEATLANDS:

Due to the fact that the excavation of peat was not completed on the "mined" forestry plots until after the planting season progress beyond selecting tree species and fertilizer rates cannot be reported. Since the planting season for establishing

tree seedlings is a relatively short time period in late May, it is doubtful much can be done with this field experiment during 1978.

SECONDARY SUCCESSION ON DISTURBED PEATLANDS:

Excellent progress has been made by correspondence (written and telephone) on locating suitable peatland areas that have been harvested over the past 30 or 40 years that can be studied to ascertain secondary succession as a means of natural reclamation of mined peatlands. Approximately 20 areas have been visited to make a preliminary decision on the suitablity of using the areas for the study. Statistical sampling the designs have been evaluated and a sampling procedure arrived at for the study.

LITERATURE REVIEW:

We are continuing to accumulate and review literature pertaining to forestry reclamation and tree planting including secondary succession on organic soils.

EACH PLOT HAS 16 TREES PLANTED WITH A 3'X 3' SPACING. SPACING BETWEEN PLOTS IS 4' WITH 8' BETWEEN REP's.

Rep I

BS	SP	NS	HPop	BS	WS	BS	HPop
WS	WS	BS	SP	NS	HPop	SP	BS
SP	NS	SP	BS	HPop	SP	NS	NS
NS	BS	HPop	WS	WS	NS	HPop	WS
HPop	HPop	WS	NS	SP	BS	WS	SP

4' BETWEEN Plots

8' BETWEEN REPLICATIONS

Rep II

NS	HPop	NS	SP	BS	NS	BS	SP
SP	BS	WS	WS	HPop	WS	WS	BS
WS	NS	SP	HPop	WS	SP	HPop	WS
BS	SP	HPop	BS	SP	HPop	SP	NS
HPop	WS	BS	NS	NS	BS	NS	HPop

8' BETWEEN REPLICATIONS

Rep III

WS	BS	HPop	SP	WS	SP	NS	HPop
HPop	SP	NS	HPop	NS	HPop	BS	BS
SP	HPop	BS	NS	BS	WS	HPop	NS
BS	WS	SP	WS	HPop	BS	WS	SP
NS	NS	WS	BS	SP	NS	SP	WS

Ditch Center Line

Ditch Center Line

N

EACH PLOT HAS 16 TREES PLANTED WITH A 3'X 3' SPACING. SPACING BETWEEN PLOTS IS 4' WITH 8' BETWEEN REP'S.

Ditch Center Line

Ditch Center Line

N

Rep I

3	8	1	7	6	5	4	2
WS	NS	SP	H Pip	NS	SP	WS	NS
BS	SP	NS	BS	H. Pop.	WS	SP	H Pop
NS	WS	BS	WS	SP	BS	BS	SP
H. Pip	BS	WS	NS	BS	NS	H. Pip	WS
SP	H. Pip	H. Pip	SP	WS	H. Pop.	NS	BS

4' BETWEEN Plots

8' BETWEEN REPLICATIONS

Rep II

2	3	6	8	7	4	5
BS	NS	BS	WS	SP	SP	H. Pip.	NS
H Pip	BS	SP	SP	H. Pop.	WS	SP	SP
WS	NS	WS	NS	B.S.	BS	WS	H Pip
SP	H Pip	NS	BS	NS	NS	BS	BS
NS	WS	H. Pip.	H. Pip.	WS	H. Pip.	NS	WS

8' BETWEEN REPLICATIONS

Rep III

4	8	3	6	2	5	7	1
H Pip	WS	WS	SP	NS	H Pip	BS	H Pip
WS	NS	BS	H Pip	BS	SP	NS	WS
BS	SP	H Pop	BS	SP	NS	WS	SP
SP	H Pop	NS	NS	WS	BS	H Pop	NS
NS	BS	SP	WS	H Pip	WS	WS	BS

Ecological and Floristic Studies of the Peatland Vegetation of Northern Minnesota (Dr. Eville Gorham & Dr. Herbert Wright, Jr., University of Minnesota)

SUMMARY:

1. The peatlands of northern Minnesota include the vast uninterrupted area north of Upper Red Lake, as well as smaller areas that represent infilling of shallow depressions on glacial drift or encroachment of peatland over poorly drained landscape. This project will focus on the Red Lake peatland, with some comparisons with smaller units in northeastern Minnesota.

2. The vegetation patterns on the Red Lake peatland are unique in the country for their scope and for the detail and sensitivity by which they reflect hydrologic and ecological conditions. Special attention will be paid to the ovoid patterns in the central part of the area, and to their relation to raised bogs and water tracks.

3. Vegetational communities will be identified and quantitatively described on the various units of the patterns with use of the relevé method, followed by compilation of phytosociological tables arranged according to environmental variables. Water samples will be taken for analysis of pH, conductivity, calcium, nutrient ions, and color. Water levels will be measured, and chemical analyses of surface peat samples will be made (cations and minor metal ions).

4. Sites accessible to roads will be studied, but the principal study area will be in the complex of ovoid patterns about 5 miles west of Highway 72, where several vegetation types are well-displayed on existing aerial photographs.

5. In addition to the systematic relevés of the anticipated 10-15 major vegetation units, search for rare and endangered species (e.g. orchids) will be made, along with observations on their habitat conditions.

6. The field work will be coordinated with such new large-scale aerial photography that may be organized, to provide ground truth for the compilation of maps based on air-photo interpretation.

Vegetation Analysis of Selected Beltrami, Koochiching, and St. Louis County Peatlands by Remote Sensing Methods
(Dr. Merle Meyer, University of Minnesota)

OBJECTIVES:

Phase I. Preparation of 100% site-specific vegetation classification maps and areas from medium scale 1:15,840 aerial photography.

Basic vegetation classification will be accomplished with the most recent 1:15,840 summer B & W infrared forest aerial photography of the project areas (Beltrami, 1976; Koochiching, 1973; St. Louis, 1972). Stages involved will be: (a) photography procurement, (b) photography and overlay preparation, (c) preliminary field reconnaissance, (d) photo interpretation, (e) editing, (f) final field check, (g) detail transfer, (h) final drafting and (i) final formatting.

Phase II. Aerial photography and mapping of vegetation plot transects and large-scale sampling photo plots of representative vegetation types.

A two-camera 35mm aerial photography camera system (focal lenghts f 28mm and 200mm, respectively) will provide color infrared photo samples along (up to) 35 miles of representative transect selected by the investigators. The basic transect will be continuous

stereo or physical coverage at a film scale of 1:84,000 -- later to be enlarged to circa 1:24,000 on color prints. At selected intervals along the transects will be systematically spaced photographs (circa 2-3 per 1:84,000 frame) at a scale of 1:12,000 -- later to be enlarged to circa 1:3,000 on color prints.

The 1:84,000 transect photography will serve two purposes: (1) to assist in the basic vegetation classification on the 1:15,840 B & W photography and (2) to serve as a working base for field checking by all investigators. The 1:12,000 scale photography will also assist in the basic vegetation classification and to serve as a field checking and classification base for all investigators.

PROCEDURE:

Phase I.

1. Personnel training; location and purchase of 1:15,840 scale photos (circa 280 prints), working materials (overlay and drafting film, etc.); purchase of nine (9) stable film 1:24,000 orthophoto quadrangle copies for Beltrami, Koochiching; and 1:24,000 scale cronapaque copies of 6 quadrangles for the Toivola locations.

2. Photo overlay preparation (140 frames).

3. Preliminary field reconnaissance.

4. Photo interpretation of 1:15,840 scale photography on alternate photos (circa 140 frames); editing. Use of 35mm CIR transects and photo plots from Phase II to assist in delineation.

5. Field checking.

6. Transfer of photo overlay detail to 1:24,000 scale base map overlays (140+ setups); editing pencil copies.

7. Final drafting of 1:24,000 vegetation overlays; editing; duplication; assembly (15 overlays).

8. Area measurement of type classifications by quadrangle; tabulation and summary into overall final tables.

Phase II.

1. Equipment and materials assembly; personnel training; flight planning.

2. Aerial photography with a two-camera unit -- 28mm for continuous strip at film scale of 1:84,000 and 200mm for photo plots at a film scale of about 1:12,000; film processing; inspection; possible reflights; preparation of internegatives; printing; labeling; assembly of working strips.

3. Selection of type classification examples; incorporation with final 1:24,000 scale maps and vegetation overlays.

DELIVERY DATES:

One or two of the key quadrangles will be selected for early completion and delivery by the end of December. The remainder will be completed by June 30, 1979.

REPORTS/DELIVERY MATERIALS:

1. Quarterly Progress Reports will be filed with the DNR on a quarterly basis beginning three months after initiation of the project.

2. Upon completion of the project, the following items/materials will be delivered:

   -- Fifteen 1:24,000 scale stable film Cronapaque photomaps or orthophotos, board-mounted and each

with its vegetation overlay on clear stable film -- delineations and title block in black.

- Transects and photo samples will be located on the mounting board adjacent to the photomap to which they pertain. Where pertinent, type lines and designations will be added.

- A final narrative report will be filed wherein a statement of objectives, detailed procedures and area summaries will be clearly stated and presented. Among the illustrations will be a series of 8½x11 portions of the 1:24,000 vegetation overlays representative of the different vegetation complexes -- probably up to 6-8 such pages. Each area will be selected which has CIR transects and sample plots. The location of a key sample plot will be spotted on each map and the actual 3½x5 color plate of that sample plot will be affixed, with proper identifications, in the lower right (or left) hand corner of the page. This will permit the reader to get a better idea of the sequence and the levels of actual mapping and aerial photography involved. Some consideration will also be given to this 1:1 (1:24,000 scale) map portion being preceeded by its parent total map overlay reduced to fit the 8½x11 page. Certainly, detail will be lost in so doing, but will help in the overall visualization of the job and product.

Anaylsis of Minnesota Peat for Possible Industrial Chemical Use (Dr. Charles Fuchsman, Bemidji State University)

OBJECTIVES:

The purpose of the project is to acquire chemical analytical data on Minnesota peat deposits, thereby enabling the State of Minnesota to consider whether, and to what degree, the industrial chemical uses of peat constitute realistic policy alternatives for peatland management.

The need for such data was documented in a report submitted earlier to the Minnesota Department of Natural Resources Peat Program ("The Industrial Chemical Technology of Peat," by C. H. Fuchsman, Feb., 1978). It was pointed out in that report that, in Europe, peat is used commercially to produce wax and peat coke, and it is highly probable that in the Soviet Union peat components will soon become a primary base for production of single-cell protein for livestock feed. In addition, humic acids present in peat appear to offer significant possibilities as viscosity-control additives in oil-well drilling muds and as water purification substances.

These types of industrial use of peat represent, in general, the possibility of economically viable relatively small-scale uses of peat (when compared with energy uses), and are adaptable to low-capitalization, labor-intensive locally-managed modes of production. They thus represent potential for economically beneficial activities in chronically poor, high-unemployment areas. Such activities are likely to be only minimally disturbing to the natural environment and to the social structure of the area.

The most immediate need, in determining whether European chemical technology is relevant to Minnesota peat, is the determination of the phosphorus and ash contents of peat (which would establish the suitability of Minneosta peat for the production of high-

quality peat coke); and the analysis of bitumen content of the peat, and of its wax component (which would indicate the potential value of the peat for the production of wax).

Somewhat less pressing are requirements for information on the soluble and easily hydrolyzable carbohydrate components of peat (which would bear on the suitability of the peat for single cell protein production); and of humic acid content (which would bear on the prospects of the peat for water purification use, and for viscosity-control applications).

We propose to assemble in usable form, a collection of pertinent published peat analytical methods, now largely dispersed in the foreign language literatures of countries active in this field, and to use the most appropriate of these methods in the laboratory phase of the project.

REPORTS AND OTHER WRITTEN MATERIAL:

1. A manual of practical analytical methods, employed by European laboratories in the chemical analysis of peat, will be assembled. The texts, where available originally in German or Russian or other foreign language, will be translated. Correspondence with foreign experts will be used, as needed, to assure accuracy and to obtain additional information. Critical annotations will be provided. American analytical methods (e.g., from the coal industry) will also be included, for comparative purposes, or where otherwise pertinent.

2. Approximately seventy-two samples (described in section D) will be subjected to a preliminary screening analysis which will include phosphorus, ash, and bitumen assays. Quantitative data on other constituents may be generated for many samples, where such data can be conveniently obtained in connection with the primary analyses noted above. (Thus,

it is expected that contents of water soluble and readily hydrolyzable substances, and of humic acids, will be obtained for approximately thirty samples).

3. Approximately twenty samples, not included in the original seventy-two samples will be screened for either phosphorus and ash, or for bitumens, where they represent sites close to those of other samples significantly high in bitumen or low in phosphorus.

4. Samples high in bitumen content or low in phosphorus will be analyzed in greater detail for characteristics appropriate to the intended area of commercial use, (e.g., wax content; saponification and acid value of waxes).

5. Small numbers (5-10) of individual peat samples will be analyzed in greater detail by methods appropriate to the commercial use of peat for single-cell protein production and for use in water purification.

6. Quarterly reports and a final report will record and interpret the data obtained.

An Institutional View of Minnesota's Peatlands

Minnesota has the most extensive peat deposits of any state in the Union with the exception of Alaska. Most of these 7.2 million acres of peatland are undeveloped, although in recent years there has been considerable pressure to industrialize several selected areas.

Since over 90% of Minnesota's peatlands are either owned or administered by the State, Minnesota finds itself in a unique position vis-à-vis this resource. An opportunity virtually unprecedented in resource management is currently being afforded Minnesotans. That is, a comprehensive peatland policy can be formulated prior to any major exploitation taking place. The State should be able to direct the timing, extent, location, and type of development in an orderly and even-handed manner.

To facilitate this, it was recognized early in the study that some basic questions had to be answered. Should leasing continue to be the mechanism by which state-owned peat is made available to developers? Should leasing be supplemented or replaced entirely by another mechanism? What modifications could be recommended to improve our present system of leasing? What is the legal definition or classification of peat in Minnesota? In other states?

In December of 1976 the Legislative Commission on Minnesota Resources (LCMR) addressed these questions by allocating $29,670 to find a project entitled "Potential of Peat as a Powerplant Fuel". The findings of Part I of this study are available in the report entitled "Present Perspective for Peat Decision Making", November 1977.

Following completion of the above report, work has continued examining such areas as: royalties, their history, current application, and possible modification; peat taxation, primarily studied by the Tax Research Unit of the Minnesota Department of Revenue with background information supplied by Peat Project Staff; statutory requirements of other states, and federal agencies with regard to minerals; and economic analysis of the peat resource to predict product demand, being conducted with the Tax Research Unit.