STUDY STATEMENTS

1985-86

NORTHERN FOREST RESEARCH CENTRE

CANADIAN FORESTRY SERVICE

5320 - 122 STREET

EDMONTON, ALBERTA

T6H 3S5

APRIL 1985

NORTHERN FOREST RESEARCH CENTRE

STUDY STATEMENTS, 1985-86

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NOR-1

FOREST INSECT AND DISEASE SURVEYS AND MANAGEMENT SYSTEMS

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Forest insect and disease survey

3. New: Cont.: X 4. No.: NOR-1-01 (NOR-1-033)

5. Study Leader: B. Moody and H. Cerezke

6. Key Words: Detection, appraisal, distribution, parasites, hosts, damage, predators, biological control, hazard, susceptibility, stability, management, parks, recreation, symptoms, damage, effluents, easement atmosphere

7. Location of Work: Region wide

8. Study Objectives:

   1. To gain an improved knowledge of forest insects and diseases in the region for the purpose of minimizing damage to trees and shrubs attributable to these organisms and to provide an advisory service to management agencies and the public, and to contribute to FIDS national overview of important pest conditions.

   2. Provide management agencies with diagnostic impact and appraisal services relating to effects of insects, diseases, climate influences, and pollutants on trees and shrubs and other types of vegetation.

9. Goals for 1984-85:

   1. Survey, map, and report on major forest pests of the region, i.e. mountain pine beetle, forest tent caterpillar, spruce budworm, jack pine budworm, and spruce beetle.

   2. Conduct special surveys for particular pests or of designated areas.

   3. Compile and publish an Information Report on the forest pest situations in the region for 1983 and make predictions for 1984. Draft copy of the report will be sent to FIDS coordinator in Ottawa for national compilations.

4. Provide pest extension service and technology transfer to various client agencies and general public.

5. Represent NoFRC and CFS on various provincial, regional, and national forest insect and disease committees and advisory groups.

6. Organize and conduct annual interagency FIDS review and planning meeting with representatives (contact persons) from three prairie provinces, the Northwest Territories and Parks Canada (Prairie and Western Region).

7. Publish Forestry Report on FIDS if on NoFRC priority list.

8. Publish Forest Management Notes on forest pest conditions and forecast for each of the prairie provinces and the NWT.

9. Collaborate with project NOR-35 for diagnostic and taxonomic service of tree and shrub diseases and the upkeep of the Mycological Herbarium.

10. Work towards the production of the first draft of a standard survey methodology manual suitable for the region.

11. Continue dwarf mistletoe surveys and report on provincial forests surveyed.

12. Collaborate with Bill Ives and Dick Wong and provide assistance with photography and insect collection for the pictorial guide to forest and shade tree insects of the Canadian prairies.

10. Accomplishments in 1984-85:

1. Aerial and ground surveys were conducted, and areas of tree mortality or severe-to-moderate infestations were mapped of major forest pests (spruce budworm, mountain pine beetle, spruce beetle, forest tent caterpillar, and jack pine budworm) in the three prairie provinces and the Northwest Territories. Aircraft time for surveys is largely provided by outside agencies.

   Major areas mapped and reported with moderate-to-severe defoliation are: 1) A total of 170 000 ha of spruce budworm infestation in the region; 2) 1 935 000 ha of aspen stands defoliated primarily by the forest tent caterpillar; and 3) 786 000 ha of jack pine budworm infestation in Manitoba. Mountain pine beetle infestation was mapped over 11 000 ha in southern Alberta, and the spruce beetle infestation on 1500 ha in northern Alberta.

2. Many special surveys for particular pests or of designated areas were conducted and reports prepared. Examples are as follows:

   a. Special surveys were conducted for overwinter survival and brood-gallery development of mountain pine beetle in southern Alberta, Cypress Hills, Saskatchewan and Alberta, and several national parks in cooperation with study NOR-1-143.

b. Ground surveys were conducted along Wabasca River for spruce beetle abundance and current attacks.

c. Conducted field experiments to test spruce budworm pheromones in two types of traps for use in monitoring budworm populations. This was in cooperation with Dr. Sanders (CFS, GLFRC).

d. Elm bark beetle surveys were conducted with Alberta Environment and Alberta Agriculture but beetles were not detected in Alberta.

e. Surveys to detect new or introduced pests also included baited traps for possible introduction of gypsy moth and the European pine shoot moth. One male gypsy moth was trapped in Sherwood Park.

f. Special pest surveys were conducted in three forest nurseries, jack pine regeneration, white spruce plantations, and jack pine seed orchard in Saskatchewan and pine plantations in Manitoba.

g. Identified dwarf mistletoe infection of residual jack pine trees during control operations in burnt-over areas in northern Alberta, for the Alberta Forest Service.

h. Nematode infested logs were collected in Manitoba and sent for identification of the Pinewood nematode.

3. Compiled and published Information Report on the forest pest situations in the region for 1983 and made predictions for 1984. Draft copy of the report was sent to Ottawa for FIDS national report.

4. Pest extension services were provided and about 2000 inquiries were processed. Information booths on tree pests were displayed to the general public, on numerous occasions, and pest leaflets and other material were distributed.

   a. Workshops, lectures, and talks on forest pests were presented on 30 occasions, e.g. to Parks Canada staff, courses sponsored by Alberta Agriculture, staff of tree nurseries, AFS staff, Parks and Recreation, etc.

   b. T.V., radio, and newspaper interviews were given on pest problems.

5. Represented NoFRC and CFS on various committees and advisory groups:

   a. Representation and report prepared for the Alberta Pest Control Advisory Council.

   b. Representation and two reports prepared for the Forest Pest Control Forum (Ottawa).

   c. Also provided representation and reports for:

- Manitoba DED Advisory Committee
- Saskatchewan Advisory Council - Plant Disease (Saskatoon)
- Saskatchewan Advisory Council - Insect Control (Saskatoon)
- DED Advisory Council - Saskatchewan (Regina)
- Alberta Horticultural Environment Subcommittee (Edmonton). Herb Cerezke served as secretary 1984 and prepared a chapter for proposed technical publ. "Trees in the Urban Landscape".
- Alberta Extension Horticultural Committee (Red Deer)
- CANUSA and Eastern Spruce Budworm Council

6. Annual interagency FIDS review and planning meeting was conducted at NoFRC with representations from three prairie provinces, the Northwest Territories and Parks Canada.

7. Other Forestry Reports given priority over FIDS.

8. FIDS Forest Management Note published on pest conditions in Saskatchewan.

9. Collaborated with project NOR-35 for diagnostic and taxonomic service of tree and shrub diseases and the upkeep of the Mycological Herbarium.

10. Work towards the production of the first draft of a survey methodology manual continued and is 60% completed.

11. Systematic roadside surveys of jack pine dwarf mistletoe were continued in Saskatchewan in 1984.

12. Collaborated with Bill Ives and Dick Wong and provided significant assistance with photography and insect collections for the illustrated report "A pictorial guide to the forest and shade tree insects of the prairie provinces".

Additional Accomplishments:

13. Contributed to the initiation of a national program to detect early signs of acid rain (pollutants) damage to the forests of Canada.

14. Involved in the preparation of a pest management program under the Canada-Manitoba Forest Renewal Agreement NOR-36.

11. Goals for 1985-86:

1. Survey, map, and report on major forest pests of the region, i.e. mountain pine beetle, spruce beetle, forest tent caterpillar, spruce budworm, jack pine budworm, dwarf mistletoe, and needle cast or needle rust. (Moody)

2. Conduct special surveys for particular pests or of designated areas. (Moody, Cerezke)

3. Compile and publish an Information Report on the forest pest situations in the region for 1984 and make predictions for 1985. Draft copy of the report will be sent to FIDS coordinator in Ottawa for national compilations. (Moody, Cerezke)

4. Provide pest extention service and technology transfer to various client agencies and general public. (Moody, Cerezke, FIDS staff)

5. Represent NoFRC and CFS on various provincial, regional, and national forest insect and disease committees and advisory groups. (Moody, Cerezke)

6. Organize and conduct annual interagency FIDS review and planning meeting with representatives (contact persons) from three prairie provinces, the Northwest Territories and Parks Canada (Prairie and Western Region). (Moody, Cerezke)

7. Publish Forestry Report on FIDS. (Moody, Cerezke)

8. Publish Forest Management Notes on forest pest conditions and forecast for each of the prairie provinces and the NWT. (Moody)

9. Complete and submit first draft of a standard survey methodology manual suitable for the region. (Moody)

10. Collaborate with Bill Ives and Dick Wong and provide assistance with photography and insect collection for the pictorial guide to forest and shade tree insects of the prairie provinces. (Moody)

11. Establish plots to contribute the national program to detect early signs of acid rain (pollutants) damage to the forests. (Moody)

12. Provide functional guidance for NOR-36-04 Forest pest management and damage appraisal (Manitoba), Development Agreements for surveys of forest pest conditions and their damage, and in providing pest control advisory services and technology transfer. (Moody)

12. Publications 1984-85:

Moody, B.H. and H.F. Cerezke. 1984. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba, and the Northwest Territories in 1983 and predictions for 1984. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Inf. Rep. NOR-X-261.

Moody, B.H. and H.F. Cerezke. 1984. Contribution In: Forest Insect and Disease Conditions in Canada 1983. Compiled by T.E. Sterner and A.G. Davidson. Environ. Can., Can. For. Serv., Ottawa.

Still, G.N. 1984. Forest insect and disease conditions in Saskatchewan in 1983 and forecasts for 1984. Forest Management Note 29.

Unpublished Reports:

Cerezke, H.F. 1984. Report to Environmental Committee of Alberta Horticulture Advisory Committee.

Cerezke, H.F. 1984. Chapter prepared for Tech. Rep. for Alta. Agric. distribution for "Trees in Urban Landscape". Chap. titled: Root development, structure and function. 8 p.

Emond, F.J. 1984. Alberta Pest Control Advisory Meeting report from the Canadian Forestry Service. Report prepared for the APCA.

Emond, F.J. 1984. Insect and disease surveys of Saskatchewan provincial tree nurseries. File Report.

Emond, F.J. 1984. Canadian Forestry Service 1984 Report to the Saskatchewan Advisory Committee, Insect Control and the Saskatchewan Advisory Council, Crop Protection, Plant Disease Committee.

Gates, H. 1984. Insect and disease conditions in the Northwest Territories. File Report.

Gates, H. 1984. Spruce beetle survey, Wood Buffalo National Park, 1984.

Grandmaison, M. 1984. Forest tent caterpillar post-hatch survey for Alberta, 1984. File Report.

Grandmaison, M. and H. Gates. 1984. Trembling aspen defoliation in Alberta during 1984 and predictions for 1985. File Report.

Moody, B.H. 1984. Report on the spruce budworms in the prairie provinces and the Northwest Territories 1984. Report prepared for the 12th Annual Forest Pest Control Forum, Ottawa.

Moody, B.H. 1984. Report on the status and control of other pests in the prairie provinces, 1984. Report prepared for the 12th Annual Forest Pest Control Forum, Ottawa.

Moody, B.H. 1984. Status of major forest insects and diseases in the prairie provinces and the NWT, 1983-84. Contribution to report to working group on forest insect and diseases, North American forestry Commission, October 1984.

Moody, B.H. 1984. Highlights of forest insect and disease research in the prairie region. Contribution to the Canadian report to the North American Forestry Commission, October 1984.

Petty, J. and H. Gates. 1984. Insect and disease conditions in Waterton, Banff, Jasper, Kootenay, Yoho, and Elk Island national parks, 1984. Report prepared for the National Parks.

Petty, J. 1984. Circular areas of dead and dying lodgepole pine. Report prepared for the Alberta Forest Service.

Petty, J. 1984. Dying jack pine in Pine Point area. Report prepared for Can. Dep. Ind. Affairs Nor. Dev.

Still, G.N. 1984. Trembling aspen defoliation in Manitoba, 1984 and forecasts for 1985. File Report.

Still, G.N. 1984. Jack pine budworm defoliation in Manitoba, 1984.

Still, G.N. 1984. Spruce budworm defoliation in Manitoba, 1984.

Tidsbury, C. 1984. Jack pine budworm in Saskatchewan, 1984 and forecasts for 1985. File Report.

Tidsbury, C. 1984. Forest tent caterpillar infestation in Manitoba, 1984 and defoliation forecasts for 1985. File Report.

Tidsbury, C. 1984. Spruce budworm infestation in Manitoba, 1984 and forecasts for 1985. File Report.

These timely reports are promptly distributed to provincial and regional foresters, national and provincial park superintendents and warden staffs, agricultural representatives, provincial entomologists and pathologists, city parks and recreation staffs, other national FIDS regions, FIDS Director in Ottawa, etc.

13. Resources 1985-86:

PYs:	Prof.:	Moody	0.5
		Cerezke	0.3
	Tech.:	Emond	1.0
		vice Petty	1.0
		Still	1.0
		Grandmaison	1.0
		Tidsbury	1.0
		Gates	1.0
	Term/Student:		1.2
	Total:		8.0

O & M: $54,000

Capital: $5,000

14. Signatures:

B.H. Moody
Investigator

Program Director

H.J. Cerezke
Investigator

C.R. Tidsbury
Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Sawfly systematics

3. New: Cont.: X 4. No.: NOR-1-02 (NOR-1-058)

5. Study Leader: H.R. Wong

6. Key Words: Tenthredinoidea, Nearctic Region, distribution, hosts, keys, life history, morphology, new genera, new species, biogeography, revision, Symphyta, evolution, phylogeny

7. Location of Work: Edmonton, Alberta

8. Study Objectives:

   1. To study external and internal morphology, biogeography, evolution, and maintain taxonomic expertise in this group of insects at the national and international level.

   2. To identify and describe the various sawfly species in their mature and immature forms.

9. Goals for 1984-85:

   1. Identify larval and adult sawflies for research personnel, institutions, and laboratories.

   2. Submit the paper on the "Larvae of the North American genera of Diprionidae (Hymenoptera: Symphyta)" for review by the technical board.

   3. Identify for the Smithsonian Institute, Washington, D.C. 48 adults of Pristiphora Latreille.

   4. When time permits, redescribe the known species of Pristiphora in North America for use in the study on the revision of this genus.

   5. Supervise the research of a visiting scholar from the Forest Research Institute, Chinese Academy of Forestry, Beijing, People's Republic of China.

10. Accomplishments in 1984-85:

1. a. Identified over 1000 larval and adult sawflies for the Forest Insect and Disease Survey of the Northern Forest Research Centre; provincial agencies; regional clients, and in-service personnel.

   b. Reviewed 2 manuscripts for the Canadian Entomologist.

2. A number of corrections were made to the paper on the larvae of the North American genera of Diprionidae (Hymenoptera: Symphyta), which necessitated retyping before submission to the review board.

3. The 48 adult specimens of Pristiphora Latreille have been identified for the Smithsonian Institute, Washington, D.C. They will be returned in the New Year.

4. Time did not permit work on redescription of Pristiphora in North America in 1984.

5. Supervised the research of the visiting scholar from the Forest Research Institute, Chinese Academy of Forestry, Beijing, People's Republic of China by:

   a. making available reference material

   b. specimens for study

   c. arranging for contacts with other scientists in Canada and the United Sates

   d. planning and accompanying him on field trips

   e. proposing a study project with the Northern Forest Research Centre.

Additional Accomplishment:

6. Presented the following scientific paper at the 32nd Annual Meeting of the Entomological Society of Alberta:

   Wong, H.R. Observations on the life history and habits of Nematus calais Kirby (Hymenoptera: Tenthredinidae) defoliating willows in Alberta.

11. Goals for 1985-86:

1. Identify larval and adult sawflies for research personnel, institutions, and laboratories.

2. Review for the Canadian Entomologist, a manuscript of nearly 400 pages submitted for publication.

3. Complete review and submit for publication "Larvae of the North American genera of Diprionidae (Hymenoptera: Symphyta)" for review by the technical board.

4. Continue supervising the research of the visiting scholar from the Forest Research Institute, Chinese Academy of Forestry, Beijing, People's Republic of China.

12. Publications 1984-85:

Drouin, J.A. and H.R. Wong. 1984. Brich leaf-mining sawflies in Alberta (Hymenoptera: Tenthredinidae). Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Inf. Rep. NOR-X-260.

13. Resources 1985-86:

PYs: Prof.: Wong 0.3

Tech.: Nil

Term/Student: 0.3

Total: 0.6

O & M: $1,000

Capital: Nil

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Biological assessment of insects injurious to trees and forests

3. New: Cont.: X 4. No.: NOR-1-03 (NOR-1-143)

5. Study Leader: H.F. Cerezke

6. Key Words: Forest habitats, plantations, seed orchards, shelterbelts, tree nurseries, damage impact, integrated control, population monitoring, insect ecology and behavior, bark beetles, woodborers, budworms, seed and cone insects, regeneration pests, pheromones

7. Location of Work: Region wide

8. Study Objectives:

   1. To study the biology of specific forest insects within the region.

   2. To investigate the field response of the mountain pine beetle to synthetic pheromones and the application of pheromones in control strategies.

   3. To provide technical and advisory services to clientele concerning insect and other related problems of shrubs, trees, and forests.

9. Goals for 1984-85:

   1. Continue role in assessment of MPB within the region with FIDS cooperation.

   2. Continue representation on MPB Technical Committee and provide input into CAN/US MPB Action Plan as required.

   3. Finalize report on 1982 MPB pheromone experiments in Cypress Hills with co-authors.

   4. Complete the analyses of MPB pheromone data collected in 1983 and combine with that obtained in 1982 for joint authorship publications.

5. Finalize report on MPB rearing experiment completed in 1982.

6. Time permitting, finalize the following three reports:

   a. Impact studies of the jack pine budworm (Choristoneura pinus pinus) in Nisbet Provincial Forest, Sask.

   b. Surveys of spruce budworm populations and damage impact in Riding Mt. National Park, 1979-80.

   c. Control studies of seed and cone insects in mature white spruce trees with carbofuran near Grande Prairie, Alberta.

7. Continue cooperative field studies with Drs. H. Wieser and E. Dixon and Alberta Forest Service on MPB pheromone testing and application.

8. Provide consultory and information service to clientele as requested.

10. Accomplishments in 1984-85:

1. Monitoring for mountain pine beetle in cooperation with FIDS and outside agencies (AFS, Alta. Parks, Sask. Parks, and Parks Canada) reported under NOR-1-01.

2. Represented NoFRC on MPB Technical Committee: attended and reported at meeting Nov. 1, 1984 (Victoria); submitted updated report for CAN/US MPB Action Plan; and attended CAN/US meeting (Victoria) as NoFRC representative, prepared minutes of meeting.

3. Completed report on 1982 studies on MPB in Cypress Hills; published 1984.

4. All measurements required for 1983 data were completed; some analyses still required. Report preparation in progress with co-authors from University of Calgary.

5. All data are complete but require some analysis.

6. a. "Impact studies of jack pine budworms": some progress made toward preparation of first draft report.

   b. "Surveys of spruce budworm populations and damage": no progress.

   c. "Control studies of seed and cone insects ": paper revised and submitted for typing.

7. Cooperative field studies on MPB pheromone testing and applications with Drs. H. Wieser and E. Dixon and Alberta Forest Service were continued in 1984 and included:

   a. Field-testing of several pheromone analog compounds to record numbers caught, sex ratios, and beetle size. Seven compounds were field-tested including the compound 'frontalin' and its attraction to a predaceous Clerid beetle.

b. Field tested three different release rates of two best compounds and related to beetles caught, sex ratio, and change in time.

c. Sampled pheromone-baited and unbaited MPB-killed trees to compare the efficiency of each tree class for absorbing beetles, as measured by attack density.

d. Tested baited traps with two bait formulations in cooperation with AFS, in limber pine. Results indicate less success than for lodgepole pine.

e. Placed logs of three pine species, limber pine, jack pine, and lodgepole pine in two infestation areas to determine host selection and attack patterns in the field.

f. Tallied numbers and sex ratios of MPB reared from limber pine logs and established that sex ratio changes with duration of emergence or flight period.

g. Conducted, in cooperation with AFS, a large-scale tree-baiting program in three lodgepole pine stands of merchantable size to attempt to draw in, concentrate, and hold MPB for subsequent clearcut removal-control.

h. Helped coordinate pheromone tree bait placement and distribution wth AFS and Saskatchewan and Alberta Prov. Parks personnel in the Cypress Hills.

8. Provided a variety of advisory and training services to clientele, including the following: participation at provincial planning and review meetings on mountain pine beetle; aerial and ground surveys of bark beetles; two lectures to university students and field staff; four training seminars to provincial/federal agencies; pest identifications, control recommendations and technical reference materials; and participation in "Black spruce mortality" Workshop (NeFRC).

11. Goals for 1985-86:

1. Continue role in assessment of MPB within the region with FIDS cooperation (NOR-1-01).

2. Continue representation on MPB Technical Committee and provide input into CAN/US MPB Action Plan as required.

3. Complete the analyses of MPB trap catch data collected in 1984 and prepare first draft report with co-workers from University of Calgary titled: "Attractiveness of structural analogs of brevicomin to mountain pine beetle in field bioassay studies in southwestern Alberta, 1982 to 1984".

4. Complete the analysis of MPB rearing experiment on jack pine and summarize in report format. (Likely a note in Can. Entomol.)

5. Prepare final reports of the following three studies:

   a. Impact studies of the jack pine budworm in the Nisbet Prov. Forest, Saskatchewan (For. Management Note or short journal publication).

   b. Surveys of the spruce budworm populations and damage in Riding Mt. National Park (Inf. Rep.).

   c. Control studies of seed and cone insects in mature white spruce trees with carbofuran near Grande Prairie, Alberta (journal publication).

6. Continue cooperative field studies with Drs. Wieser and Dixon at Univ. Calgary and Alberta Forest Service on MPB pheromone testing and applications.

7. Provide consultory and technology transfer services to clientele as requested.

12. Publications 1984-85:

Cerezke, H.F., J.H. Borden, and T.N. Trott. 1984. Field tests with semiochemicals for the mountain pine beetle in the Cypress Hills, Alberta. Can. For. Serv. Res. Notes 4:16-18.

Unpublished Reports:

Cerezke, H.F. 1984. Report on a spruce beetle infestation along the Wabasca River, June 1984. 4 pp.

Cerezke, H.F. 1984. Spruce beetle survey--Footner Lake Forest, Oct. 15-16, 1984. 1 p.

Cerezke, H.F. 1984. Spruce beetle seminar, Oct. 17, 1984, High Level, Alberta. 9 pp.

Cerezke, H.F. 1984. Survival studies of the mountain pine beetle in lodgepole pine collected in Kootenay National Park, Jan. 1984. 3 pp.

Cerezke, H.F. 1984. Progress Report to CAN/US lodgepole pine/mountain pine beetle program; Action Plan Item III-A. 2 pp.

13. Resources 1985-86:

PYs: Prof.: Cerezke 0.7

Tech.: Nil

Term/Student: 0.3

Total: 1.0

O & M: $6,000

Capital: Nil

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Forest insect diagnostic and biosystematic services

3. New: Cont.: X 4. No.: NOR-1-04 (NOR-1-154)

5. Study Leader: H.R. Wong and W.G.H. Ives

6. Key Words: Insects, larvae, damage, hosts, parasites, biological control, galls, seasonal occurrence, distribution, nomenclature, taxonomy, identification, reference collection, insectary, life history

7. Location of Work: Edmonton, Alberta

8. Study Objectives:

   1. Provide diagnostic and biosystematic services to clients, in-service personnel, outside agencies, and scientists engaged in biological and taxonomic research on insects.

   2. Maintain and improve the regional collection of insects and mites.

   3. Initiate biological and echological studies of forest insects that cause economic damage in the Canadian prairies.

9. Goals for 1984-85:

   1. Provide diagnostic and biosystematic services for the more difficult determinations on mature and immature insects damaging forest and shade trees.

   2. Maintain and improve reference collection of insects and mites.

   3. Provide information and specimens to scientists engaged in taxonomic and biological studies.

   4. Determine the spread of introduced insects in the Canadian prairies.

   5. Collect and determine the more common insects of young trees in plantations and scarified areas at Hinton, Alberta.

6. Continue the preparation of the pictorial guide to the forest and shade tree insects of the Canadian prairies:

   a. Identification of immature and mature insects.

   b. Conducting a literature review of the forest insects of this region (transferred from NOR-10-181).

7. Determine the major insects attacking the poplar stooling beds in tree nurseries.

8. Distinguish the damage of Petrova metallica (Busck) and Petrova albicapitana (Busck) attacking lodgepole pine in Alberta.

10. Accomplishments in 1984-85:

1. Determined several thousand insect specimens in the mature and/or immature stages submitted to the Northern Forest Research Centre and handled over a thousand enquiries from in-service personnel, clients, outside agencies, and scientists.

2. a. Over two hundred specimens determined by specialists in Ottawa and by myself have been incorporated into the insect reference collection.

   b. Over five hundred specimens collected by personnel of the Insect and Disease Survey were reared, in which over one hundred and fifty were overwintered to obtain biological information and specimens for the reference collections.

   c. Over five hundred specimens were pinned, spread, labelled, or preserved for the reference collection.

3. Biological information and/or specimens were provided to Dr. W.C. McGuffin and Dr. P.T. Dang, Biosystematic Research Institute, Ottawa, Ontario.

4. a. A survey was made in 1984 for the following introduced insects, which have entered southeastern Manitoba in recent years.

   - The distribution of the introduced pine sawfly, which was first collected in 1983, remained unchanged.

   - The European spruce sawfly present since 1969, appears to have increased in numbers, but not in distribution. In some areas of southern Manitoba, it was collected more frequently than the native green-headed spruce sawfly.

   - The larch casebearer, present since 1965, has not increased in numbers or extended its range from last year.

   b. The following introduced insects present in Ontario were surveyed to determine if they have spread into the Canadian prairies:

- The mountain ash sawfly has finally spread to Manitoba. It was collected for the first time at Falcon Lake in 1984.

- The European pine shoot moth present in Ontario and British Columbia is still absent in Manitoba and Alberta.

- A male Gypsy moth was captured in a pheromone trap set out by Agriculture Canada, Food Production and Inspection Branch at Sherwood Park. Further pheromone traps will be set out in 1985 to determine if this destructive species has become established in Alberta.

5. The most common insects attacking young trees in plantations and scarified areas in Hinton were still: Petrova albicapitana (Busck), Petrova metallica (Busck), Pissodes terminalis Hopping, and Hylobius warreni Wood.

6. Continued the preparation of the pictorial guide to forest and shade tree insects of the Canadian prairies by identifying and rearing over 4000 specimens, preparing over 700 specimens for photographing and overwintering approximately 2000 specimens. Over 3000 slides have been taken during 1984-85 of insects and their damage. Over 60 color plates have been prepared. Accompanying texts have been prepared for approximately 30 of them.

7. The major insects attacking poplar stooling beds in the nurseries have been determined as Janus abbreviata (Say), Aegeria tibialis, and Chrysomela scripta (Fabricius).

8. Larvae of Petrova metallica (Busck) feed down the pith causing the shoot to swell, while larvae of Petrova albicapitana (Busck) partially girdle the shoot and do not cause any noticeable swelling.

Additional Accomplishment:

9. The following scientific paper was presented at the 32nd Annual Meeting of the Entomological Society of Alberta:

   Drouin, J.A. and H.R. Wong. Life history and distribution of Petrova metallica (Lepidoptera: Tortricidae) in Alberta.

11. Goals for 1985-86:

1. Provide diagnostic and biosystematic services for the more difficult determinations on mature and immature insects damaging forest and shade trees. (Wong)

2. Maintain and improve reference collection of insects and mites. (Wong)

3. Provide information and specimens to scientists engaged in taxonomic and biological studies. (Wong)

4. Determine the spread of introduced insects in the Canadian prairies. (Wong)

5. Determine the species of ants attacking lodgepole pine stumps in the Hinton area of Alberta. (Wong)

6. Continue the preparation of the pictorial guide to the forest and shade tree insects of the Canadian prairies by:

   a. Identifying immature and mature insects and obtaining the necessary photographs.

   b. Conducting a literature review of the forest insects of the region.

   c. Prepare text and figures for the guide. (Ives, Wong)

7. Prepare for publication a manuscript on Petrova albicapitana (Busck) and Petrova metallica (Busck) (Lepidoptera: Tortricidae) in Pinus contorta stands of Alberta with J.A. Drouin and C.L. Rentz. (Wong, Drouin)

8. Prepare for publication a Forest Management Note on the major insects attacking poplar stooling beds in the nurseries of the Canadian prairies. (Wong)

12. Publications 1984-85:

Nil

13. Resources 1984-85:

PYs:	Prof.:	Wong	0.7
		Ives	0.5
	Tech.:	Szlabey	1.0
	Term/Student:		0.3
	Total:		2.5

O & M: $3,000

Capital: Nil

14. Signatures:

Investigator

Program Director

Investigator

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Damage appraisal of major forest pests

3. New: Cont.: X 4. No.: NOR-1-05 (NOR-1-184)

5. Study Leader: B.H. Moody

6. Key Words: Damage, appraisal, impact, hosts, forest pests, management, mortality growth loss

7. Location of Work: Prairie provinces, Northwest Territories

8. Study Objectives:

   1. To determine the significance of specific forest pests in terms of measured damage to the tree and forest stands.

   2. To develop or modify appraisal methods for assessment of losses caused by forest pests; and to provide information on forest depletion that can be used in the national forest statistics data program.

9. Goals for 1984-85:

   1. Remeasure 37 impact plots and assess damage by the mountain pine beetle in the national parks. Establish additional plots if required.

   2. Prepare first draft of a literature review on the effects of major forest pests on tree mortality and growth in the forests of the region.

   3. a. Remeasure for the fourth year, 17 spruce budworm impact plots in Manitoba and assess data.

      b. Assess for the second year damage caused by the jack pine budworm in 10 permanent plots in Manitoba.

      c. Reassess dwarf mistletoe impact plots in Saskatchewan and establish additional plots if required.

4. Continue to investigate the use of remote sensing techniques as a tool to assess pest-caused damage to the forests.

5. Continue to develop effective working relationships with officials of provincial and industrial forest resource management agencies.

10. Accomplishments in 1984-85:

1. Tree condition was re-assessed for the fourth year on 37 impact plots for damage caused by the mountain pine beetle in pine stands in the national parks (Yoho, Kootenay, Waterton). Volume analyses of live trees and beetle-killed trees have been completed and a report prepared.

2. Work on the first draft of a literature review of the effects of major forest pests on tree mortality and growth in the region, commenced and is about 50% completed.

3. a. Spruce budworm damage in 17 impact plots established in 1981 in Manitoba was assessed and information recorded. Defoliation in 1984 was moderate-to-severe and mortality of balsam fir high, 90% in some plots.

   b. Defoliation caused by the jack pine budworm was assessed for the second year on 10 permanent plots in Manitoba.

   c. Stem analysis was completed on 30 trees with varying intensity of dwarf mistletoe infection in jack pine stands in Saskatchewan. Radial growth measurements using a Digimicrometer, a tree-ring measuring machine, is 50% completed.

4. In cooperation with this study, the Saskatchewan Forest Branch, SDPRR has taken color infrared photography of the spruce budworm outbreak at Red Earth and will delineate the infested areas.

5. Continued to develop effective working relationships with officials of provincial and industrial forest resource management agencies. This has been effective in redirection of harvest cuts to areas with tree mortality caused by forest pests or into area with new infestations in an effort to prevent further damage or deterioration of dead trees.

Additional Accomplishments:

6. Temporary prism plots were established in a range of lodgepole pine stands to evaluate six hazard rating systems developed for the mountain pine beetle. This is a joint effort with B.C. and the U.S.A.

7. Participated in and prepared a report for a pest-caused depletion workshop between FIDS and FSSB.

8. Provided input into new study on Damage appraisal under the Fed./Manitoba MOU, NOR-36-04.

11. Goals for 1985-86:

1. Remeasure 37 impact plots and assess damage by the mountain pine beetle in the national parks and prepare report. Establish additional plots if required.

2. Complete first draft of a literature review on the effects of major forest pests on tree mortality and growth in the forests of the region.

3. a. Remeasure for the fifth year, 17 spruce budworm impact plots in Manitoba, assess data, and prepare report.

   b. Assess for the third year damage caused by the jack pine budworm in 10 permanent plots in Manitoba in collaboration with NOR-36-04 Development Agreement, Pest Management Program.

   c. Reassess dwarf mistletoe impact plots in Saskatchewan and establish additional plots if required.

4. Continue to investigate the use of remote sensing techniques as a tool to assess pest damage in cooperation with project NOR-4 and FIDS project at Petawawa.

5. Continue to develop effective working relationships with officials of provincial and industrial forest resource management agencies.

12. Publications 1984-85:

Unpublished Reports:

Moody, B.H. 1984. Depletion estimates for insects and diseases, Western and Northern Region. Report prepared for the FIDS Workshop on Depletion, Nov. 6-8, 1984, Ottawa and Petawawa.

13. Resources 1985-86:

PYs:	Prof.: Moody	0.5
	Tech.:	Nil
	Term/Student:	Nil
	Total:	0.5

O & M: $3,000

Capital: Nil

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Forest tree rusts of western North America

3. New: Cont.: X 4. No.: NOR-1-06 (NOR-35-026)

5. Study Leader: Y. Hiratsuka

6. Key Words: Cronartium, Pucciniastrum, Peridermium, Melampsora, Chrysomyxa, cytology, morphology, taxonomy, Urendinales inoculation experiment, pathogenicity

7. Location of Work: Edmonton (laboratory, greenhouse, and mycological herbarium), western North America with particular emphasis on northern region (field)

8. Study Objectives:

   1. To acquire a comprehensive knowledge and to improve diagnostic capability on the forest tree rusts of western North America with particular emphasis on the northern region in terms of identity, host range, life history, distribution, and pathogenicity.

   2. To study aspects of cytology, taxonomy, life history, and host-parasite relationship of conifer needle rusts, pine stem rusts, and poplar-conifer rusts of the region, and related species in the world.

9. Goals for 1984-85:

   1. Continue western gall rust study in relation to genetic improvement program of lodgepole pine supported partly with the fund supplied by the Province of Alberta through University of Alberta. Act as a scientific authority for contract work with the University of Manitoba (PRUF).

   2. Continue professional development leave in Japan and study pine stem rusts and other forest tree rusts until August 1984.

   3. Publish a journal paper on juvenile seedling infection of lodgepole pine with E. Allen and an Information Report on western gall rust.

4. Complete and submit manuscript of an Information Report entitled "Impact of pine stem rusts of hard pines in Alberta and the Northwest Territories--10 year plot study".

10. Accomplishments for 1984-85:

1. Continued western gall rust study in relation to genetic improvement program of lodgepole and jack pines. The study is supported partly with the fund supplied by the Province of Alberta (Forest Research Branch) through the University of Alberta.

   a. Continued to collect scions of field resistant and susceptible lodgepole pine from 3 Alberta locations and grafted. So far 96 graftlings are planted in a field at NoFRC.

   b. Continued host-parasite relationship study by comparing different kinds of reactions on lodgepole and jack pine families and various other hard pine species. Ultrastructural aspects of this study has been conducted by Dr. J. Reid and Mr. T. Hopkin of the Department of Botany, University of Manitoba with a PRUF contract arranged through NoFRC.

   c. Presented a paper entitled "Research activities on western gall rust in Canada" at Kanto Regional Meeting, Mycological Society of Japan (Tokyo 1984).

2. Continued professional development leave to Japan and Korea till the end of August 1984 and investigated mainly pine stem rusts of soft and hard pines. One journal paper (with Drs. Kakishima, Shibata, and Sato) is in press and two others are in advanced stages of preparation. A paper entitled "Some observations of pine stem rusts in Asia" was presented at Phytopathological Society of Alberta, Annual Meeting (Edmonton).

3. A journal paper entitled "Inoculation of young seedlings of lodgepole pine with Endocronartium harknessii" is submitted to a journal.

4. An Information Report entitled "Impact of pine stem rusts of hard pines in Alberta and the Northwest Territories--10 year plot study" is in an advanced stage of preparation (by Powell, van Sickle, Hiratsuka).

5. Attended IUFRO Working Party Meeting on "Rusts of hard pines" in Athens, Georgia, and participated in the discussion sessions and a field trip mainly on southern pine stem rusts especially on fusiform rust.

11. Goals for 1985-86:

1. Continue investigation of western gall rust in conjunction with the genetic improvement program of lodgepole and jack pines. A part of the work is expected to be supported by the fund made available by the Alberta Forest Service (Forest Research Branch) through the University of Alberta.

a. Continue to collect scions of field resistant and susceptible lodgepole pine from 4 Alberta locations and graftlings will be planted in a field at NoFRC.

b. The following publications will be prepared:

Western gall rust (Information Report)

Histopathology of western gall rust (journal paper)

Resistant reactions of two Asian hard pines to western gall rust (journal paper)

Inhibition of spore germination of Endocronartium harknessii by four fungicides (journal paper)

c. Attempt to establish genetically identical young plants of lodgepole and jack pines by: tissue culture plantlets, rooted hypocotyl, or excised embryo methods to test existence of western gall rust races.

d. Tissue culture of lodgepole and jack pines will be established for the study of host-parasite interactions.

e. Axenic cultures of western gall rust will be established for future studies.

2. Examine pine stem rust samples collected during the professional development leave (1983-84). Two journal papers will be prepared on morphology and cytology of Asian pine stem rusts.

3. Complete an Information Report entitled "Impact of pine stem rusts of hard pines in Alberta and the Northwest Territories--10 year plot study" with Drs. Powell and van Sickle.

12. Publications 1984-85:

Cummins, G.B. and Y. Hiratsuka. 1984. Families of Uredinales. Rep. Tottori Mycol. Inst. 22:191-208.

Kakishima, M, Y. Hiratsuka, H. Shibata, and S. Sato. 1984. Cronartium blister rust on Pinus densiflora having Pedicularis resupinata var. caespitosa as an alternate host. Trans. Mycol. Soc. Jap. 25:315-318.

Allen, E. and Y. Hiratsuka. 1985. Artificial inoculation of young seedlings of lodgepole pine with Endocronartium harknessii. Can. J. Bot. (in press)

13. Resources 1985-86:

PYs: Prof.: Hiratsuka 0.8

Tech.: Maruyama 0.8

Term/Student: 0.3

Total: 1.9

O & M: $6,000

Capital: $10,000

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Forest diseases: Research and technical transfer services

3. New: Cont.: X 4. No.: NOR-1-07 (NOR-35-153)

5. Study Leader: Y. Hiratsuka

6. Key Words: Mycology, herbarium, culture collection, nomenclature, identification

7. Location of Work: Northern Forest Research Centre

8. Study Objectives:

   1. To conduct short-term investigation of tree diseases as need arises.

   2. To provide diagnostic and taxonomic service of tree diseases and other forest fungi.

   3. To maintain and improve diagnostic and taxonomic service capabilities of tree disease pathogens and other forest fungi in the region.

   4. To prepare checklists of forest fungi of important areas (e.g. national parks, provincial parks, etc.), diagnostic keys for identification, and other related publications.

9. Goals for 1984-85:

   1. Start review process of the first draft of an information publication on major tree and shrub diseases of the prairie provinces in early 1985.

   2. Provide diagnostic and identification service of the tree and shrub diseases.

   3. Maintain and upgrade the Mycological Herbarium and a fungus culture collection.

   4. Continue investigation of blue stain fungi and other fungi associated with mountain pine beetle infestation with Drs. Ayer and Browne of the University of Alberta. Publish a journal paper on fungi isolated from mountain pine beetle with Dr. A. Tsuneda.

5. Continue investigation of Armillaria root rot with Dr. Ayer (U of A) and a graduate student (Mr. K. Mallett) with a grant from the Province of Alberta (AFDRTF).

6. Publish the following reports and pest leaflets:

   - Aspen-poplar decay (Information Report)

   - Western gall rust (Pest Leaflet)

   - Silver leaf (Pest Leaflet)

10. Accomplishments for 1984-85:

1. Some progress has been made to complete the first draft of an information publication on major tree and shrub diseases of the prairie provinces.

2. Provided diagnostic and identification service of tree and shrub diseases.

3. Maintained and upgraded the Mycological Herbarium and fungus culture collection.

4. Continued investigation of blue stain fungi and other fungi associated with mountain pine beetle infestation with Dr. A. Tsuneda (Tottori Mycological Institute) and Dr. W. Ayer (Univ. of Alberta). A journal paper is in press and another paper reporting a new fungus in the pupal chamber of mountain pine beetle is in preparation.

5. Continued investigation of Armillaria root rot with a graduate student (Mr. K. Mallett, U of A) and Dr. W. Ayer (U of A, Chemistry) with a grant from the Province of Alberta (AFDRTF) administered through the University of Alberta. A journal publication entitled "A detection method for Armillaria mellea in forest soils" has been submitted. The following two papers have been presented at scientific meetings:

   Mallett, K.I. and Y. Hiratsuka. 1984. Identity of the Armillaria mellea complex in Alberta. American Phytopathological Society - Canadian Phytopathological Society Joint Meeting, Guelph, Ontario. Phytopathology 74:824.

   Mallett, K.I. and Y. Hiratsuka. 1984. A new method to detect Armillaria root rot in forest soils. Phytopathological Society of Alberta, Edmonton, Alberta.

6. Four reports and pest leaflets were prepared and published (or in press). See under 12. Publications.

11. Goals for 1985-86:

1. Complete the first draft of an information publication on major tree and shrub diseases of the prairie provinces and start editorial and review processes.

2. Continue investigation of Armillaria root rot disease of intensively managed conifer forests. Two short journal papers and a Ph.D. thesis (by Mr. K. Mallett) are expected to be completed. If the Alberta government grant (AFDRTF) will be extended for 1985-86, further investigation on biological species varification and pathogenicity studies will be continued.

3. Continue investigation of blue stain fungi and other microorganisms associated with mountain pine beetle with Drs. Tsuneda (Tottori Mycological Institute) and Ayer (U of A Chemistry). Host a visiting scientist, Dr. K. Suzuki (University of Tokyo) supported by NSERC Strategic Grant through the University of Alberta. Dr. Suzuki will investigate water relationships of mountain pine beetle-attacked trees with possible cooperations of Drs. Swanson, Addison, and Dymock (NoFRC) as well as Drs. Ayer and Higginbotham (U of A).

12. Publications 1984-85:

Hiratsuka, Y. and A.A. Loman. 1984. Decay of aspen and balsam poplar in Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Inf. Rep. NOR-X-262.

Hiratsuka, Y. and P.J. Maruyama. 1985. Western gall rust. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Pest Leaflet. (in press)

Maruyama, P.J. 1984. A new host and distribution record of a larch needle blight, Meria laricis Vuill. in Alberta. Can. Plant. Dis. Serv. 64(1):19.

Maruyama, P.J. 1985. Silver leaf. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Pest Leaflet. (in press)

Tsuneda, A. and Y. Hiratsuka. Phialidic and annellidic conidiation of Ceratocystis clavigera. Can. J. Bot. (in press)

13. Resources 1985-86:

PYs: Prof.: Hiratsuka 0.2

Tech.: Maruyama 0.2

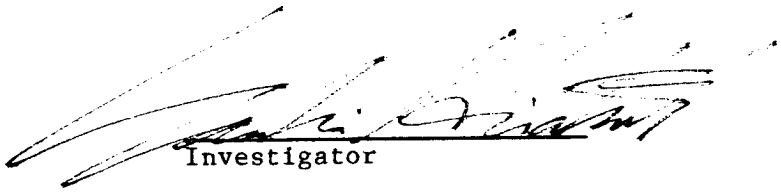
Term/Student: Nil

Total: 0.4

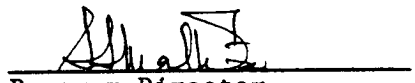
O & M: $5,000

Capital: Nil

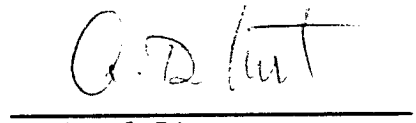
14. Signatures:



Investigator



Program Director



Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 11, 1985

1. Project: Forest Insect and Disease Surveys and Management Systems

2. Title: Effects of ice-nucleating agents on canker, dieback, and mortality of juvenile forest trees and amenity species

3. New: Cont.: X 4. No.: NOR-1-08 (NOR-35-194)

5. Study Leader: H. Zalasky

6. Key Words: Canker, dieback, mortality, juvenile trees, amenity species, ice nucleating agents, frost, frost damage, fungal succession, remedial measures, technical transfer

7. Location of Work: Northern Forest Research Centre, Edmonton, intensively managed forest stands, provincial nurseries, and homeowners in our region

8. Study Objectives:

   1. To determine the effects of INA and microclimate on cold tolerance of seedlings and juvenile trees and use knowledge gained to develop more effective overwintering guidelines and to enhance field performance.

   2. Investigate the use of non INA agents or competition to control populations of INA on the phylloplane of trees and neutralize their mediation in frost.

   3. Assemble photos and photograph trees and parts of trees to illustrate the effects of frost damage and demonstrate how to diagnose symptoms even though they have been initiated in past years to aid in remedial measures of growth problems, undesirable multileadering or stunting.

   4. To investigate red belt symptoms, winter browning, bark discoloration, and subsequent severe defoliation and changes in refoliation patterns.

9. Goals for 1984-85:

   1. Prepare first draft of manuscript on "Bacterial ice nucleating patterns, chemical, morphological, and INA changes" for approval and review.

2. Prepare illustrative and text material for a frost damage diagnostic report.

3. Prepare a Forest Management Note on INA work and its implications.

4. Determine the photoperiod and storage treatments required to substantially reduce freeze damage in conifer seedlings as a result of INA mediation.

5. Continue with the role of fungal spores as INA agents and their subsequent activity during molding.

6. Advisory and consulting services on the health of trees and shrubs, identification, and professional service.

Additional Goals:

7. Determine if pairing known INA inocula of different microorganisms changes the INA potential when tested on acclimated vs. stored acclimated seedlings.

8. Using similar test seedlings in 7, determine the INA potential of certain microorganisms each known to produce an organic substance previously tested or untested for ice nucleation in water droplets.

9. Determine the INA potential of chemically purified organic substances applied prior to and tested during acclimation and storage of conifer seedlings.

10. Accomplishments for 1984-85:

1. "Bacterial ice nucleating patterns, chemical, morphological, and INA changes" with the author.

2. Prepared 6 sections of text for a frost damage diagnostic report.

3. "Frost, ice nucleating agents, and frost damage" has been accepted for Forest Management Note.

4. Acclimating seedlings with photoperiod [8 L:16 D (Light:Dark)] served to decrease the INA potential of microorganisms from a high initial value to a zero with time (9 wk). Storing acclimated seedlings at -2°C served to increase the INA potential from a threshold at 4 wk storage to a maximum value at 9 wk.

5. Fungal spores were successfully produced in culture and tested for INA activity in acclimated seedlings as well as in stored acclimated seedlings. Because inoculated seedlings were misted frequently, no spores germinated and the stored seedlings were free of molding. Killed seedlings became moldy three weeks after the seedlings were moved to a greenhouse bench.

6. Have processed 26 nursery-related problems concerning winter damage, general consultation, and herbicide damage. Most of the requests came from private nurseries. Several requests came from provincial nurseries in Ontario, Manitoba, and British Columbia. Have answered 25 homeowner inquiries relating mostly to winter damage; the remainder were of miscellaneous nature. Research consultations and data requests totalled 9. One silvicultural consultation came from AFS. Reviewed two journal papers and provided one translation.

7. Pairing different known INA organisms usually changed the INA potential of one of the pair, either higher or lower. In a few combinations the activity of INA did not change or the activity of INA dropped to zero.

8. Some microorganisms producing specific organic substances were active INA agents in partially acclimated seedlings and lost INA activity in fully acclimated seedlings. The remaining ones showed no INA activity. At least one of each previously shown to have active or non-active INA were active in seedlings stored at -2°C.

9. Seventeen organic substances were tested for INA activity on acclimated and stored acclimated seedlings tested at -5°C. Ten showed good INA activity on acclimated seedlings. Five were a factor in frost damage of stored acclimated seedlings.

11. Goals for 1985-86:

1. Prepare and submit for review a draft of "Bacterial ice nucleating patterns, chemical, morphological, and INA changes".

2. Prepare and submit for review illustrative and text material for a frost damage diagnostic report.

3. To initiate a manuscript on "the effects of INA bacteria, yeast, and fungi on conifer seedling mortality".

4. To initiate a manuscript on "the effects of INA organic substances on conifer seedling mortality".

5. Identify control factors for INA organisms.

6. Determine bio-control measures for specific INA organisms.

7. Advisory and consulting services on the health of trees and shrubs, identification, and professional service.

12. Publications 1984-85:

Zalasky, H. 1985. Frost, ice nucleating agents and frost damage. Forest Management Note No. 30.

13. Resources 1985-86:

PYs: Prof.: Zalasky 1.0

Tech.: Nil

Term/Student: 0.3

Total: 1.3

O & M: $5,000

Capital: Nil

14. Signatures:

Harry Zalasky
Investigator

Program Director

Regional Director

NOR-3

RESOURCE ECONOMICS AND STATISTICS

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Resource Economics and Statistics

2. Title: Socio-economic and statistical analyses of forest management practices and of development opportunities for forest based economics in the prairie provinces and Northwest Territories

3. New: Cont.: X 4. No.: NOR-3-01 (NOR-3-123)

5. Study Leader: D.M. Boylen

6. Key Words: Economics of forest resource management, production costs, marketing systems, forest industry, employment/economic impacts, economic development, forest statistics

7. Location of Work: Prairie provinces and NWT, Ottawa

8. Study Objectives:

   1. To provide socio-economic and statistical data, analyses and documentation for policy and program development policy of regional forestry research and technology transfer programs.

   2. To provide evaluations of the costs of integrated forest management practices, the socio-economic benefits and impact of forest sector activities in the region, to be used for development and programs such as job creation and federal-provincial Agreements.

9. Goals for 1984-85:

   1. Publish Information Reports on Saskatchewan, Manitoba and NWT.

   2. Develop and implement a new forestry industry survey for updating the primary wood-using industry data base in region.

   3. Prepare necessary documentation for the Canada-Alberta Agreement.

   4. Continue participation on the management committee of Natural Resources Sub-agreement in NWT.

   5. Prepare a proposal for consideration on the development of an integrated forest management-technology transfer project in NWT.

6. Prepare an evaluation framework for the Saskatchewan and Manitoba forest renewal agreements. Develop project evaluation procedures.

7. Continue to identify and provide economic analyses in intensive forest management practices.

8. Develop new Study proposals (statements) reflecting new mandate for economic analyses relating to the development agreements in the region.

9. Develop new Study proposals (statements) reflecting areas of need in forest resource economics research.

Added Goals:

10. Complete summary report(s) for ENFOR project (P-207) "Development of an integrated operation for aspen wood products and energy from aspen biomass.

11. Develop and supervise a PRUF contract with the University of Alberta.

12. Provide reviews/comments of journal articles, reports, proposals and briefings.

10. Accomplishments in 1984-85:

1. Information Report on Manitoba was published in August, 1984. The Saskatchewan report will be published in March, 1985. The NWT report has received the first review set of observations and is being revised (Bohning).

2. A research contract to evaluate approaches to forest industry surveys was completed. The draft Report on Recommended Approach to a Study of Primary Wood Producing Industries in Alberta, Manitoba, and Saskatchewan by The Levy-Coughlin Partnership was received March, 1984 and resulted in substantial planning changes. Planning (both before and after the contract) for the new forest industry surveys was also incorporated under agreement activities (ref. NOR-36-11).

3. Discussion papers, legal agreements, facilitating Cabinet and Treasury Board documents were prepared for the Canada-Alberta Agreement.

4. Participation on the management committee of NWT Natural Resources Sub-agreement was continued until June 1984. Thereafter, assistance on economic and forestry matters was given to the representative, as requested.

5. In order to prepare an integrated forest management-technology transfer project, 2 background studies were required:

   The first was contracted by DIAND to W.R. Dempster and Associates/Sauze Forestry Services who completed his report, Sawtimber Supply Study - Fitz Smith in September, 1984.

The second project was conducted and a draft report completed by W. Ondro, Marketing Plan for Lumber Products and Feasibility Analysis for proposed Fitz Smith Sawmill near Fort Smith, NWT. October, 1984.

6. A contract was tendered to Dennis DePape of Intergroup Consulting Economists, Winnipeg to prepare a report on Evaluation-Frameworks, Components, Possibilities for the Manitoba Agreement for consideration in February-March, 1985 (Boylen, Williamson, Davidson). A National Taskforce on Evaluation is being conducted by CFS HQ with expected results in June 1985.

7. A research study on the economics for fertilization of lodgepole pine was continued (Ondro, Kuhnke). Scientists at NoFRC were contacted to identify future interdisciplinary studies (Ondro). Using the results of the PRUF contract on forest economic research needs, studies are being proposed in vegetation management, fire, growth and yield. A paper on the Economics of thinning in Canada is being prepared for the IUFRO conference in 1985 (DeFranceschi, Boylen). (see NOR-3-003, Goals 1985-86)

8. Eight study proposals were submitted to the Manitoba Research MOU Committee for funding under the Agreement. Six were approved. In Saskatchewan, eight brief study outlines are currently being circulated in the provincial forest branch.

9. Regional input into the national economic task force was given at several meetings. (Boylen)

10. The ENFOR project (P-207) report was split into two summary report contracts - one focussing on the energy generation component and the other on the winter harvesting costs, procedures etc. Errors were identified in some calculations of the initial report and were rectified. (Ondro)

11. Two PRUF contracts with U of Alberta personnel were completed.

    a. The study on Forest Economics Research Needs for the West-Central Region of Canada by William Phillips, James Beck and Wayne Lamble was completed in May, 1984. It is being reviewed for joint publication as a CFS Information Report and an Applied Research Bulletin of the U of Alberta Department of Rural Economy for April, 1985 (Boylen, Heit, Williamson). A summary article has been prepared and submitted to the Forestry Chronicle by the Authors.

    b. A study involving Regional Econometric Analyses of the Structure of the Sawmilling Industry in the Canadian Prairie Provinces was initiated supervised and will be completed in March, 1985 (Boylen, Williamson). A PhD. thesis entitled An Economic Analysis of the Production Structure of the Sawmilling Industry in Alberta by Kamal Banskota was assisted and completed in November, 1984.

A paper on Factor Substitution and Economies of Scale in the Alberta Sawmilling Industry by Kamal Banskota, William Phillips and Timothy Williamson was submitted for journal publication and is currently being reviewed.
Initial discussions and study planning have taken place with professors at U of Alberta and U of Manitoba for three future PRUF studies. (Boylen, Williamson).

12. Several research articles were reviewed for referred journals, as well as comments on national/regional briefings/reports and outside research proposals.

11. Goals for 1985-86:

1. Publish Information Report on NWT industry structure.

2. Publish joint Information Report on forest economics research needs (Boylen).

3. Publish two Information Reports derived from ENFOR 207 (Ondro, Boylen).

4. Publish journal article on factor substitution and economies of scale in Alberta sawmilling industry (Williamson).

5. Prepare for review journal article on structure of sawmilling industry in prairie provinces (Williamson).

6. Initiate proposed studies under the Manitoba Agreement.

7. Develop study proposals for consideration under the proposed Saskatchewan research MOU to be funded by the Agreement (Williamson, Daniel).

8. Develop 3 study proposals for consideration under the PRUF program.

9. Continue to provide input for the national economic task force and the evaluation task force, as required (Boylen).

10. Continue to provide socio-economic and statistical data, analysis and documentation for policy and program development, as required.

11. Continue to provide reviews/comments of journal articles, reports, proposals and briefings.

12. Publications 1984-85:

Ondro, W.J. and Williamson T.B. The Forest Industry in the Economy of Manitoba, 1979-80. NoFRC Information Report NOR-X-263, 1984.

Canada/Alberta Forest Resource Development Agreement, October 25, 1984 (and related documents.).

Canada/Saskatchewan Forest Resource Development Agreement, June 21, 1984 (and related documents).

Canada/Manitoba Forest Renewal Agreement, March 15, 1984 (and related documents).

13. Resources 1985-86:

PYs:	Prof.:	Boylen	0.6
		Williamson	0.6
		De Franceschi	0.5
		Kuhnke	0.4
		Ondro	0.1
	Tech.:	Bohning	1.0
	Term/Student:		
	Total:		3.2

O & M: $8,000

Capital:

14. Signatures:

Investigator

Program Director
(Development)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Resource Economics and Statistics

2. Title: Forestry and socio-economic statistics and analysis/DEVMIS

3. New: Cont.: X 4. No.: NOR-3-02 (NOR-3-123)

5. Study Leader: D.M. Boylen/D. Kuhnke

6. Key Words: Provincial, regional and national forest statistics (e.g., silviculture, growth, depletion, accrual and inventory), socio-economic statistics, evaluation frameworks, DEVMIS

7. Location of Work: Prairie provinces and NWT, Petawawa NFI

8. Study Objectives:

   1. To develop and interpret forestry and socio-economic statistics at the stand, provincial, regional and national levels in order to provide advice and guilelines for improved forest management decision-making by resource managers and researchers.

   2. To assist in the development and implementation of management information systems and evaluation frameworks for the forest renewal agreements.

9. Goals for 1984-85:

   1. Participate with FSSB in the development and implementation of the Canadian Forest Resource Data program as well as the new Canadian Forest Change Data program.

   2. Complete cataloguing and conversion of NoFRC region permanent sample plots.

   3. Publish a Forest Management Note on silvicultural data, with NOR-10.

   4. Participate with NOR-36 in the development and implementation of management information systems and evaluation frameworks for the forest renewal agreements.

   5. Coordinate updating and expansion of regional data bases especially those for silviculture and regional industry/economy data.

10. Accomplishments in 1984-85:

1. Attended meetings with FSSB for the development and implementation of CFRD. Also initial meetings for the 1986 inventory program. CFCD program changed emphasis to forest and disease survey work.

2. Work on CPSPC file was continued; 541 plots were catalogued. A large effort to finish the file was temporarily halted due to hiring freeze.

3. Forest Management Note has been completed and will be changed to an Information Report.

4. Attended meetings in connection with the forestry agreements DEVMIS. Developed administrative record keeping sheets, maps etc.

5. Prepared and contributed to short data reports eg. federal lands, vehicles, white spruce volumes as required.

11. Goals for 1985-86:

1. Participate with FSSB (PNFI) in the development and implementation of the Canadian Forest Resource Data program.

2. Complete planning for the 1985 publication of Silviculture Statistics for Canada (1975-85) and the 1986 Forest Inventory.

3. Complete cataloguing and conversion of NoFRC region permanent sample plots.

4. Continue to participate with NOR-36 in the development and implementation of management information systems and evaluation frameworks for the forest renewal agreements.

5. Coordinate updating and expansion of regional data bases.

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs: Prof.: Boylen 0.2
Kuhnke 0.6

Tech.:

Term/Student:

Total: 0.8

O & M: $9,000

Capital:

14. Signatures:

Investigator

Program Manager
(Development)

Investigator

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Resource Economics and Statistics

2. Title: Interdisciplinary studies in forestry research

3. New: X Cont.: 4. No.: NOR-3-03

5. Study Leader: D.M. Boylen

6. Key Words: Interdisciplinary forest management economics, cost-effectiveness, benefit:cost, risk:benefit, decision-making models

7. Location of Work: Prairie provinces and NWT, Ottawa

8. Study Objectives:

   1. To provide socio-economic and statistical data, analyses and documentation for interdisciplinary studies in forest management.

   2. To provide socio-economic and statistical data, analyses and documentation for a regional perspective to national forest economic studies.

9. Goals for 1984-85:

   1. Complete economic data analysis of the effect of fertilization on dbh and height growth in 70- and 30-year-old lodgepole pine stands. Prepare jointly with I. Bella and R. Yang an Information Report on the economic impact of fertilizing on growth of 70-year-old lodgepole pine. (Ondro)

   2. Development of one interdisciplinary research study proposal through discussion with scientists at NoFRC. (Ondro)

10. Accomplishments in 1984-85:

    N/A

11. Goals for 1985-86:

1. Prepare and publish paper on the economics of thinning for IUFRO conference. (Boylen, De Franceschi)

2. Publish journal article on the economics for fertilization of lodgepole pine. (Ondro)

3. Initiation of an interdisciplinary research study proposed in 1984-85. (Ondro)

4. Review available published/unpublished literature on economics of alternative methods of vegetation management for timber production. Identify and priorize economic problem analyses. Initial planning with NOR-7 and NOR-10 of the economic components to a regional vegetation management research plan. (Boylen, DeFranceschi)

5. Development of an interdisciplinary research study proposal in fire economics. (Williamson)

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs:	Prof:	Boylen	0.2
		Ondro	0.9
		Williamson	0.4
		De Franceschi	0.5
	Tech.:		0.0
	Student (International Exchange)		0.3
	Total:		2.3

O & M: $10,000

Capital:

14. Signatures:

Diane M. Boylen
Investigator

Program Manager

Regional Director

NOR-4

STAND PRODUCTIVITY AND FOREST INVENTORY

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1985

1. Project: Stand Productivity and Forest Inventory

2. Title: Growth and yield of five commercially important native species in Alberta, Saskatchewan, and Manitoba

3. New: Cont.: X 4. No.: NOR-4-01 (NOR-4-045)

5. Study Leader: I.E. Bella

6. Key Words: Pinus banksiana, P. contorta var. latifolia, P. resinosa, Picea glauca, Populus tremuloides, tree and stand growth, yield tables, thinning and spacing

7. Location of Work: Various locations in Alberta, Saskatchewan, and Manitoba

8. Study Objectives:

   1. To construct yield tables for use in natural, unmanaged lodgepole pine, jack pine and aspen stands.

   2. To determine the effect of different types and intensities of thinning on subsequent growth and yield of lodgepole pine, jack pine and aspen.

   3. To determine growth and development of four indigenous conifer species, Picea glauca, Pinus banksiana, P. resinosa, and P. contorta var. latifolia at various spacings on major site types, so that optimum spacing can be selected for specific management objectives in future planting.

   4. Use all available growth and yield information on these species to derive and/or adapt a suitable stand growth model for evaluating stand management options in terms of growth and yield.

9. Goals for 1984-85:

   1. Co-operate in a problem analysis of R & D needs in stand tending, growth and yield for Manitoba, Saskatchewan, and NWT in relation to the upcoming agreements, and memorandums of understanding. (Bella).

2. Organize a field tour in the Hinton area for the international symposium on lP management. (Bella)

3. Co-author and present a paper on fertilization at the lP symposium. (Bella)

4. Publish a journal article and prepare and publish a note on biological damage in young lP stands. (Bella)

5. Direct (Bella) the remeasurements (COSEP) of permanent growth plots in lP.

6. Publish journal article on tree growth response to line clearings in western Alberta.(Bella)

7. Establish plots (Bella); carry out prescribed spacing and tree measurements (Lux and COSEP) as in the original plan, for expanding the lP spacing study in the Gregg Burn (south of Hinton) to obtain stand development information following spacing at age 25.

8. Continue to provide advice on measureational problems including thinning, growth and yield and stand modelling, as well contribute to technology transfer on related problems as required to the federal-provincial agreements. (Bella)

10. Accomplishments in 1984-85:

1. Cooperated in a problem analysis of R & D needs in stand tending, growth and yield for Manitoba in relation to the upcoming agreements, and memorandums of understanding.

2. Organized a field tour in the Hinton area for the international symposium on lP management.

3. Coauthored and presented a paper on fertilization at the lP symposium in Spokane, Washington.

4. An article on biological damage in young lP was submitted and accepted for publication by the For. Chron. A note is in preparation from further analysis of these data showing the distribution of the two most important pest damage categories by tree size classes.

5. The remeasurements of 80 permanent growth plots in lP has been completed.

6. A journal article on tree growth response to line clearings in western Alberta is going through reviews.

7. The lP spacing study in the Gregg Burn (south of Hinton) was expanded to obtain stand development information following spacing at age 25. Plots were established, spacing and tree measurements were done as in the original plan. An establishment report was prepared.

8. Continued to provide advice on measureational problems including thinning, growth and yield and stand modelling, as well contribute to technology transfer on related problems as required to the federal-provincial agreements.

11. Goals for 1985-86:

1. Publish journal article in tree growth response to line clearings in western Alberta. (4-10)

2. Publish journal note on the distribution of the two most important pests by tree size classes in young lP. (4-4)

3. Cooperate in a problem analysis of R & D needs on stand tending, growth and yield in Alberta and Saskatchewan in relation to the upcoming Agreements and MOUs. (4-28)

4. Carry out project leader duties for NOR-4. (4-42)

5. Publish a journal note on logging practices and subsequent development of aspen stands in Saskatchewan. (4-24)

6. Pool all available information or jP thinning in Manitoba and Saskatchewan and prepare an information report as a guide for the forester managing jP. (4-6)

7. Continue to provide advise on mensurational problems including thinning, growth and yield and stand modelling, as well as contribute to technology transfer on related problems as required to the federal-provincial agreements. (4-18 and 4-5MA)

8. Provide functional guidance to P.A. and Winnipeg suboffices as required. (4-41)

9. Review the status of the aspen thinning and pruning study near Swan River, Manitoba, and develop plans for assessment. Discuss pathological aspects with Y. Hiratsuka and R. Wall. (4-22)

10. Direct remeasurement of PSPs in strip-thinned jack pine in SE Manitoba. (4-6)

11. Complete analysis and publish a Forest Management Note on the Teepee Pole Creek lP spacing study. (4-8)

12. Publications 1984-85:

Weetman, G.A., Yang, R.A. and Bella, I.E. 1984. Nutrition and fertilization of lodgepole pine. Paper presented at the Lodgepole pine management symposium, Spokane, Wash. and Vancouver, B.C., May 1984. Wash. State University. In press.

Bella, I.E. 1984. Lodgepole pine post conference field trip report. In the above proceedings. In press.

Bella, I.E. 1984. Growth models for yield forecasting in aspen and jack pine. Page 2 in "Growth, Yield and ENFOR". Enviro. Can., For. Serv., Edmonton, Alberta. For. Rep. 29.

Bella, I.E. 1984. Growth, yield, and ENFOR. Page 1 in "Growth, Yield, and ENFOR". Environ, Can., Can. For. Serv., Edmonton, Alberta. For. Rep. 29.

Bella, I.E. 1984. Red pine outgrows jack pine in southeastern Manitoba. page 3 in "Growth, Yield, and ENFOR". Environ. Can., Can. For. Serv., Edmonton, Alberta. For. Rep. 29.

Bella, I.E. 1984. Spacing is the key to improved yields in lodgepole pine. Page 4 in "Growth, Yield, and ENFOR". Environ, Can., Can. For. Serv., Edmonton, Alberta. For Rep. 29.

Ondro, W. and Bella, I.E. 1984. Integrated utilization makes aspen an economic resource. Page 5 in "Growth, Yield and ENFOR". Environ. Can., Can. For. Serv., Edmonton, Alberta. For. Rep. 29.

13. Resources 1985-86:

PYs:	Prof.:	Bella	0.8
	Tech.:	Vice Kolabinski	1.0
	Term/Student:		
	Total:		1.8

O & M: $8,000

Capital:

14. Signatures:

Investigator

Program Director

Regional Director

SUMMARY OF ACTIVE THINNING, SPACING AND YIELD STUDIES IN CONIFERS
1985

Study No.	Location	Soil and Site	Stand age at establishment	Date of	Date of remeas.*	No. of plots	Plot size (acres)	Treatment	
								Method	Intensity
1-lP	Alberta	Varied	Varied	1951 1952 1953	1961 1974 1984 (1994)	100	0.1 0.5	N.A.; these are permanent growth and yield plots	
2-jP	Sandi-lands, Man.	Stratified sand and gravel outwash; moist	15	1952	1957 1962 1967 1971 1977 1983 Spr. (1987 A)	16	0.1	Low selection thinning to specified Stand Density Index every 5 years, except in 1971 & later	Control, no thinning - 2 plots Thinned: to 40%,50%,60%,70% 80%, 100%, & 120% of control SDI 2 plots each
3-jP	Sandi-lands, Man.	Medium sand; fresh	40	1958	1963 1968 1973 1978 1983 Spr. (1988 A)	20	0.1	Merchantable Selection thinning, low and crown. Only trees with dbh over 4" were removed.	Control, no thinning - 4 plots Thinned: Heavy low 4 plots Light low 4 plots Heavy crown 4 plots Light crown 4 plots
4-jP	Sandi-lands Forest Res., Man.	a. Sand, fresh	9	1964	1965 1968 1973 1978 1983 Spr. (1988 Spr.)	15	.002 .007	Mechanical Strip-thinning	Control, 5 plots Thinned 1-way: 5 plots Thinned 2-way: 5 plots
		b. Sand, fresh	11	1967	1969 1976 1981 (1986 A)	5	.002 - .007	Mechanical Strip-thinning	Thinned 1-way 5 plots

SUMMARY OF ACTIVE THINNING, SPACING AND YIELD STUDIES IN CONIFERS
1985 (continued)

Study No.	Location	Soil and Site	Stand age at establishment	Date of	Date of remeas.*	No. of plots	Plot size (acres)	Treatment Method	Treatment Intensity
		c. Sand, moist	9	1964	1965 1968 1973 1978 1983 Spr. (1988 Spr.)	15	.002 - .007	Mechanical Strip-thinning	Control: 5 plots Thinned 1-way: 5 plots Thinned 2-way: 5 plots
4-jP	Sandi lands, Forest Reserve,	d. Sand, moist	11	1967	1969 1976 1981 (1986 A)	5	.002 - .007	Mechanical Strip-thinning	Thinned 1-way: 5 plots
		e. Sandy till, fresh	13	1965	1967 1970 1974 1979 1984 A	10	.002 - .007	Mechanical Strip-thinning	Control: 5 plots Thinned 1-way: 5 plots
		f. Sandy till, fresh	17	1966	1968 1970 1975 1980 A (1985 A)	10	.002 - .007	Mechanical Strip-thinning	Control: 5 plots Thinned 1-way: 5 plots
		g. Sand, dry	13	1965	1967 1970 1974 1979 1984 A	10	.002 - .007	Mechanical Strip-thinning	Control: 5 plots Thinned 1-way: 5 plots
5-1P	McKay, Alberta	Silt loam to sandy loam	22	1954	1960 1969 1979 (1989)	16	.20 - .738	Low selection thinning	Control: 3 plots 1.5m spacing: 3 plots 1.8m spacing: 3 plots 1.8m spacing: rethinned. 3 plot 2.4m spacing: 3 plots 3.7m spacing: 1 plot

SUMMARY OF ACTIVE THINNING, SPACING AND YIELD STUDIES IN CONIFERS
1985 (continued)

Study No.	Location	Soil and Site	Stand age at establishment	Date of	Date of remeas.*	No. of plots	Plot size (acres)	Treatment	
								Method	Intensity
6-jP -rP	Sandi-lands, Forest Reserve	Sand, fresh	3 y.o seedlings planted	1963	1973 1978 1983 (1988 A)	32	Variable	49 trees in a 7x7 matrix at 4x4, 6x6, 8x8 10x10 ft. spacing plus a 2-row surround. Four replications.	
6b-wS	Sandi-lands and Riding Mtns.	Sand, fresh Fresh till.	3 y.o seedlings planted	1963 1962	1973 1978 1983 A (1988 A)	32	variable	as above	
7-1P	a.1 Gregg Burn	three site types	7	1964	1966 1971 1976 1981 (1986 A)	30	variable	100 trees in a 10x10 matrix at densities 200, 400, 800, 1600, 3200 stems/ac.	
	2 Gregg Burn	three site types	27	1984	(1989 Spr.)	24	variable	100 trees in a 10x10 matrix at densities 400, 800, 1200, 1600 stems/ac.	
	b. Tepee Pole Creek	three site types	25	1967	1972 1977 1982 (1987 A)	30	variable	100 trees in a 10x10 matrix at densities 200, 400, 800, 1600, 3200 stems/ac.	
8-rP	a. Sandi-lands	N/A	N/A	1980	N/A	6x4		Control: 20x20m 1. Control, 2. 8'x8', 3. 10'x10' 4. 12'x12' Treated: 30x30m	
-jP	b. Belair	N/A	N/A	1981(treat) 1982(contr)		4	2(20x20 m) 2(10x10 m)		
-jP	c. Hadash.	N/A	N/A	1981		6	20 x 20 m	3 areas; in each 1 control, 1 thinned.	

SUMMARY OF ACTIVE THINNING AND OTHER GROWTH STUDIES IN ASPEN
1985

Study No.	Location	Soil and Site	Stand age at establishment	Date of	Date of remeas.*	No. of plots	Plot size (acres)	Treatment	
								Method	Intensity
1 (MS133)	Turtle Mtn. For. Res.	Non telluric mesic clay loam till	11	1948	1953 1960 1965 1971 1976 1981 (1986 A)	5	0.2	Regular spacing & alternate strips	Control, no thinning-2 plots Thinned: 5'x5', 7'x7', & 20' alternate strips - 1 plot each
2 (MS155)	Pelly, Sask.	Non telluric mesic clay loam till	14	1951	1957 1962 1967 1972 1977 1983 Spr. (1988 Spr.)	14	0.2	Thinned to fixed SDI every 5 yrs. except in 1972 & later	Control, no thinning-2 plots Thinned: to 120, 100, 80, 70, 60, & 50% of SDI of control in 1951 - 2 plots each intensity
3 (MS146)	Riding Mountain National Park	Non telluric mesic clay loam till	14	1950	1960 1965 1971 1976 1981 (1986 A)	4	0.1	Regular spacing	Control, no thinning-1 plot Thinned: 8'x8', 10'x10', 12'x12' - 1 plot each
		Telluric mesic silty clay loam till	23	1950	1960 1965 1971 1976 1981 (1986 A)	8	0.2	Regular spacing	Control, no thinning-2 plots Thinned: 8'x8', 10'x10', 12'x12' - 2 plots each
4. (MS232)	Porcupine Mtn., Swan River, Manitoba	Non telluric mesic clay loam till	15	1964	1969 (1985 Sp.)	24	0.1	Thinning to regular spacing and pruning	Control, no thinning-12 plots Thinned and Pruned: 12'x12' spacing with 5 pruning treatments

* Planned measurement years are in brackets.

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1985

1. Project: Stand Productivity and Forest Inventory

2. Title: Stand modelling of the growth and development of important forest types in the prairie provinces

3. New: Cont.: X 4. No.: NOR-4-02 (NOR-4-075)

5. Study Leader: H. Grewal Co-operator: I.E. Bella

6. Key Words: Tree and stand growth, stand development, density-competition effects, yields, stocking, site, ecological systems, models, simulation, aspen, jack pine, black and white spruce, red pine, lodgepole pine

7. Location of Work: Manitoba, Saskatchewan and Alberta

8. Study Objectives:

To forecast growth and yield of forest stands growing under a range of site and density conditions using a stand growth model developed for this purpose.

9. Goals for 1984-85:

1. Gather growth and yield data from provincial and industrial forest services for calibrating STEMS model for white, black spruce and red pine. (NOR-4-02, Grewal)

2. Organize a workshop on stand models for forest industries and provincial forest services to assess the usefulness of STEMS to their inventory and management programs. (NOR-4-02, Grewal and Bella)

3. Complete Ph.D thesis research and writeup by November 1984. In order to achieve goal 2 an education leave is requested for the summer of 1984 (May to August) so that thesis work may be carried out at U.B.C. with the help of research committee. (NOR-4-02, Grewal)

4. Install an improved version of STEMS incorporating management options on new computer at NoFRC. (NOR-4-02, Grewal)

10. Accomplishments in 1984-85:

1. Gathered growth and yield data and calibrated STEMS for white spruce. Black spruce and red pine calibration is postponed until data is available.

2. A workshop on the usefulness of the STEMS was organized for forest industries and provincial forest services to assess the usefulness of STEMS to their inventory and management programs on 28th and 29th February 1984.

3. An education leave was taken from May to August 1984 in order to carry out thesis work at UBC with the help of research committee. A first draft of Ph. D. thesis was prepared.

4. An improved version of STEMS incorporating management options was installed on new computer at NoFRC.

11. Goals for 1985-86:

1. Prepare information report on "Guidelines for the use of STEMS in the management of lodgepole pine and white spruce". (4-1)

2. Complete Ph.D. thesis entitled "Improved methods of modelling white spruce growth and yield in Alberta. (4-3)

3. Gain familiarization with FORCYTE-11 program which predicts nutrient cycling in aspen stand (in cooperation with Ivor Edwards and mike Apps). (4-19)

4. Undertake a technology transfer program to promote the use of STEMS for the management of lodgepole pine and white spruce. (4-2)

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs:	Prof.:	Grewal	0.8
		Bella	0.2
	Tech.:		
	Term/Student:		
	Total:		1.0

O & M: $3,000

Capital:

14. Signatures:

Harjit S. Grewal
Investigators

[signature]

[signature]
Program Director

[signature]
Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1985

1. Project: Stand Productivity and Forest Inventory

2. Title: Transformation and movement of applied fertilizer elements (N, P, S) in selected lodgepole pine stands

3. New: Cont.: X 4. No.: NOR-4-03 (NOR-4-102)

5. Study Leader: J. Baker

6. Key Words: Acid soluble-alkali labile nitrogen, acid soluble alkali stable nitrogen, acid insoluble humin nitrogen, aluminum sulfur, sulfate-sulfur

7. Location of Work: Edmonton, Hinton, Alberta (Edson map sheet 83F)

8. Study Objectives:

To determine the influence of a soil series on the transformation of N, P and S fertilizers and the accumulation and distribution of these in the various inorganic and organic soil fractions. To also determine the association, if any, of a specific nutrient fraction with growth.

9. Goals for 1984-85:

1. Publish journal article entitled, "Nitrogen shifts and content changes in the horizons of two Luvisol soils following fertilization".

2. Publish a report on the five year effects of fertilization on the N-S relationships in Luvisols supporting 30-year old lodgepole pine stands.

3. Continue a laboratory study to test the effects of various N-carriers on soil and to observe any movement of fertilizer - organic matter reaction products within and/or through the profile.

Added Goal

4. Results of a simulated soil column study have been written up, "Response of a Podsolic Luvisol (Mercoal) to urea-nitrogen" to be published in a journal.

10. Accomplishments in 1984-85:

1. A paper "Nitrogen shifts and content changes in the profiles of two Luvisols 10 years after fertilization" has been submitted to the Journal of Soil Science (January 5, 1985).

2. A report, "Nitrogen and sulfur in soils supporting 30-year-old lodgepole pine stands 5-years after fertilization",originally intended for an information report, has been submitted as a file report because the 10-year effects of fertilization has been already submitted to a journal. Pertinent data from that report will be combined with similar foliage. data on S/N ratios for a journal publication. (see added achievement #7 in study 04-05)

3. Laboratory investigation of various N fertilizers and their effects on the Mercoal soil type was replaced by a much quicker field trial with the additional advantage that results would be pertinent to actual field conditions. This trial is given under NOR-04-05 as added accomplishment #6.

4. A laboratory study involving simulated soil columns utilizing a Podsolic Gray Luvisol (Mercoal) and 3 rates of urea-N was undertaken. Results obtained were generally in agreement with those published by Ogner and confirm that urea-organic matter reaction products are readily transported through the soil profile.

11. Goals for 1985-86:

1. Publish:

   a. "Nitrogen shifts and content changes in the profiles of two Luvisols following fertilization" in the journal of soil science. (4-17)

   b. "Response of a podsolic gray Luvisol to urea-N" in a soils journal. (4-62)

2. Continue analyses of lodgepole pine tissues for both studies NOR-4-03 and NOR-4-05. (4-19)

3. Continue soil analyses with reference to essential nutrients and effects on these by various N-fertilizers. Results will again be applicable to both studies 04-03 and 04-05. (4-19)

12. Publications 1984-85:

Baker, J. 1984. "Nitrogen and sulfur in soils supporting 30-year-old lodgepole pine stands 5-years after fertilization". File Report, NoFRC, Edmonton, Alberta.

Baker, J. 1984. Response of a podsolic Luvisol (Mercoal) to urea-nitrogen. File Report. NoFRC, Edmonton, Alberta.

13. Resources 1985-86:

PYs: Prof.: Baker 1.0

Tech.:

Term/Student:

Total: 1.0

O & M: $3,000

Capital:

Grants & Contributions:

14. Signatures:

Joseph Baker
Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1985

1. Project: Stand Productivity and Forest Inventory

2. Title: Fertilization of established lodgepole pine stands

3. New: Cont.: X 4. No.: NOR-4-04 (NOR-4-122)

5. Study Leader: R.C. Yang

6. Key Words: Pinus contorta, B. 19a, tree nutrition, nutrient deficiencies, nitrogen, phosphorus, sulphur

7. Location of Work: Hinton, Alberta

8. Study Objectives:

To assess the effects of fertilizing 70-year-old and 30-year-old lodgepole pine stands on stand growth and yield.

9. Goals for 1984-85:

1. Publish Information Report on ten-year growth response of 70-year-old lodgepole pine to fertilization. (Yang)

2. Publish Information Report on ten-year results of fertilizing 30-year-old lodgepole pine stands. (Yang)

3. Prepare a Management Note on fertilizing lodgepole pine in west-central Alberta. (Yang and Baker)

4. Participate and contribute lodgepole pine symposium by co-authoring an article on lP nutrition and fertilization. (Yang and Bella)

5. In cooperation with Dr. M. Micko, University of Alberta, publish report on the effect of fertilization on lP specific gravity and tracheid length. (Yang and Micko, U of A)

6. Provide advice and carry out technology transfer on mensurational problems relating to forest fertilization. (Yang)

10. Accomplishments in 1984-85:

1. An Information Report entitled "Ten-year growth response of 70-year-old lodgepole pine to fertilization in Alberta" has been published (NOR-X-266).

2. An Information Report entitled "Fertilization improves diameter and volume growth of 30-year-old lodgepole pine in west-central Alberta" has been published (NOR-X-268).

3. A manuscript entitled "Fertilization improves stand productivity of preharvest lodgepole pine" for publication as a Forest Management Note was prepared and currently under second revision.

4. In cooperation with Drs. G. Weetman (UBC) and I.E. Bella, a paper entitled "Nutrition and fertilization of lodgepole pine" was presented at lodgepole pine symposium held at Spokane, Wa. and Vancouver, B.C.

5. A manuscript entitled "Effects of fertilization on wood density and tracheid length of 70-year-old lodgepole pine in Alberta" has been prepared and is currently under review.

6. Provided advice on forest fertilization and mensurational problems to AFS and sub-offices as requested.

11. Goals for 1985-86:

1. Publish a Forest Management Note entitled "Fertilization improves stand productivity of preharvest lodgepole pine". (Yang and Bella) (4-55)

2. Revise and publish a journal article on effects of fertilization on wood density and tracheid length of 70-year-old lodgepole pine. (Yang, Wang, and Micko, U of A) (4-15)

3. Remeasure and conduct data analysis for fertilization studies in black spruce (The Pas) and jack pine (Saskatchewan). Assess potential of Alberta Interprovincial white spruce fertilization trial and 2 addition fertilization trials in Saskatchewan. (Yang) (4-40)

4. Continue to provide advice and carry out technology transfer on mensurational problems related to forest fertilization. (Yang) (4-18)

12. Publications 1984-85:

Yang, R.C. 1984. Fertilization of lodgepole pine in Alberta improves stand growth. (In) Growth, Yields and ENFOR. NoFRC Forestry Report No. 29.

Weetman, G.A., Yang, R.C., Bella, I.M. 1984. Nutrition and fertilization of lodgepole pine, Paper presented at the lodgepole pine symposium, Spokane, Washington and Vancouver, B.C., May 14-16, 1984. In press.

Yang, R.C. 1984. Ten-year growth response of 70-year-old lodgepole pine to fertilization in Alberta. Inf. Rep. NOR-X-266.

Yang, R.C. 1985. Fertilization improves diameter and volume growth of 30-year-old lodgepole pine in west-central Alberta. Inf. Rep. NOR-X-268.

13. Resources 1985-86:

PYs: Prof.: Yang 0.6

Tech.: Lux 0.7

Term/Student:

Total: 1.3

O & M: $3,000

Capital:

14. Signatures:

RYang
Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1985

1. Project: Stand Productivity and Forest Inventory

2. Title: Fertilization and thinning of semi-mature lodgepole pine stands

3. New: Cont.: X 4. No.: NOR-4-05 (NOR-4-195)

5. Study Leader: R.C. Yang Co-operator: J. Baker

6. Key Words: Pinus contorta, tree nutrition, photosynthesis, nutrient prescription, nitrogen, thinning, nitrogen fractionation, immobilization, mineralization

7. Location of Work: Hinton, Alberta

8. Study Objectives:

To assess the effects of thinning and fertilizing semi-mature lodgepole pine on stand growth, to assess the contribution of individual fertilizer elements to the growth response; and to develop a diagnostic technique for prescribing nutrient requirements for lodgepole pine stands in the foothills of Alberta.

9. Goals for 1984-85:

Subject to final approval of the study plan:

1. Establish plots according to the study plan; thin designated blocks to a desired density; tag and tally all crop trees on plots. (Yang)

2. Sample thinned (cut) trees for biomass, foliar N concentrations, percentage proportions of tree components, i.e., needles, twigs, branches, bole etc., to estimate N content of these prior to fertilization. (Yang and Baker)

3. Sample ground vegetation as per Item 2. (Baker)

4. Sample soil profile to 120 cm (4 ft.) in 4-5 pits to describe profile and estimate background levels of nutrients N, P, Al, Mn, etc. (Baker)

5. Set up 2 to 3 field lysimeters in the study area to monitor both the movement of N and organic matter within the soil profile as a result of urea-organic matter interactions and reaction product synthesis. (Baker)

Added Goals

6. To establish trial plots for assessing forest soil reactions to various N sources.

7. To determine foliar S/N ratio in 40-year-old lodgepole pine and to assess the validity of using the ratio as a diagnostic technique for prescribing lodgepole pine nutrient requirements.

10. Accomplishments in 1984-85:

1. A total of 72 plots have been established according to the study plan; half of these plots were thinned to a desired density. All crop trees were tagged and dbh tallied.

2. Sampling for biomass, foliar N concentration, and proportions of tree components was completed; some 40 trees were samples. Analysis to determine nutrient contents in tree components is in progress.

3. Sampling for ground vegetation is postponed to coincide with the application of fertilizer.

4. Sampling for soils profile and background nutrient levels are postponed to 1985-86.

5. According to PFRC experiences, lysimeters provides only qualitative but little quantitative information on nutrient downward movement. Subject to final approval, the installation of lysimeters in the study will be cancelled.

6. Trial plots to compare forest soils reactions to various N sources have been established in the vicinity of the study area. Chemical analysis to determine nutrient levels at varying soil depths is in progress.

7. Chemical analysis has been completed. Data analysis is currently in progress.

11. Goals for 1985-86:

1. Sample for nutrient content of ground vegetation and soils at various depths before fertilization (Baker, Lux and Yang). (4-19)

2. Apply fertilizer (ammonia nitrate) to plots according to the experimental design (0, 180, 360, and 540 kg/ha of N and 40 kg/ha of P and S for all plots) (Yang and Lux). Prepare an establishment report (Yang) (4-19).

3. Act as a scientist authority in a study to assess existing information in this region on white spruce growth after release from trembling aspen competition (Yang). (4-1MA)

4. Conduct problem analysis of white spruce-aspen mixedwood stands with respect to silvicultural treatments and mensurational responses. (Yang and Waldron). (4-30)

5. Analyze the results from forest soil reactions to three N sources and prepare a manuscript for publication as a journal note (Baker and Yang). (4-60)

6. Complete data analysis on S/N ratio in lodgepole pine tissue and prepare a manuscript for journal publication (Yang and Baker). (4-61)

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs:	Prof.:	Yang	0.4
	Tech.:	Lux	0.3
	Term/Student:		
	Total:		0.7

O & M: $3,000

Capital:

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1985

1. Project: Stand Productivity and Forest Inventory

2. Title: Forest inventory

3. New: Cont.: X 4. No.: NOR-4-06 (NOR-22-142)

5. Study Leader: W.C. Moore, Cooperators: W. Chow, R. Hall, S. Price

6. Key Words: forest type polygons, geographic information systems (GIS), mapping and analyses of resources system (MARS), biomass inventories, change monitoring, multi-level remote sensing, satellite imagery, aerial photography, large-scale photo (LSP) sampling, photo/imagery interpretation

7. Location of Work: Alberta, Saskatchewan, Manitoba, Northwest Territories

8. Study Objectives:

   1. To provide Forest Management Advice and prescriptions services by evaluating, developing, coordinating and applying regionally unique forest inventory and mapping techniques for appraising and monitoring changes in the forest resource, principally through Remote Sensing and Interpretation research, in collaboration with Centre colleagues, federal agencies, provincial governments, educational institutions and industries.

   2. To support growth and yield, Forest Ecology and Soils, silviculture and environmental impacts of silvicultural practices research and development as appropriate.

9. Goals for 1984-85:

   1. Publish Information Report on computer mapping for biomass inventories, and develop detailed specifications for a digital image analysis system that can be interfaced with a computer mapping system in collaboration with colleagues, clients, and possibly an outside contractor. (W. Moore and W. Chow)

   2. Prepare and submit a Forest Management Note for review on use of Procom-2 Image Transfer System equipment for change mapping with Landsat imagery and aerial photography. (W. Moore)

3. Prepare and submit an information report for review on environmental assessments with development of multi-level remote sensing interpretation for change and trend predictions. (W. Moore and R. Hall)

4. Initiate acquisition of a state-of-the-art computer mapping system for three-phase capabilities (i.e., inventory databases, database analyses, and resources management); in conjunction with regional economic development agreements, forest insect and disease survey, and northern development programs; and in cooperation with a Forestry Statistics and Systems Branch lead--if funds become available. (W. Moore, W. Chow and S. Price)

5. Initiate acquisition of a state-of-the-art digital image analysis system for interface with a new computer mapping system--if funds become available. (W. Moore and W. Chow)

6. Provide advisory services in remote sensing, and subsequent computer mapping, applications to NoFRC clients and colleagues as required, and particularly as follows.: (W. Moore)

   a) act as scientific authority for biomass contact;

   b) initiate cooperation with Remote Sensing Geographic Information Project of the Canada Centre for Remote Sensing, possibly as a member of a Working Group;

   c) continue technology-transfer assistance to DIAND for annual mapping of burned land with satellite imagery;

   d) continue coordination with, and promotion of, LSP sampling development and technology transfer;

   e) continue as member of the Alberta Advisory Committee on Remote Sensing.

10. Accomplishments in 1984-85:

1. An Information Report manuscript, "A mapping and analysis if resources system application: forest inventories to biomass inventories", reviewed and submitted for publication. A prototype MARS capability is now available at the Centre for testing mapping concepts. in addition, specifications for complimentary digital image analysis systems have been reviewed.

2. Forest Management Note prepared that is based on completed ENFOR contract supervision for use of the Procom-2 equipment to update forest land areas by township covering all non-inventoried parkland and prairie areas of the three prairie provinces at 1:250 000 scale from Landsat imagery; example mapping of all burned forest land of the Northwest Territories (see 6c below); and, experimental Softwood-Mixedwood-Hardwood area typing at 1:50 000 scale from Landsat imagery in the non-inventoried Parklands region of Saskatchewan.

3. The multi-level remote sensing Goal for an Information Report has been reduced to a File Report on the concept. A review of the literature uncovered a USA report on the subject for a 1 Mha area, but not a more complex forested area, that required about nine person years and over $180,000 to complete. This Goal will be extended with emphasis on more economic manual technique development for forested areas, rather than digital techniques for desert areas, pending the availability of an updated GIS and complimentary digital image analysis system.

4. Intitiated a successful coordination meeting of provincial forest inventory/mapping representatives in Prince Albert that was sponsored by the Development Program. Specific provincial requirements and activities for acquiring GIS under the Agreements were compared, and a consultant to Saskatchewan effectively outlined alternatives in the technology. It might be possible to acquire a color terminal and cartographic quality plotter in conjunction with an Alberta GIS under the Agreements.

   Eight workers and a supervisor were available under the Environment 2000 Program to reproduce 88 FSSB summary forest inventory maps for the Northwest Territories. These have potential as a future data base. The earlier conversion of inventory maps to biomass maps was an example of data analysis with GIS. The demonstration of Procom-2 capabilities to Saskatchewan, in conjunction with the above meeting, provides an example of change monitoring potential for management purposes. In addition, several of the Environment 2000 workers were seconded to Alberta to assist them with map digitizing and supplementary data entries. Pilot photo-digitizing trial also conducted under the program, with AFS and REAP collaboration, as base for feasibility determination.

5. Discussions with provincial forestry agencies indicate digital image analysis systems are too expensive in time, facilities and operations for the sizes of areas and resolution of detail required. More research and development, particularly for suitability of classifications and economy of operations, is required. Agencies appear to be interested in Procom-2 techniques in the interim, and digital image analysis adjuncts to GIS are worthy of consideration. A digital image analysis option should be maintained for work with newer-technology satellite data and for potential integration with GIS data.

6. The Prince Albert GIS meeting (above) and an international meeting on GIS for Decision Makers in Edmonton were attended for exchanges of information. Several communications with forestry agencies within each of the four jurisdictions in the region, plus central agencies, served similar purposes.

   a. Completed Scientific Authority requirements for two ENFOR (NOR-28-05) contracts. The first was for a statistical estimate of the forested land areas, by a contractor, in the non-inventoried portions of the three prairie provinces. The second entailed an alternative proposal using the Procom-2 and Landsat imagery for a 100% sample. This was implimented, supervised and reported upon using the same contractor.

b. Contacts were made with the Lands Directorate of DOE and the Canada Centre for Remote Sensing who are conducting a multi-level remote sensing/mapping trial for an agriculture area in Manitoba. This might later be extended to forested areas. In addition, contacts have been made with AFS, REAP and the Remote Sensing Centre in Alberta, and PNFI, to identify similar or extended possibilities and support in Alberta. This is a long-term project that relates to Goals 3, 4 and 5 above.

c. Manuscript, "Mapping of Burned Forest Land in the Northwest Territories", for journal publication is under review.

d. Co-Scientific Authority with R. Hall on PRUF contract and market survey for assessments of LSP sampling.

e. Named to the organizing committee for the 10th Canadian Symposium on Remote Sensing, May 1986.

11. Goals for 1985-86:

1. Complete Information Report "A mapping and analysis of resources system application: forest inventories to biomass inventories" under the ENFOR Program (NOR-28-05) (W. Moore and W. Chow). (4-43)

2. Complete reviews and submit paper, "Mapping of burned forest land in the Northwest Territories", for journal publication. (W. Moore) (4-58).

3. Publish Forest Management note, "Procom-2 mapping technique for forest depletion monitoring". (W. Moore) (4-44)

4. Review regional objectives for forest inventory data acquisition and mapping and remote sensing applications related to national roles and prepare file report for review. (W. Moore and R. Hall) (4-57)

5. Complete file report on multi-level remote sensing and mapping as a basis for further investigations of the concept in cooperation with the Alberta Forest Service. (W. Moore and R. Hall) (4-45)

6. Complete file report for review on the economics of photo-digitizing of forest maps for their inclusion in digital data bases that is based on experience with the Environment 2000 Program. (W. Moore) (4-59)

7. Provide additional forest management advice and prescription services in forest inventory, mapping and remote sensing applications to clients and colleagues as required, and particularly as follows:

a. provide research, development and coordination support for GIS and forest inventory data bases within the region as required under the Development Agreements (W. Moore and S. Price).

b. further development of economic, yet accurate, applications for change monitoring and reconnaissance mapping in cooperation with Alberta and Saskatchewan (W. Moore).

c. cooperate with CFS Development Directorate for forest inventories on federal lands in the region (W. Moore).

d. continue as a member of the Alberta Advisory Committee on Remote Sensing and as a member of the organizing committee for the 10th Canadian Symposium on Remote Sensing, May 1986, (W. Moore). (4-51)

8. Evaluate HP digitizer and microcomputer combination with Procom-2 for rapid new determination of change from satellite imagery (W. Moore and R. Hall) (4-56).

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs: Prof.: Moore 1.0

Tech.:

Term/Student:

Total: 1.0

O & M: $7,000

Capital:

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1985

1. Project: Stand Productivity and Forest Inventory

2. Title: Development and application of large-scale photo and image analysis techniques to forest inventories

3. New: Cont.: X 4. No.: NOR-4-07 (NOR-22-188)

5. Study Leader: R.J. Hall

6. Key Words: Large scale photography (LSP), aerial photography, photo mensuration, photogrammetry, satellite imagery, image analysis, forest resource, inventory, assessment, vegetation damage, statistical analysis

7. Location of Work: Alberta, Saskatchewan, Manitoba, Northwest Territories and Yukon Territory

8. Study Objectives:

   1. To apply new techniques in the regional application of large-scale photography in acquiring and analyzing resource inventory data.

   2. To provide advisory and technology transfer services in the acquisition, uses, and analyses of remote sensing imagery; mapping; and in the operation of interpretation equipment.

   3. To design and develop photo acquisition and measurement/interpretation system components as required for regional applications.

   4. To maintain an image acquisition and analysis laboratory for cooperative studies.

   5. To assess and apply digital image analysis techniques in the interpretation and classification of forest resources in the region.

   6. To provide advisory services in survey design, interpretation methods and analyses as required.

9. Goals for 1984-85:

1. Supervise contract for computer intervalometer, and conduct operational trials in Alberta (REAP) and in the Yukon (DIAND) in the 1984 field season for several resource inventory applications. Collaborate with field work and advise on analysis and interpretation of LSP. Analyze data for reports. (R. Hall)

2. Publish information report "Considerations for use of large-scale aerial photographs in regeneration assessment", and continue development of methodology for regeneration assessments with NeFRC and Alberta Energy and Natural Resources, and initiate preparation of User's Guide. (R. Hall).

3. Complete M.Sc. thesis on the analysis of simulated thematic Mapper data for forest and land cover classification in the NWT. (R. Hall)

4. provide advisory services and presentation in remote sensing for NoFRC clients and colleagues as required, particularly as follows:

   a. To continue as member of the Forestry Working Group of the Canadian Advisory Committee on Remote Sensing. (R. Hall)

   b. To be a member of the scientific and technical committee for the 9th Canadian Remote Sensing Symposium to be held in St. Johns during August, 1984. (R. Hall)

   c. Supervise contracts to publish the Alberta Forest Fire history Atlas depending on available funds. (R. Hall and G. Delisle)

5. Write, update, and modify microcomputer programs for more efficient operations and additional applications. (R. Hall)

6. Supervise contract for a market survey on the camera system. (R. Hall and W. Moore)

Added Goals

7. To supervise PRUF contract with the Faculty of Forestry, UBC for visiting lecturer Ray Spencer, University of Melbourne, on a technical review and determination of status of large-scale photo sampling across Canada. (R. Hall and W. Moore)

8. Prepare paper for the special Alberta theme issue of the Canadian journal of Remote Sensing on change detection for aspen defoliation with Landsat MSS digital data. (R. Hall)

9. Prepare paper for 9th Canadian Symposium on Remote Sensing on options for application of large-scale photographs. (R. Hall)

10. Accomplishments in 1984-85:

1. A $20 000 computer intervalometer contract was awarded and the operational unit is expected in March, 1985. Approximately 110 line miles of photography were acquired for DIAND operational requirements and are currently being analyzed. Trials have been successful and DIAND have requested NoFRC expertise to supervise contracts to produce their own 70-mm LSP camera system. Total cost to exceed $100 000 over 2 years and will provide DIAND capability to meet their own needs, in addition to providing services for other government agencies for resource applications in the Yukon. A formal DIAND (NAP)/NoFRC Agreement has been completed, and $88 000 in contracts were awarded to acquire a Laser Rangefinder, Vinten Cameras and Magazines by March, 1985.

   Careful flight planning and coordination resulted in excellent color positive photography being acquired for operational trials in Alberta for REAP. Applications include assessing woody regrowth on developed pasture lands managed by Public Lands Division, Alta. En. & Nat. Res., and fuelwood assessment for application by the Forest Technology School. Ground surveys were conducted and interpretation and data analysis are in progress. A LSP Review and Implementation Committee was formed consisting of a member from REAP, AFS, AND NoFRC.

   Technician has now acquired knowledge and experience to operate the NoFRC camera system.

2. Published information report, "Use of large-scale aerial photographs in regeneration assessments", NOR-X--264. Delay of Hunter and Associates contract report to NeFRC has delayed project implementation using Development Agreement funding, which would also be a basis for a user's guide. Review of $150 000+ contract report was completed in Newfoundland, and future work hinges on review by Nfld. Forest Resources and Lands.

3. Thesis writing is in progress with March as a goal for defence.

4. Advice and assistance were provided to clients and colleagues on LSP, image analysis, flight planing, statistics, forest inventory, programming, and 11 reports were reviewed. Attended meeting and provided technical material as member of Forestry Working Group of CACRS. Reviewed abstracts, assisted in program, and provided reviewers as committee member of 9th Canadian Symposium on Remote Sensing. Base negatives were completed for the Alberta Forest Fire History Maps, and a written text has been completed and is under review. Landsat softwood enhancements were evaluated at the request of the Canada Centre for Remote Sensing.

   An invited presentation was given to the Canadian Forest inventory Committee meeting and a short note "Use of Large-scale photography for assessment of regeneration stocking" was prepared and will be published in the minutes. Other major presentations include the Forest Inventory Technical mission of the people's Republic of China, participation at the CFS Remote Sensing Workshop, and instruction at Satellite Remote Sensing for Forestry Workshop.

5. An Altek AC74 3-axis digitizer and encoders were installed on the Interpretoskop to provide a new peripheral to the hP 9825T microcomputer. A universal subroutine to read the AC74 was written and incorporated into several programs. Programs were modified to utilize the HP 7470 plotter anduser documentation on may programs were completed. Programs have been transferred to DIAND and REAP. An HP 9816 and graphics printer is badly needed.

6. A $20,000 market survey for PILP was supervised. Results were negative but too much emphasis was placed on the NoFRC camera system components and not enough on the system concept. PILP have expressed interest to follow-up on the report and to work on a different approach.

7. Much technical information, advice, direction, equipment demonstrations and a trip to the field were provided to Ray Spencer to assist him in undertaking a study of LSP sampling across Canada. Following a quick review, a revised report has been received and is being prepared for limited distribution as a contractor's report.

8. A paper entitled, "Change detection methodology for aspen defoliation with Landsat MSS digital data", by R.J. Hall, P.H. Crown and S.J. Titus was written, reviewed and accepted for publication.

9. A paper entitled, "Application of Large-scale photography to forest resource inventories: What are the options?", by R.J. Hall, D.J. Morgan and R.H. Bowlby was written, reviewed, and presented at the 9th Canadian Symposium on Remote Sensing.

11. Goals for 1985-86:

1. Airborne test new computer camera control system in Edmonton. Set up contracts for modification to MOT approvals for Pod and Rack. Continue operational trials in Alberta (REAP) and in the Yukon (DIAND) in the 1985 field season depending on status of MOT approval. Complete data analyses prepare 1 or 2 reports, and submit to review of 1983 + 1984 cooperative applications work with REAP. Collaborate with field work for 1985 projects, and advise on analysis and interpretation of LSP. Prepare descriptive report on camera system depending on status. Depending on available funds, supervise contracts to assemble camera system for DIAND-Whitehorse, and incorporate laser altimeter and tip-and-tilt technology. (R. Hall) (4-46)

2. Complete final stages of M.Sc. thesis. Prepare and submit a journal paper for review on Thematic Mapper results. Present seminar to DIAND-Forest Resources NWT staff in Fort Smith. (R. Hall) (4-49)

3. Continue methodology developments for forest renewal. First phase is in summarizing the problem of user objectives. Continue discussions with NeFRC as required. (R. Hall) (4-48)

4. Write, update, and modify microcomputer programs for expanded capabilities and additional application for in-house use and for clients in cooperative projects. (R. Hall) (4-47)

5. Provide advisory services in remote sensing and forest inventory to NoFRC clients and colleagues as required, particularly as follows:

   a. To continue as member of REAP-AFS-NoFRC LSP Review and Implementation Committee. (R. Hall)

   b. To continue assistance to Parks Canada in Banff on their monitoring program to assess visitor use impact causing damage on alpine vegetation. (R. Hall)

   c. Supervise contracts to publish the Alberta Forest Fire History Maps depending on available funds. (R. Hall and G. Delisle)

   d. To continue as member of Forestry Working Group of the Canadian Advisory Committee on Remote Sensing (R. Hall) (4-50) (4-51)

6. Evaluate HP digitizer and microcomputer combination with PROCOM-2 for rapid area determinations of change from satellite imagery. (R. Hall and W. Moore) (4-56)

12. Publications 1984-85:

Hall, R.J., G.N. Still, and P.H. Crown. 1983. Mapping the distribution of aspen defoliation using Landsat color composites. Can. J. Remote Sensing 9(2):86-91. (Dec. issue received in Feb. 1984).

Hall, R.J., 1984. Use of large-scale aerial photographs in regeneration assessments. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alta. Inf. Rep. NOR-X-264.

Hall, R.J., P.H. Crown and S.J. Titus. 1984. Change detection methodology for aspen defoliation with Landsat MSS digital data. Cdn. J. Remote Sensing 10(2):135-142.

Hall, R.J., D.J. Morgan and R.H. Bowlby. 1984. Application of large-scale photography to forest resource inventories: What are the options? Presented to 9th Canadian Symposium on Remote Sensing. [in-press].

Spencer, R.D. 1984. Technical review of large-scale photo sampling for forestry across Canada. PRUF Contractor's Report, 71 pp.

13. Resources 1985-86:

PYs:	Prof.: Hall	1.0
	Tech.: Walsh	1.0
	Term/Student:	
	Total:	2.0

O & M: $14,000

Capital:

14. Signatures:

Ron Hall
Investigator

Program Director

Regional Director

NOR-5

FIRE MANAGEMENT SYSTEMS AND GUIDELINES

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1985

1. Project: Fire Management Systems and Guidelines

2. Title: Fire behavior in boreal forest fuels

3. New: Cont.: X 4. No.: NOR-5-01 (NOR-5-086)

5. Study Leader: Z. Chrosciewicz

6. Key Words: Canadian Forest Fire Weather Index, fire behavior, fire effects, danger rating

7. Location of Work: Various areas within the western and northern region

8. Study Objectives:

   1. To determine fire spread and intensity for major fuel complexes under various weather combinations.

   2. To assess fire effects in terms of fuel reduction and plant succession over a range of burning conditions.

   3. To establish guidelines for rational uses of fire in manipulation of various fuel combinations.

   4. To assist fire control agencies in application of the resulting guidelines.

9. Goals for 1984-85:

   1. Publish "Foliar moisture content variations in jack pine, black spruce, white spruce, and balsam fir, central Alberta".

   2. Publish "Foliar heat content variations in jack pine, black spruce, white spruce, and balsam fir, central Alberta".

   3. Publish "Fire behavior and effects in a semi-mature jack pine stand, central Alberta".

   4. Provide advisory services as required.

10. Accomplishments in 1984-85:

1. Following local reviews and revision, the manuscript on "Foliar moisture-content variations in four coniferous tree species of central Alberta" was submitted for publication to the Canadian Journal of Forest Research.

2. Following local reviews and revision, the manuscript on "Foliar heat-content variations in four coniferous tree species of central Alberta" was submitted for publication to the Canadian Journal of Forest Research.

3. Data analysis was continued and the manuscript on "Fire behavior and effects in a semi-mature jack pine stand, central Alberta" is in preparation. It should be available for local review as an Information Report by the end of fiscal 1984-85.

4. On request, acted as a referee for the Canadian Journal of Forest Research, and then also critically reviewed papers for other forms of publication both in Canada and abroad (four manuscripts).

11. Goals for 1985-86:

1. Conclude publication of "Foliar moisture-content variations in four coniferous tree species of central Alberta". (5-1)

2. Conclude publication of "Foliar heat-content variations in four coniferous tree species of central Alberta". (5-2)

3. Publish "Fire behavior and effects in a semi-mature jack pine stand, central Alberta". (5-7)

4. Prepare and submit for publication "Jack pine regeneration by the use of controlled burning and a seed-tree system in central Saskatchewan". (5-42)

5. Prepare and submit for publication "Postburn establishment and growth of jack pine plantations on clear-cut areas in central Saskatchewan". (5-43)

6. Compute, prepare, and submit for publication "Correlations between the standard fuel moisture codes and the actual moisture contents of dimensionally categorized fuels on jack pine cutovers in central Saskatchewan". (5-8)

7. Survey jack pine growth in postburn plantations and on seed-tree burns in central Saskatchewan. (5-42, 5-43)

8. Provide advisory services as required. (5-26)

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs: Prof.: Chrosciewicz 1.0

Tech.: Nil

Term/Student: Nil

Total: 1.0

O & M: $1,000

Capital: Nil

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1985

1. Project: Fire Management Systems and Guidelines

2. Title: Evaluation and development of fire detection-suppression technology

3. New: Cont.: X 4. No.: NOR-5-02 (NOR-5-131)

5. Study Leader: C.J. Ogilvie and vice Newstead

6. Key Words: Aerial patrols, lookouts, weather data collection, storm tracking, wildfire mapping, remote sensing, retardants, combustion lab, air tankers

7. Location of Work: Throughout region

8. Study Objectives:

   1. Develop techniques for wildfire surveillance and mapping.

   2. Identify the most advantageous primary detection medium for given conditions.

   3. Develop techniques to evaluate fire retardants and determine the optimum application required to inhibit fire spread in different fuels under varying burning conditions.

   4. To analyze and disseminate information to fire management agencies through technical assistance, consultation, and training.

9. Goals for 1984-85:

   1. Re-evaluate fire detection research needs in region and recommendations to achieve same and prepare File Report.

   2. Develop testing and evaluation techniques to assess rheological coating and retardancy characteristics of selected fire retardants on standard fuel beds using the retardant application and combustion systems.

   3. Collect lightning fire origin data to be used for supporting the lightning fire prediction model. Data including holdover time, burning characteristics, moisture contents, and bulk densities of

fuels at the point of ignition will be combined with weather indices to quantify the parameters affecting the ignition and smouldering process.

4. Complete File Report on currently available infrared systems, operational procedures, availability, sensitivity, accuracy, and costs and distribute to clientele.

5. Compile fire weather and fire report data for calibration and performance of the CFWI in Saskatchewan.

6. Prepare File Report on use of infrared and LLP system for improved fire detection and send to clientele.

7. Initiate assessment of procedures to map large wildfires using thermovision, pyroelectric videocon tubes, and visible light video systems.

8. Provide technical services and training to client agencies.

10. Accomplishments in 1984-85:

1. Wrote a File Report on fire detection research needs in the region and submitted it to the project leader for review. The conclusion of this report was that the study should be a mix of short-term operationally oriented goals and relatively long-term basic research oriented goals.

2. Developed testing and evaluation techniques to assess fire retardants and ran one cycle of tests for water, polytrol 200, and firetrol 931 unthickened. Forty-eight tests have been run, 24 on water, 12 on polytrol 200, and 12 on firetrol 931 unthickened. The tests are run at 4 different applications rates--0.04", 0.07", 0.10", and 0.15" and three time intervals between application and ignition--0 min., 15 min., and 30 min. Test results were recorded on the weight time recorder and the video system supplemented with personal observations. The results have been encouraging in that the equipment has been reliable and the weight loss over time graph for the ignitor bed has been almost identical for each test.

3. Collected lightning fire origin data on five fires in Saskatchewan. Data is obtained by accompanying the initial attack crew stationed at La Ronge. This crew is to be on fires as quickly as possible so travelling with them affords a unique opportunity to gather data very soon after the "fire arrival!". The data collected in the field includes representative moisture content and bulk density samples taken at 3 levels in the duff near the point of ignition, as well as notes and pictures on fuel location, type arrangement, etc. FWI and LLP information pertaining to each fire is collected after the fact.

4. Completed File Report on currently available infrared systems, operational procedures, availability, sensitivity, accuracy, and costs. The report was submitted to the project leader for review.

5. R. Smith has made good progress entering Sask. SITREP data for the period 1978-83 into the computer. Fire weather data for the same time period has now been computer archived.

6. This File Report is being prepared and will include data on LLP accuracy scan extender reliability and range tests of the AGA thermovision.

7. Kept abreast of developments in this area in particular the system being developed by Prince Albert Aviation. Conducted a test to compare the sensitivity of xedar pyroelectric videocon with AGA 750 thermovision. In this test the AGA equipment was superior to the videocon in both picture quality and sensitivity.

8. Provided liaison and technical services to client agencies as follows:

   a. Made the burning lab available and provided aid to Dr. V.J. Lieffers, Dept. of Forest Science, U of A. Dr. Lieffers is conducting experiments on the fertilizing effect of ash on seedlings.

   b. Conducted a controlled burn at Clifford E. Lee Nature Sanctuary near Edmonton. Approximately 2 acres of heavy grass was burned to provide grazing for geese. This project took a good deal of time with the cooperation of others, including equipment from AFS.

   c. Conducted field work to map 3 new towers in the Fort a la Corne forest located 20 miles east of Prince Albert. This work consisted of drawing a sketch map and taking a set of panoramic photos. The final maps are not yet complete.

   d. Supplied to Saskatchewan fire control a map of the area that would be seen from Mile 13 tower if it was extended 20 ft. The map was drawn from panoramic photos taken from a helicopter hovering 20 ft. above the existing tower. The tower has since been raised and now sees into an important area that was previously screened.

   e. Supplied to Saskatchewan fire control seen-area maps for five possible tower sites in the eastern part of Meadow Lake Provincial Park. The maps were drawn from sketches and photographs taken from a hovering helicopter. The maps revealed the best site and construction will start in the spring.

   f. Conducted a demonstration fire in the combustion lab for the Minister of State (Forestry) and staff.

11. Goals for 1985-86:

1. Develop statistically-sound test matrix and continue comparative evaluations on selected retardants in the combustion laboratory. Prepare a report on the results to date for distribution to client agencies. [C.O.] (5-58)

2. Continue to collect lightning fire origin data. [C.O.] (5-17)

3. Complete compilation of fire weather and fire report data for calibration and performance of the CFWI in Saskatchewan. [C.O.] (5-51)

4. Finish report on use of infrared and LLP system for improved fire detection. [C.O.] (5-15)

5. Continue assessment of procedures to map large wildfires. [C.O.] (5-18)

6. Provide technical services and training to client agencies and in-house guidance to Saskatchewan Agreement Fire Specialist. [C.O.] (5-56, 5-26)

7. Compile Information Report: "Annotated bibliography of CFS fire research in the prairie provinces and N.W.T.". [vice Newstead, M.E.A.] (5-75)

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs: Prof.: Vacant 1.0

Tech.: Ogilvie 1.0

Term/Student: Nil

Total: 2.0

O & M: $4,000

Capital: Nil

14. Signatures:

Investigator

J. M. Powell
Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1985

1. Project: Fire Management Systems and Guidelines

2. Title: Evaluation of the role of fire in forest and intermingled vegetation in the prairie provinces, Rocky Mountains, and far north

3. New: Cont.: X 4. No.: NOR-5-03 (NOR-5-168)

5. Study Leader: G. Delisle and vice Dubé

6. Key Words: Fire ecology, fire history, fire cycle, fire type, fire climax, fire scar rating

7. Location of Work: Region wide

8. Study Objectives:

   1. To develop and implement fire management programs in designated national parks.

   2. To define the needs and priorities of client agencies in the area of fire impact assessments.

9. Goals for 1984-85:

   1. Prepare summary data reports for Nahanni/Wood Buffalo fire history studies. [D.D]

   2. Publish fire history atlas for Alberta. [Transferred from study NOR-5-04 (174) G.D.]

   3. Provide advisory services to National Parks with emphasis on fire management guidelines. [G.D/D.D.]

   4. Continue field work on forest fuels in Jasper National Park. [G.D.]

   5. Collect research data in support of prescribed burning in selected national parks. [G.D.]

   6. Publish French [co-authored with M.E. Alexander] and English version of Forestry Technical Report "Overview and annotated bibliography on the Canadian Forest Fire Danger Rating System." [G.D.]

7. Complete analysis and reports associated with Pukaskwa National Park fire history/ecology/management project. [M.E.A. transferred from NOR-5-04 (174)]

Added Goal:

8. Complete course work related to Masters thesis. [G.D.]

10. Accomplishments in 1984-85:

1. No progress before resignation of scientist. [D.D.]

2. Scribing of maps has been completed and maps sent for printing. Text has been submitted for review. [G.D.]

3. Technical advices were provided to Jasper National Park managers in regard to the Mushroom Patch experimental burning planned for April/May 1984. The project aborted due to the unavailability of the right weather conditions. [G.D.]

4. Fieldwork on forest fuels in Jasper National Park has been completed. Between June 1/84 and Oct. 1/84, 37 plots were established for a total of 74 plots for the whole project. Samples of four small tree (less than 3 m in height) species, 5 shrub species, and duff were collected in order to develop biomass regression equations. Lab work based on field samples is in progress. Up to date, ovendried weight per size class has been determined for shrubs species and for one tree species. Duff bulk density and silica content work has been completed. First progress report on the Jasper Fuel Study has been presented to Parks Canada. [G.D.]

5. No opportunities during the 1984 field season. [G.D.]

6. French version completed to the same point as the English version. [G.D.]

7. Analyses associated with report on the forest fire environment of Pukaskwa National Park completed. Write-up started. Latest draft of report forwarded to GLFRC on Dec. 12. Further progress prevented due to commitments associated with Goals 4, 6, and 7 of Study NOR-5-05 (NOR-5-191). [M.E.A.]

8. Two courses required as partial fulfilment for the Master's degree (For.-545, Advanced fire management and For.-546, Advanced fire ecology) have been successfully completed. [G.D.]

11. Goals for 1985-86:

1. Analyze data and complete M.Sc. thesis, U of A, entitled "Fuels in the forested stands around Jasper townsite, Jasper National Park, Alberta" and present progress report to Parks Canada. [G.D.] (5-63)

2. Provide advisory services to National Parks with emphasis on the management guidelines. [G.D.] (5-61)

3. Publish fire history atlas for Alberta. [G.D.] (5-27)

4. Prepare summary data reports for Nahanni National Park fire history study. [G.D.] (5-38)

5. Complete analysis and reports on Pukaskwa National Park Fire History and Ecology Study. [M.E.A.] (5-24)

6. Supervise and coordinate the regional fire research program. [Project Leader] (5-59)

7. Continue to provide technology transfer, participation on committees, task forces etc. aimed at improving the protection and use of Canada's forests through efficient fire management. [Project Leader and others] (5-26)

8. Prepare regional fire research strategy, including integration of studies under the Forestry Development Agreements and Memorandums of Understanding. [Project Leader] (5-78)

9. Conduct regional fire research technical subcommittee meeting. [Project Leader] (5-79)

10. Participate, as federal representative on N.W.T. Fire Management Committee. [Project Leader] (5-80)

12. Publications 1984-85:

Mastrogiuseppe, R.J.; Alexander, M.E.; Romme, W.G. 1985. Forest and rangeland fire history bibliogrpahy. In Proceedings of Wilderness Fire Symposium (J.E. Lotan, B.M. Kilgore, W.C. Fisher, R.W. Mutch, eds.) USDA For. Serv., Intermt. For. and Range. Exp. Stn., Ogden, Utah. Gen. Tech. Rep. INT- (in press).

13. Resources 1985-86:

PYs:	Prof.:	vice Dubé	1.0
		Delisle	1.0
	Tech.:		0.0
	Term/Student:		0.3
	Total:		2.3

O & M: $7,500

Capital: Nil

14. Signatures:

Investigator

Investigator

J. M. Powell
Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1985

1. Project: Fire Management Systems and Guidelines

2. Title: Decision-aid models for use in fire management

3. New: Cont.: X 4. No.: NOR-5-04 (NOR-5-174)

5. Study Leader: B.S. Lee

6. Key Words: Fire behavior, fuels, fireline production, fire statistics, fire effects, decision models, fire management, computer systems

7. Location of Work: Regional

8. Study Objectives:

   1. To identify the key factors relating to the occurrence, behavior, and effect of wildfires on the cost-effectiveness of fire control decisions.

   2. To build, test, and operate relevant decision-aid models designed to assist fire management agencies in optimizing the allocation and use of available resources during demanding or multiple fire occurrence situations.

   3. To develop and maintain regional data bases on fire weather, fire occurrence, fire environments and fire management activities for use in fire research and fire management activities.

9. Goals for 1984-85:

   1. Prepare regional fire research strategy in anticipation of Forestry Development Agreements and Memorandums of Understanding. [D.D.]

   2. Publish an Information Report on the development and application of the initial-attack planning model, incorporating fire-line productivity, rate-of-spread, fuels, and other related information. [R.N.]

   3. Publish an Information Report on the status of all airtanker/retardant drop pattern data compiled and analyzed to date. [R.N.]

4. Publish Proceedings of Intermountain Fire Council Meeting. [D.D.]

5. Supervise and coordinate the regional fire research program by:

   a. preparing and maintaining annual/monthly administrative reports;

   b. staffing two vacant research positions;

   c. writing and submitting for classification three Position Analysis Schedules;

   d. reviewing manuscripts from fire research study leaders; and

   e. attending relevant administrative meetings. [D.D.]

6. Provide technology transfer, participate on committees, task forces, and review boards aimed at improving the protection and use of Canada's forests through efficient fire management by:

   a. hosting the Regional Fire Research Subcommittee;

   b. participating at the Intermountain Fire Council annual meeting;

   c. participation on the Northwest Territories Fire Management Program Committee; and

   d. attending the annual meeting of the Canadian Committee on Forest Fire Management (formerly the Canadian Committee on Forest Fire Control). [D.D.]

7. Initiate a mission-oriented problem analysis in operations research for forest fire management. [B.L.]

8. Continue development of the Western and Northern Region Fire Data Library including information from fire reports, daily fire weather records, and other fire statistics. [B.L.]

10. Accomplishments in 1984-85:

    1. Fire research priorities were developed for the Manitoba and Saskatchewan Forestry Development Agreements and Memorandums of Understanding. [D.D]

    2. NoFRC Information Report on the development and application of the initial-attack planning model was not completed due to the transfer of R. Newstead. The goal will be reassigned in 1985-86. [R.N.]

    3. The NoFRC Information Report on the status of all airtanker/retardant drop pattern data compiled to date was submitted to the editors where it is under "final preparation". [R.N.]

    4. The Proceedings of the Intermountain Fire Council Meeting were submitted to the editors where it is under "final preparation". [D.D.]

5. Supervision and coordination of the fire research program:

   a. prepared and maintained annual/monthly administrative reports;

   b. staffed one of two vacant positions;

   c. prepared six Position Analysis Schedules;

   d. reviewed manuscripts from fire research study leaders; and

   e. attended relevant administrative meetings. [D.D.]

6. Technolgy transfer, task forces, and review boards aimed at improving the protection and use of Canada's forests through efficient fire management:

   a. The Regional Fire Research Subcommittee was not hosted formally during fiscal year 1984-85 due to the attention given to individual agency research priorities in goal 1.

   b. Participation in the Intermountain Fire Council included co-chairman of the Banff Annual Meeting and editor of the Proceedings.

   c. Issue papers prepared for the Northwest Territories Fire Management Program Committee were reviewed.

   d. B. Lee attended the annual meeting of the Canadian Committee on Forest Fire Management. [D.D.]

7. A mission-oriented problem analysis in operations research for forest fire management was initiated. An outline and meeting itinerary were prepared, however, due to the federal government spending freeze, formal problem analysis interviews have yet to be initiated. [B.L.]

8. The existing project fire data base was evaluated to determine what modifications and/or improvements are required to ensure it will continue to meet the needs of research and client agencies. As part of this evaluation, two pilot studies were initiated:

   a. The development of computer-based historical fire weather information system for the Western and Northern Region. This information system (FIREWXBASE) will archive Canadian Forest Fire Weather Index System (FWI) data for all cooperating fire weather stations in the Western and Northern Region. FIREWXBASE will also contain a suite of utility programs for analyzing and summarizing fire weather data. [B.L.]

   b. A pilot fire occurrence data base project was initiated for Wood Buffalo National Park. This data base, consisting of wildfire report information for 500 fires over a time period of 12 years, will be used for simulation modelling exercises to be conducted over the next few years. [B.L.]

Additional Accomplishments:

9. Attended the National Parks Fire Management Course sponsored by Parks Canada where a lesson entitled "1980 Rolling River Fire, Riding Mountain National Park: a fire behavior case history analysis" was presented. [B.L.]

10. Reviewed and commented on a manuscript entitled "Manitoba Forest Fuel Mapping System with LANDSAT Data", prepared by the Manitoba Remote Sensing Centre, Manitoba Fire Management and Communication Section and the Canada Centre for Remote Sensing. [B.L.]

11. Served on the instructor cadre for the Fire Behavior for Fire Managers Course sponsored by Indian and Northern Affairs Canada. [B.L.]

12. Presented two lectures at the Hinton Forest Technology School, one for an Alberta Forest Service course for senior fire protection staff entitled, "Keeping Current--A Fire Management Workshop" and a second one for NAIT students. The lectures included topics on computer modelling, data base management, and fire management information systems. [B.L.]

13. Served as review committee chairman on two NoFRC manuscripts:

    a. W.C. Moore and W. Chow. Forest inventories to biomass inventories: a computer mapping application;

    b. W.C. Moore. Mapping of burned forest land in the Northwest Territories. [B.L.]

14. Provided technical advice and consultation to Subprogram 9 - Electronic Systems for Enhanced Fire Protection under the Canada-Manitoba Forest Renewal Agreement. Specifically this consisted of the development of hardware and software specifications for the acquisition of a micro-computer system for use in fire management in the Province of Manitoba (see NOR-36-06). [B.L.]

11. Goals for 1985-86:

1. Develop a decision framework of data and information needs for a regional fire data library, including information from fire weather records, fire reports, and daily fire situation reports. This will include the continued development of FIREWXBASE and the preparation of a draft user's guide. [B.L.] (5-23)

2. Submit a problem analysis report in operations research and prepare a multi-year research study plan. [B.L.] (5-66)

3. Publish an Information Report on the development and application of the initial-attack planning model, incorporating fire-line productivity, rate-of-spread, fuels, and other related information. [B.L. & R.N.] (5-40)

4. Participate as the CFS member on the CCFFM Working Subcommittee to Revise the Glossary of Forest Fire Management Terms. [B.L.] (5-90)

5. Act as NoFRC representative to the "Subprogram 9 - Electronic Systems for Enhanced Fire Protection" advisory committee under the Canada-Manitoba Forest Renewal Agreement (see NOR-36-06). [B.L.]

6. Continue to provide technology transfer services with respect to fire management systems, computer modelling, and decision-aid models as required. [B.L.] (5-88)

7. Commence development leave to obtain a masters degree in fire operations research. [B.L.] (5-87)

8. Complete analysis of recent fire history for Wood Buffalo National Park and prepare a report. [B.L.] (5-91)

9. Publish Information Report on the status of all airtanker/retardant drop pattern data compiled to date. [R.N.] (5-41)

10. Publish Proceedings of the 1983 Intermountain Fire Council meeting. [D.D.] (5-46)

12. Publications 1984-85:

Alexander, M.E.; Lee, B.S.; Lee, C.Y. 1984. Hourly calculation of the Fine Fuel Moisture Code Initial Spread Index and Fire Weather Index with the Texas Instrument model 59 hand-held calculator. Agric. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Study NOR-5-191. File Rep. No. 7. 17 p.

Lee, B.S. 1984. 1980 Rolling River Fire, Riding Mountain National Park: a fire behavior case history analysis. Paper presented to the National Parks Fire Management Course, Oct. 29-Nov. 2, 1984, Parks Canada National Training Centre, Jasper, Alta.

Lee, B.S. 1985. Fundamentals of computer modelling, data base management and fire management information systems. Paper presented to the Alberta Forest Service "Keeping Current ..." fire Management Workshop, February 11-15, Forest Technology School, Hinton, Alta.

13. Resources 1985-86:

PYs:	Prof.: Lee	1.0
	Tech.: Smith	1.0
	Term/Student:	0.3
	Total:	2.3

O & M: $4,000.00

Capital: Nil

14. Signatures:

Bryan S. Lee
Investigator

J. M. Powell
Program Director

C. R. Kay
Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1, 1985

1. Project: Fire Management Systems and Guidelines

2. Title: Fire danger and behavior rating in forest and rangeland environments

3. New: Cont.: X 4. No.: NOR-5-05 (NOR-5-191)

5. Study Leader: M.E. Alexander

6. Key Words: Canadian Forest Fire Danger Rating System, wildfire case histories and studies, fire behavior estimation, fire environment

7. Location of Work: Regional

8. Study Objectives:

   1. To develop, evaluate, interpret, and apply the Canadian Forest Fire Danger Rating System.

   2. To improve the assessment and prediction of wildfire behavior in terms and by methods which are useful to fire management agencies.

9. Goals for 1984-85:

   1. Publish Information Report entitled "Fire behavior in the black spruce-lichen woodland fuel complex: The Porter Project, Caribou Range, N.W.T.", co-authored with C.E. Van Wagner (PNFI), B.J. Stocks (GLFRC), and B.D. Lawson (PFRC).

   2. Publish Information Report entitled "Spring fires in a semi-mature trembling aspen stand, central Alberta", co-authored with D. Quintilio and R.L. Ponto.

   3. Submit final drafts of French (co-authored with G.P. Delisle) and English versions of a manuscript entitled "An overview and annotated bibliography on the Canadian Forest Fire Danger Rating System (CFFDRS)" for publication as a Forestry Technical Report by CFS-HQ.

4. Coordinate national CFS inter-establishment documentation team effort associated with an experimental burning project in the lowland black spruce fuel type, northern Alberta (July), pending cooperation of Alberta Forest Service.

5. Continue data compilation and analyses associated with the publication of case histories/studies of selected wildfires (e.g., 1980 Rolling River Fire - Riding Mt. NP).

6. Participate as CFS W & N Region representative in cooperative projects of the CFS National Fire Danger Working Group, including continued development of the Fire Behavior Indexes subsystem of the CFFDRS.

7. Provide advice and services as required, including serving as the CFS W & N Region representative on the Central and Western Region Fire Weather Committees.

8. Publish Can. For. Serv. Res. Notes article "Prescribed fire behavior and impact in an eastern spruce-fir slash fuel complex."

10. Accomplishments in 1984-85:

1. NoFRC Information Report on Porter Lake experimental burning project not completed due to other study activities (Goals 4, 6, and 7). Head fire ROS/Initial Spread Index relationship incorporated into 1984 interim edition of FBP System as Fuel Type C-1 (see Alexander, Lawson, Stocks, and Van Wagner 1984).

2. NoFRC Information Report on experimental fires in a semi-mature trembling aspen stand not completed due to other study activities (Goals 4, 6, and 7). Data incorporated into head fire ROS/Initial Spread Index relationship of Fuel Type D-1 in 1984 interim edition of FBP System.

3. Drafts of CFFDRS overview/annotated bibliography not completed due to other study activities (Goals 4, 6, and 7).

4. Reconnaissance of AFS candidate sites for experimental burning project in the black spurce-Labrador tea-Cladonia fuel type completed May 14-15. Suitable area found at Big Fish Lake in the Footner Lake Forest. Initial plot layout and weather station installation completed June 25-29. AFS/CFS cooperative agreement and CFS research work plan prepared. Preburn work (stand aging, fuel weights-forest floor/shrubs/dead and down, lesser vegetation characteristics), fuel moisture sampling (hourly and daily collection), stand vs. 10-m open wind comparison, and plot establishment (20 plots, 0.1-1.0 ha) completed July 9-18. Inclement weather prevented any successful experimental fires from being completed. Laboratory and data analysis completed and file report summarizing 'Phase I' of the project initiated. Representative set of slides sent to other participating CFS fire research projects (GLFRC, PFRC, PNFI).

5. Initial work completed on the 1982 Torrens Fire in west-central Alberta that spread downslope for a portion of its initial run. Summary included in March 1984 CRFWC Seminar proceedings (see Alexander 1985b). Presentation on the 1980 Rolling River Fire case study made by B.S. Lee at Oct. 1984 Parks Canada Fire Management course based on analyses completed to date.

6. a. Attended three sessions of the CFS Fire Danger Group in 1984 to work on various aspects of the Canadian Forest Fire Danger Rating System (CFFDRS): Jan. 15-27, PNFI; Mar. 22-26, PNFI; and Nov. 13-16, CIFFC, Winnipeg.

   b. Contributed to the publication of the fourth edition of the tables for the Canadian Forest Fire Weather Index (FWI) System (see Canadian Forestry Service 1984).

   c. Undertook implementation of the 1984 version of the FWI System in the W & N Region (e.g., distribution of tables and computer program, etc.).

   d. Co-authored User Guide on the 1984 interim edition of the Canadian Forest Fire Behavior Prediction (FBP) System (see Alexander, Lawson, Stocks, and Van Wagner 1984). Undertook implementation in W & N Region.

   e. Prepared proposal to formalize the ad hoc CFS Fire Danger Group as a national working group on the CFFDRS and submitted to CFS-HQ (Jan. 1985).

7. a. Acted as external reviewer on eight unsolicited manuscripts:

   - The effect of forest floor manipulation on nitrogen status and tree growth in an eastern Ontario jack pine ecosystem (Can. J. For. Res.) by M.G. Weber, I.R. Methven, and C.E. Van Wagner.

   - A comparison of fire-weather severity in northern Alberta during the 1980 and 1981 fire seasons (For. Chron.) by D.A. Harvey and B. Janz.

   - Equations and Fortran program for the Canadian Forest Fire Weather Index System (CFS For. Tech. Rep.) by C.E. Van Wagner and T.L. Pickett.

   - Fire history and preservation management of coast redwood forest (J. For.) by D.F. Jacobs, D.W. Cole, and J.R. McBridge.

   - Forest fire research in the Canadian Forestry Service. (PNFI Inf. Rep.) by C.E. Van Wagner.

   - Synoptic fire climatology of Great Slave Lake area, 1977-1982 (AES Rep.) by R.B. Street and E.C. Birch.

   - Effects of fire and topography on the Athi Plains Ecosystem, Keyna (African J. Ecol.) by J.B. Stelfox and R.J. Hudson.

- Fine Fuel Moisture Model (USDA For. Serv. INT Res. Pap.) by R.C. Rothermel, R.A. Wilson, and G.A. Morris.

b. Reviewed two-volume book "Fire and Forestry" [Vol. I - Forest Fire Behavior Effects; Vol. II - Forest Fire Organization Management] by C. Chandler, P. Cheney, L. Trabaud, P. Thomas, and D. Williams for the Forestry Chronicle (see Alexander 1985a).

c. Presented guest lecture on "Fire Behavior Research in the Canadian Forestry Service" to fire management class students at the Alberta Forest Technology School, Hinton (Feb. 17).

d. Chaired/organized the 2nd technical seminar and 6th business meeting of the Western Region Fire Weather Committee held at AES Western Regional Office in Edmonton (Mar. 6). Compiled and edited minutes/proceedings (see Alexander 1985b). Presented an overview of 16 Feb. 1983 bushfire situation in SE Australia prior to showing a video tape.

e. Provided assistance on development AFS fuel inventory handbook for natural forest stands re sampling design, calculation methodology, etc. (Mar. 12-13).

f. Served as instructor (physics and chemistry of forest fires, CFFDRS, and fire behavior prediction) at AFS Advanced Fire Behavior Course held at Hinton FTS (Apr. 3-6).

g. Prepared interim manual on a system for fire danger rating in the provincial parks of Alberta's prairie region (see Alexander 1984c). Conducted 1-day training session for park rangers and regional/HQ staff at Vulcan, Alberta (Apr. 13).

h. Organized the first technical and scientific seminar of the Central Region Fire Weather Committee held at AES Central Regional Office in Winnipeg. Made two presentations: a) CFFDRS update, and b) overview on video tape of 16 Feb. 1983 SE Australia bushfires. Compiled and edited proceedings (see Alexander 1985c). Attended CRFWC Technical Subcommittee meeting at same time (Apr. 17). Chaired and compiled minutes for the 10th annual business meeting held in Saskatoon. (Jan. 29, 1985).

i. Attended two pre-course meetings in Edmonton of a proposed AFS Fire Behavior/Computer Applications workshop scheduled for Feb. 1985 at FTS Hinton (Sep. 18 and Oct. 15).

j. Attended AFS Fall Fire Review held in Edmonton (Nov. 7) and made presentations on: a) 1984 interim edition of the FBP System and b) 1984 Big Fish Lake Experimental Burning Project.

k. Presented lecture on "Fire Documentation in Relation to Ecological Studies" to University of Alberta Advanced Fire Ecology (For. 546) class (Dec. 6). Prepared reading list and lecture handout for students.

l. Served as consultant and scientific authority on 2-year PRUF project "Climatology of Atmospheric Conditions Related to Extreme Forest Fire Behavior in West-central and Northern Canada" being undertaken by the University of Alberta.

m. Served as instructor (CFFDRS) at INAC Fire Behavior for Fire Managers Course held at Yellowknife (Jan. 14-18). Pre-course meeting held in Edmonton (Dec. 11).

n. Analysis of various aspects of the Drought Code for two N.W.T. stations using long-term record (1953-80) completed in anticipation of changes in overwinter adjustment of the DC methodology being proposed by PFRC. File Report summarizing results initiated.

o. Analysis of the relationship between the Fine Fuel Moisture Code and the Cladonia Fire Hazard Index completed at request of AFS (see Hirsch and Alexander 1984).

p. Dew-point temperature tables for fire weather stations with ventilated thermometers prepared for three elevation ranges analogous to FWI System RH tables. (K.G. Hirsch, FO-1 term).

q. Attended CFS National Fire Research Workshop held Mar. 27-29 at PNFI (made presentations on proposed CFS/AES Policy on Meteorological Services to Forestry and 1984 CFS/AFS NW Alta. Experimental Burning Project).

r. Completed third revision of bibliography supplement to CFS-GLFRC handbook (Inf. Rep. O-X-287) on fuel and fire behavior description (see Alexander and McRae 1984).

8. Article on prescribed fire behavior and impact in an eastern spruce-fir slash fuel complex was published in the Jan.-Mar. 1984 issue of Canadian Forestry Service Research Notes (see Alexander 1984b). Slide show being prepared as a case study. (K.G. Hirsch, FO-1 term)

11. Goals for 1985-86:

1. Prepare and submit manuscript "Fire behavior in the black spruce-lichen woodland fuel complex: the Porter Lake Project, N.W.T." for publication as an NoFRC Information Report (co-authored with B.D. Lawson, B.J. Stocks, and C.E. Van Wagner). (5-31)

2. Coordinate national CFS inter-establishment documentation team effort associated with an experimental burning project in the black spruce-Labrador tea-Cladonia fuel type. (5-72)

3. Prepare and submit manuscript "Spring fires in a semi-mature trembling aspen stand, central Alberta" for publication as an NoFRC Information Report (co-authored with D. Quintilio and R.L. Ponto). (5-67)

4. Prepare and submit manuscript on the relationship between the Fine Fuel Moisture Code and Cladonia Fire Hazard Index for publication as an NoFRC Forest Management Note (co-authored with K.G. Hirsch). (5-29)

5. Continue to participate in cooperative projects of the CFS Fire Danger Group associated with the research development, and application of the Canadian Forest Fire Danger Rating System. (5-30)

6. Continue to provide advice and services with respect to fire danger and behavior rating as required, including serving on the Central and Western Region Fire Weather Committees. (5-32)

12. Publications 1984-85:

Alexander, M.E. 1984a. Book review: Forest Fire Prevention and Control. For. Chron. 60(1):54.

Alexander, M.E. 1984b. Prescribed fire behavior and impact in an eastern spruce-fir slash fuel complex. Can. For. Serv. Res. Notes 4:3-7, 25. [French version published as: Comportement et effets d'un brulage dirige d'un melange de dechets combustibles d'epinettes et de sapins dans l'Est. Revue de recherches du Service canadien des forets 4:30-35].

Alexander, M.E. 1984c. A system for fire danger rating for the provincial parks of Alberta's prairie region: interim manual. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Study NOR-5-191 File Rep. No. 6. 45 p. + appendices.

Alexander, M.E.; Lawson, B.D.; Stocks, B.J.; Van Wagner, C.E. [listed in alphabetical order]. 1984. User Guide to the Canadian Forest Fire Behavior Prediction System: rate of spread relationships. Interim edition. Environ. Can., Can. For. Serv., Fire Danger Group. 73 p. [1st printing - July 1984; revision and 2nd printing - Sept. 1984].

Alexander, M.E.; Lee, B.S.; Lee, C.Y. 1984. Hourly calculation of the Fine Fuel Moisture Code, Initial Spread Index, and Fire Weather Index with the Texas Instruments model 59 hand-held calculator. Agric. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Study NOR-5-191 File Rep. No. 7. 17 p.

Alexander, M.E.; McRae, D.J. 1984. Bibliography supplement to CFS prescribed burn handbook. Ont. Min. Nat. Resour., Aviation & Fire Manage. Cent., Sault Ste. Marie, Ont. Fire Manage. Bull. 88 (revised). 6 p.

Alexander, M.E. 1985a. Book review: Fire and Forestry. For. Chron. 61(2): (in press)

Alexander, M.E. (compiler and editor). 1985b. Western Region Fire Weather Committee (WRFWC); minutes of sixth business meeting and proceedings of second technical and scientific seminar (Mar. 6, 1984, Edmonton, Alta.). Agric Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Study NOR-5-191 File Rep. No. 9.

Alexander, M.E. (compiler and editor). 1985c. Proceedings of the first Central Region Fire Weather Committee technical and scientific seminar (Apr. 17, 1984, Winnipeg, Man.). Agric. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Study NOR-5-191 File Rep. No. 10.

Canadian Forestry Service. 1984. Tables for the Canadian Forest Fire Weather Index System. 4th edition. Environ. Can., Can. For. Serv., Ottawa, Ont. For. Tech. Rep. 25. 48 p.

Hirsch, K.G.; Alexander, M.E. 1984. Analysis of the relationship between the Cladonia Fire Hazard Index and the Fine Fuel Moisture Code. Agric. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Study NOR-5-191 File Rep. No. 8. 20 p.

13. Resources 1985-86:

PYs: Prof.: Alexander 1.0

Tech.: Maffey 1.0

Term/Student: 0.6

Total: 2.6

O & M: $17,500

Capital: Nil

14. Signatures:

Martin E. Alexander
Investigator

J. M. Powell
Program Director

C. D. Thiel
Regional Director

NOR-7

ENVIRONMENTAL EFFECTS OF TOXIC SUBSTANCES AND VEGETATION MANAGEMENT

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 16, 1985

1. Project: Environmental Effects of Toxic Substances and Vegetation Management

2. Title: Assessment of air pollutant impact on forest systems and of industrial development in natural areas

3. New: Cont.: X 4. No.: NOR-7-01 (NOR-7-114)

5. Study Leader: D.G. Maynard, P.A. Addison, S.S. Sidhu, M.J. Apps, S.C. Zoltai, and vice Muldrew

6. Key Words: Sulphur gases, elemental sulphur, vegetation, lodgepole pine, biomonitoring, environmental impact assessment, advisory

7. Location of Work: Region wide with emphasis on west-central Alberta

8. Study Objectives:

   1. Describe and assess changes in the forest ecosystem as a result of two sour gas plants in west-central Alberta.

   2. Determine the mechanism of elemental sulphur dust impact to the forested soil-plant system.

   3. Assess the impacts of industrial development on the terrestrial environment and recommend measures for mitigating the damaging impacts of the proposed developments.

9. Goals for 1984-85:

   1. Prepare and submit to Canterra Energy Limited and Gulf Canada Resources Inc., an annual report describing the research accomplishments in 1983.

   2. Prepare and submit for review a journal article on the influence of elemental S dust on the vascular plant communities in the foothills of Alberta.

3. Prepare and submit for review a journal article on the spatial, temporal, and vertical variability of total element content and pH in forest soils.

4. Prepare and submit for review a journal article on the population dynamics Thiobacillus as they relate to changes in soil chemistry caused by elemental S.

5. Continue to measure elemental S deposition and the movement and change of elements in forest soils as a result of elemental S. (For preparation and submission of report in 1985-86.)

6. Continue studying the factors that control the mobility and form of pollutants and other elements in the soil.

7. Initiate a study to determine the influence of elemental S dust and liming on the growth and elemental content of the upper crown of lodgepole pine.

8. Submit for review a journal article on the deposition of pollutants from sour gas processing as measured by lichen and moss element content. (Carried over from 1983-84.)

9. Complete and publish the following papers (carried over from 1983-84):

    a. Quantification of branch dwelling lichens for the detection of air pollution impact.

    b. Biomonitoring of the effects of sour gas processing on the forested ecosystem in west-central Alberta.

    c. Forestry Report - Air Pollution and Forests.

    d. Effect of particulate elemental sulfur on bryophytes.

Added Goals:

10. Assume responsibility for LRTAP activities in the region.

11. Assume responsibility for the study on the environmental effects of vegetation management.

12. Assess the impact of a large-scale elemental sulfur fire on the block at Ram River sour gas plant on the forest in the vicinity.

13. Collaborate with other researchers on the determination of the forms of sulfur in stream samples from the Kananaskis area.

14. Present a seminar to the Department of Forest Science, University of Alberta.

15. Participate in a modelling workshop at University of Colorado, Fort Collins.

10. Accomplishments in 1984-85:

1. An annual report was written, submitted, and accepted by Canterra Energy Ltd. and Gulf Canada Inc. in fulfilment of contractual requirements.

2. Before it was possible to determine the influence of sulphur dust on the vascular plant community, it was necessary to determine the precision of the measurement technique involved. This has been completed and a journal article entitled "Precision of Plant Community Measurements" has been written and is in the final stages of review (within group) before submission. It is anticipated that the article will be submitted directly to the journal after approval by management.

3. All of the total element concentrations and pH data has been collected and collated. Because of the very large variability, total elemental concentrations were not useful in assessing possible changes in soil chemical properties (owing to acid deposition adjacent to the sour gas plants). Preliminary studies on the extractable cations and anions, however, indicated that the extractable concentrations are more useful. Therefore, the preparation of a journal article was delayed until the extractable concentrations data was determined. The determination of the extractables required setup and evaluation of the ion chromatographic system which has been completed with the exception of the concentrator column. A test has been made of extracting solutions as described in NOR-7-02.

4. The first draft of the journal article entitled "The interaction of soil chemistry and sulphur oxidizing bacteria in a forest soil contaminated by elemental sulphur" is completed. The paper was written in collaboration with Dr. J.J. Germida, University of Saskatchewan and is presently with him for final amendments. Following the incorporation of his comments, the paper should be ready for direct submission to the journal after management approval.

5. The deposition collectors have now been removed from sites close to the sulphur blocks after the collection of two years of monthly data. In 1984, two samplings of the soil profile at the gradient sites at Strachan were carried out and the total analysis by ICP has been completed. Lysimeters were monitored until the end of August and samples have been analyzed. These data are in the process of collation and synthesis.

6. A major experiment that was designed to determine the effects of elemental sulphur concentration, nutrient availability, and source of sulphur oxidizing organisms on the Thiobacillus population, SO_4 generation, pH and solubility of other elements is underway. Initial results indicate that pH and conductivity change very quickly when Thiobacilli populations are provided with adequate substrate and nutrients. The delays in sulphur oxidation seed in the field may be largely a result of poor environmental conditions for the growth and functioning of these organisms.

7. Four 13 m towers were installed at sites at varying distances from the sulphur dust source. Soil analyses (10 reps) have been carried out and show substantial gradients in pH, S, and several other elements. From the top of the towers, one branch from each of five trees have been collected with pole pruners and separated into 7 age classes. The needles have been counted, dried, weighed and ground, digested, and analyzed for 10 elements by ICP. Sampling will continue on a monthly basis during the frost-free period and every two months in winter.

8. A paper entitled "Chemical composition of lichen and moss material around sour gas processing" has been written and is currently being revised prior to submission.

9. These publication goals have been completed.

Added Accomplishments:

10. The taking on of the responsibility for the LRTAP study in the region resulted in involvement in hosting the annual field meeting at Rocky Mountain House, participation at the Ottawa organizational meeting for Acid Rain-National Early Warning System (AR-NEWS) program, sitting on the AR-NEWS national implementation committee and providing advice on air pollution effects monitoring to sister laboratories (MFRC and PFRC).

11. Efforts were made to initiate a study on the environmental effects of vegetation management. Most of the activity to date has been in the general organization of this study and on how it related to other projects (NOR-10, 3). Several meetings have been attended to both share information and to ensure that efforts are not duplicated.

12. A major sulphur fire on the block at Canterra Energy Limited, Ram River Gas Plant necessitated that three trips be made to the plant to assess both the initial and ultimate impact of the SO_2 produced on the forest. Two meetings with Canterra and Alberta Forest Service staff were attended and advice on impact and possible remedial action was provided through this means rather than a report.

13. A paper entitled "Sulfur constituents of a watershed in the Rocky Mountains of Alberta" has been submitted by co-author M. Mitchell to the Canadian Journal of Forest Research. This paper reports data from the Marmot Creek Watershed.

14. Upon invitation by the University of Alberta, Department of Forest Science, a seminar on the influence of elemental sulfur on a forest ecosystem was presented.

15. Upon invitation by the National Resource Ecology Laboratory of University of Colorado, Fort Collins, participated in a computed modelling workshop on soil nutrient cycling.

11. Goals for 1985-86:

1. Provide consultative and advisory services and undertake studies to resolve problems related to industrial development in natural areas as needs and opportunities arise in consultation with the Program Director. Attend workshops and symposia. (All professionals)

2. Prepare and submit for review a paper on spatial, temporal, and vertical variability of pollutants and other elements in forest soils. (Maynard, Addison. Carried over from 1984-85)

3. Prepare and submit for review a journal article on the effects of pollutant deposition on soil chemistry. (Maynard, Addison)

4. Continue to determine the factors that control the mobility and form of pollutants and other elements in forest soils. (Maynard)

5. Publish a journal article on the influence of soil chemistry on the population of Thiobacillus in contaminated soils. (Maynard, Addison)

6. Complete the study on the impact of low pH and high conductivity on the moss Pleurozium and prepare a manuscript for review. (Addison)

7. Publish a journal article on the deposition of pollutants from sour gas processing as measured by lichen and moss elemental content. (Addison)

8. Re-examine biomonitoring plots in the vicinity of sour gas processing in west-central Alberta. (Maynard, Addison)

9. Consult with and assist NoFRC FIDS staff to carry out their responsibility to CFS AR-NEWS program in the region. (Sidhu, Addison)

10. Publish a journal article on the effects of concentration and duration of exposure to SO_2 on the lichen Evernia mesomorpha. (From NOR-7-02, Addison)

11. Complete and publish a journal article on the distribution of SO_2 in forest canopies. (Carried over from NOR-7-02, Addison)

12. Prepare and publish results of SO_2 intermittant fumigation effects on aspen photosynthesis and growth. (From NOR-7-02, Addison)

13. Prepare and submit to the Research Management Division of Alberta Environment an annual report on the research accomplishments in 1984-85. (From NOR-7-02, Maynard, Addison)

14. Publish a paper entitled "Effects of SO_2 on leaf conductance, xylem tension, fructose, and sulphur levels in jack pine seedlings". (From NOR-7-02, Addison)

15. Complete and submit a paper on the distribution and effects of smelter emissions in the Thompson, Man. area. (Carried over from 1983-84 Hogan at GLFRC, from NOR-7-02)

16. Prepare and submit for review a journal article on the influence of elemental S dust on the vascular plant communities in the foothills of Alberta. (Carried over from 1984-85, Addison)

17. Complete study to determine the influence of elemental S dust on the growth and elemental content of the upper crown of lodgepole pine. (Addison)

18. Complete preparation and submit for review an Information Report on uranium mining and milling and radionuclides in the terrestrial environment. (Carried over from 1983-84, Apps)

19. Publish a journal note on the colorimetric determination of elemental S in forest litter. (Maynard, Addison)

20. Continue to participate in the DOE Regional Screening and Coordinating Committee and to participate in environmental assessment through regional technical subcommittees of RSCC. (Zoltai, Addison)

12. Publications 1984-85:

Addison, P.A. 1984. Quantification of branch dwelling lichens for the detection of air pollution impact. Lichenologist 16:297-304.

Addison, P.A., K.A. Kennedy, and D.G. Maynard. 1984. Monitoring of plant ecological effects of sour gas processing in west-central Alberta. Can. For. Serv. Inf. Rep. NOR-X-265. (in press)

Addison, P.A., S.S. Malhotra, and A.A. Khan. 1984. Effect of sulfur dioxide on woody boreal forest species grown on native soils and tailings. J. Environ. Qual. 13:333-336.

Kennedy, K.A., P.A. Addison, and D.G. Maynard. 1985. Effects of particulate elemental sulfur on bryophytes. Environ. Pollut. Ser. A. (in press).

Maynard, D.G., J.W.B. Stewart, and J.R. Bettany. 1984. Sulfur cycling in grassland and parkland soils. Biogeochem. 1:97-110.

Maynard, D.G., J.W.B. Stewart, and J.R. Bettany. 1985. The effects of plants on soil sulfur transformations. Soil Biol. Biochem. (in press)

Samoil, J.K. and G.B. Turtle (eds.). 1985. Air Pollution and Forests. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Rep. 30. (Contributions by Addison, Apps, Kennedy, Hogan, L'Hirondelle, and Maynard)

13. Resources 1985-86:

PYs:	Prof.:	Addison	0.6
		Apps	0.2
		Maynard	0.8
		Sidhu	0.4
		Zoltai	0.1
		Vice Muldrew	0.1

Tech.:	Radford	0.8
	Ridgway	1.0
Term/Student:		0.6
Total:		4.6

O & M: 5 K

Capital: Nil

14. Signatures:

Investigator

Program Director

Investigator

Regional Director

Investigator

Investigator

Investigator

Investigator

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 16, 1985

1. Project: Environmental Effects of Toxic Substances and Vegetation Management

2. Title: Impact of air pollution mixtures on forest vegetation and soils

3. New: Cont.: X 4. No.: NOR-7-02 (NOR-7-182)

5. Study Leader: D.G. Maynard and P.A. Addison

6. Key Words: Sulphur dioxide (SO_2), nitrogen oxides (NO_x), vanadium, nickel

7. Location of Work: Oil sands areas of Alberta, Northern Forest Research Centre

8. Study Objectives:

Determine the sensitivity of boreal forest plant species to air pollutants and the influence of environmental factors including soils on that sensitivity.

9. Goals for 1984-85:

1. Prepare and submit to the Research Management Division of Alberta Environment an annual report on the research accomplishments in 1983.

2. Complete the study on the influence of SO_2 concentration and duration of exposure on net photosynthesis of Evernia mesomorpha. Prepare and submit a journal article. (Carried over from 1983)

3. Complete and publish a journal article on the distribution of SO_2 in forest canopies. (Carried over from 1983)

4. Determine the influence of environmental history on the response (net photosynthesis) of jack pine to SO_2 fumigations.

5. Determine the influence of intermittant fumigation on photosynthesis and biomass of jack pine and aspen.

6. Determine the effectiveness of various extracting solutions in determining available cation and anion concentrations in forest soil litter and mineral horizons.

7. Provide consultative services to government, university, and industry staff as well as to the general public. Participate in workshops and symposia.

8. Complete and publish a paper on the effect of SO_2 on the physiology of jack pine seedlings.

Added goals from NOR-32-178:

9. Complete requirements for papers submitted to journals:

   a. Flin Flon paper

   b. Thompson paper

   c. Moss bag paper

10. Complete work required for the publication of the Forestry Report.

11. Prepare a publication on the five-year comparisons from the Thompson study. (Carried over 1983-84 to be completed January 31, 1984)

12. Prepare a File Report on acid rain monitoring within the region. (Carried over 1983-84)

13. Prepare and submit an article on the use of ICAP-AES in the measurement of S in biological material.

10. Accomplishments in 1984-85:

1. Report that described research activities in 1983-84 was submitted and accepted by the Research Management Division of Alberta Environment.

2. A study that determines the influence of SO_2 concentration and duration of exposure on net photosynthesis and respiration of Evernia mesomorpha has been completed. In addition, the recovery of this lichen after 4 and 24 hours has been quantified. A paper entitled "The effect of SO_2 on photosynthetic response and recovery in Evernia mesomorpha" has been written and is submitted to the New Phytologist.

3. The data from sulphation plates from both the Fort McMurray and Rocky Mountain House areas have been synthesized but detailed statistical treatment is still lacking. This latter aspect still requires a significant amount of time and therefore this goal will not be accomplished this year.

4. On two occasions during the summer of 1984, jack pine and aspen samples (5 replicates) were collected from three locations in the Athabasca Oil Sands area. These locations had high, medium, and low

frequencies and concentrations of SO_2 present. The sample branches were re-cut under water and transported cool to NoFRC where they were placed in a controlled environment chamber. On the next day, photosynthesis was measured with the Li-6000 system and the plants were exposed to an 'event' of SO_2. The three hour event peaked at a concentration of 0.78 ppm SO_2 which lasted for 20 minutes. The plants were remeasured after the fumigation. Some of the data (that for aspen) is being synthesized at this time. The data for jack pine was discarded since the cut-branch technique could not be made to work. Stomatal resistances in pine were so high that pollutant gases would not enter.

5. Aspen were grown under controlled conditions from root cuttings collected at Fort MacKay. The 3 h SO_2 fumigation was the same as above and was based on air quality monitoring in the oil sands area. There were three frequencies of fumigation - 5, 2, or 0 episodes per week. At 0, 3, 6, and 8 weeks, the NAR of 10 plants in each treatment was measured and plants were harvested for biomass determinations (leaf area, height, leaf and stem DW). Preliminary interpretation of results shows that there was no significant difference in NAR between week 0 and week 8 for any of the treatments. Leaf sulfur content increased significantly in the 5 per week treatment compared to the other two frequencies. The only differences in biomass were at 6 weeks, where leaf and stem dry weight of the 5 per week treatment were greater than for the controls. Jack pine material is currently being grown for a similar experiment.

6. The effectiveness of 11 extracting solutions in determining available cation and anion concentrations in forest soil litter has been tested. All 11 remove similar amounts of the SO_4-S and NO_3-N anions however, there are significant differences in the total S in solution extracted by the various solutions. There were also significant differences among extracting solutions for the cations determined. The final determinations are being completed now and a journal article will be submitted next year.

7. Consultative services have been rendered to a variety of government (US-DOE, federal and 2 provinces), industry (both energy and consulting companies) and university researchers and managers. In addition, there was involvement in DOE-RSCC and RHC committees and several M.Sc. and Ph.D. advisory and examinating committees. Several papers for both national and international journals were reviewed.

8. A paper entitled "Effects of SO_2 on leaf conductance, xylem tension, fructose, and sulphur levels in jack pine seedlings" has been submitted to the journal Environmental Pollution Series A.

9. These papers have the following status:

   a. Published

   b. In internal review at GLFRC - second draft

   c. Draft is not completed.

10. The Forestry Report is in press.

11. It is our understanding that this paper is in the process of being completed possibly by March 1985.

12. This goal will not be accomplished.

13. A paper entitled "Sulphur analysis of environmental materials by inductively coupled plasma atomic emission spectrometry" was presented to the Sulphur '84 Symposium - Sulphur Development Institute of Canada in June 1984.

11. Goals for 1985-86:

Study terminated.

The goals required to complete this study have been transferred to NOR-7-01 and NOR-7-06 and are marked as such in those studies.

12. Publications 1984-85:

Hogan, G.D and D.L. Wotton. 1984. Pollutant distribution and effects in forests adjacent to smelters. J. Environ. Qual. 13:377-382.

Hogan, G.D. and D.G. Maynard. 1985. Sulphur analysis of environmental materials by vacuum inductively coupled plasma atomic emission spectrometry (ICP-AES). In Proc. Sulphur '84. The Sulphur Development Institute of Canada, Calgary, June 3-6 (in press).

13. Resources 1985-86:

Nil - study terminated.

14. Signatures:

Doug Maynard
Investigator

Program Director

Investigator

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 16, 1985

1. Project: Environmental Effects of Toxic Substances and Vegetation Management

2. Title: Transportation of radionuclides released from uranium mining and milling operations and their effects on forest vegetation and soils.

3. New: Cont.: X 4. No.: NOR-7-03 (NOR-7-186)

5. Study Leader: M.J. Apps

6. Key Words: ^{222}Rn, ^{226}Ra, airborne radioactivity, uranium mining and milling, forest vegetation and soils

7. Location of Work: Uranium City - Wollaston Lake, Saskatchewan and Northern Forest Research Centre

8. Study Objectives:

   1. Develop methods for the measurement of various uranium-series radionuclides in plants and soils.

   2. Gather baseline data on the distribution of radionuclides (U, Th and their daughters) in forest vegetation and soils.

   3. Study the dynamics of cycling of radionuclides and associated elements, and their eventual fate in terrestrial ecosystems.

9. Goals for 1984-85:

   1. Complete preparation and submit for review an Information Report on uranium mining and milling and radionuclides in the terrestrial environment. (Carried over from 1983-84) (Deadline June 1984)

   2. Continue investigation of extent and mechanisms of radionuclide transport into the terrestrial environment in the Beaverlodge area. Prepare and submit for review a journal article on transport via dust and radon daughters. (Deadline Dec. 1984)

3. Complete analysis of 1983 Wollaston Lake reconnaissance survey samples. Prepare a progress report on the findings.

4. Further improve and modify procedures for the determination of radionuclides in soils and vegetation.

5. Undertake baseline studies in proposed development areas as needs and opportunities arise.

6. Provide consultation to regional clients and CFS staff on matters relating to nuclear activities in the region. Represent CFS on regional and national committees as required.

If time permits:

7. Prepare a journal manuscript for review on procedures for the determination of radionuclides in soils and vegetation.

8. Design field laboratory and greenhouse experiments with cooperators (NOR-7) to investigate the uptake of radionuclides and their effects upon native forest vegetation.

10. Accomplishments in 1984-85:

1. A draft summarizing the past, present, and potential future uranium activities in the region and identifying possible source areas for terrestrial impact has been given informal review. Condensation of the text and preparation of the data tables is required before submission for formal review. Data for a second part, reviewing existing information pertaining to uranium radionuclides in vegetation and soils as it pertains to the region, has been collected and a draft summary is in preparation.

2. Radiochemical analysis for Th^{-230} and Ra^{-226} levels in lichen samples (Cladina and Cetraria spp.) from 12 off-tailings locations near the abandoned Lorado and Gunnar uranium mills have been performed. In addition, approximately 50 samples of other forest species have been sorted, cleaned, ground, and prepared for radiochemical analysis. This analysis was delayed until difficulties with Pb^{-210} and initial Th^{-230} analysis problems were resolved. Synthesis of the completed analysis data requiring several weeks to perform, must be completed before it can be determined whether sufficient experimental data exists to prepare a journal article without further laboratory analysis.

3. A report entitled "1983 baseline studies: radionuclides (terrestrial component)" was submitted to the Economic Advisor, W & NR Environment Canada in June 1984. A more detailed summary of the field work including gamma radiation field surveys on the Gunnar tailings areas was prepared as a File Report "1983 baseline studies in the Wollaston Lake area and Gunnar abandoned tailings: terrestrial components" at the request of EPS, Regina office. Since these reports were prepared, radiochemical analysis of lichen samples (Cladina and Cetraria spp.) at 6 locations in the Wollaston Lake area have been completed. The results will be incorporated in the report associated with 1 and 2 above.

4. a. An alpha beta counting system, fitted with a non-standard gamma detector was installed in January and procedures for its routine use for Th^{-230}, Pb^{-210}, Ba^{-133}, gross alpha, gross beta, and gross gamma measurements established.

   b. Procedures previously developed for sequential analysis of U, Ra^{-226}, $PB^{-}210$, and Po^{-210} in vegetation were modified to include Th^{-230} and Th^{-232}. A procedure by Dr. Miedema (Eldorado Nuclear) not currently in the literature was adapted to provide rapid Th analysis. At the same time, analytical reproducibility and recovery problems with the Pb^{-210} procedure (not identifiable until the alpha beta system became available) were discovered and led to the abandonment of Pb^{-210} analysis.

   c. A novel and inexpensive alpha spectral data storage and analysis system was developed to reduce routine analysis time required for Th^{-230}, Th^{-232}, and Ra^{-226} spectral analysis. A Radio Shack Co-Co microcomputer (with disk drive; total cost less than $800) was interfaced to the alpha spectroscopy system providing raw data storage at much less cost than the commercially available equipment. Appropriate software was developed in Basic to provide both hard copy display and numerical analysis of the raw data.

5. No new baseline studies were undertaken in 1984. Completion of earlier work is referenced in 3 above.

6. A series of Environmental Impact Statements, unsolicited DSS proposal, and AECB radioisotope licence renewals were reviewed. In addition, assistance was provided to the National Uranium Tailings Program by acting as a Field Officer for one contract. Consultative services were provided to the Radiation Health Branch (Alberta Government) and to researchers at the University of Alberta.

11. Goals for 1985-86:

Study terminated. PY transferred to NOR-7-01 (0.2) and NOR-12 (0.8). Goal 1 (1984-85) carried over to NOR-7-01.

12. Publications 1984-85:

Nil - study terminated.

13. Resources 1985-86:

Nil - study terminated.

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 16, 1985

1. Project: Environmental Effects of Toxic Substances and Vegetation Management

2. Title: Environmental impact of residue chemistry of forestry herbicides

3. New: X Cont.: 4. No.: NOR-7-04

5. Study Leader: P.A. Addison, S.S. Sidhu, and Vice Muldrew

6. Key Words: Herbicides, forest system, persistence, degradation, adsorption, desorption, environmental impact, residue chemistry

7. Location of Work: Region wide

8. Problem Analysis:

Herbicides, as well as nonchemical methods of weed control such as site scarification, prescribed burning, mechanical and manual treatments provide a wide range of options for forest weed management. Even though the effectiveness of herbicides for control of weed species in forestry has been recognized since the introduction of the phenoxy herbicides, their use in forestry has lagged far behind that of agriculture. At present, forestry use of herbicides in Canada is less than 0.5% of the total used in agriculture. The limitation in the use of herbicides as a silvicultural tool is to some extent a result of the lack of information available on the environmental effects of these compounds in the natural environment. While various herbicides have been tested by CFS over the last several decades, herbicide studies have never constituted a top priority in forest management research activities. In addition, the agrochemical industry has never had a research and development program of any duration for forestry use of herbicides in Canada.

Currently, the Forest Pest Management Institute (FPMI) of CFS, as a National Institute, has the mandate to conduct herbicide research for forest resource management in Canada. The aims of FPMI's Herbicide Research Project are to accelerate the development of new herbicides, to refine and improve methods of utilizing existing products, and to improve application technology and formulation characteristics to enhance effectiveness of the herbicides while minimizing the impact on the forest ecosystem.

One of the major areas of concern, with significant data gaps, is the fate of herbicides entering the forest ecosystems. Available information on residue chemistry and environmental impact of forest herbicides under Canadian climatic conditions, particularly in the boreal forest, is very limited. Therefore, NoFRC proposes to carry out research, relevant to the Western and Northern Region, on the persistence, mobility, degradation, and fate of forest herbicides and their metabolites in the terrestrial environment. In addition, attempts will be made to assess the impact of herbicide application on the plant community as a whole to evaluate the influence of this silvicultural practice on plant community structure and forest productivity. These studies are essential if sufficient information is to be generated to make informed decisions regarding the use of herbicides in this region.

In order to avoid fragmentation of environmental impact and residue research studies, NoFRC will ensure that the data collected is available to FPMI, provincial governments, and the public. Also, the information obtained from this study will be integrated into vegetation management guidelines/prescriptions to be developed through a parallel study on "Field Testing and Evaluation of Forestry Herbicides" in NOR-10. Initially, three major herbicides, namely Roundup, Velpar, and Garlon, will be investigated.

9. Study Objectives:

   1. Determine the fate of herbicides in the forest ecosystems, by studying persistence, lateral and downward movement, degradation, and adsorption/desorption characteristics in regionally important forest soils under laboratory and field conditions.

   2. Evaluate the impact of herbicides on the structure, composition, and dynamics of forest plant communities.

   3. Provide federal, provincial, and industrial resource managers in the region with advice on the environmental effects of the use of herbicides in forestry applications.

10. Goals for 1984-85:

    Nil - new study

11. Accomplishments in 1984-85:

    Nil - new study

12. Goals for 1985-86:

    1. Review available published and unpublished literature on the use of herbicides in forestry applications.

    2. Set up liaison with scientists at FPMI, universities and provincial institutions who are involved in herbicide research.

       a. Review available literature on current techniques in the analysis of herbicides and herbicde residues.

b. Review and develop field sampling design and procedures to sample vegetation and soils.

c. Review and develop the capability of NoFRC to analyze for proposed herbicides and herbicide residues.

3. Prepare detailed plan of the study to determine the direct environmental effects of herbicide applications in natural forested areas for implementation.

4. Collaborate with Manitoba Environment's herbicide project which is part of Canada/Manitoba Regional Forestry Agreement.

13. Publications 1984-85:

Nil - new study

14. Resources 1985-86:

PYs:	Prof.:	Addison	0.3
		Sidhu	0.6
		Vice Muldrew	0.9
	Tech.:	Fairbarns	1.0
		Vice Fenn	1.0
	Term/Student:		0.3
	Total:		4.1

O & M: 11 K

Capital: 100 K

15. Signatures:

Investigator

Program Director

Investigator

Regional Director

Investigator

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 16, 1985

1. Project: Environmental Effects of Toxic Substances and Vegetation Management

2. Title: Environmental impact of silvicultural practices on soil-plant nutrient dynamics, tree growth, and physiology

3. New: X Cont.: 4. No.: NOR-7-05

5. Study Leader: P.A. Addison, D.G. Maynard

6. Key Words: Nutrient cycling, nutrient uptake, tree growth and physiology, ecosystem stability, herbicides

7. Location of Work: Region wide

8. Problem Analysis:

The forests of Canada are part of the heritage of all Canadians but for years we have ignored the need to maintain them as viable entities. The result of our inattention to the forest has resulted in vast areas that are either understocked or where tree growth is being suppressed by competition with other plants. It has recently become evident that reforestation of our commercial forest land base and the growth rates of established forests are inadequate to sustain forest production and forestry jobs even under current levels of use. Improved management of our forests is essential if we are to sustain or improve yields into the next century.

The manipulation of a forest for improved yields is not without difficulties however, and can result in a system that is more prone to perturbations from natural stresses in the environment. For example, a monoculture of crop trees, the ultimate management strategy to maximize tree productivity, is highly susceptible to disease and insect infestation. One of the fundamental objectives in forest management therefore, must be to ensure the maintenance of a resilient and dynamic ecosystem. The added advantage of such a system is the multi-use nature of the forest as recreational areas, wildlife habitats and watersheds.

The greatest challenge in this study is to attempt to resolve the conflict between what appears essential to ensure productive forests and what is prudent to use in our environment. Owing to the extremely large back-log of inadequately stocked forested lands, the forest industry and provincial

governments are looking to the use of herbicides as a "quick fix" for the problem. On the other hand, environmental groups, residents of forested areas, and fish and wildlife organizations are expressing concern over what they see as the widespread dissemination of toxic chemicals into their environment without due consideration for potential effects. It is essential that CFS, as an independent research organization, take the lead role in evaluating not only the effectiveness of all practicable silvicultural methods but also their environmental consequences. Only if we can demonstrate that any particular practice does not unduely disrupt the long-term stability of an ecosystem and its primary components of production, decomposition, and nutrient cycling, will it be possible to satisfy both environmentalists and the forest industries. The need for these results is considerable and in order to reduce the time required to provide meaningful conclusions, attempts will be made to simulate the system at the process level. In this manner, it may be possible to evaluate the influence of both natural and man-made perturbations (i.e., drought, succession, fertilization, and successive mechanical and chemical treatments) on the forest in the future.

The key to the success of this study is the anticipated cooperation with Silvicultural and Economic groups. Only by close association, common study sites, and frequent discussions will it be possible to truly evaluate the effectiveness, feasibility and consequences on the manipulation of the forest. The synthesized results provided to industry, provincial governments, and the public will enable informed decisions to be made on the use of silvicultural practices including herbicides in the forest of the Western and Northern Region.

9. Study Objectives:

   1. Determine the influence of herbicide application and other silvicultural practices on the long-term stability of nutrient balance and the biological (mycorrhizal associates, N-fixation, decomposition) and chemical (pH change, cation and anion availability) control of tree nutrition.

   2. Provide federal, provincial, and industrial resource managers with advice on the environmental effects of the use of various silvicultural practices.

10. Goals for 1984-85:

    Nil - new study

11. Accomplishments in 1984-85:

    Nil - new study

12. Goals for 1985-86:

    1. Review available literature on the influence of herbicide applications and other silvicultural practices on the nutrient dynamics of forest systems.

2. Plan and design the experimental procedure to determine the effect of proposed silvicultural practices on fores nutrient cycling.

13. Publications 1984-85:

Nil - new study

14. Resources 1985-86:

PYs:	Prof.:	Addison	0.1
		Maynard	0.1
	Tech.:		Nil
	Term/Student:		Nil
	Total:		0.2

O & M: 2.0 K

Capital: Nil

15. Signatures:

Investigator

Program Director

Investigator

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 16, 1985

1. Project: Environmental Effects of Toxic Substances and Vegetation Management

2. Title: Analytical Services Laboratory

3. New: Cont.: X 4. No.: NOR-7-06 (NOR-7-807)

5. Study Leader: Y.P. Kalra, D.G. Maynard

6. Key Words: Analysis, soils, vegetation, water

7. Location of Work: Northern Forest Research Centre

8. Study Objectives:

   1. Maintain a high quality analytical laboratory suitable to support ongoing research studies by providing precise analyses of soil, vegetation, and water samples.

   2. Provide an efficient analytical service commensurate with budget-equipment allocations.

   3. Develop analytical techniques as required by user request and as time permits.

9. Goals for 1984-85:

   1. Provide analytical services to research scientists, cooperators.

   2. Provide assistance to other technical staff using the facilities of the Analytical Services Laboratory.

   3. Prepare a File Report of the work performed in the laboratory during 1983-84.

   Added Goal:

   4. Continue involvement with other analytical laboratories to test quality control of sample analyses.

10. Accomplishments in 1984-85:

1. Provided analytical services to research scientists and cooperators, in particular NOR-1, 4, 5, 10, and 12.

2. Provided assistance to technical staff using the facilities of the Analytical Services Laboratory.

3. Prepared a File Report of work performed in the laboratory during 1983-84.

Added Accomplishment:

4. Maintained an active role in the activities of WEALA (Western Enviro-Agricultural Laboratory Association), particularly the check soil sample program.

11. Goals for 1985-86:

1. Provide analytical services to research scientists and cooperators. (Kalra)

2. Provide assistance to staff from other projects who wish to use the facilities of the Analytical Services Laboratory. (Kalra)

3. Prepare a File Report of the work performed in the laboratory during 1984-85. (Kalra)

4. Set up auto-analyzer system and digestion apparatus to replace macro-Kjeldahl digestion and distillation system for the analysis of ammonium in natural materials. (Kalra, Maynard)

5. Prepare and submit for review a journal article on the effectiveness of selected soil extractants for the determination of available cations and anions. (From NOR-7-02, Maynard, Kalra)

6. Update safety procedures in the Analytical Services Laboratory and ensure that those using the laboratory do so in an acceptably safe manner. (Kalra)

12. Publications 1984-85:

Singh, T. and Y.P. Kalra. 1984. Predicting solute yields in the natural waters of a subalpine system in Alberta, Canada. Arct. Alp. Res. 16:217-224.

13. Resources 1985-86:

PYs:	Prof.:	Kalra	1.0
		Maynard	0.1
	Tech.:	Shuya	1.0
		Radford	0.2
	Term/Student:		0.6
	Total:		2.9

O & M: 12 K

Capital: Nil

14. Signatures:

Y. P. Kalra
Investigator

Program Director

Doug Maynard
Investigator

Regional Director

NOR-10

REGENERATION AND PLANTATION MANAGEMENT

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Ecological land classification of Banff and Jasper national parks

3. New: Cont.: X 4. No.: NOR-10-01 (NOR-23-148)

5. Study Leader: W.D. Holland

6. Key Words: Resource inventory, land inventory, biophysical mapping, vegetation inventory, land use interpretation guides

7. Location of Work: Banff and Jasper national parks and Northern Forest Research Centre, Edmonton

8. Study Objectives:

To provide a land, soil, and vegetation inventory of Banff and Jasper national parks, including maps and report, and research studies, plus interpretation of data for land use planning and management within the parks.

9. Goals for 1984-85:

1. Present final seminar to Banff-Jasper wardens on using the reports and inventory data.

2. Publish journal manuscript entitled "Plants new to Alberta from Banff and Jasper national parks". (Submitted to the Canadian Field-Naturalist.)

3. Publish the brochure "Using Biophysical Resource Inventory".

4. Prepare and submit for review and publish journal article on soil climate study in Banff National Park.

10. Accomplishments in 1984-85:

1. The final seminar to Banff-Jasper wardens on using the reports and inventory data was presented in September 1984. About 45 people were present.

2. Galley proofs of the manuscript entitled "Plants new to Alberta from Banff and Jasper national parks" were returned to the publisher (the Canadian Field-Naturalist) in mid-October 1984.

3. The brochure "Using Ecological Resource Inventory" was published in August 1984.

4. The journal article on soil climate study in Banff National Park is scheduled for completion by P.A. Achuff as time permits.

11. Goals for 1985-86:

Nil - study terminated.

12. Publications 1984-85:

Corns, I.G. and P.L. Achuff. 1984. Plants new to Alberta from Banff and Jasper national parks. The Canadian Field-Naturalist. In press.

Holland, W.D. 1984. Using ecological resource inventory. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. 39 pp.

Achuff, P.L. and G.M. Coen. Soil climate study in Banff National Park. In preparation.

13. Resources 1985-86:

Nil - study terminated

14. Signatures:

W. D. Holland
Investigator

Program Director
(Forest Resources)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Ecological land classification of Kootenay, Mount Revelstoke, and Glacier national parks

3. New: Cont.: X 4. No.: NOR-10-02 (NOR-23-187)

5. Study Leader: W.D. Holland

6. Key Words: Resource inventory, land inventory, biophysical mapping, vegetation inventory, land use interpretation guides, wildlife resources, aquatic resources

7. Location of Work: Kootenay, Mount Revelstoke, and Glacier national parks and Northern Forest Research Centre, Edmonton

8. Study Objectives:

To provide an ecological land classification of Kootenay, Glacier, and Mount Revelstoke national parks, including maps and report, and research studies, plus interpretation of data for land use planning and management within the parks, with integration of land, soil, vegetation, wildlife, and aquatic resource components.

9. Goals for 1984-85:

1. Provide camera-ready reports for the B.C. parks by March 31, 1984. Publication of reports will be as follows:

   a. Ecological (Biophysical) Land Classification of Kootenay National Park.

   b. Ecological (Biophysical) Land Classification of Mount Revelstoke and Glacier national parks.

2. Present final seminars in the above parks to assist wardens in becoming familiar with the final reports and how to use them.

3. Publish paper for the Forestry Working Group subcommittee to CECSS (Canada Expert Committee on Soil Survey). Subject matter is on soil interpretations for forestry, with inclusion of the following publications in the CECSS' proposed Handbook of National Guidelines for Soil Interpretations for Forestry.

   a. Holland, W.D. Windthrow hazard. Discussion paper for the Forestry Working Group, CECSS, Ottawa, Nov. 14, 1983. Resubmitted Nov. 1984.

4. Continuation of consultative advice to Parks Canada.

10. Accomplishments in 1984-85:

1. The reports for Kootenay and Mt. Revelstoke-Glacier National Parks are published. Distribution has been delayed because of late arrival of the accompanying maps.

2. The final seminars in the above parks were presented in September 1984.

3. A paper was submitted for publication by the Forestry Working Group of the CECSS:

   a. Holland, W.D. Windthrow hazard. Discussion paper for the Forestry Working Group, CECSS, Ottawa, Nov. 14, 1983. Resubmitted Nov. 1984.

4. Consultative advice continued.

11. Goals for 1985-86:

1. Goal 3 above transferred to Study NOR-10-10

2. Study terminated.

12. Publications 1984-85:

P.L. Achuff, W.D. Holland, G.M. Coen, and K. Van Tighem (eds.). 1984. Ecological land classification of Kootenay national park, British Columbia. Vol. I: Integrated resource description. Alberta Institute of Pedology No. M-84-10, University of Alberta, Edmonton and Canadian Forestry Service, Edmonton. 373 pp. plus color plates and maps.

P.L. Achuff, W.D. Holland, G.M. Coen, and K. Van Tighem (eds.). 1984. Ecological land classification of Mount Revelstoke and Glacier national parks, British Columbia. Vol. I: Integrated resource description. Alberta Institute of Pedology No. M-84-11, University of Alberta, Edmonton and Canadian Forestry Service, Edmonton. 261 pp. plus color plates and maps.

13. Resources 1985-86:

Nil - study terminated

14. Signatures:

W. D. Halland
Investigator

Program Director
(Forest Resources)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Silvicultural investigations

3. New: Cont.: X 4. No.: NOR-10-03 (NOR-10-176)

5. Study Leader: L.G. Brace

6. Key Words: Silvicultural prescriptions, mechanization, guidelines, planning, computer data bank, forest vegetation management

7. Location of Work: Northern Forest Research Centre, Edmonton, Alberta

8. Study Objectives:

   1. To coordinate all NOR-10 studies with other NoFRC projects.

   2. To promote the development and dissemination of silvicultural knowledge through work with national, regional, and local committees, development of data bank criteria, establishment of the silvicultural component of a data bank (to include stock performance and silviculture mechanization components) and cataloging and assessment of silviculture guidelines and decision models.

   3. To publish scientific and technical reports of silvicultural interest, regionally and nationally, stressing regeneration silviculture.

   4. To provide liaison and input as required to relevant regional and national programs, including the Canadian Forest Resource Data Program, and the Mechanization of Silviculture Program.

   5. Supervise research contracts and develop in-house research studies as an outgrowth of contracts where appropriate.

9. Goals for 1984-85:

   1. Participate in problem analysis on research priorities in MOUs for Manitoba and Saskatchewan. (NOR-10-176, Brace)

2. Continue as project leader and coordinator of NOR-10 and as chairman of Regional Reforestation Technical Committee, Coordinator of Wood Buffalo IEE review, and regional representative on NACMEC. (NOR-10-176, Brace)

3. Continue inventory and data bank for mechanization of silviculture study. Cooperate with GLFRC and provinces in equipment evaluations. Conduct mechanization of silviculture workshop and report proceedings. (Inf. Rep.) (NOR-10-176, Brace and Gorman)

4. Cooperate with Regional Resource Data Specialist in updating the CFRDP National Silviculture Report. Publish FMN on 1981-83 data. (NOR-10-176, Brace and Kuhnke)

5. Publish Information Report on regional hare damage. (NOR-10-176, Brace)

6. Continue to contribute comments and review on documents for Canada/USA LP/MPB committee. (NOR-10-176, Brace)

10. Accomplishments in 1984-85:

1. Participated in Manitoba MOU analysis and initiated work on ongoing Saskatchewan MOU.

2. Continued. 1984 RRTC meeting sponsored by Alberta and results reported to RSAC. Wood Buffalo IEE on hold. Gorman attended NACMEC meeting on behalf of study and also the CPPA seminar and equipment demonstration at Thunder Bay, Ontario.

3. Mechanization work included:

   a. Continued update of equipment inventory for region.

   b. Video and mechanical assessment of projects in region, including deep ploughing (Holland), scarification blade (St. Regis), FMC equipment (Canal Flats), Bracke Mounder (Ft. Vermilion, McMinn), Donaren Disc Trencher (Grande Prairie), Raumfix Rake (PAPCO).

   c. Displays and public information work at fairs.

   d. Preparation of workshop proceedings for publication.

4. National Silviculture Report updated and publication.

5. No progress on hare report. Activity curtailed and future work possible under Canada/Manitoba Agreement by contract in 1987-88, 1988-89. File Report distributed to regional silviculturists.

6. Contribution made to PFRC (Safranyik) re management strategies for reducing beetle risk in pine stands.

11. Goals for 1985-86:

1. Prepare a vegetation management project overview and analysis and develop and coordinate forest vegetation management project at NoFRC in conjunction with NOR-3 (Economics) and NOR-7 (Environment). (10-56)

2. Participate in problem analysis on research priorities in MOUs for Saskatchewan and Alberta. (10-51)

3. Continue as project leader and coordinator of NOR-10 and act as chairman of Regional Reforestation Technical Committee and member of NACMEC. Also coordinate Wood Buffalo IEE review. (10-14 and 10-3MA) (P-314)

4. Cooperate with Edwards (NOR-12) in drawing up contract for extension of ENFOR P-205 for 1984-85 through 1986-87. (10-55)

5. Act as regional contributor to IUFRO meeting in Jasper, October 1985. Includes presentation of report on use of color video in equipment evaluation. (10-57)

6. Cooperate with Economics project (NOR-3) in updating CFRDP National Silviculture Data bank and prepare publication. (10-15)

7. Continue inventory and equipment evaluation work on mechanization of silviculture program. Make GLFRC inventory operational on NoFRC system during 1985-86. Plan workshop for 1986-87. (10-17)

8. Continue as member of Canada/USA LP/MPB Committee. (10-38)

9. Supervise the development and application of a forest site classification for Manitoba utilizing a term PY under the Canada-Manitoba Forest Renewal Agreement (Waldron). (10-2MA)

10. Provide functional guidance to technician (N.W.) establishing silviculture demonstrations under the Canada-Manitoba Forest Renewal Agreement (Waldron) (10-5MA)

12. Publications 1984-85:

Gorman, R. 1984. Proceedings of NoFRC workshop on mechanization of silviculture. Inf. Rep. NOR-X-xxx. In press.

13. Resources 1985-86:

PYs:	Prof.:	Brace	0.5
	Tech.:	Gorman	1.0
	Term/Student:		-
	Total:		1.5

O & M: $8,000
Capital: -

14. Signatures:

Investigator

Program Director
(Forest Resources)

Regioanl Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Chemical controls of pests and vegetation in managed forests

3. New: Cont.: X 4. No.: NOR-10-04 (NOR-9-132)

5. Study Leader: J. Drouin

6. Key Words: Efficacy, spraying toxicology, pesticides, registrations, residuals, formulations, herbicides, pheromones

7. Location of Work: Prairie Region

8. Study Objectives:

   1. To develop control methods and assess needs on the use of herbicides and pesticides and evaluate pheromones as a tool in forest management.

   2. Conduct pesticide efficacy trials for various dosages, formulations and timing and to determine percent mortality of host species.

   3. Provide data to aid registration recommendations for selected chemical products.

9. Goals for 1984-85:

   1. Continue assessment and monitoring of established herbicide plots in Alberta/Manitoba on the established 1, 2, 3-5 year measurements, continue field tests of Velpar Liquid "over the top" hydraulic sprays; DPX T6376 applications at lower dosage of 70 g/ha and with Garlon at 1 L/ha at Slave Lake and Grande Prairie.

   2. Assist Alberta Forest Service in proposed 2,4-D glyphosate and hexazinone aerial spray program in Peace River block, Calling Lake and Swan Hills.

   3. Continue evaluations of pheromones with National Research Council:

      a. For the boxelder twig borer complex, to clarify biology and taxonomy of P. aesculana.

b. For evaluating distribution of pitch twig moths P. albicapitana and P. metallica with further large-scale trapping at Hinton with W.G.H. Ives and Cam Rentz. Study start mid-May to end of July.

c. Monitor pine shoot moth R. buoliana baits and effectiveness - baits (6 + 1 check) at Waterton Parks, Porcupine Hills, Alberta and Piney, Manitoba.

4. Review and terminate seed/cone insect trials, phenology and life history.

5. Continue strong support with FPMI, ECW, ECPUA, herbicidal pesticide impacts and as Summarizer and Chairman for Silviculture Section, ECW, Western.

6. Prepare Information Report on pheromones/effectiveness on Proteoteras spp.

Added Goal

7. Review, edit and revise chemical control pest leaflets for Olds College extension course and conduct 1 day course.

10. Accomplishments in 1984-85:

1. Continued assessments, monitoring of established herbicide plots in Alberta/Manitoba, on the established protocols of 1, 2, 3-5 year measurements. Continued with field tests of Velpar Liquid applied with spot gun at Faust, Slave L. using new protocols/guidelines adopted by Silviculture Group, ECW, Western; due to priorities set by FPMI for Velpar registration, DPX 6376 and a Garlon application was omitted from the proposals for 1984 at Slave L. and Grande Prairie respectively.

2. Assisted Dupont Canada and Alberta Forest Service with Velpar "L" aerial spray and spot gun applications at Calling Lake near Athabasca, Alberta. Three rates of hexazinone liquid were applied by microfoil boom and helicopter (drift-free) at 2.2, 3.2, and 4.2 kg a.i./ha on 12 ha area of 3 replicated one hectare plots plus control on May 15. Spot gun trials were applied as per protocols on May 16 with pre-spray vegetative assessment on June 4-6 and post-veg. on Aug. 1-3. All treatments showed excellent controls of Calamagrostis grasses and weeds with acceptable control of the major brush species at the 32 kg a.i./ha rate. Conifer release was also very good in 16-year-old aspen/poplar site using spot gun applications at 4-8 ml in 1.5-2.0 m spacing. No treatment was superior over the other at 4 or 8 ml at spacing indicated above. Injury to crop tree was minimal except where spots were located within one metre of the crop stems.

3. Continued evaluation of pheromones with National Research Council at Saskatoon, Dr. E.W. Underhill with Dr. H.R. Wong and C. Rentz on Petrova spp. to obtain biology, populations and distribution in Alberta as well as biology of Proteoteras spp. and monitoring of the pine shoot moth with newly developed sex-attractant by T.G. Gray at PFRC. A File Report is attached.

a. Field testing of 12 baited Zoecon^{R} traps at St. Albert and Leduc for P. aesculana and to obtain biology and populations.

b. Four traps were set out near Piney, Manitoba and Belly River, Waterton Park and three in the Porcupine Hills to monitor spread/distribution of pine shoot moth (R. buoliana). New improved baits were obtained from T.G. Gray, PFRC. No adults were recovered in 1984.

c. Zoecon baited traps were increased to 234 throughout Alberta in 1984. Thirteen traps were set up at 18 locations from Clear Hills to Waterton Park. Three locations were in jack pine and one in a lodgepole/jack pine mix. Traps at 14 locations were serviced at weekly intervals, the remainder every second week. Distribution was widespread, populations low to extreme. Altitude plays a very important part in distribution of these two species. (See attached report or Can. Ent. publication to follow.)

4. Reviewed, terminated seed/cone insect studies (J. Muldrew/J. Drouin) and chemical controls. Data insufficient, erratic. Controls too variable as was cone crop availability.

5. Continued close ties with FPMI, as Chairman and Summarizer for Expert Committee on Weeds, Silviculture Section (Western). Organized, chaired first meeting of representatives (industry, governments, federal/provincial, chemical companies) to ECW Silviculture on July 5 for prairies and B.C.: main topic protocols/guidelines for herbicide research in western regions; mycorrhizal research and other concerns.

   A tour was organized as requested July 9-13 of past-future Alberta research sites and the proposed Project Osborne site north of Ft. St. John, B.C. Attending for all or part were from 14-28 participants from Alberta Forest Service, Alberta Environment, forest industry, chemical industry as well as personnel from NoFRC, PFRC and numerous BCMF research representatives. Examined were aerial applications, most aspects of forest weeds management, i.e., herbicides, mechanical, manual, fire, scarification, chemical thinning and/or combined treatments. The tour covered areas from Calling Lake, Slave Lake, Faust, Swan Hills, Grande Prairie to Ft. St. John and was an unqualified success of intent/accomplishments.

6. Report on Proteoteras aesculana by Wong, Drouin, Szlabey, Dang published in Can. Ent. 1983.

7. Reviewed, edited, revised chemical control for 21 Pest Leaflets - conducted 1 day course on Insects/Controls in forest, shade, shelterbelt/ornamentals for Olds College Extension Course for licensed commercial applicators.

11. Goals for 1985-86:

1. Summarize and publish the results of efficacy and crop tolerance experiments in Alberta and Manitoba. (10-75)

2. Continue assessment and monitoring of established herbicide plots in Alberta/Manitoba as per ECW (Western) protocols - continue field tests with Velpar Liquid at Faust, Slave L., Grande Prairie, Edson and with Garlon (XRM-4021) at Calling Lake; with hexazinone granular 10G at Faust - all for conifer release. (10-71)

3. Assist Dupont Canada/Alberta Forest Service for vegetative assessments in Alberta at Calling Lake hexazinone aerial spray and spot gun application in accordance with protocols. Assume lead in test plots being discontinued by Dupont Inc. at Calling Lake. (10-71)

4. a. Continue evaluation of pheromones with National Research Council and PFRC on Proteoteras spp. and Petrova spp. (10-66)

   b. Continue field work on biological damage and seed-feeding Proteotuae spp. (10-65)

   c. Monitor pine shoot moth R. buoliana distribution and spread. (10-67)

   d. Explore possibilities of sex-attractant development for shoot, terminal root weevils with NRC, and Dr. J. Borden, Simon Fraser University. (10-68)

5. Continue forest vegetation management program (i.e. efficacy and crop tolerance field tests) with strong support from/with FPMI, ECW, ECPUA and as Summarizer and Chairman for Silviculture Section (ECW Western). (10-69, 10-70)

12. Publications 1984-85:

Drouin, J.A. 1984. Expert Committee on Weeds Research Report Vol. 3 Western Canada Section, Regina. pp. 283-307.

Drouin, J.A. 1984. Annual revision of insect pests and controls on berry crop. In WCCP Report (1984). 4 pp.

Cerezke, H.F., J.A. Drouin, and B. Neill. 1984. Annual revision of insects pests and controls on shelterbelts, ornamentals and shrubs. In WCCP Report (1984). 13 pp.

Cerezke, H.F. and J.A. Drouin. 1984. Insect pests and controls in seasoned wood and timber structures. In WCCP Report (1984). 3 pp.

Soehngen, U., M. Steiner, and J.A. Drouin. 1984. Annual revision of insect pests and controls on houseplants and on greenhouse woody ornamentals and crops. In WCCP Report (1984). 19 pp.

Drouin, J.A. 1984. The northern pitch twig moth and a pitch twig moth, Petrova albicapitana and P. metallica in Alberta, 1984. File Report. 8 pp.

Drouin, J.A. 1984. The boxelder twig borers, Proteoteras aesculana Riley, and Proteoteras willingana (Kearfott) in Alberta, 1984. File Report. 4 pp.

Wong, H.R., J.A. Drouin, C.L. Rentz. Petrova albicapitana and P. metallica (Lepidoptera: Tortricidae) in Pinus contorta stands of Alberta. Can. Entomol.

13. Resources 1985-86:

PYs: Prof.: -

Tech.: Drouin 1.0

Term/Student: -

Total: 1.0

O & M: $6,000

Capital: -

14. Signatures:

Investigator

Program Director
(Forest Resources)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Silvicultural research and technology transfer, Manitoba and Saskatchewan

3. New: Cont.: X 4. No.: NOR-10-05 (NOR-10-196)

5. Study Leader: J. Ball

6. Key Words: Silviculture, research, demonstrations, appraisals, liaison technology transfer, spruce, pine, poplar, vegetation management

7. Location of Work: Manitoba and Saskatchewan

8. Study Objectives:

   1. To establish strong lines of communication with various forest management agencies in Manitoba and Saskatchewan.

   2. To assess, maintain and conduct silvicultural research, field trials, and demonstrations in Manitoba and Saskatchewan.

   3. To observe forest management in the field providing up-to-date silvicultural information directly to the agencies involved, identifying forest management problems requiring research.

9. Goals for 1984-85:

   1. a. Publish Information Report "Five-year performance of jack pine and white spruce container and bare-root stock on prepared burns in central Saskatchewan".

      b. Compile, analyze and prepare a draft Forest Management Note on ten year results of the above. (NOR-10-196, Ball)

   2. Continue remeasurement of projects MS 226, 227 and 190 for analysis and preparation of case histories (Fish Road, Montago Ridge, Beaver Creek, etc.). (NOR-10-196, Ball and Dyck)

3. Perform silviculture liaison and technology transfer function with Manitoba and Saskatchewan clientele via Winnipeg suboffice. (NOR-10-196, Ball)

4. Continue to assess existing silvicultural research projects in Manitoba and Saskatchewan to determine suitability for remeasurement and reporting. Transfer file to Manitoba. (NOR-10-196, Ball)

5. Remeasure 20-year-old white spruce spacing trials at Riding Mountain for Bella. (Jameson's study) (NOR-10-196, Dyck)

6. Remeasure MS 238 "Regenerating cut-over X2B and V2 sites by planting and seeding on scalped strips, Manitoba Paper Company Limits" and prepare a Forest Management Note on 1965 establishment (area 2). (NOR-10-196, Ball and Dyck)

7. Publish Forest Management Note "Fertilization improves red pine seed production." (NOR-10-196, Dyck)

8. Remeasure MS-69 (one plot); cooperate with the National Park in regenerating the tiploid clone and prepare a File Report--contingent upon National Park's cooperation. (NOR-10-196, Ball and Dyck)

9. Co-operate with Pidwirny's masters thesis on black spruce fertilization at Wabowden and Wanless; CFS will measure and analyze thinning plus fertilizer response, and also prepare a File Report. (NOR-10-196, Ball, Dyck and Pidwirny)

10. Prepare a FMN on 3 sizes of container stock reared at PFRN as part of contract work with AFS at Grande Prairie. (NOR-10-196, Ball and Walker)

10. Accomplishments in 1984-85:

1. a. This IR has been reviewed twice. A third revision--discarding the paper pot data--has been prepared.

   b. Compilation of 10 year data will begin when statistical procedures in a) are agreed.

2. Remeasurements of MS 226, 227, and 190 are complete although spring '85 photos would be desirable. Data have been collected on 18 areas (2 others are destroyed and 3 small ones at Nutamik were not located). Case history drafts have been compiled on 7 areas to date.

3. Contacts were made with officials of companies, the province, and associations, i.e., MFA Forestry Week Comm., CMJFRC, CIF, with foresters and technicians in the field and at opening ceremonies (Canada-Manitoba Forestry Agreement, MFA centre at Hodgson, Fort Whyte Nature Centre etc.). MFA at Hadashville were provided with several days of trail interpretation. Displays were assembled, maintained and disassembled at St. Vital; attended display at Red River Exhibition, transported posters, literature and trees to Swan River and The Pas etc. Attended Mechanization of Silviculture Symposium at NoFRC and CPPA (Woodlands) symposium at Thunder Bay, forest renewal workshop at Petawawa etc. Liaison between NoFRC study leaders and Winnipeg suboffice was provided.

4. MS 112 was remeasured and data sent to Bella. Assisted Bella with assessment of MS 232 (thinning and pruning aspen in the Duck Mountain). Assisted contractor assessing MS files located in Manitoba.

5. Remeasurements were taken and data sent to Bella.

6. Remeasurements were taken. Compilation has not yet begun.

7. This FMN is with the reviewers.

8. Background information has been prepared; communications with Parks at Winnipeg and Riding Mountain, including a field tour of the clone, have been fruitless. (A proposal to do this work had been submitted to Parks early last spring.) The Manitoba Section of the CIF has been approached to endorse this project.

9. Contact has been maintained with Pidwirny who has published his thesis on this. Raw data (and discs from Wabowden) have been sent to Bella.

10. A draft FMN "Cold frame growth of white spruce and lodgepole pine container seedlings, Alberta" has been prepared.

11. Goals for 1985-86:

1. To review past herbicide work in Manitoba and initiate a cooperative vegetation management trial involving:

   a. A reconnaissance of past CFS herbicide trials at Riding Mountain

   b. An on-site inspection of all recent (last 3 years) industrial and provincial herbicide trials throughout Manitoba.

   c. Identification of candidate areas for a 1986 forest vegetation management trial establishing treatment plots and conducting baseline assessments in 1985 prior to treatment in 1986. (10-58)

2. a. Publish

   - FMN "Fertilization improves red pine seed production". (Dyck) (10-44)

   - IR "Field performance of jack pine and white spruce container and bare-rroot stock on prepared burns in central Saskatchewan". (10-18)

   - FMN "Cold frame growth of white spruce and lodgepole pine in 40 and 55-cm^3 containers, Alberta". (10-18)

   b. Prepare

   - FMN Seeding and planting on shallow, rocky soil sites, Abitibi Price Limits, Manitoba (MS 238). (10-53)

- FMN "Field performance of jack pine and white spruce container and bare-root stock on prepared burns in Saskatchewan--10 year results". (10-18)

- IR Planting and seeding white spruce under aspen--30 case histories. (MS 226,227,190, Alta.). (10-40)

3. Assess usefulness of existing silviculture research projects in Manitoba (Waldron, Ball) for remeasurement and supervise NOR-36-07-1 study leader (Kolabinski) developing guidelines for management of white and black spruce (MS 182, MS 216, MS 219, MS 228 etc.). (10-41, 10-4MA)

4. Perform liaison and technology transfer function with Manitoba clientele. (10-42)

5. Remeasure MS-69 (one plot); cooperate with the National Park in regenerating the triploid clone and prepare a file report--contingent upon RMNP cooperation. (10-54)

12. Publications 1983-84:

Nil

13. Resources 1985-86:

PYs: Prof.: Ball 1.0

Tech.: Dyck 1.0

Term/Student:

Total: 2.0

O & M: $12,000

Capital:

14. Signatures:

Investigator

Program Director
(Forest Resources)

District Manager

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Forest ecology and site productivity

3. New: Cont.: X 4. No.: NOR-10-06 (NOR-10-193)

5. Study Leader: I.G.W. Corns

6. Key Words: Forest ecology, site productivity, forest soils, site modification, succession, ecological classification

7. Location of Work: Northern Forest Research Centre, Edmonton, Alberta; Boreal Forest in Western and Northern Region

8. Study Objectives:

   1. Quantification of site forest productivity relationships through multivariate analysis.

   2. To present Alberta forest ecological classification data in a field guide format readily comprehensible to government and industrial operational foresters, providing interpretations of the data for forest management purposes.

   3. To characterize and analyze environmental influences upon tree growth on highly productive forest sites in our region, with the objective of learning potentially manageable chemical and physical factors responsible for growth. The role of some micronutrients, still unknown for our area, would be evaluated.

   4. To further document plant succession and early tree growth in young (<25 yr) lodgepole pine forests originating from pulpwood clearcutting in western Alberta.

   5. To initiate a study on tree root development and subsequent growth in relation to modification of soil properties through logging and subsequent site preparation activities. The study would be conducted in an ecosystematic framework. In addition to monitoring effects of compaction erosion, alteration of drainage etc., several methods of site "rehabilitation" would be tested.

9. Goals for 1984-85:

1. Publish Information Reports on synthesis of ecological classification (including biogeoclimatic) data for field guide on western Alberta forest ecosystems and their management. (NOR-10-193, Corns and Annas)

2. Publish following reports:

   a. Vegetational indicators as independent variables in forest growth prediction in west-central Alberta. (NOR-10-193, Corns and Pluth)

   b. Plants new to Alberta from Banff and Jasper national parks.

3. Prepare draft report for review on forest succession 24 years after clearcutting (Edson Forest). (NOR-10-193, Corns)

4. Continue data evaluation and plot selection for analysis and characterization of highly productive forest sites in the region, with objective of determining potentially manageable chemical and physical factors (including several micronutrients). Existing data plus new plot data are required. Work plan to be provided. (NOR-10-193, Corns)

5. Continue literature review of effects of soil modification during logging and site preparation upon subsequent site productivity and initiate field study of same (possible contributions from study 135, 176, 190, 192 or cooperation with CWS). Work to be undertaken within an ecological classification framework. Work plan to be provided.

Added Goals

6. Prepare and present paper "Interpretation of site factors for mechanized site preparation" to Mechanization of Silviculture Workshop March 1-2, 1984 at NoFRC.

7. Prepare and present lecture on "Site classification in Alberta" to Dr. K. Hellum's silviculture class at U of A.

8. Act as scientific authority on CFS-PRUF contract to Drs. G.H. LaRoi and D.J. Pluth of U of A. Project deals with "Development of lodgepole pine and white spruce site index curves and productivity-site relationships from ecologically classified permanent sample plots in western Alberta".

9. Prepare and present material on woody vegetation identification to Alberta Environment Industrial Pesticide Applicators course at Olds, March 26, 1984.

10. Accomplishments in 1984-85:

1. A manuscript entitled "Common forest plants of Alberta" was circulated for review and consideration as an Information Report. Minor revision was made and report is now with editor. A second manuscript dealing

with forest ecosystem classification and management interpretations has been put on the word processor, revised and is nearly ready for submission to review committee.

2. a. Published (Forest Ecology and Management 9:13-25).

   b. In press (galley proofs returned to Canadian Field-Naturalist).

3. No progress.

4. Additional soil samples and forest mensuration data from highly productive sites (and less productive sites for comparison) in west-central Alberta are being made available to CFS by Drs. LaRoi, Pluth and Annas of the U of A. The data were gathered as part of a CFS-PRUF contract.

5. Literature review was completed and a field study was initiated in St. Regis FMA on four soil types with forests logged 0-20 years ago. Soil bulk density and moisture transects were sampled on 33 clearcuts and 6 uncut control stands. Bulk density data have been compiled and graphed. A greenhouse study has been initiated involving growth of lodgepole pine and white spruce seedlings on the four soils reconstructed to 3 bulk density levels.

6. Presented paper "Interpretation of site factors for mechanized site preparation" to Mechanization of Silviculture Workshop, March 1-2, 1984 at NoFRC.

7. Presented lecture on "Site classification in Alberta to Dr. K. Hellum's silviculture class at U of A.

8. Acted as scientific authority on CFS - PRUF contract to Drs. G.H. LaRoi and D.J. Pluth of U of A. Work is proceeding according to schedule.

9. Prepared and presented display and lecture material on wood vegetation identification to the Alberta Environment Industrial Pesticide Applicators course at Olds, Alberta, March 26, 1984.

11. Goals for 1985-86:

1. Complete "Common forest plants of Alberta" and ecological classification field guide for publication. (10-34)

2. Prepare draft report for review on forest succession 24 years after clearcutting (Edson Forest). (10-25)

3. Continue data evaluation and plot selection for analysis and characterizaton of highly productive forest sites in the region, with objective of determining potentially manageable chemical and physical factors (including several micronutrients). Existing data plus new plot data are required. Sampling in Saskatchewan and Manitoba is planned for 1985. (10-22)

4. Continue study of effects of soil modification during logging and site preparation. Calibration of bulk density equipment to be completed. (10-35)

5. Prepare and present paper on effects of logging and site preparation equipment on soil compaction and subsequent tree growth, at IUFRO meeting in Jasper, Sept. 29 - Oct 3, 1985. (10-35)

6. Continue to act as scientific authority on CFS - PRUF contract to Drs. G.H. LaRoi and D.J. Pluth of U. of A. project deals with "Development of lodgepole pine and white spruce site index curves and productivity-site relationships from ecologically classified permanent sample plots" in western Alberta. (10-61)

12. Publications 1984-85:

Achuff, P.L. and I.G.W. Corns. In press. Plants new to Alberta from Banff and Jasper national parks. Canadian Field-Naturalist.

Corns, I.G.W. In press. Interpretation of site factors for mechanized site preparation. Proc. Mechanization of Silviculture Workshop, NoFRC March 1-2, 1984.

Corns, I.G.W. and D.J. Pluth. 1984. Vegetational indicators as independent variables in forest growth prediction in west-central Alberta. Forest Ecology and Management 9:13-25.

Corns, I.G.W. and R.M. Annas. In press. Ecological classification of Alberta forests and its application for forest management. Proc. High Latitude Silviculture Comm. Meet., Fairbanks, Alaska, Aug. 14-17, 1983.

13. Resources 1985-86:

PYs: Prof.: Corns 1.0

Tech.: Allan 1.0

Term/Student: -

Total: 2.0

O & M: $16,000

Capital: -

14. Signatures:

Investigator

Program Director
(Forest Resources)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Field performance of planted stock

3. New: Cont.: X 4. No.: NOR-10-07 (NOR-10-190)

5. Study Leader: N. Walker

6. Key Words: Silvicultural prescriptions, field performance, container seedlings, bareroot stock

7. Location of Work: Northern Forest Research Centre and Western and Northern Region

8. Study Objectives:

   1. To carry out research required to improve regeneration silviculture, especially in the area of field performance of planted stock. This may involve either in-house research or cooperative research with other agencies, including companies and provincial governments in the region.

   2. To publish results of research on field performance of coniferous seedings.

   3. To provide advice and consultation to provincial and industrial clients regarding plantation performance.

9. Goals for 1984-85:

   1. Cooperate in preparation of FMN on 3 sizes of container stock reared at P.R.F.N. (NOR-10-190, Walker and Ball)

   2. Complete remeasurement and analysis of 10 to 15 container seedling plantations and 1974 plantings of Hillson containers at Hinton and prepare draft FMN. (NOR-10-190, Walker)

   3. Continue performance measurements of co-op seedlings performance study with AFS at Grande Prairie. Prepare annual status report for file. (NOR-10-190, Walker)

4. Remeasure CFS aspen conversion plots in Alberta and provide data to Ball. (NOR-10-190, Walker and Ball)

5. Complete and publish information report on jack pine regeneration. (NOR-10-190, Walker and Sims)

Added Goal:

6. Plant white spruce seedlings with shadeframe protection as part of the co-op seedling performance study with AFS at Grande Prairie.

10. Accomplishments in 1984-85:

1. FMN on 3 size of container stock reared at P.R.F.N. in preparation. (Ball and Walker) (NOR-10-05)

2. Completed remeasurements and analysis of 10 to 15 container seedling plantations and 1974 plantings of Hillson containers at Hinton and prepared draft FMN. (Walker and Ball)

3. Performance measurements completed of co-op seedling performance study with AFS at Grande prairie. Annual status report prepared for file. (1985)

4. CFS aspen conversion plots in Alberta remeasured, data compiled and report provided to Ball. (NOR-10-05)

5. Information report on jack pine regeneration published. (NOR-x-259, Walker and Sims)

6. Planted white spruce seedlings with shadeframe protection on the clay and organic sites of the co-op seedling performance study with AFS at Grande Prairie.

11. Goals for 1985-86:

1. Study terminated. Cooperative seedling performance study with AFS at Grande Prairie transferred to new silviculture study NOR-10-09. FMN on 10-year performance of containerized seedlings in Alberta transferred to NOR-36-05-1.

12. Publications 1984-85:

Walker, N. 1984. Progress report on factors affecting field performance of containerized and bareroot stock in Alberta. AFS-CFS Cooperative Project. File Report.

Walker, N. and P. Sims. 1984. Jack pine seed dispersal from slash and seedling performance on prepared seedbeds. Inf. Rep. NOR-259.

13. Resources 1985-86:

Nil - study terminated.

14. Signatures:

J Walker
Investigator

Program Director
(Forest Resources)

G. R Hunt
Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Evaluation of mortality in stands of young trees in plantations and scarified areas

3. New: Cont.: X 4. No.: NOR-10-08 (NOR-09-181)

5. Study Leader: W.G.H. Ives and C.L. Rentz

6. Key Words: Jack pine, Pinus banksiana Lamb., lodgepole pine, Pinus contorta Dougl., white spruce, Picea glauca (Moench) Voss, insect damage, tree diseases, stocking standards, site classes, reforestation, browsing, rodent damage

7. Location of Work: Prairie provinces and Edmonton

8. Study Objectives:

To determine whether or not pine tree survival from establishment to age 35 years is related to site conditions, and if so, to prepare a set of survival curves for each site class.

9. Goals for 1984-85:

1. Assess third-year mortality in lodgepole pine plots near Hinton.

2. Prepare a File Report summarizing third-year mortality of trees in lodgepole pine plots near Hinton.

3. (Transferred from Study NOR-9-185). Prepare the report "Dispersal and impact of the larch sawfly parasite Olesicampe benefactor and the hyper-parasite Mesochorus dimidiatus" for publication, should any rewriting be required.

10. Accomplishments in 1984-85:

1. Third-year mortality in lodgepole pine plots near Hinton was assessed.

2. Data were transferred to computer storage and third-year mortality calculated.

3. The report "Dispersal and impact of the larch sawfly parasite Olesicampe benefactor and the hyper-parasite Mesochorus dimidiatus" was published.

11. Goals for 1985-86:

1. Assess third-year mortality in jack pine plots in the Sandilands Provincial Forest, Manitoba and prepare File Report. (10-64)

2. Assess fourth-year mortality in lodgepole pine plots near Hinton, Alberta and prepare File Report. (10-63)

3. Collaborate with Dr. Wong (NOR-1-04) in the preparation of illustrations and text for "A pictorial guide to the forest and shade tree insects of the prairie provinces". (10-72)

12. Publications 1984-85:

Ives, W.G.H. 1984. Malacosoma disstria Hubner, forest tent caterpillar (Lepidoptera: Lasiocampidae). Pages 311-319 in J.S. Kelleher and M.A. Hulme, 1984 (eds.). Biological control programmes against insect and weeds in Canada 1969-1980. Commonwealth Agricultural Bureau, Farnham Royal, Slongh, England.

Ives, W.G.H. 1984. Operophtera bruceata (Hulst), Bruce spanworm (Lepidoptera: Geometridae). Pages 349-351 in J.S. Kelleher and M.A. Hulme, 1984 (eds.). Biological control programmes against insect and weeds in Canada 1969-1980. Commonwealth Agricultural Bureau, Farnham Royal, Slongh, England.

Ives, W.G.H. and J.A. Muldrew. 1984. Pristiphora erichsonii (Hartig), larch sawfly (Hymenoptera: Tenthredinidae). Pages 369-380 in J.S. Kelleher and M.A. Hulme, 1984 (eds.). Biological control programmes against insect and weeds in Canada 1969-1980. Commonwealth Agricultural Bureau, Farnham Royal, Slongh, England.

Muldrew, J.A. and W.G.H. Ives. 1984. Dispersal of Olesicampe benefactor and the hyper-parasite Mesochorus dimidiatus in western Canada. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alta. Inf. Rep. NOR-X-258.

13. Resources 1985-86:

PYs: Prof.: Ives 0.5

Tech.: Rentz 1.0

Term/Student:

Total: 1.5

O & M: $16,000

Capital: -

14. Signatures:

Investigator

Program Director
(Forest Resources)

Investigator

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1985

1. Project: Regeneration and Plantation Management

2. Title: Vegetation management techniques and tools for forestry

3. New: X Cont.: 4. No.: NOR-10-09

5. Study Leader: New/L.G. Brace

6. Key Words: Vegetation management, nurseries, prescriptions, site preparation, stand maintenance, treatments, manual, mechanical, chemical, efficacy, tolerance, silvicultural response, survival, growth, environmental impact, economics, public consultation

7. Location of Work: Alberta

8. Problem Analysis:

Forestry has traditionally been a major provider of wealth in our economy and recently the Canadian Council of Resource and Environment Ministers (CCREM) established new goals for a 40% increase in the harvest and a doubling of forest productivity by the year 2000 is part of a plan for increasing employment and economic gain from forestry. These plans coincided with the realization that our reforestation and stand maintenance record across Canada is inadequate, with nonsatisfactorily restocked (NSR) stands totalling about 25 million hectares and vast areas of forest operating below their productive capability because of poor maintenance.

Regionally, the mixedwood forest illustrates the problem well. Mixedwoods occupy 50% of our regional forest land base and account for 300 000 of the 500 000 ha of nonsatisfactorily restocked NSR land in the region. Desirable softwood species are difficult to regenerate and grow because of competition from grass, brush, aspen suckers and damage from hares. A new vegetation management strategy is needed to overcome these problems, including a plan for research to provide more information about the effectiveness and costs of an array of site preparation and stand maintenance tools, including manual, mechanical, and chemical treatments, prescribed fire and combinations thereof. Ideally this research requires a framework of treatment prescriptions set within an ecological classification system to facilitate technology transfer to operational use.

Recently there has been considerable emphasis on herbicides as a tool--almost to the point of seeing herbicides as a panacea--for site preparation and stand maintenance. National groups like the Canadian Confederation of Professional Foresters' Association (of which the CIF is a member) and the CPPA have issued policy statements emphasizing the need for herbicide use in forestry. The CCREM formed a special committee in 1981 to increase the number of herbicides available for forestry use and to shorten the period required for registration of herbicides. A recent PRUF contract report prepared for the NoFRC, entitled "Herbicide Use in Forestry: A literative survey and assessment of its environmental impact and its future potential for forest management in the prairie provinces of Canada" documents the need for increased herbicide use in forestry. In 1984, a national tree nursery herbicide committee was formed to promote the registration of more herbicides for nursery use.

The government is currently developing a 3-year action plan on pesticides--which includes herbicides--to be incorporated into a cabinet document under the leadership of Agriculture Canada. This document expresses ongoing concerns about chemicals in the environment, including emphasis on fully assessing and adopting non-chemical alternatives wherever possible, and the immediate need for more effective public consultation. It also expresses continuing concern about aerial application of chemicals.

CFS has responded to the need for more herbicide research by proposing a National Forest Weeds Program with a Herbicide Sub-Program and a Forest Weeds Planning and Coordinating Committee. This Committee will function in a policy/coordinating role for CFS.

9. Study Objectives:

1. Develop a research plan applicable to Alberta and conduct research into vegetation management techniques, incorporating input from projects NOR-3 (Forest Resource Economics) and NOR-7 (Environmental Impact and Residue Chemistry of Forestry Herbicides).

2. Maintain close liaison with CFS regional forest vegetation management studies.

3. Cooperate with other agencies in developing improved public consultation on herbicide use in forestry by provision of factual data.

10. Goals for 1984-85:

Nil - new study

11. Accomplishments in 1984-85:

Nil - new study

12. Goals for 1985-86:

1. Develop a problem analysis and research plan for forest vegetation management in Alberta as a component of the regional co-ordinated forest vegetation management research plan. This will require consultation and cooperation with economics (NOR-3) and environment (NOR-7) staff. (10-62)

2. Collect and analyze available cost effectiveness data for various vegetation management techniques in Alberta. (10-62)

3. Continue measurement of cooperative field performance trial (with AFS) at Grande Prairie (transferred from 10-07). (10-21)

13. Publications 1984-85:

Nil - new study

14. Resources 1985-86:

PYs:	Prof.:	Brace	0.5
		Vacant	1.0
	Tech.:	Vice Walker	1.0
	Term/Student:		
	Total:		2.5

O & M: $9,000

Capital: -

Grants and Contributions:

15. Signatures:

Investigator

Program Director

Regioanl Director

CANADIAN FORESTRY SERVICE

STUDY PROPOSAL

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 15, 1984

1. Project: Regeneration and Plantation Management

2. Title: Soil amelioration in boreal forests

3. New: X Cont.: 4. No.: NOR-10-10

5. Study Leader: W.D. Holland

6. Key Words: Site preparation, scarification, subsoil ripping, vibrating deep-soiler, deep ploughing, soil climate

7. Location of Work: Alberta, Saskatchewan, and Manitoba

8. Problem Analysis:

Study objective 1:

More than a dozen different silvicultural machines are currently being used for site preparation in this region (Gorman 1984). Users want to know which machine(s) they should use in order to obtain the maximum biological response and economic result desired by forestry interests (Anonymous, Silvicultural Workshop 1984). Preliminary evaluations have been made; e.g. Smoothstone Lake, Saskatchewan and elsewhere (Riley and Sutherland) but many site variables have been omitted.

The current CFS assessment procedure does not record soil characteristics such as genetic classification, detailed morphological description, or physical and chemical changes resulting from the use of silvicultural machinery (S.M.).

The problem may be summarized as a need to increase the amount and kind of tests and evaluations of different kinds of silvicultural machinery for forest site preparation. Specific impacts that need to be measured are the effect of silvicultural machinery on those items not included in the GLFRC assessment procedure:

a. Soil variables--including soil classification by mapping unit and pedon unit, soil horizons disturbed, area of surface disturbed, soil texture, drainage, nutrient status, changes from natural soil consistence (especially compactness) permeability, bulk density, moisture status, water-stability of soil aggregates as well as external site characteristics of elevation and aspect.

b. Vegetation variables--including ground cover species.

c. Regeneration results--including competing vegetation, species survival and regeneration growth rates.

d. Variation of machine operator skills--e.g., training and experience, speed of machine operations, spacing of machine operations.

Background:

Most silvicultural treatments have been concerned with manipulation of the biological resource component. Trials have included spacing, thinning, planting positions, planting stock improvement, species suitability, survival and growth studies, and forest fertilization. Site preparation for physical manipulation of sites by chopping, harrowing, blading, scalping, rotoraking, plowing, bedding, prescribed burning, and use of herbicides are discussed by Smith (1962) and Pritchett (1979). Site preparation techniques are designed to improve conditions for seeding or planting that result in increased germination or seedling survival and tree growth rates. Goals are exposure of mineral soil, elimination of competing vegetation, and improvement of soil-plant water relationships.

Rennie (1958 and personal communication 1984), Taylor (1971), and others report on a range of site preparation techniques throughout the world. Little of this work has been done in Canada (Mechanization of Silviculture Unit, 1984) where the prime objective of site preparation, even in southern Canadian conditions of soil and climate, is to provide an increased supply of soil moisture and heat, in line with the goals listed earlier. Forest managers recognize that to achieve improved forest regeneration success in this region forest managers must develop a sequence of site preparation techniques that begins with physical site treatments (scarification, plowing, etc.) followed by chemical treatments (herbicides, fertilizers) and silvicultural treatments (spacing, thinning, stand tending, etc.). An immediate requirement is to assess present site preparation methods and to improve them where possible.

Study objective 2:

In the boreal forest, approximately 50% of most map sheets have soils developed on hard, compact glacial till that has been compressed by ice approaching one mile in thickness. Since deglaciation, these materials have weathered slowly and have developed soils with shallow rooting depths (hence low rooting volume for plants). Fine, clayey textured soils developed on glaciolacustrine deposits bring the amount of soil that may benefit from physical amelioration to 60-70% of most map sheets.

In addition, the environmental factors of soil formation in the boreal forest cause many of these soils to develop luvisolic profiles (C.S.S.C. 1978b). The pedogenic results are Gray Luvisols, identified by eluvial Ae and illuvial Bt horizons, signifying presence of downwardly translocated clay. Agronomically and silviculturally, this pedogenic result is interpreted as surface mineral soil horizons that form hard crusts on exposure, with dense compact subsoil horizons that inhibit root

penetration and development. These features are the basis of the subclass "D" limitation (a physical restriction to rooting by dense or consolidated layers other than bedrock) that was used for classifying the Land Capbility for Forestry portion of the Canada Land Inventory (Whitecourt 83J, 1968).

Many of the forest soils in this region fall below the wilting point during the growing season (Duffy 1967). Clayton et al. (1977) described the temperature classes of the soil climate in the boreal forests as cool to moderately cool. Thus, in order to attempt improved forest regeneration and increased forest growth rates, a fundamental requirement is amelioration of the soil in order to provide greater availability of soil moisture to plants (increased rooting volume) and higher soil temperatures.

To change the soil climate and to achieve the soil amelioration objective listed above requires solution of the following sequence of problems:

a. Identify soils likely to benefit by specified treatments (i.e., limitations that may be overcome by ameliorative treatment).

b. Development of soil ameliorative techniques and equipment to use on those soils selected as most likely to respond to treatment. Suggested techniques are subsoil ripping, vibrating deep-soiler, and deep ploughing.

   Questions to be answered for treatment of Gray Luvisols and some Brunisols (i.e., those containing fragipans), are:

   - What is the optimum depth of soil disturbance; i.e., does the entire Bt horizon have to be loosened?

   - How important is the conservation of surface soil horizons? The LFH, or litter surface, of forest soils contains most of the nutrients, and together with the Ae horizon, contains most of the microflora and mesofauna. How are these upper soil horizons best managed? Does it matter if they become covered, as in deep ploughing?

   - What is the effect of soil amelioration on acidic subhorizons; i.e., low pH Bt horizons of Gray Luvisols? Will they become more acid or less acid?

   - What is the effect of soil amelioration on aluminum toxicity; particularly in soils with bisequa morphologies, classified as Brunisolic Gray Luvisols, and occurring on the more stable landscape segments of western Alberta?

   - How is a lower bulk density of soil maintained; i.e., how does one prevent luvisolic subsoils from recompacting?

   - What is the optimum mixing of subsoil and parent material, i.e., does lime from the C horizon improve the acidic Bt horizon?

- Will amelioration techniques destroy or deplete soil organic matter, in particular organic nitrogen?

- What are the most effective ameliorative techniques for soils of mixed morphology (e.g., sandy soil over silt or clay are among our most productive forest soils at the present time)? Will deep ploughing harm these soils or improve them? How should shallow peat over mineral soils and poorly drained soils be ameliorated?

- What happens to soil moisture as a result of subsoil amelioration? Does internal soil drainage improve? Can moisture storage be increased? Is more moisture available for roots?

- What happens to soil temperatures as a result of subsoil amelioration?

c. Field testing the impact of soil amelioration on specific sites to determine:

- the effect of timing of operations.

- costs of site preparation.

- the response of aspen and competing vegetation species.

- regeneration and growth response to silvicultural treatments following soil amelioration.

Background

Extensive literature is available on soil amelioration techniques such as deep ploughing, mostly in Europe (see list of references). Many of the tests have been done on soils used for agriculture and on poorly drained marine clays near the Baltic Sea; e.g., Denmark, Germany, Poland, Finland. Work in forested soils in Sweden has been primarily with highly developed podzols derived from granitic materials. British work has occurred mostly on fen and moor areas with poorly drained organic soils, many of them with thin ortstein iron pans.

Rennie (1958, 1984) emphasizes the importance of planting position where surface roughness has been developed or a cloisonné type of ploughing has been done. Work on luvisolic soils on glacial till materials, with conditions more similar to ours, has apparently been carried out in southern France and southern Germany (Hellum 1983). Deep ploughing efforts have been carried out in the U.S.S.R. and Czechoslovakia, but translations are slow and difficult to obtain. United States experience appears to be more concerned with compaction caused by machinery working in the forest (Andruse and Froehlich, 1982).

In Canada, some soil amelioration by deep ploughing has been done on deep peats in Newfoundland (Wilton 1970), and on solonetzic soils in Alberta (Harker 1975, Peters 1982, Hermans 1983). In the Mayerthorpe area, some soil amelioration work on luvisolic soils has been done by a vibrating deep-soiler recently imported from Germany (Preugchas 1984). The first

experiment with soil amelioration (deep ploughing, vibrating deep-soiler) after forest harvest is presently in progress on luvisolic soils in the Whitecourt area, and is being done by the Soil Science Department, University of Alberta, through a PRUF contract to D.J. Pluth.

The functions of ploughing for the improvement of tree growth by alteration of the site are summarized by Taylor (1971) as follows:

- regulating water movement.

- improving soil aeration.

- reducing compaction.

- mobilizing nutrients, particularly nitrogen.

- reducing competition from natural vegetation.

- providing a favorable planting position.

The principal advantage of ploughing in our region is to change some adverse soil feature (soil limitation) in order to increase rooting volume and soil heat to improve forest regeneration and forest growth rates. Anticipated additional advantages of deep ploughing in our region are:

- increased rooting volume, water availability, and soil heat.

- more uniform distribution of soil water.

- improved soil drainage.

- less slash burning required, i.e. atmospheric pollution is reduced.

Restraints:

A number of issues appear to prevent development and testing of site preparation and soil amelioration techniques for forest regeneration purposes:

1. Costs--Many forest companies are inhibited by costs of machinery and the expensiveness of field operations (Gorman 1984). Hence trials are limited and results are few, preventing the development of adequate silvicultural prescriptions. Government expenditure is required to test machinery, modify it where necessary, and demonstrate its use. A large number of trials are necessary in order to develop silvicultural prescriptions over a range of field conditions.

2. Slash disposal--Excessive slash that is left over as a result of forest harvesting activity is a restraint to site preparation because it precludes easy operation of S.M. Machinery may clog with debris, or is prevented from contact with the soil, and may even be broken by excessive amounts of slash. Huge amounts of slash may become a fire hazard in this region. Pritchett (1979) points out the gradual increase of public objection to smoke because of slash disposal by

burning. Heavy equipment may be used for slash disposal, but is costly and may reduce exposure of mineral soil. An inexpensive method of slash disposal by incorporation of site organic matter into mineral soil is still needed.

3. Stumps--Remnants from cutover natural forests, stumps are an obstacle to use of some kinds of silvicultural machinery. An economic method of removal, burial, or incorporation into the mineral soil is needed.

4. Aspen roots in cutover areas--Disturbance of aspen trees by cutting or site preparation activity usually results in unwanted aspen suckering. Techniques are required to prevent aspen suckering in areas where it is an unwanted species in the next rotation.

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9. Study Objectives:

1. To evaluate silvicultural machinery for forest site preparation in terms of impact on soils and vegetation and subsequent seedling survival and growth rates.

2. To develop methods that will ameliorate the physical condition of boreal forest soils in order to improve regeneration success and forest growth rates.

3. To disseminate knowledge of forest soils by writing and by providing soil advisory services.

10. Goals for 1984-85:

Nil - new study

11. Accomplishments in 1984-85:

Nil - new study

12. Goals for 1985-86:

1. Prepare a critique of the existing CFS equipment evaluation methodology and report to NACMEC. Develop and pilot test a modified evaluation (after receiving feed back from NACMEC) which incorporates increased emphasis on soils. (10-60)

2. Prepare user's manual on Forest Soils of the Prairie provinces, which defines and describes forest soils and presents guidance for their use. (10-73)

3. Provide advisory services on forest soils as requested, eg.

   a. Selection of seed orchard sites re: Canada-Manitoba Agreement.

   b. Site descriptions for NOR-10-08. (10-74)

4. Continue consultations aimed at assessing the potential of subsoilers:

   a. Dr. H. Schulte-Karring, Bod Neuenahr-Ahrweiler, West Germany.

   b. Carl Laelble GMBH, Bocknang, W. Germany.

c. Dr. Peter Bullock, Rothamsted Experimental Station, Harpenden, England.

The purpose of the above contacts is to obtain advice for the best method of subsoiler operation (e.g. depth, speed, time, and intensity of operation, special problems, available soil and yield data, costs, etc.). (10-59)

Contingent upon the availability of a vibrating deep-soiler, carry out a field trial for site improvement in over-dense lodgepole pine stands and in juvenile spruce stands.

5. Continue PRUF contract with U. of A. soils department. (10-59)

13. Publications 1984-85:

Nil - new study

14. Resources 1985-86:

PYs: Prof.: Holland 1.0

Tech.: -

Term/Student: -

Total: 1.0

O & M: $7,000

Capital: -

15. Signatures:

W. D. Holland
Investigator

Program Director
(Forest Resources)

Regional Director

NOR-12

NURSERY MANAGEMENT AND TREE IMPROVEMENT

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 22, 1985

1. Project: Nursery Management and Tree Improvement

2. Title: Forest tree seedling and seed physiology

3. New: Cont.: X 4. No.: NOR-12-01 (NOR-10-192)

5. Study Leader: I.J. Dymock

6. Key Words: Tree seedling physiology, cold hardiness, dormancy, physiological and biochemical testing, influence of environmental parameters, bareroot and container stock production, accelerated growth and flowering, cone and seed production and physiology, post-harvest physiology

7. Location of Work: Northern Forest Research Centre, Edmonton, Alberta; locations within Western and Northern Region as may be required

8. Study Objectives:

   1. Plans, develops, and conducts investigations into physiological aspects of: 1) growing, conditioning, and physiological testing of container and bareroot seedlings, 2) field performance of seedlings, and 3) cone and seed development and production, in support of improved reforestation and forest management strategies.

   2. Analyses and interprets existing and new research data and procedures and assesses reliability and applicability of results in support of new or improved reforestation and management strategies including cone and seed production in seed production areas and seed orchards, stock conditioning and physiological testing up to the planting phase, and initial field performance of bareroot and container seedlings.

   3. Disseminates and promotes research and provides consultative services to federal, provincial, and forest management agencies concerning tree physiology as it relates to cone and seed production, seedling conditioning and physiological testing, field performance of seedlings and related areas of tree growth and productivity.

   4. Performs the duties of a seed analyst for certification of forest reproductive material moving in international trade.

9. Goals for 1984-85:

1. Seedling physiological research (NOR-12-192, Dymock).

a. Produce 1984 stock in sufficient numbers for all study requirements under NOR-12-192.

b. Complete cold hardiness tests on 1983 bS and 1P.

c. Complete dormancy tests on 1983 bS, wS, and 1P.

d. Evaluate 1983-84 data and prepare a draft journal report on cold hardening and dormancy testing of bS and 1P seedlings during overwintering.

e. Initiate cold hardiness and dormancy testing of wS and rP, and collect, preserve, and store replicates of wS and rP material for analysis of selected endogenous cellular metabolites during 1985-86.

f. Continue methods/bioassays development for studying the role of endogenous cellular metabolites of interest in tree seedling physiology.

g. Initiate biochemical analysis of selected endogenous cellular metobolites proposed to have roles in regulating cold hardiness, dormancy, and overwintering capabilities of 1983 bS and 1P seedlings.

h. Present a report on the influence of light quality and extended photoperiod during the first half year of growth of twelve conifer species grown under greenhouse conditions, based on work carried out during 1983-84 in collaboration with Ms. Sherri Wilson, at the 1984 Federal/Provincial Nurseryman's Meeting to be hosted by the CFS at the NoFRC during September 1984.

2. Cone and seed physiological research (NOR-12-192, Dymock)

a. Initiate study on promoting early flowering in conifers through the use of extended photoperiod, differing supplemental light regimes, and growth regulator applications. Study treatments to begin on 1P during late January 1984, six weeks after seeding in 5.4 litre square pots. Material will be outplanted in NoFRC nursery during August 1984. Annual assessment of male and female flowering and subsequent cone/seed production to commence during spring 1985. Initiate part II of study using wS as experimental material in November 1984.

b. Perform lecture and laboratory instructor duties in Forest Science 417 - Tree Seed Biology and Handling from February 14 to March 16, 1984 during leave absence of Dr. A.K. Hellum from the University of Alberta.

c. Begin cooperative research project with Dr. A.K. Hellum on ecophysiology of lodgepole pine cone and seed maturation in the

Alberta foothills during June 1984. Initiation of this study is subject to approval of support funds for A.K.H. through PRUF, AFDRTF, CFS/University of Alberta block grant funds.

3. Provide consultative services to NoFRC staff and CFS regional clients concerning tree physiology and cone and seed production. (NOR-12-192, Dymock).

4. Perform seed analyst duties as may be required (NOR-12-192, Dymock).

5. Complete publication of the following papers from Ph. D. thesis (NOR-12-192, Dymock).

   a. The gibberellin status of Heliantus annuus at two stages of vegetative growth.

   b. The transport and metabolism of ent-Kaurene in Helianthus annuus.

Added Goals:

6. Perform the duties as a supervisor of research support staff (NOR-12-192, Dymock).

7. Prepare a proposal for the employment of up to five persons under a supplementary Environment 2000 program to provide employment at NoFRC for ten weeks (NOR-12-192, Dymock).

10. Accomplishments in 1984-85:

1. Seedling physiological research (NOR-12-192, Dymock)

   a. Production of 1984 seedling research material for NOR-12-192.

      - Produced 461 trays (32,270 seedlings) each of wS and rP and 40 trays (2,800 seedlings) each of bS and lP, in Spencer-Lemaire (Five) containers for 1984-85 overwintering studies.

      - Produced 720 wS seedlings in 5.4 litre square pots for accelerated growth/promotion of flowering studies in native conifer species.

   b. 1983-84 cold hardiness testing of bS and lP

      - Completed weekly freezing tolerance tests on bS and lP at -5°C, -10°C, and -15°C for durations of 6.0, 24.0, and 168.0 hours. Freezing tests were followed by oscilloscope/square wave deformation (SWD) testing 24 hours after returning exposed seedlings to greenhouse conditions, and assessment of survival and/or shoot and root damage four weeks after being returned to the greenhouse. Tests on bS and lP were completed on April 25/84 and May 23/84 respectively.

   c. 1983-84 dormancy testing of bS, wS, and lP.

      - Completed weekly dormancy testing which consisted of stem cambial activity testing using the oscilloscope/SWD method, root

growth capacity (RGC) testing, time to bud break (TTBB) testing, and collection and preservation of bud and root tip samples for mitotic index determinations. Final dormancy tests on bS, lP, and wS were completed on May 9/84, May 23/84 and May 30/84 respectively. Mitotic index determinations are progressing slowly, but will accelerate with the addition of a term technical support person to be hired to March 31, 1985.

d. Evaluation of 1983-84 data and report preparation.

- Data collated, key-punched into computer files on VAX system, summary and analysis of data is in progress.

- Reviewed literature further on cold hardiness/dormancy testing and the physiology of overwintering in tree seedlings. Concluded two additional reported methods of cold hardiness testing should be assessed. Freezing tolerance/conductivity/survival testing method of Columbo, Webb and Glerum (1982), and differential thermal analysis method of Wallner et. al. (1982) should be incorporated into overwintering studies during 1984-85 and 1985-86 respectively. Both methods could prove useful tools for nursery management in this region if their evaluation proves successful. Draft journal report on cold hardiness/dormancy testing of bS and lP during overwintering will include 1984-85 data in support of 1983-84 data. Report to be ready for review by mid-1985. Additional weekly oscilloscope/SWD and bud/root tip mitotic index testing, and bi-weekly RGC and TTBB dormancy testing and bi-weekly freezing tolerance/conductivity/survival testing of 1984 bS and lP were initiated September 10, 1984.

e. 1984-85 cold hardiness and dormancy testing of wS and rP.

- Initiated weekly cold hardiness testing of 1984 wS and rP containerized seedlings using the freezing tolerance/survival/oscilloscope/SWD testing method on September 10, 1984.

- Initiated bi-weekly cold hardiness testing of 1984 wS and rP using a modification of the freezing tolerance/conductivity/survival method of Columbo, Webb and Glerum (1982) on September 10, 1984.

- Initiated weekly dormancy testing of 1984 wS and rP using RCG, TTBB, oscilloscope/SWD, and bud/root mitotic index tests on September 10, 1984.

- Initiated weekly measurement of growth parameters (height; RCD; shoot and root fresh weights (FW) and shoot/root ratios of FW; shoot and root dry weights (DW) and shoot/root ratios of DW; relative moisture content of shoots and roots) and phenological condition of roots, shoots and buds.

- Initiated weekly collection, FW determinations, freezing at -25°C, freeze-drying, DW determinations, and storage of replicate samples of wS and rP shoots and roots for biochemical analyses of selected endogenous cellular metobolites of interest in overwintering. Analyses will commence in 1985-86.

f. Methods/bioassays development.

- Analytical methods for analysing pigments, phenolics, gibberellins and abscisic acid have been reviewed, preliminary testing carried out, and adaptations made to suit current HPLC methodologies. The dwarf rice biossays for GA's has been tested and found satisfactory for use.

g. Role of selected endogenous cellular metabolites in cold hardening, dormancy and overwintering capabilities of bS and 1P.

- Little progress has been achieved on analysing bS and 1P seedlings. Initial analyses will be done on phenolics, GA's, and ABA. These will be started by March 1985. Criteria for determining samples for analysis will be determined by results of cold hardiness and dormancy testing under goals 1b and 1c.

h. Preparation of a report titled "Effects of light quality and photoperiod on twelve conifer species".

- The report co-authored by Ian Dymock and Sheri Wilson was presented by Dymock at the annual Federal/Provincial Nurserymen's Meeting at NoFRC, September 11-12, 1984. The report will be published in the proceedings of the meeting compiled by E. Harvey (NOR-12-039) in 1985.

2. Cone and seed physiological research (NOR-12-192, Dymock).

a. Promotion of early flowering in conifers.

- Initiated study on promoting early flowering in conifers. Part I involves attempting to promote early flowering in 1P through the use of accelerated growth conditions during the first year of growth. Experimental design involved use of two photoperiods (18 hour day/6 hour night; 24 hour day/ no dark period), three different types of supplemental lighting sources (high pressure sodium vapour; fluorescent plus incandescent; fluorescent), and four hormone treatments (ethanol control; gibberellin A4+7; naphthalene acetic acid; GA4+7 plus NAA).

- Lodgepole pine seed was sown into limed peatmoss (pH5.5) in 5.4 litre square black polyethylene pots in mid-December 1983, at 8 seeds per pot. After germination, seedlings were reared under sodium lamps for six weeks. At four weeks each pot was thinned to one seedling (the most vigorous according to height & stem diameter), and fertilization began at weekly intervals using NPK at 125-60-159 ppm plus Fe and micronutrients. At six weeks potted seedlings were randomly selected for distribution among 2 X 3 factorial design for photoperiod and supplemental light treatments. For each of six photoperiod vs light treatments, the 96 assigned pots of seedlings were divided into blocks of eight seedlings and 3 replicates of eight seedlings were randomly assigned the four hormone treatments. Hormones were applied in 100 ml aliquots of 1% ethanol bi-weekly starting at

week 12, over 20 weeks ending at week 30. Height measurements were recorded for each tree one week following each hormone treatment. At 31 weeks, all pots were moved outdoors to shade-frames, and hardening fertilizer treatments initiated weekly using NPK at 44-101-156 ppm plus Fe and micronutrient. After 4 weeks, 12 trees from each treatment were outplanted in the NoFRC nursery during the first week of September 1984. All remaining trees per treatment were destructively sampled (7-12 trees per treatment). Final measurements of height; RCD; shoot and root FW; S/R (FW); number of branches recorded; all destructively sampled shoots and roots frozen at -25°C, and freeze-dried prior to dry weight determinations of roots; needles; stems, branches and buds; and S/R (DW) determined. All freeze-dried control materials have been stored for future hormone analysis.

- Annual assessment of growth and male/female flowering will be made beginning in Spring 1985 for least five years following outplanting.

- Data entry and analysis of results are in progress.

- Initiated part II of study on promoting early flowering in conifers using wS as experimental stock. Seeds of wS were seeded in 5.4 litre square black polyethene pots on November 1, 1984. After germination, seedlings were reared under sodium lamps up to six weeks. At four weeks each pot was thinned to three seedlings, and fertilization begun at weekly intervals using NPK at 125-60-159 ppm plus Fe and micronutrients. At six weeks (December 14, 1984) potted seedlings were randomly selected for distribution in the 2X3 factorial design for photoperiod and supplemental light treatments. Five growth regulator treatments (water control; ethanol control; GA4+7; NAA; GA4+7 and NAA) have been randomly assigned to three blocks of eight seedlings per treatment. Seedlings are to be thinned one final time to one per pot and bi-weekly hormone treatments will commence January 25, 1985 for a 20 week period.

b. Forest Science 417 Course Teaching Duties.

- I was appointed as a part-time assistant professor in the Forest Science Department at the University of Alberta for the period February 14 to March 16, 1984 as a replacement for Dr. A.K. Hellum, during his leave of absence on CIDA-related duties in Thailand during the same period. I prepared and taught seven 75 minute lectures; prepared and supervised four 3 hour lab sessions; prepared and graded one mid-term examination; and prepared and graded one-third of the final examination in the course. The course enrollment (10) consisted of senior undergraduates (5) and graduate level students (5). The thrust of my lectures and labs was on the physiology of tree seed development, maturation and germination as it relates to collection, cleaning, storage and testing of tree seed, and an in-depth evaluation of tree seed quality.

c. Cooperative study of lodgepole pine cone/seed maturation with Dr. A.K. Hellum, Forest Science Dept., University of Alberta.

- Initiated study on ecophysiology of seed maturation in lodgepole pine in the Alberta Foothills. AKH was able to obtain start-up funds from CFS/U. of A. block grant for one full-time assistant and through Alberta government (PEP) for two term positions. NOR 12-192 contributed O & M funds for vehicles, CFS travel expenses, materials, supplies, and some equipment rental. CFS provided crew staffing (regular staff, COSEP, ENVIRONMENT 2000) and facilities for cone storage, seed extraction and cleaning, cone freezing tolerance testing, tree aging and growth ring analysis on stem sections.

- Reconnaisance field trip (IJD/AKH) carried out to examine potential collection areas in Coleman, Rocky Mountain House, Hinton, and Grande Prairie areas April 30 - May 3, 1984. Selected three elevations 500 feet apart north of Coleman, south-west of RMH at Base Line Mountain, and south of Grande Prairie on the Proctor and Gamble leasehold.

- Initiated collection of second year cones of 1P at the designated sites July 23-26 and every four weeks thereafter to late October 1984 (IJD/AKH). Felled 20-30 trees at each site each time, from trees having 20 or more cones of sufficient age (2 years), using chain-saws and collected one stem disk per tree felled.

- Cone yield per tree recorded; cone moisture contents per site determined; seeds extracted from 17 cones/tree for at least 15 trees per site; 8 cones from at least 15 trees per site stored at +10°C for after-ripening study at U. of A.; remaining cones stored at +20°C prior to freezing tolerance testing at NoFRC (IJD/AKH).

- Extracted seed/tree/site cleaned further at U. of A.; X-rays taken of replicate samples for morphology assessment; samples stratified at +5°C or left at +20°C; germination tests to determine germination rate and percent carried out +/- stratification at U. of A. on each month's collection.

- Initiated freezing tolerance tests on intact cone samples from each site. Cones were exposed to -5°C, -10°C, -15°C, -20°C, -25°C, +20°C, and +105°C respectively for periods ranging from 6.0 hours up to 168.0 hours (one week). Seeds were extracted and tested for viability using the tetrazolium chloride method of Leadem (1981). Tests were carried out on each month's collection. Tetrazolium testing continues (IJD).

- Initiated aging of felled trees and analysis of tree ring growth over the last 5 years, from collected disk samples. Analyses will be completed by March 1985 (IJD).

3. Consultative services (NOR-12-192), Dymock).

   a. Provided consultative services to pathologists, entomologists, environmental forestry researchers, EPS, and CWS personnel at NoFRC as requested on matters of tree physiology, cone and seed production, use of freeze-drying equipment and use of biochemical methods of analysis in their respective investigations.

   b. Provided consultative services to AFS Research Branch staff, University of Alberta researchers in departments of Forest Science and Botany, to industrial forest agencies and individuals as requested on matters relating to seedling/tree growth, cone/seed physiology, and plant physiology in general.

   c. Attended the 1984 Federal/Provincial nurserymen's Meeting, hosted by the CFS in Edmonton, Alberta, September 11-12, 1984.

   d. Visited provincial nurseries in The Pas, Manitoba and Prince Albert and Big River, Saskatchewan, June 11-15, 1984, with Edwards, Van Dyk and Harvey to examine facilities and consult on nursery related problems.

   e. Visited Novatel greenhouse complex, Joffre, Alberta with NoFRC staff to examine conifer production capabilities and the first contract crop of wS being produced June 6, 1984.

   f. Provided consultative services as a scientific reviewer and review board chairperson for manuscript reviews, policy statements and documents, unsolicited proposals, AFDRTF proposals, and as a CFS contact person and reviewer for PRUF proposals.

   g. Acted as NOR-12-192 coordinator for 1985 Open House at NoFRC.

   h. Acted as a member of the Safety and Energy committee during 1984.

4. Seed analyst duties (NOR-12-192, Dymock).

   - No requests were received for seed analysis in 1984. No activities were carried out under this goal in 1984.

5. Complete publication of two Ph. D. thesis-related papers (NOR-12-192, Dymock).

   - Very little progress was made on this goal other than re-organizing the data format for tables and figures. References are to be up-dated prior to submission to journal (Can. J. Bot.) for review.

6. Supervisor of research support staff (NOR-12-192, Dymock).

   - Performed duties as supervisor of one technical support staff member (Dendwick, EG-ESS-06) as of April 1, 1984 (0.75PY).

- Performed duties as supervisor of two COSEP staff (Thomson and Macen) during summer 1984 (0.66 PY).

- Performed duties as a supervisor of Environment 2000 field and lab assistants to December 31, 1984 (1.13 PY).

7. Environment 2000 supplementary proposal (NOR-12-192, Dymock).

- Prepared a proposal for the employment of five persons under a supplementary Environment 2000 program to provide employment for ten weeks. Proposal sponsored by CIF/Rocky Mountain Section. Funding approved for employment of four persons between November 26, 1984 - February 1, 1985. Subsequently extended to March 19, 1985 for continued employment of four (E2K) lab assistants.

11. Goals for 1985-86:

1. Seedling physiological research (12-49, 12-51, 12-60)

a. Produce 1985 stock in sufficient numbers for all study requirements under NOR-12-01.

b. Complete weekly and bi-weekly cold hardiness tests on 1984 bS, 1P, wS, and rP.

c. Complete weekly and bi-weekly dormancy tests on 1984 bS, 1P, wS, and rP.

d. Incorporate 1984-85 data on cold hardiness and dormancy testing of overwintering 1984 bS and 1P with 1983-84 data. Complete data entry and analysis. Prepare draft journal report (Can. J. Forest Res.) on cold hardiness and dormancy testing of overwintering bS and 1P for manuscript review. Prepare a poster session research paper on "Overwintering physiology of bS and 1P in a cold temperate climate" for presentation at the joint meeting of the Canadian and American Societies of Plant Physiology, June 23-27, 1985, at Brown University, Providence, Rhode Island, U.S.A. Initiate further supplementary cold hardiness and dormancy testing of 1985 bS and 1P, including cooperative DTA/cold hardiness testing by Steve Wallner (Colorado State University) on NOR-12-192 samples.

e. Evaluate 1984-85 data on cold hardiness and dormancy testing of 1984 wS and rP. initiate supplementary cold hardiness (including DTA) and dormancy testing of 1985 wS and rP.

f. Initiate complete cold hardiness (including DTA) and dormancy testing of 1985 jP and collect, preserve and store replicates of jP material for analysis of selected endogenous cellular metabolites during 1986-87.

g. Continue methods/bioassays development for studying the role of endogenous cellular metabolites of interest in tree seedling physiology.

h. Continue biochemical analysis of selected endogenous cellular metabolites of stored 1983 bS and 1P seedlings proposed to have roles in regulating cold hardiness, dormancy and overwintering capabilities. Initiate similar analyses of stored 1984 wS and rP seedlings.

2. Cone and seed physiological research (12-62, 12-66)

a. Promotion of early flowering in conifers.

- Complete data analysis of growth parameters of 1984 study of the effects of photoperiod, light types, and growth regulator applications on lp. Prepare/present an oral research paper at the Western Regional Meeting of the Canadian Society of Plant Physiologists February 17-18, 1985 at the University of Calgary on "Influence of extended photoperiod and different light regimes on early growth of Lodgepole Pine". Assess overwintering survival and subsequent growth of outplanted 1P during 1985. Prepare and present a poster session research paper on "The influence of growth regulators, photoperiod and supplemental light on growth and survival of Lodgepole pine" at the 12th International Conference on Plant Growth Substances at Heidelberg, West Germany, August 26-31, 1985. Prepare a draft manuscript for review (Can. J. Forest Res.) on the same topic.

- Continue study on the influence of photoperiod, light types, and growth regulator applications on accelerating growth and promoting early flowering of wS. Initiate bi-weekly growth regulator applications January 25, 1985 and bi-weekly measurements of growth parameters February 1, 1985. Initiate hardening off of material for outplanting June 1, 1985. Destructively sample representative trees from each treatment. Outplant 12 trees per treatment in the NoFRC nursery starting July 12, 1985. Evaluate growth parameter data on accelerated wS.

- Initiate third part of study on the promotion of early flowering in conifers using bS or jP in November 1985.

b. Ecophysiology of seed maturation in lodgepole pine in Alberta Foothills (Cooperative study with Dr. A.K. Hellum. Dept. of Forest Science, University of Alberta).

- Complete tree aging and growth analysis (IDJ). Complete germination testing +/- stratification and after-ripening tests. Complete analysis of X-rayed seed/tree/site. Complete seed weight analyses and germination/moisture content tests (AKH).

- Contribute to the preparation of a paper on results of 1984 collection and analyses for presentation by AKH at a symposium on: Conifer Tree Seed in the Inland Mountain West, August 5-9, 1985, Missoula, Montana, U.S.A. Paper to be co-authored by AKH and IJD. Topic of presentation will be related to the effect of seed maturity requirements for cold stratification in lodgepole pine in the Alberta Foothills.

- Continue study for a second field season, subject to the availability of funds for AKH through: PRUF, AFDRTF, AERTF, CFS/U. of A. block grant, or provincial or federal employment programs. (i.e. STEP, PEP, Alberta Environmental Employment Program; Environment 2000 or its equivalent, etc.) CFS participation for 1985 is restricted to scientific/technical advisory roles for Dymock/Dendwick respectively. CFS will make available those facilities utilized during 1984 for personnel working as assistants to Hellum (U. of A.). Instruction in the use of laboratory facilities, and in field work requirements will be provided on request.

3. Provide consultative services to NoFRC staff and CFS regional clients concerning tree physiology and cone and seed production (12-57).

4. Perform seed analyst duties as may be required (12-52).

5. Perform duties as supervisor of research support staff (Dymock).

   - Complete writing of PAS for Tree Physiology Research Technician for classification review.

   - Perform duties as supervisor of one technical support person.

   - Perform duties as supervisor of four Environment 2000 lab assistants to March 29, 1985.

   - Perform duties as supervisor of COSEP (or its equivalent) summer students from May to September 1985.

12. Publications 1984-85:

Dymock, I.J. and S. Wilson. 1984. Effect of light quality and photoperiod on twelve conifer species. Presented as a report at the annual Federal/Provincial Nurserymen's Meeting, hosted by CFS in Edmonton, Alberta, September 11-12, 1984. To be published in the proceedings compiled by E. Harvey.

13. Resources:

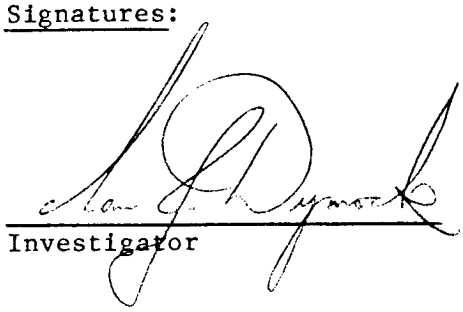
PYs:	Prof.:	Dymock	1.0
	Tech.:	Dendwick	1.0
	Term/Student:		
	Total:		2.0

O & M: $10,000

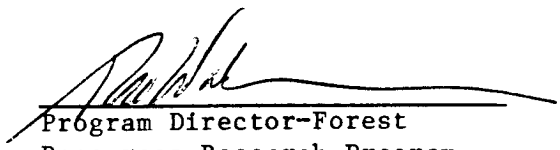
Capital:

Grants & Contributions:

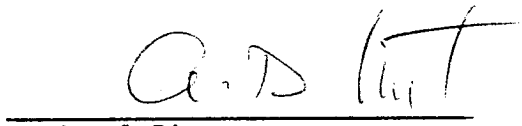
14. Signatures:



Investigator



Program Director-Forest
Resources Research Program



Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 22, 1985

1. Project: Nursery Management and Tree Improvement

2. Title: Provenance tests for coniferous species

   Experiment a. (Formerly MS187) Provenance experiments with the white spruce of Manitoba and Saskatchewan.

   Experiment b. (Formerly MS089) Red Pine (Pinus resinosa) provenance experiment.

   Experiment c. (Formerly MS088) Scots pine (Pinus sylvestris) provenance experiment.

   Experiment d. (Formerly MS234) A test of twelve Norway spruce provenances from northern Europe and Siberia -- Riding Mountain Research Area.

   Experiment e. (Formerly MS019) All-range jack pine provenance experiment, Manitoba-Saskatchewan sub-experiment.

   Experiment f. (new) Geographic variation in black spruce, Northern Region component.

3. New: Cont.: X 4. No.: NOR-12-02 (NOR-12-050)

5. Study Leader: J.I. Klein

6. Key Words: Geographic variation, seed sources, seed zones, Alberta, Manitoba, Saskatchewan, exotic species, Picea abies, Picea glauca, Picea mariana, Pinus banksiana, Pinus resinosa, Pinus sylvestris

7. Location of Work: Wasagaming, Vassar, Piney, Mafeking, Sundown and Carberry, Manitoba; Holbein, Indian Head, and P.A. Pulp Camp 6, Saskatchewan; Reno, Alberta

8. Study Objectives:

   1. To screen populations of conifer species for possible usefulness for planting in various areas within the Northern Region.

2. To obtain an indication of the probable usefulness of further provenance testing or similar research with the species under trial and to guide the planning of such research.

3. To obtain information on patterns of geographic variation in the species under trial.

4. To identify adapted genotypes among the introduced populations for further breeding uses.

9. Goals for 1984-85:

Scots Pine:

1. Measure the test plantations following the 25th growing season after planting. (NOR-12-050, Klein)

Black Spruce:

1. Measure the test plantations following the 10th growing season after planting. (NOR-12-050, Klein)

10. Accomplishments in 1984-85:

Scots pine:

1. The test plantations were not measured following the 25th growing season after planting, owing to a lack of sufficient support and casual staffing resources.

Black spruce:

1. The test plantations were only partly measured following the 10th growing season after planting, owing to a lack of sufficient support and casual staffing resources. The partial measurement may not be useable unless the measurement of the same plantation can be completed before the 1985 growing season.

11. Goals for 1985-86:

1. Review the status of all experiments in this study, and write an evaluative report recommending maintenance or discontinuance of each experiment. (12-37)

2. Complete measurement of the black spruce test plantations with assistance from incremental staffing under Federal/Provincial Forest Development Agreements. (12-10)

12. Publications 1984-85:

Nil

13. Resources 1984-85:

Nil

14. Signatures:

J D Klein
Investigator

Program Director
Forest Resources Research

Regional Director
of Forestry

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 22, 1985

1. Project: Nursery Management and Tree Improvement

2. Title: Breeding jack pine for the Northern Region. First selection cycle.

3. New: Cont.: X 4. No.: NOR-12-03 (NOR-12-051)

5. Study Leader: J.I. Klein

6. Key Words: Pinus banksiana, progeny test, family test, seed orchard, forest genetics, tree breeding, artificial selection, grafting, clone bank, Saskatchewan, Manitoba, Alberta

7. Location of Work: Sundown, Marchand, Stead, Oakbank, and Boggy Creek, Manitoba; Smeaton, Meadow Lake, and Hudson Bay, Saskatchewan; Wildwood, Alberta

8. Study Objectives:

   1. To identify wild jack pine genotypes that are genetically superior in terms of economic yield for areas of major jack pine planting activity in the Northern Region.

   2. To produce scions or control-pollinated seed of the superior genotypes for propagation of seed orchard trees.

   3. To identify genetically superior source areas for seed collection.

9. Goals for 1984-85:

   1. Prepare a regional tree improvement research strategy in anticipation of forestry development agreements and memorandums of understanding. (NOR-12-051, Klein)

   2. Publish a Forest Management Note on the 10-year results of the western breeding district family test. (NOR-12-051, Klein)

   3. Publish the manuscript entitled "Establishment of a jack pine seed orchard by dense planting and selection thinning" in the Forestry Chronicle. (NOR-12-051, Klein)

4. Publish a journal paper on the 10-year results of the eastern breeding district family test. (NOR-12-051, Klein)

5. Produce a special report of maps and source lists for the breeding program. (NOR-12-051, Klein)

6. Revise and publish in a journal the voluntary paper submitted to the 1982 IUFRO genetics meeting. (NOR-12-051, Klein)

7. Propagate trees for province of Manitoba seed orchards by grafting and by controlled pollination of eastern breeding district families selected at 10 years. (NOR-12-051, Klein)

8. Graft scions for a Province of Manitoba seed orchard of central breeding district parent clones selected at 5 years. (NOR-12-051, Klein)

9. Graft about 150 scions, plant 175 grafts, and tend more than 3000 clone bank grafts to increase the inventory of grafts required for clone bank completion to 3130 of 3185 required, and to increase clone bank stocking to 2250 grafts. Likelihood of successful grafting for about 55 positions is poor or nil according to previous results or due to scion supply deficiencies. (NOR-12-051, Klein)

10. Promote, coordinate, and enhance greater use of tree improvement technology in this region. (NOR-12-051, Klein)

11. Act as regional contact for the national tree improvement program. (NOE-12-051, Klein)

12. Implement moving of trees in Birds Hill 1972 seed orchard to adjacent new site at 5 m x 5 m spacing, and obtain seed pollinated after final thinning. (NOR-12-051, Klein)

10. Accomplishments in 1984-85:

1. Regional tree improvement strategy concepts were incorporated in progress in the jack pine seed orchard program in Manitoba, and in a draft proposal for tree improvement under the Canada-Saskatchewan Forest Renewal Agreement.

2. Drafting of a Forest Management Note on the 10-year results of the western breeding district family test was not done. Considerable time was spent on data processing to carry out cubic lattice analysis within locations.

3. The manuscript entitled "Establishment of a jack pine seed orchard by dense planting and selection thinning" completed the local review process and was sent to The Forestry Chronicle in June. Comments were received in October, but there has been no time available for revision since then.

4. There was no time available to work on a journal paper on the 10-year results of the eastern breeding district family test.

5. The special report of maps and service lists for the breeding program is to be produced by the forest genetics research technician. His time has been occupied by preparations for controlled pollination, supervising removal of stumps from the clone bank, and design and planning of a greenhouse for Manitoba jack pine seed orchards.

6. There was no time to revise for publication the paper submitted to the 1982 IUFRO genetics meeting.

7. Grafting of eastern breeding district families to produce stock for Province of Manitoba seed orchards was done in March 1984. Most of the winter and spring of 1984 were spent preparing for and implementing controlled pollination of selected trees in selected families in the eastern breeding district family test. Because there were insufficient pollen or conelets for some crosses, it will be necessary to repeat this exercise.

8. Grafting of central breeding district parent clones selected for superior 5-year progeny height was done in March 1984.

9. One hundred ninety five scions were grafted for clone bank completion. Success with some difficult clones increased the inventory of grafts required for clone bank completion to 3143 of 3185. Mortality in the clone bank, mainly to Armillaria, amounted to 27 grafts in 1984, and the final inventory was 3116 positions of 3185 required. Most of the summer of Mr. Manka, 3 COSEP students and a 3-person Environment 2000 crew was spent on planting 170 grafts, tending of clone bank grafts, and removal of stumps from the plantation. Present stocking of grafts not at risk is 2218 of 3185, 32 grafts short of the goal.

10. Greater use of tree improvement technology in this region has been promoted in planning a seed orchard greenhouse in Manitoba, in the writing of four new position descriptions, in meeting with provincial contacts, and in program planning.

11. Responsibility as regional contact for the national tree improvement program was carried out in hosting Dr. D.P. Fowler on a visit to Alberta to collect information for a task force report on the national program.

12. Moving of trees in the 1972 seed orchard on the Birds Hill property was not implemented owing to a lack of time and funds. This goal has been abandoned.

11. Goals for 1985-86:

1. Provide functional guidance for development of jack pine seed orchards in Manitoba under the Canada Manitoba Forest Renewal Agreement. (12-6MA)

2. Publish a Forest Management Note on the 10-year results of the western breeding district family test. (12-13)

3. Under the Canada-Manitoba Forest Renewal Agreement, produce a special report of maps and source lists for the breeding program. (12-2MA)

4. Develop the improvement programs under the Saskatchewan and Alberta memorandums of understanding. (12-30)

5. Harvest cones from the mass selection seed orchard at Birds Hill for a yield test. (12-15)

6. Measure the central breeding district family test at 10 years from planting, with assistance from incremental staffing under the Manitoba and Saskatchewan Agreements. (12-19)

7. Promote, coordinate, and enhance greater use of tree improvement technology in this region, and act as regional contact for the national tree improvement program. (12-6, 12-7)

8. Plant 649 grafts and tend more than 3100 clone bank grafts to increase clone bank stocking to 2800 positions of 3185 required, and to maintain the inventory of grafts required for clone bank completion at close to 3100. (12-1)

9. Publish the manuscript entitled "Development of a jack pine seed orchard by mass selection" in the Forestry Chronicle. (12-4)

10. Conduct a workshop on tree improvement techniques under the Canada-Manitoba Forest Renewal Agreement. (12-1MA)

12. Publications 1984-85:

Klein, J.I. 1984. Genetic improvement of jack pine for the Prairie Provinces, 1981-1983. In Proc. 19th Meetg. Can. Tree Improv. Assoc., Part 1:150-153.

13. Resources:

PYs:	Prof.:	J. Klein	1.0
	Tech.:	vice Nanka	1.0
	Term/Student:		
	Total:		2.0

O & M: $11,800

Capital:

Grants and Contributions:

14. Signatures:

J I Klein
Investigator

Program Director
Forest Resources Research

Regional Director
of Forestry

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 22, 1985

1. Project: Nursery Management and Tree Improvement

2. Title: Forest nursery research and technology transfer

3. New: Cont.: X 4. No.: NOR-12-04 (NOR-10-039)

5. Study Leader: E. Harvey

6. Key Words: Root pruning and wrenching, storage and packing, storage mold, disease control, seedling mortality, Pinus, Picea, conifer seedbed culture, containerized seedling rearing, quality control, stock quality monitoring

7. Location of Work: Northern Forest Research Centre, Edmonton, Alberta; Provincial Tree Nursery, Oliver; Alberta Forest Service Nurseries, Smoky Lake; Saskatchewan Department of Tourism and Renewable Resources Nurseries, Big River, Chitek Lake, MacDowall, Prince Albert, PFRA Tree Nursery, Indian Head, Saskatchewan; Pineland Nursery, Hadashville, Manitoba; Clearwater Provincial Forest Nursery, The Pas, Manitoba; St. Regis (Alberta) Ltd., Hinton; Blue Ridge Lumber (1981) Ltd., Whitecourt

8. Problem:

1. Alberta, Saskatchewan and Manitoba shipped over 51 million containerized and bareroot tree seedlings in 1984 and future increase is anticipated. The signing of the Forest Resources Development Agreements for Manitoba and Saskatchewan in 1984 will ensure that seedling productive capability will increase to meet increased demands. The present cost of producing a seedling of plantable size is 9 cents for container stock and 11 cents for bare root stock. The operating costs of nurseries in the region is in excess of 6 million dollars per annum. While it is important to ship sufficient numbers of seedlings in order to maintain adequate stocking in the field, it is of equal or even greater importance to ensure that the seedlings shipped are of high quality so that they will establish and grow rapidly in the field. Poor plantation establishment and later growth and survival are often a result of cultural problems in the nursery. Plantation failure usually necessitates costly re-scarification, site preparation and planting.

Size standards for suitable planting stock are lacking in the region. It is important to determine desirable morphological qualities that will enable stock to establish on particular sites. Stock that has certain morphological characteristics may be more suited to a particular site than stock with differing morphological characteristics. Field performance of various size classes of nursery stock several years after outplanting is the best test of the effectiveness of any size class standards.

In addition to knowing the size class of stock that is planted, it is also important to continually monitor the quality of the stock. Material attributes such as bud dormancy, water status, mineral nutrition, carbohydrate status and morphology as well as performance attributes such as vigor tests, root growth potential and frost hardiness should be closely monitored. The prairie region is behind some of the other regions, for example, British Columbia, Ontario and Oregon, in evaluating the quality of nursery stock. Some of the techniques from these regions should be adopted and modified for conditions specific to the prairie region. The predictive abilities of these techniques should be quantified by outplanting trials.

Size classes and stock quality are largely influenced by seedbed density in the nursery. High density may result in poor root system, poor top form and high top/root ratio. Low density may result in lower productivity and therefore higher cost of seedling production. Root culturing treatments such as root pruning and wrenching have been used in adequately spaced beds in order to improve root system fibrosity, increase root regeneration potential, decrease top/root ratio, and improve seedling growth and survival in stressful conditions in the field. Proper seedbed spacing and root culturing treatments may be used to improve the size class and stock quality of nursery stock in the prairie region.

Weed control is an ongoing problem at all bareroot nurseries and at some container nurseries where seedlings are placed outside the greenhouses for a 'hardening off' period. Weeds compete for valuable water and nutrients and may cause a serious reduction in nursery stock quality. Due to the rising cost of labor and the danger of damaging small seedlings, hand weeding is often not a viable method of weed control. There is an extreme shortage of herbicides registered for use in forest tree nurseries in Canada. As of January 1984, the only herbicides registered for use in nurseries were dazomet and methyl bromide (soil fumigants) and dacthal and simazine (pre-emergent herbicides). Presently, there are several herbicides that are registered in Canada that have potential for minor use in forest nurseries. Relavent data on crop tolerance and efficacy are needed for these minor use registrations. In July 1984, a Tree Nursery Weed Control Committee (Ron Hallet, CFS, Fredericton; Eileen Harvey, CFS, Edmonton; John Maxwell, B.C.F.S., Surrey; Bruce Neill, C.D.A., Indian Head; and Charles Waywell, O.M.N.R., Guelph) was formed to set priorities on choice of herbicides and species for submission for minor use registration and to establish a standard testing and reporting procedure for herbicide testing in nurseries.

9. Study Objectives:

1. To conduct laboratory, greenhouse, and field research into seedling production, handling, storage problems, size class standards and stock quality monitoring.

2. To improve general nursery practices, including seedling handling, disease control, weed control, cultural operations, and innovations for seedbed treatments.

3. To advise on containerized and bareroot production of seedlings.

4. Maintain liaison between NoFRC and regional nursery facilities.

5. To conduct OECD seed inspections as required.

10. Progress to Date:

- Various problems in the regional nurseries have been investigated.

- A study for Parks Canada on their Native Plant program was completed and advice was given to Parks Canada on regeneration and reclamation.

- An inventory and monitoring program for nursery stock was developed.

- Site investigations for nurseries in Alberta and Saskatchewan were carried out.

- Simpson Timber (Alberta) Ltd. was given cultural advice on the start up of their container program.

- Two workshops (one in Edmonton and one in Prince Albert) on Basics of Fertilization, Insects and Diseases Common to Nurseries and Greenhouses were organized; a workshop on forest seed was held at NoFRC and Pine Ridge Forest Nursery; the 1981 Intermountain Nurserymen's Association Meeting was held in Edmonton.

- A monitoring program for soil and foliage from regional bareroot nurseries was developed.

- Sodium lamps were installed in the greenhouses.

11. Goals for 1984-85:

1. Gain familiarity with regional nursery production systems for bareroot and containerized stock. Provide technology transfer including advisory services on the production system, employing field trials, demonstrations and workshops as appropriate.

2. Cooperate in conducting the Regional Nurserymen's Meeting at NoFRC and prepare proceedings for publication.

3. Monitor soil fertility and seedling nutrition in bareroot nurseries in the region; maintain monitoring program already underway.

4. Participate in review of nursery problems and develop a method of approach for a research project within the priorities set.

5. Undertake training in seed inspection and conduct OECD seed inspection as required.

12. Accomplishments in 1984-85:

1. Visited the prairie nurseries (both bareroot and container) in order to gain familiarity with regional production systems. Provided technology transfer and advised regional nurserymen of any workshops or publications which might be of benefit to them. Insect problems (strawberry root weevil and leatherjackets) investigated at Big River Nursery and suggestions for their control made. A seed quality problem (poor germination) was investigated and germination tests were conducted for Prince Albert nursery. A File Report will be written regarding this. Investigated dust problems in Prince Albert nursery packing shed and suggested possible solutions. Completed white spruce/jack pine spacing study that was established at Pineland Nursery by R. Huber and prepared a File Report regarding this.

2. Conducted the regional nurserymen's meeting at NoFRC in September 1984. Proceedings will be prepared when all of the papers have been submitted.

3. Soil fertility and seedling nutrition monitoring for bareroot nurseries in the region completed for Saskatchewan and Manitoba and 2/3 completed for Alberta.

4. Reviewed nursery problems in the region. The following priorities are suggested for nursery operations research: 1) size standards for bare root and container nursery stock; 2) a system for stock quality monitoring in the region; 3) seedbed spacing and root culturing (such as wrenching and root pruning); 4) herbicides for use in the nurseries.

5. Attended the OECD Seed Inspectors' Workshop in Victoria and sent 'Request to Present Collections Plans' letter to Reid Collins Nurseries Ltd. No OECD seed inspections were required.

13. Goals for 1985-86:

1. Investigate greenhouse and nursery problems and provide routine advisory service and technology transfer to regional nurseries. (12-40)

2. Monitor soil fertility and seedling nutrition in bareroot nurseries in the region; maintain monitoring program already underway and provide appropriate recommendations to nursery managers on soil fertility management. (12-65)

3. Publish the proceedings of the 1984 Regional Nurserymen's Meeting as an Information Report. (12-56)

4. Complete a File Report, "Recommendations for Improving the Quality of Seed Sown at Saskatchewan Forest Nurseries" and submit to the Province. (12-40)

5. Prepare and submit for peer review a plan to study the establishment of size class standards and methods of monitoring stock quality in the region. (12-55)

6. Prepare and submit for peer review a plan for continuation of Huber's study, incorporating root pruning and wrenching as operational factors. (12-68)

7. Participate on the National Tree Nursery Weed Control Committee as required, collect relevant data on crop tolerance and efficacy for minor use registrations. (12-69)

8. Conduct OECD seed inspections as required. (12-44)

14. Publications 1984-85:

Harvey, E.M. 1984. White spruce (Picea glauca (Moench) Voss) and jack pine (Pinus banksiana Lamb.) spacing demonstration plots at the Pineland Provincial Forest Nursery, Hadashville, Manitoba. File Report.

15. Resources 1985-86:

PYs: Prof.: Harvey 0.8

Tech.:

Term/Student:

Total: 0.8

O & M: $6,000

Capital:

16. Signatures:

E. M. Harvey
Investigator

Program Director
Forest Resources Research

G. D. Hunt
Regional Director
of Forestry

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 22, 1985

1. Project: Nursery Management and Tree Improvement

2. Title: Greenhouse and nursery operations

3. New: Cont.: X 4. No.: NOR-12-05 (NOR-10-810)

5. Study Leader: E. Harvey

6. Key Words: NoFRC greenhouse and nursery, facilities maintenance, management and planning

7. Location of Work: NoFRC, Edmonton

8. Study Objectives:

   1. To administer NoFRC greenhouse and nursery facilities.

   2. To provide advice on rearing bareroot and container stock to NoFRC R & D staff.

9. Goals for 1984-85:

   1. Administer the NoFRC greenhouse and nursery facilities.

   2. Prepare a NoFRC nursery facilities plan.

   3. Assist in the production of 25,000 containerized blue spruce for National Forest Week and NoFRC displays as 'give-a-ways'.

   4. Start bedding plants for NoFRC outdoor beds and grow and maintain tropicals to be installed in reception area.

10. Progress to Date:

    Sodium lamps were installed in the greenhouse.

11. Accomplishments in 1984-85:

    1. Routine administration was carried out and an extensive "clean up" of these areas was conducted.

2. A NoFRC nursery facilities plan was prepared and submitted to the Project Leader, Nursery Management and Tree Improvement. One windrow was removed from the nursery; Siberian larch were planted in the west windrow, the triploid aspen were re-propagated; the FIDS insect collection trees were moved to the southwest corner.

3. Colorado blue spruce containers (25,000) were grown for distribution by NoFRC during National Forestry Week and at public information displays.

4. Bedding plants were grown for the NoFRC outdoor beds and tropical plants were supplied for the reception area.

12. Goals for 1985-86:

1. Administer the NoFRC greenhouse and nursery facility. (12-42)

2. Finalize NoFRC nursery facilities plan and initiate and supervise the implementation of the approved plan. (12-70)

3. Grow 50,000 Colorado blue spruce for distribution during National Forest Week and at NoFRC public information displays. (12-71)

4. Start bedding plants for NoFRC outdoor beds and grow and maintain tropicals to be installed in reception area.

13. Publications for 1984-85:

Nil

14. Resources 1985-86:

PYs:	Prof.:	Harvey	0.2
	Tech.:		
	Term/Student:	Mills	0.5
	Total:		0.7

O & M: $10,000

Capital:

Grants & Contributions:

15. Signatures:

Investigator

Program Director
Forest Resources Research

Regional Director
of Forestry

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 22, 1985

1. Project: Nursery Management and Tree Improvement

2. Title: Nursery soil fertility and seedling growth

3. New: Cont.: X 4. No.: NOR-12-06 (NOR-10-135)

5. Study Leader: I.K. Edwards

6. Key Words: Nutrient uptake, plant nutrition, Pinus contorta, Pinus banksiana, Picea glauca, Picea mariana, Pinus resinosa

7. Location of Work: Edmonton, Smoky Lake, Athabasca, and Slave Lake, Alberta; Prince Albert and Big River, Saskatchewan; Hadashville and The Pas, Manitoba

8. Study Objectives:

   1. To determine the nutrient requirements for growth and hardening off of bareroot and containerized conifer seedlings.

   2. To determine the effect of residual soil fertility on growth of bareroot seedlings.

   3. To develop guidelines for efficient water use in bareroot nurseries.

   4. To determine for aspen ecosystems in Alberta, biomass, nutrient content, and rate of nutrient cycling and adapt these data to the FORCYTE growth simulation model developed under the ENFOR program.

9. Goals for 1984-85:

   1. Complete publication of:

      a. Fertilization guide for conifer seed production (FMN).

      b. Erodibility index for forest land (IR).

      c. Soil fertility and site productivity (IR). (NOR-10-135, Edwards)

   2. Review contractor's report on ENFOR Project P-205 and undertake added analysis as needed. (NOR-10-135, Edwards and Brace)

3. Provide advisory service, investigate problems, and offer recommendations on soil fertility and tree nutrition as requested by industry and government agencies. (NOR-10-135, Edwards)

4. Continue experiment on the effects of residual fertility on jack pine and white spruce at Prince Albert. Soil and foliage samples will be collected for analysis before and after the growing season. (NOR-10-135, Edwards and Van Dyk)

5. Initiate study on nutrient requirements for hardening of containerized wS and lP seedlings. Prepare a study plan for review, stating approach to the problem and the solution expected. (NOR-10-135, Edwards and Van Dyk)

10. Accomplishments in 1984-85:

1. a. Complete final revision of the manuscript, "Fertilization and conifer seed production" (FMN). It is ready to be submitted to the Editor.

   b. The manuscript received second review and has been revised accordingly (IR). It is ready to be submitted to the Editor.

   c. The manuscript was revised following the initial review (IR). It is ready for the second review.

2. A Literature Review only was received from the contractor and reviewed. Plans are underway for termination of the contract because of the contractor's inability to prepare a final report as required. Receivables, including field sheets and taped data records, have been submitted and are being checked prior to termination of the contract.

3. Provided advisory service, as requested, to federal, provincial, and industrial forest nurseries. Interpreted results of soil and plant analyses and recommended soil amendments and fertilizer application. Conducted tests on nutrient solutions to check performance of irrigation systems. Soil from a Saskatchewan seed orchard (P.A. Pulpwood Ltd.) was chemically analyzed; irrigation, acidification, and drainage were recommended.

4. Collections and analysis of plant and soil samples from jack pine and white spruce seedbeds (2-0) continued. Jack pine will be lifted in spring of 1985 and white spruce will be grown for one more season. Results indicate that leaching loss of nutrients is occurring and suggest that irrigation water should be applied more judiciously.

5. Prepared a study plan for review which was approved. A study of nutrient requirements for hardening lP and wS seedlings indicated that spruce was easier to harden than pine. Optimum concentration of the hardening solution for spruce was 22N-101P-150K and for pine was 4.4N-101P-150K. After conditioning for 5 weeks at 8 h photoperiod and 4 weeks in a 10°C-day and 2°C-night regime, both species survived at -5°C but only spruce survived at -10°C. Data analysis continues but a presentation of the report, "Conditioning containerized tree seedlings

for cold tolerance" was made at the annual Federal-Provincial Nursery Meeting held at Edmonton. The report will appear in the proceedings of the meeting.

11. Goals for 1985-86:

1. Complete publication of:

   a. Erodibility index for forest land (IR).

   b. Soil fertility and site productivity (IR). (12-45)

2. Act as project leader and coordinator of NOR-12. Participate in development of research priorities in MOU's for Saskatchewan and Alberta. (12-67)

3. Set up plot instrumentation and act as Scientific Authority for contract project (P-314) to determine rate of nutrient cycling in aspen and gather data for calibration of FORCYTE growth simulation model. Develop, with the assistance of M. Apps and H. Grewal, application of project data to the FORCYTE model. (12-59)

4. Draft report for review on nutrient requirements for hardening of wS and lP. Initiate study on nutrient requirements for hardening bS and jP. (12-58)

5. Review contractor's report on ENFOR P-205 and undertake added analysis as needed. Original contract terminated before report completed. New contract (P-323) will do additional analysis and prepare report on ENFOR P-205. To act as Scientific Authority for this latter contract. (12-64)

6. Continue experiment on effects of residual soil fertility on succeeding crop of bareroot seedlings. (12-48)

7. Provide advisory service, investigate problems, and offer recommendations on soil fertility and tree nutrition as requested by industry and government agencies. (12-54)

12. Publications 1984-85:

Edwards, I.K. 1984. Conditioning containerized tree seedlings for cold tolerance. Proceedings of the annual Federal-Provincial Nurserymen's Meeting held at Edmonton, September 11-12, 1984.

Edwards, I.K. 1985. Fertilization and conifer seed production. Forest Management Note.

13. Resources:

PYs:	Prof.:	Edwards	0.8
		Apps	0.8
		Grewal	0.2
	Tech.:	Van Dyk	1.0
	Term/Student:		
	Total:		2.8

O & M: $6,000 (+ENFOR funding under NOR-28-05)

Capital:

Grants & Contributions:

14. Signatures:

J. K. Edwards
Investigator

Program Director
Forest Resources Research

Regional Director
of Forestry

NOR-13

FOREST HYDROLOGY AND MICROCLIMATE RESEARCH

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 24, 1985

1. Project: Forest Hydrology and Microclimate Research

2. Title: Research coordination in the Alberta Watershed Research Program; Marmot, Streeter, Tri Creeks, Spring Creek experimental basins

3. New: Cont.: X 4. No.: NOR-13-01 (NOR-13-017)

5. Study Leader: R.H. Swanson

6. Key Words: Hydrology, forest climate, gauged basin soil water

7. Location of Work:

Marmot Basin	115°09'05"W	50°56'57"N
Streeter Basin	113°03'48"W	50°06'59"N
Tri Creeks	117°15'00"W	53°09'00"N
Spring Creek	117°51'11"W	54°55'06"N

8. Study Objectives: To coordinate the efforts of cooperating agencies toward fulfilling the following:

   1. To learn how to manage forested public lands for the protection of existing water supplies and the enhancement of future supply by alteration of regime or yield through timber harvest.

   2. To broaden the overall knowledge base in the hydrology of range lands, forested lands, and alpine areas.

   3. To propose and to test specific land management practices designed to increase annual water yield, retard flood peaks or improve on-site watershed condition.

   4. To evaluate and test existing land management practices with respect to their influence on the hydrologic regime of specified test areas.

   5. To act as consultant and adviser in proposing and evaluating the influence of various land management practices on the local and regional surface and groundwater hydrology.

9. Goals for 1984-85:

   1. Publications: Complete and publish:

      a. Forestry report on Marmot snow, Marmot Cabin creek results, Streeter basin results and Marmot Twin treatment description. (Swanson)

b. Range-watershed management implications of the Streeter basin project. Information Report coauthored by Swanson, Golding, Hillman, Singh, and Telfer.

c. The management of lodgepole pine forests for water. Symposium proceedings, Lodgepole Pine Symposium, May 8-16, 1984, Spokane and Vancouver, B.C.

2. Interraction with provincial clients:

a. Convene Steering Committee, Alberta Watershed Research Program. (February 1984, tentative)

b. Provide assistance to the Watershed Management Section, Alberta Forest Service, regarding application of research findings to management problems and the operation of the Tri Creeks watershed project.

c. Provide Canadian Forestry Service input to the ad hoc committee formed to evaluate the potential of watershed management in water supply via a pilot watershed management project.

3. Interraction with project scientists:

Complete installation and testing of instrumentation to measure evaporation from soil and vegetation in summer, evaporation and/or melt of snow in spring at the James River forest microclimate study site.

4. Provision of data:

Assist in use of the Mount Allan snow data. Advise as requested in formation of master plan for the Mt. Allan-Marmot basin Olympic and recreational ski development.

5. Interraction with outside agencies and other NoFRC staff:

a. Attend meeting of associate Committee on Hydrology subcommittee on Research Priorities, Ottawa, January 25, 1984.

b. Participate in review of existing and future role of NoFRC in hydrological research by Ottawa CFS staff and local client agencies.

c. Attend annual meeting of the Associate Committee on Hydrology as CFS member, Quebec City, June 13-15, 1984.

d. Assist with 'problem' course for graduate student John Berry, University of Alberta. (John is conducting snow measurements in conjunction with our studies at our James River site).

10. Accomplishments in 1984-85:

1. Publications:

a. The first draft of the Forestry Report is about 90% completed. The sections on Marmot-Cabin and Streeter have been written. All of the data for the section on Marmot snow have been analyzed. This should be in first reviews by January 25, but it may be late March before it is ready for publication because some new photography of Marmot is desirable.

b. The water yield aspects of this report as well as that for Cabin creek had to be completed in order to finish the Forestry Report above. These two were combined to make one report featuring the results of both Marmot Cabin and Streeter basins. This is intended for the Journal of the Canadian Water Resources Association and is currently in its last review prior to submission to the journal. It should be in the journal's hands by 31 March, but we will probably not know whether it has been accepted or not.

c. This paper was finished and presented at both the Spokane and Vancouver venues. It was final typed and sent to the editor of the proceedings on 6 June 1984: Receipt acknowledged in letter from editor dated 26 July 1984.

2. Interraction with provincial clients:

a. The Steering Committee meeting was not convened in February as originally scheduled because of the uncertainty caused by the internal review of the Hydrology project. It was however, convened on 6 June. Most of the discussions centered around further analyses of the extensive collection of data that now exists for Marmot. The Water Survey of Canada and the Atmospheric Environment Service agreed to catalog existing data and make recommendations as to further analyses that should be done. All agreed that the Research Coordinator did not have the sole responsibility for data analyses beyond those necessary to evaluate the forest cutting experiments.

b. Numerous ad hoc meetings were held with AFS land use personnel. In addition, more formal consultations in the form of participation in a public forum of the clear-cutting controversy at Hidden Creek in southern Alberta, lectures to AFS field staff at Rocky Mountain House, and students at the Forest Tech. School at Hinton.

c. The ad hoc committee tabled its report which requested the Alberta Forest Service to commit the land necessary for this project. Several meetings were held with AFS Research Branch personnel to help firm up this commitment. The AFS has indicated that the project has very high priority, and that it is willing to consider the long-term allocation of the land and timber necessary to carry out this project.

3. Interraction with project scientists:

   The instrumentation has been installed and is undergoing further testing. See NOR-13-02.

4. Provision of data:

   This has been a particularly onerous task this year as I have had frequent requests for these data. Since we are not normally a data publishing agency, these have had to be prepared on an "as needed" basis.

5. Interraction with outside agencies and other NoFRC staff:

   a. I indicated to the chairman of the Associate Committee on Hydrology subcommittee on Research priorities that the review of the microwave measurement of snowpack by Bernier was in final review. I did not attend the meeting on January 17, in Ottawa, in person.

   b. Participated in inhouse reviews of the project.

   c. I attended the meeting of the Associate Committee on Hydrology in Quebec City as scheduled. As a result of that meeting, I was appointed as lead convenor for the International Association of Hydrological Sciences Symposium on Forest Hydrology and Watershed Management to be held in Vancouver in August 1987. I attended a meeting for convenors in Ottawa in November 1984.

      I also have made tentative arrangements to host the Canadian Hydrology Symposium in 1988 in the Banff-Kananaskis area. This symposium would deal mainly with the results from studies completed in Canadian experimental and research basin studies. It would serve as a vehicle for a final report and wrap-up of the Marmot research.

   d. We loaned John Berry two of our CR21 microloggers and several sets of sensors for installation at the James River site. John was able to get several days' data that will enable him to write his thesis. These data also are a preliminary set of data for our much more comprehensive work this coming winter in the same area.

11. Goals for 1985-86: (All Swanson unless otherwise indicated)

    1. Publications:

       a. Publish "The hydrological effects of timber harvest at Marmot Creek and Streeter watershed, Alberta". (Swanson, Golding, Rothwell, Bernier) (13-13)

       b. Publish Forestry Report (Marmot-Streeter results, Mount Allan snow). (Swanson, Bernier) (13-14)

c. Prepare for review Information Report on the Streeter Basin project. (Swanson, Golding, Hillman, Singh, Telfer) (13-16)

2. Interraction with provincial clients:

a. Convene Steering Committee, Alberta Watershed Research Program. (13-8)

b. Provide assistance to the Watershed Management Section, Alberta Forest Service, regarding application of research findings to management problems and the operation of the Tri Creeks watershed project. (13-8)

c. Provide Canadian Forestry Service input to the ad hoc committee formed to evaluate the potential of watershed management in water supply via a pilot watershed management project. (13-7)

3. Provision of data:

a. Continue to assist in use of the Mount Allan snow data. Advise as requested in formation of master plan for the Mt. Allan-Marmot basin Olympic and recreational ski development. (13-1)

b. Assume responsibility (from Swanson) for the operation and maintenance of the automated weather stations on Marmot Watershed. Transfer data for 1982-1984 to files on NoFRC computer. Prepare format for compilation and ready access to these data in computer format. (Hurdle) (13-1)

4. Interraction with outside agencies and other NoFRC staff:

a. Attend annual meeting of the Associate Committee on Hydrology as CFS member, St. Johns, Newfoundland, May or June 1985. Also attend normally scheduled meeting of Research Priorities subcommittee at this time. (13-9)

b. Prepare program for International Symposium on Forest Hydrology and Watershed Management for Vancouver, August 9-22, 1987. (For meeting of convenors during July-August 1985 in Vancouver). (13-9)

c. Make preliminary arrangements for Canadian Hydrology Symposium 1988 at Banff and/or Kananaskis. (13-9)

12. Publications 1984-85:

Swanson, R.H. 1984. Managing lodgepole ecosystems as watersheds. In: Proceedings, Lodgepole Pine Symposium: the species and its management, May 8-10, 1984, Spokane, Washington, and May 14-16, 1984, Vancouver, B.C. (in press)

13. Resources 1985-86:

PYs: Prof.: Swanson 0.8

Tech.: Fisera 1.0
Hurdle 0.4

Term/Student: Nil

Total: 2.2

O & M: $6,600

Capital: Nil

14. Signatures:

Robert H. Swanson
Investigator

G. M. Powell
Program Director

A. D. Kent
Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 24, 1985

1. Project: Forest Hydrology and Microclimate Research

2. Title: Vegetation manipulation-disposition of snow in forest clearings

3. New: Cont.: X 4. No.: NOR-13-02 (NOR-13-177)

5. Study Leader: P.Y. Bernier and R.H. Swanson

6. Key Words: Hydrology, modelling, snowmelt, evapotranspiration, soil water movement, transpiration

7. Location of Work: Phase I - James River microclimate site near Sundre, Alberta

Phase II - Southern portion of Bow and/or Oldman River Basin

Bark beetle outbreak areas in Alberta and/or British Columbia

8. Study Objectives:

1. To develop vegetation manipulation-hydrologic models applicable to the prescription and evaluation of forest management techniques in the Saskatchewan River headwaters.

2. To conduct studies as needed to meet the above objective in order to define mathematical relationships describing energy exchange and energy partitioning in the processes of snow accumulation, snowmelt, evaporation and transpiration in the various microclimates created by partial and/or complete forest harvest.

8a. Current problem analyses:

1. Snow disposition in clear-cuts

The manipulation of vegetative cover affects the disposition of water on a watershed. In rainfall dominated areas, the effect of forest removal is a relatively predictable increase in annual water yield, plus an increase in stormflow response which is especially marked when storms occur during low flow periods. In snow dominated regions, the effect is not so easily explained. Snow lies on the ground for weeks or months and in some

clear-cutting situations, the modification of the near-ground microclimate could influence the evaporation of snow to the point of negating the increases in water yield induced by the removal of trees.

The evaporation process is affected by wind speed, temperature, and vapour concentration gradient. Work in Wyoming has shown that air-borne snow particles will evaporate within 3000 m of their point of origin. We do not know the importance of air-borne evaporation in the large clear-cuts of the Alberta foothills.

Evaporation also occurs from snow on the ground, even at temperatures below 0°. This is thought to be an especially important type of evaporation in Chinook areas, (such as southern Alberta) where the air temperatures often exceed 0°C for extended periods. Here, evaporation from the winter's snowpack has been thought sufficient to reduce summer streamflow, and the Alberta Forest Service has had its logging practices challenged in court on this basis.

The essence of the problem is that evaporation under either situation is very likely affected to an unknown degree by the influence of clear-cut size on surface wind speed and turbulence. Until the magnitude of the problem is known, we do not know what steps to take to evaluate it under the variety of field situations that exist in the southern Alberta foothills.

The tools available to either researchers and forest managers for evaluating or predicting the effects of harvesting practices on water yield are hydrologic land use models. To be useful in the solution of the current problem, a model must allow the input of local wind speed, air temperature, and vapour concentration. The use of such models is currently beyond the capabilities of either ourselves or Alberta Forest Service personnel because of a lack of suitable site-specific data on either actual evaporation or that on wind-temperature-humidity.

This study is thus being conducted in two phases. Phase I is to determine the magnitude of evaporation from snow under chinook and non chinook conditions. This is being carried out in the James River microclimate study site near Sundre. Both large and a number of replicated small clearings are available at this site. Normal patterns of snowpack accumulation and ablation have been well documented during previous studies. If the magnitude of evaporation from snow is large enough to be of concern with respect to water yield, then Phase II, to determine the evaporation from clear-cuts in the affected areas of the southern Alberta foothills will be implemented.

2. Transpiration of beetle-infested pine

The mountain pine beetle has attacked and killed vast stands of lodgepole pine in Alberta and British Columbia. Many of these stands occupy strategic watersheds in the Saskatchewan River watershed. The impact of death on the evapotranspiration regime of affected watersheds is not known for certain but the magnitude is thought to lie between that of a healthy stand and complete clear-cut.

During 1985, Dr. Suzuki, a visiting scientist from Japan, will be examining the role of nematodes and blue-stain fungi in the stoppage of transpiration in lodgepole pine. He has requested that the NoFRC support this research by assisting in the measurement of transpiration using the Heat Pulse Velocity technique that has been perfected to a point of application in the course of our hydrological research. Dr. Suzuki's application provides and opportunity for a limited study of the changes in the transpiration regime of forest stands that occur during and following tree death.

8b. Current objectives:

1. Snow disposition phase I

   a. Determine the magnitude of evaporation from snow under open and sheltered conditions.

   b. Determine the importance of wind speed, vapor concentration, solar radiation, and air temperature in the evaporation of snow.

   c. Determine the influence of clear-cut opening dimensions on the parameters influencing evaporation from snow.

   d. Evaluate the potential importance of evaporation from snow under the clear-cutting regimes now imposed on the southern Alberta foothills.

2. Snow disposition phase II

   a. Measure the loss by snowpack evaporation from clear-cuts of commercial size in the southern Alberta foothills.

   b. Provide techniques for predicting or evaluating the impact of various sizes of clear-cuts on the hydrologic regime of affected watersheds (modifications of snow loss coefficients in WRENSS).

3. Transpiration of beetle-killed pine

   a. Assist Dr. Suzuki in using the Heat Pulse Velocity technique in determining the transpiration regime of healthy lodgepole pine trees, and those that have been attacked by the mountain pine beetle.

8c. Current resources:

1. Snow disposition phase I

   Starting date: 1984-1985
   Estimated date of completion: 1986
   Estimated Prof. PY: 0.5 per year
   Estimated Tech. PY: 1.0 per year

2. Snow disposition phase II

   Starting date: 1985-1986
   Estimated date of completion: 1989
   Estimated Prof. PY: 0.5 per year
   Estimated Tech. PY: 1.0 per year

3. Transpiration of beetle-killed pine

   Starting date: 1985
   Estimated date of completion: 1985
   Estimated Prof. PY: 0.1
   Estimated Tech. PY: 0.1

9. Goals for 1984-85:

   1. Publications:

      a. Submit for review:

         1) Management Note or brief Information Report as a users guide to the use of WRENSS. (Bernier-Swanson)

      b. Submit for publication:

         1) Journal article on the use of the variable source area simulator in small forested basins. (Water Resource Research: Bernier)

         2) Journal article on the passive microwave method for measuring snow accumulation. (Atmosphere-Ocean or Canadian Water Resources Journal: Bernier)

   2. Research activities

      For the snow disposition project (James River site)

      a. Evaluate the network of neutron meter access tubes installed during 1983. (Bernier)

      b. Complete installation of meteorological instrumentation and conduct preliminary runs to establish adequacy of the instrumentation and data prior to the 1984-85 winter season. (Swanson, Hurdle)

      c. Start gathering data on snowpack ablation at the site in January 1985. (Swanson, Hurdle, Bernier)

      Other related work

      d. Determine the location of the phreatic divide on Marmot-Cabin subbasin using water table information. (Bernier)

      e. Initiate the development of a WRENSS-like procedure for the forested portions of Alberta. (Bernier)

f. Continue analysis of Marmot stormflow data for possible use in a routing technique. (Bernier)

Added goal

g. Continue to support and update the programmed version of WRENSS procedure. (Bernier)

10. Accomplishments in 1984-85:

1. Publication:

a. Submit for review

1. The Management Note on WRENSS has been reviewed once by the review committee. At this point, because of the increasing amount of relevant material, the Note might either be upgraded to an Information Report, or to a journal article plus a Management Note.

b. Submit for publication

1. The paper entitled "Variable source areas and storm flow generation: an update of the concept and a simulation effort" has been accepted for publication with minor modification in the Journal of Hydrology.

2. The paper entitled "A review of the potential of microwaves for the remote sensing of snowpack properties" has been sent to outside reviewers for comments.

2. Research activities

a. The data from the tubes have been analyzed. Some apparently anomalous results were found, and a second replicate of the access tubes was installed to verify the data.

b. A complete set of the instrumentation was installed and tested during November. A data multiplexer device, necessary for the logging of the microclimate data, did not operate properly at the -20°C temperatures encountered. This problem has been corrected and the device retested in the -25°C chamber at the NoFRC. A second installation sequence and partial data collection run is scheduled for the week of 14 January.

c. Data collection is expected to proceed normally starting 28 January (likely the second half of the 14 January run).

d. The location of the phreatic divide has been determined as accurately as possible with the data set acquired. These data indicate that approximately 80% of cut-block #4 on Cabin Creek lies outside of the basin boundaries. Further water level data from the same wells will only substantiate our present conclusions, not provide more conclusive data. Therefore, this study will be terminated in October 1985 (at the end of the current water year).

e. Several options were examined to be used in the development of a streamflow routing routine for this procedure. We decided that the routing routine currently supplied with the WRENSS procedure is useless and misleading. We decided that we must return to the hydrologic model that WRENSS is based on, and apply it to the data from several experimental catchments in Canada in order to derive regionalized routing routines similar to those already used in WRENSS for evapotranspiration.

f. Marmot stormflow data was examined. We determined that there are an insufficient number of storms that produce stormflow to be of use in the development of a routing procedure. This aspect is therefore terminated.

g. The WRENSS procedure as programmed on the U. of A.'s Amdahl computer has been used extensively over the year by the Alberta Forest Service and Alberta Environment. This healthy demand resulted in frequent consultation calls and generated the need for periodical updates as "bugs" were found in the program, or as greater "user friendliness" of the program seemed appropriate. An identical version was also made available in FORTRAN for micro-computers. So far, copies on floppy diskettes have been requested by staff members of the B.C. Ministry of Forests, the Inland Waters Directorate and the Spokane Community College.

11. Goals for 1985-86:

1. Publications:

a. Submit for review:

1) Paper on snow evaporation or melt in forest clearings. (Swanson) (13-4)

2) Paper on soil water distribution and disposition in forest clearings. (Bernier) (13-4)

3) Paper on the use of the heat pulse velocity technique for dynamic evaluation of living tree sapwood moisture content. (Data from 1983 field season - Swanson) (13-11)

4) Paper on the design and use of a multiplexer with the CR-21 micrologger. (Hurdle, Swanson) (13-15)

b. Submit for publication:

1) "A review on the potential of microwaves for the remote sensing of snowpack properties". (Bernier) (13-12)

2) Information Report on Mount Allan snow and winter climate. (Bernier-Swanson) (13-2)

3) Information Report or jurnal article on a users guide to WRENSS. (Bernier) (13-3)

2. Research activities

For the snow disposition project (James River site)

a. Complete the gathering of soil moisture information at the James River experimental sites. (Bernier) (13-4)

b. Complete the gathering of meteorological and snow pack ablation data at the site. (Swanson, Hurdle) (13-4)

c. Analyze the results from Phase I of the snow disposition study and decide on implementation of Phase 2. (Swanson, Bernier) (13-4)

Other related duties

d. Complete gathering of ground water levels on Marmot Creek basin to determine the location of the Cabin Creek phreatic divide. (Bernier) (13-1)

e. Pursue work on the WRENSS procedure, including consultation support and upgrading of the current programmed version, and possible work on modifications for improving the compatibility of the procedure to Canadian conditions. (Bernier) (13-6)

f. Participate in the workshop in "Snow property measurement" to be held at Lake Louise on 1-3 April 1985. (13-17)

g. Install Heat Pulse Velocity (Transpiration) sensors in beetle-susceptible and nonsusceptible lodgepole pine trees. Monitor to ascertain time when transpiration ceases for correlation with concurrent histological analyses being conducted by Dr. Sukuki and Dr. Hiratsuka. (Swanson, Hurdle) (13-10)

12. Publications 1984-85:

"Variable source areas and storm flow generation: an update of the concept and a simulation effort" accepted for publication in the Journal of Hydrology.

13. Resources 1985-86:

PYs:	Prof.:	Bernier	1.0
		Swanson	0.2
	Tech.:	Hurdle	0.6
	Term/Student:		0.3
	Total:		2.1

O & M: $5,400

Capital: Nil

14. Signatures:

P Y Bessin
Investigator

G. M. Powell
Program Director

Robert H. Simonson
Investigator

G. D Fitt
Regional Director

NOR-28

WETLANDS, CLIMATE, AND ENFOR

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 24, 1985

1. Project: Wetlands, Climate, and ENFOR

2. Title: Environmental assessment and impact of developments on terrestrial environment

3. New: Cont.: X 4. No.: NOR-28-01 (NOR-28-171)

5. Study Leader: S.C. Zoltai

6. Key Words: Arctic, land use, development, impact, vegetation, terrain

7. Location of Work: Western and Northern Region

8. Study Objectives:

   1. To provide expertise in the development of essential criteria for the design of major industrial developments and for the rehabilitation of disturbed areas.

   2. To assess the impacts of industrial developments on the terrestrial environment and recommend measures for minimizing or mitigating the damaging impacts of the proposed developments.

9. Goals for 1984-85:

   1. Conduct field work in the Wager Bay area, in preparation of a National Park development. (Zoltai)

   2. Participate in assessment processes of development proposals as required. (Zoltai, Addison, Apps)

   3. Develop and maintain expertise in assessing impacts of development proposals in the terrestrial environment in various parts of the region as opportunities arise. (Zoltai, Johnson, Apps, Addison)

   4. Continue to serve as chairman of the Regional Transportation Committee, assessing and coordinating responses on environmental impacts. (Zoltai)

   5. Act as CFS representative on the Regional Screening and Coordinating Committee. (Zoltai)

6. Continue ecoclimatic region determination, as chairman of the national working group. (Zoltai)

10. Accomplishments in 1984-85:

1. Completed field work in the Wager Bay area.

2. Participated in assessment processes of development proposals (Beaufort Sea oil development, Regina rail relocation, Shoal Lake cottage development, etc.).

3. Developed and maintained expertise in assessing impacts of development in the Wager Bay area.

4. Served as chairman of the Regional Transportation Committee.

5. Acted as CFS representative of the Regional Screening and Coordinating Committee.

6. Continued coordination of ecoclimatic regions of Canada.

11. Goals for 1985-86:

1. Transfer work in environmental assessment to project NOR-7-01.

2. Terminate study NOR-28-01.

3. Transfer Goal 6 to NOR-28-02.

12. Publications 1984-85:

Zoltai, S.C. 1983. Pingos on Bylot Island, N.W.T., Canada. Polarforschung 53:43-48.

Cody, W.J., G.W. Scotter, and S.C. Zoltai. 1984. Additions to the vascular flora of the Bathurst Inlet region, Northwest Territories. Can. Field-Nat. 98:171-177.

13. Resources 1985-86:

PYs: Prof.: Nil

Tech.: Nil

Term/Student: Nil

Total: Nil

O & M: Nil

Capital: Nil

14. Signatures:

Investigator

Program Director

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 24, 1985

1. Project: Wetlands, Climate, and ENFOR

2. Title: Peatland development and ecology

3. New: Cont.: X 4. No.: NOR-28-02 (NOR-28-189)

5. Study Leader: S.C. Zoltai and J.D. Johnson

6. Key Words: Peatland, soils, chemistry, peat, vegetation, succession

7. Location of Work: Western and Northern Region

8. Study Objectives:

   1. Determine the ecology of peatland development within the region and develop guidelines for peatland management and rehabilitation.

9. Goals for 1984-85:

   1. Prepare progress report on field work in southeastern Manitoba. (Zoltai and Johnson)

   2. Conduct field work by examining and sampling in detail the vegetation, peat deposits, and surface water in at least 40 different peatlands in north-central Saskatchewan. (Zoltai and Johnson)

   3. Identify and curate collected plant samples. (Johnson)

   4. Identify plant remains in collected peat samples. (Zoltai)

   5. Determine the chemical properties of peat samples collected in 1983. (Zoltai)

   6. Obtain radiocarbon dates for 16 peat samples from southeastern Manitoba. (Zoltai)

   7. Conclude the preparation of three chapters for the book "Wetlands of Canada". (Zoltai)

   8. Prepare progress report on field work performed in the peatlands of central Saskatchewan. (Zoltai and Johnson)

9. Prepare and submit journal paper, entitled "Development of a wooded island in a fen". (Zoltai and Johnson)

Added Goal:

10. Present a paper on "Peatlands and marshes in the wetland regions of Canada" at the 1984 meeting of the Entomological Society of Canada, and prepare it for publication.

10. Accomplishments in 1984-85:

1. Brief progress report on field work in southeastern Manitoba was prepared.

2. Field work was conducted in north-central Saskatchewan by examining and sampling 76 different wetlands.

3. A total of 330 species of vascular plants, 107 species of mosses, 20 species of liverworts, and 80 species of lichens were collected, identified, and curated from the wetlands of central Saskatchewan.

4. Plant remains in 1612 peat samples have been identified to a genus level.

5. The chemical properties of 1397 samples collected in 1983 in southeastern Manitoba were determined.

6. Radiocarbon ages of 16 samples from southeastern Manitoba have been determined.

7. Three chapters for the book "Wetlands in Canada" are in advanced stages of preparation.

8. Brief progress report on the field work in north-central Saskatchewan was prepared.

9. A paper, entitled "Development of a tree bog island in a fen" has been submitted to the Canadian Journal of Botany.

10. Presented a paper "Peatlands and marshes in the wetland regions of Canada" at the Entomological Society of Canada meeting, and submitted it for review.

11. Goals for 1985-86:

1. Complete the determination of the chemical properties of samples collected in 1984-85 in north-central Saskatchewan. (Zoltai)

2. Initiate a manuscript on "The development and ecology of peatlands in the western region". (Zoltai and Johnson)

3. Determine the radiocarbon date of 15 peat samples from central Saskatchewan. (Zoltai)

4. Initiate a manuscript on the "Management of peatlands and peat resources. (Zoltai)

5. Prepare manuscript on the bryophytes new to Manitoba and Saskatchewan, collected in 1982, 83, and 84. (Johnson)

6. Finalize report and map on "Ecoclimatic regions of Canada". (Zoltai)

7. Finalize three chapters for the book "Wetlands of Canada" for publication. (Zoltai)

8. Submit paper "Earth hummocks and thufur" for publication. (Zoltai)

12. Publications 1984-85:

Zoltai, S.C. and J.D. Johnson. 1985. Development of a treed bog island in a minerotrophic fen. Can. J. Bot. (in press)

13. Resources 1985-86:

PYs:	Prof.:	Zoltai	0.9
		Johnson	0.7
	Tech.:	Ali	1.0
	Term/Student:		0.3
	Total:		2.9

O & M: $5,000

Capital: Nil

14. Signatures:

S.C. Zoltai
Investigator

Program Director

J.D. Johnson
Investigator

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 24, 1985

1. Project: Wetlands, Climate, and ENFOR

2. Title: Increasing wood production through forest land drainage

3. New: X Cont.: 4. No.: NOR-28-03

5. Study Leader: G.R. Hillman and J.D. Johnson

6. Key Words: Wetlands, peatlands, regeneration, forest growth, *Larix laricina*, *Picea mariana*, ditches, groundwater, soil water, hydrology, hydrodynamics, site preparation

7. Location of Work: Boreal forest in Alberta, Saskatchewan, and Manitoba

8. Problem:

As world demand for wood increases, so does the need for more intensive forest management. It is possible that forest land presently classed as non-productive can be economically treated to increase productivity of existing stagnant forest stands, to enhance forest regeneration and to produce new forests. Draining wetlands is one way of achieving this.

Extensive wetlands exist in the boreal forest, but few forest land drainage projects have been established in the prairie provinces portion of the forest. Consequently, little is known about the effects of such drainage on forest growth and regeneration, on water quality, on the water balance of the area, on the hydrology of adjacent, undrained areas, on soil properties, and on plant communities, in the region. However, indications are that for many wetlands drainage will enhance radial and height growth of trees sufficiently to upgrade sites from the non-productive to the productive category. Wood productivity on wet productive sites can also be enhanced through drainage.

Although considerable research has been done on drainage system design and impact in Finland, it is difficult to extrapolate Finnish results to the boreal forest in the prairie provinces because of differences in climate and other factors. The Soviet Union, too, has considerable experience in this field, and wetland conditions there are generally similar to those in Canada. However, little of the Russian material has been translated into English.

The design and evaluation of artificial drainage systems should be based on knowledge of the hydrology and hydrodynamics of the wetlands area being drained, as well as on the silvical requirements of the stands that will be affected. This information will be essential to provincial forestry services embarking on extensive drainage programs in the future. Usually, provincial forestry services are not equipped to obtain these types of data, possessing neither the scientific equipment and facilities, nor the expertise to do so. Furthermore, the amount of time their field staff can devote to non-operational tasks, such as hydrologic data gathering and analyses is limited.

The Canadian Forestry Service can play an important role in bridging knowledge gaps by collecting and analyzing soils, hydrologic and hydrodynamic data pertaining to wetlands areas in the boreal forest; by evaluating the effectiveness of existing artificial drainage systems; by assisting in the development and evaluation of new methods of draining forest soils; and by assessing the impact of drainage on the vegetation, hydrology and soils of drained wetland areas.

Benefits from this type of research include: increased wood production; increased knowledge of the hydrology and hydrodynamics of wetland areas; improved design criteria for artificial drainage systems; reduction in amount of land surface area required for artificial drainage; improved access for other forestry operations; and increased knowledge of the impact of drainage on forest growth and the environment.

The purpose of this study is to provide a body of knowledge that can be used as a basis for increasing, through drainage, wood production on poorly drained lands in the boreal forest, Western and Northern Region. Six drainage projects have been established in Alberta forests whereas there appears to be none in Saskatchewan or Manitoba forests. The initial thrust of this study will therefore be concentrated in Alberta.

The study consists of two parts. The first part involves working closely with the Alberta Forest Service in:

1) evaluating the effectiveness of existing ditch systems in Alberta forests by monitoring groundwater levels using shallow wells, and monitoring soil water content above the groundwater zone, as a function of distance from the ditches;

2) measuring soil parameters important in tree growth (soil water, temperature and fertility) over time near existing ditch systems and on undisturbed sites, carrying out analyses, and making appropriate comparisons;

3) surveying and sampling forested wetland areas to determine which sites have the greatest potential to benefit from drainage.

Information obtained from vegetation, hydrologic and soil studies will provide a basis for recommending suitable ditch depths, configurations, spacings and densities.

These studies will be conducted on areas where drainage has already been implemented. The Alberta Forest Service established one drainage project in the Athabasca Forest in 1975, one in the Slave Lake Forest (in conjunction with the University of Alberta) in 1981, and three in the Peace River Forest in 1983-84. The Saulteaux River study in the Slave Lake Forest is the most scientifically advanced of these drainage projects. Other drainage studies were set in place in the Slave Lake Forest by the Canadian Forestry Service in 1970, and in the Grande Prairie Forest by the University of Alberta in 1973.

The second part of the study is concerned with on-site changes that occur following drainage. It entails the establishment of a 2 km^2 study area in the boreal forest region of Alberta. Half of the area is designated as "control", and the other as "treated". Sample plots to measure forest growth and ground vegetation composition are then located within each half. Soil and hydrological instrumentation networks are installed in each half to statistically measure variations in soil and hydrological variables over time.

Data are collected from these networks for a period of 11 years. During the first 5 years, the pre-drainage or undisturbed condition is documented. In year 6, an artificial drainage system is constructed on the "treated" half of the study area. The remaining 5 years represent the "post-drainage" phase of the study--when the difference in results between "control" and "treated" before and after treatment is a measure of the impact of drainage on soils, hydrology and tree growth.

The relatively long pre-drainage measuring period for this study is one feature which distinguishes it from other, similar projects in Alberta.

To bring this study to a successful conclusion it will be necessary to secure the cooperation of the Alberta Forest Service at both the planning and execution stages. Advice and assistance from other agencies such as Alberta Fish and Wildlife, Environment Canada (Atmospheric Environment Service and Inland Waters Directorate) and the University of Alberta may also be requested as the study develops.

9. Study Objectives:

   1. To obtain basic information for drainage design purposes by conducting studies on the hydraulic, thermal, nutrient, and other properties of forest wetland soils.

   2. To design and construct artificial drainage systems, and to evaluate the efficiency of these and existing ditch systems.

   3. To determine the effects of drainage on forest productivity, ground vegetation, and the water/soil environment.

10. Goals for 1984-85:

   1. To advance study leader's knowledge of different types of wetlands (bog, fen, etc.), related landforms, peat profiles and associated vegetation in the boreal forest through field trips and a literature review.

2. Visit sites of existing drainage projects and to discuss wetlands drainage research requirements with field foresters and other provincial officials.

3. Obtain and compile information pertaining to drainage, forest regeneration and tree growth in the boreal forest, prairie provinces.

4. Prepare information report on the state-of-the-art of forest land drainage in the prairie provinces.

5. Submit for publication journal article on the effects of Streeter Basin treatment on soil water (transferred from study NOR-13-02 and carried over from 1983-84).

6. Submit for publication journal article on simulation of the effects of forest cover removal on subsurface flow (transferred from study NOR-13-02 and carried over from 1983-84).

11. Accomplishments in 1984-85:

1. During June 5-19, 1984 the study leader accompanied the wetlands ecology group (CFS) to Saskatchewan and assisted in the identification, description and measurement of wetland features such as type and depth of peat, vegetation, and the pH of peat and water.

2. Four drained sites in Alberta were visited, two in the Peace River Forest, one in the Athabasca Forest, and one in the Slave Lake Forest. Ditching operations, involving different kinds of equipment, were observed on the two Peace River sites. From discussions with provincial field foresters it appears that the best opportunities for immediate wetlands drainage research lie within the Peace River and Athabasca Forests where drainage projects are established and where new drainage projects are likely to be implemented in the near future.

3. Reports, pictures and maps for five forest wetlands drainage projects in Alberta were obtained.

4. No progress was made in preparing the drainage information report.

5. The article was revised, submitted for review and withdrawn. The material is to appear in an Information Report on the Streeter Basin project (NOR-13-01, Goals 1985-86, 1d).

6. The paper was reviewed by external reviewers and is being revised.

12. Goals for 1985-86:

1. On Manning, Kimiwan, and McLennan drainage projects, Peace River Forest: establish transects and tree growth sample plots; and install instrumentation to measure meteorological variables, groundwater levels and soil temperatures.

2. Collect and compile data from instrument network set up under goal 1.

3. On each transect, conduct ground vegetation surveys and measure height and radial growth of trees. (Johnson)

4. Collect and analyze soil and water samples from each transect to determine bulk density, water content, and fertility of soils. (Johnson)

5. Prepare and submit for review Information Report on the state-of-the-art of forest drainage in the prairie provinces.

6. Submit for publication journal article on simulation of the effects of forest cover removal on subsurface flow (carried over from 1984-85).

7. Prepare poster display and working exhibit for "Open House - 1985". (Robson)

13. Publications 1984-85:

Nil - new study

14. Resources 1985-86:

PYs:	Prof.:	Hillman	1.0
		Johnson	0.3
	Tech.:	Robson	1.0
	Term/Student:		0.6
	Total:		2.9

O & M: $21,000

Capital: $16,000

15. Signatures:

Investigator

Program Director

Investigator

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 25, 1985

1. Project: Wetlands, Climate, and ENFOR

2. Title: Impact of climatic variation on boreal forest biomass production

3. New: Cont.: X 4. No.: NOR-28-04 (NOR-31-179)

5. Study Leader: T. Singh, vice Powell

6. Key Words: Climatology, climatic change, climatic variation, forest biomass, proxy data, dendrochronology, tree-rings, paleobotany, pollen analysis, X-ray densitometry, isotopic measurements, historical records, forest growth, Boreal Forest Region (B)

7. Location of Work: Edmonton laboratory, prairie provinces, N.W.T.

8. Study Objectives:

   1. Assess impact of climate on forest vegetation and soils, especially those associated with forest clearcut areas.

   2. Determine extent and degree of past short- and long-term climatic fluctuations and interrelationships between key parameters and measures of forest biomass productivity in selected regions of the boreal forest.

   3. Provide climatic advice and represent CFS and NoFRC on advisory committees and other groups, including those associated with the Canadian Climate Program.

9. Goals for 1984-85:

   1. Publish paper on "Climatic variation in the boreal forest zone of the prairies and NWT". (Carried over from 1983-84). (Singh, Powell)

   2. Prepare and submit for review a report on the growing season climate of four clearcut areas associated with a seedling growth study (NOR-4-01). (Carried over from 1983-84). (Powell, Singh)

   3. Prepare a report to summarize the temperature climate of clearcut forested areas in the Hinton region. (Powell, Singh)

4. Continue to provide climatic and statistical advice and information to colleagues. Represent CFS and NoFRC on various advisory committees or working groups. (Powell, Singh)

5. Serve as chairman of the Canadian Committee on Climate Fluctuations and Man and the CCP Task Force on Proxy Data, including organizing a workshop and developing an action plan on proxy data for the CPB; and member of other CCP committees. (Powell)

6. Act as Scientific Authority for a PRUF contract for X-ray densitometric analysis of Douglas-fir tree rings for Banff (Powell). Act as scientific authorities for other contracts as required (Powell, Singh).

7. Undertake analysis of short-term climatic data for 150 stations in the central Canadian boreal forest zone. (Singh, Powell)

8. In cooperation with Forintek, prepare a short contribution on the use of black spruce in dendrochronology. (Carried over from 1983-84.) (Powell)

9. Assist Forintek in preparing a paper on tree-ring analysis and biomass estimates based on samples collected under P-149 and in 1983 under a Forintek Core funded program in Alberta. (Carried over from 1983-84.) (Powell, Singh)

10. Continue statistical analysis to better establish climate-growth relationships in the north-south tree-ring transect data and possibly initiate preparation of a report. (Singh)

11. Initiate analysis of soil temperatures after clearcutting. (Powell, Singh)

12. Initiate analysis of information on paired climate stations (open and in forest). (Powell, Singh)

10. Accomplishments in 1984-85:

1. Paper on "Climatic variation in the boreal forest region of western Canada" was revised and some further revisions are suggested by reviewers. (Singh, Powell)

2. Some further analysis was carried out for preparing the report on the growing season climate of four clearcut areas associated with a seedling growth study (formerly NOR-4-01), but report was not prepared. (Powell, Singh)

3. Report not prepared summarizing the temperature climate of clearcut forested areas in the Hinton region. (Powell, Singh)

4. Information on climatic and statistical information and techniques was provided to colleagues and others are required. Represented the CFS on the Canada Department of Agriculture Expert Committtee on

Agrometeorology and presented a report while the 1953 report was published. The report of the subcommittee (of which I was a member) reviewing the recommendations of the Agriculture-Climate CCP 1979 Workshop was also published. Attended and provided a report for the Alberta Agrometeorology Advisory Committee. Chaired the two day meeting of the CFS/AES Working Group meeting on Forest Meteorology and Atmospheric Sciences section of the 1984 volume of the Canadian Geophysical Bulletin, while the 1983 report was published. The annual report on the Centre's activities and publications of interest to geographers was submitted for the Canadian Association of Geographers Directory 1984, while the 1983 report was published. Represented the NoFRC at the Alberta Climatological Association meeting presenting a report, while the 1983 and 1984 reports were published in the proceedings. Served on the Technical Committee for the Climate Inventory Program of Alberta Energy and Natural Resources. Again served on the Western Research Program of Forintek Canada Corporation Subcommittee on "Characterization of Wood", attending two meetings to review and recommend on the research program of the Wood Science Dept. of Forintek. Served on the Biological Sciences Advisory Committee of NAIT, on the Alberta Fish and Wildlife Advisory Council, and on the council for the Rocky Mountain Section of the CIF. Attended the annual meeting of the Western Region Fire Weather Committee, and served on the Editorial Board for the climatological Bulletin. Provided a review for an NSERC proposal in forest meteorology. (Powell)

5. Represented the CFS at a "Climate in the North" workshop and presented a paper on Climate and Forestry in the North. Represented the CFS on the National Climate Advisory Committee and presented an annual report, also an update on the activities of the CCP Task Force on Climate Proxy Data of which I am chairman. Also chairman of the Canadian Committee on Climate Fluctuations and Man for whom I organized a one day workshop on Climate Proxy Data in January 1984, and a two day workshop in January 1985 which looked at climate proxy data for the period 1800 to 1860. (Powell)

6. Acted as Scientific Authority for a PRUF contract for "X-ray densitometric analysis of an old Douglas-fir stand from Banff, Alberta" based on tree rings from trees over 600 years old. Also served as Scientific Authority for an ENFOR-related contract for "Dendroclimatic reconstructions based on tree-rings from Duck Mountain, Manitoba". Contract reports are available for both studies. In addition funds were provided to support a UP contract with Forintek for a "Dendroclimatological analysis of white spruce from five tree-ring sites in the Yukon Territory" which was completed in November for the Snow and Ice Division, National Hydrology Research Institute. A report from earlier partially supported work was published by Forintek and others on living 700-year-old trees in the Canadian Rockies. (Powell)

7. Preliminary analysis of short-term climatic data for 150 stations in the central Canadian boreal forest zone was undertaken. (Singh)

8. No progress.

9. A report was prepared by Forintek for the CFS entitled "Biomass productivity of white spruce in Alberta and Manitoba", which will form the basis for a journal paper. (Powell)

10. Some contact was had with Forintek to gain a knowledge of their methods of establishing climate-growth relationships, but it appears to be undesirable that we should initiate our own work in this area at this time. (Singh)

11. A start was made to input soil temperatures from various clearcuts onto the computer preparatory to further analysis. (Powell, Singh)

12. The information of paired climate station (open and in forest) data is being assembled. (Powell, Singh)

11. Goals for 1985-86:

1. Publish paper on "Climatic variation in the boreal forest region of western Canada". (Singh, Powell)

2. Prepare and submit for review a report on the growing season climate of four clearcut areas associated with a seedling growth study (NOR-4-01). (Powell, Singh, vice Powell)

3. Continue analysis of short-term climatic data for 120 stations in the central Canadian boreal forest zone. (Singh, vice Powell)

4. Assist Forintek in preparing a paper on the use of black spruce in dendroclimatology. (Singh)

5. Assist Forintek in preparing a paper on tree-ring analysis and biomass productivity. (Singh)

6. Analyze and initiate a report on soil temperatures after clearcutting. (Singh, vice Powell)

7. Analyze and initiate a report on paired climate stations. (Singh, vice Powell)

8. Prepare summary report on the climate of clearcut forested areas in the Hinton region. (Singh, vice Powell)

9. As required provide climatic and statistical advice and information to colleagues and others, and represent CFS and NoFRC on various advisory committees. (Singh)

12. Publications 1984-85:

Jozsa, L.A., E. Oguss, P.A. Bramhall, and S.G. Johnson. 1984. Dendroclimatic reconstructions based on tree-rings from Duck Mountain, Manitoba. Forintek Canada Corp., Vancouver, B.C. Contract No. 80-68-619. 28 pp. (May)

Jozsa, L.A., S.G. Johnson, and P.A. Bramhall. 1984. X-ray densitometric analysis of an old Douglas-fir stand from Banff, Alberta. Forintek Canada Crop., Vancouver, B.C. Contract No. 80-82-604. 47 pp. (May)

Jozsa, L.A., P.A. Bramhall, and S.G. Johnson. 1984. Biomass productivity of white spruce in Alberta and Manitoba. Forintek Canada Corp., Vancouver, B.C. Contract No. 80-56-011, CFS Contract No. 27. 27 pp. (August)

Jozsa, L.A., E. Oguss, P.A. Bramhall, and S.G. Johnson. 1984. Dendroclimatological analysis of white spruce from five tree-ring sites in the Yukon Territory. Forintek Canada Corp., Vacouver, B.C. Contract No. 80-68-618. 43 pp. (November)

Luckman, B.H., L.A. Jozsa, and P.J. Murphy. 1984. Living seven-hundred-year-old Picea engelmannii and Pinus albicaulis in the Canadian Rockies. Arctic and Alpine Res. 14:419-422.

[Powell, J.M.] 1983. Canadian Forestry Service. Pages 100-101 in Canadian Geophysical Bulletin, Vol. 36. Energy, Mines and Resources Canada, Earth Physics Branch, Ottawa. 191 pp.

Powell, J.M. 1983. Canadian Forestry Service. Page 11, Appendix 4. Report of the 25th Annual Meeting of the Expert Committee in Agrometeorology. November 17-18, 1983. Agric. Can., Ottawa. 23 pp. + Appendices.

[Powell, J.M.] 1983. Canada/Environment Canada, Canadian Forestry Service, Northern Forest Research Centre. Pages 160-164 in Barr, B.M. (compiler and editor). The Canadian Association of Geographers Directory 1983. 230 pp.

Powell, J.M. 1983. Northern Forest Research Centre. Pages 91-93 in Gietz, C. (ed.) Current climatological activity in Alberta. Proc. 7th Ann. Workshop Alta. Climatological Assoc. February 1983. Alta. Agriculture. 106 pp. (November)

[Powell, J.M.] 1984. Project of the Month: Climate and Forests. Pages 1-2. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Forestry Newsletter, April.

Powell, J.M. 1984. Climate and forestry in the north. Pages 13-15 in Yarranton Holdings Ltd. (compiler). Proceedings of the Meeting on Northern Climate. Whitehorse 11-12, 1984. Govt. Can., Canadian Climate Program. 49 pp.

Powell, J.M. 1984. Northern Forest Research Centre. Pages 120-122 in Dupuis, S. (compiler) Current climatological activity in Alberta. Proceedings of the 85h Annual Workshop Alberta Climatological Association February 1984. Alta. Energy Nat. Resources, Res. Eval. Plan. Div. 147 pp. (October)

Powell, J.M. and D.W. Phillips. 1983. History and development of the Canadian Climate Program. The Operational Geographer No. 2, 1983:31-34.

Singh, T. and Y.P. Kalra. 1984. Predicting solute yields in the natural waters of a sub-alpine system in Alberta. Arctic Alpine Res. 16:217-221.

Soper, J.H. and J.M. Powell. 1985. Botanical studies in the Lake Hazen Region, Northern Ellesmere Island, Northwest Territories, Canada. Nat. Mus. Can., Nat. Mus. Natural Sci., Publ. in Natural Sciences, No. 5. vi + 67 pp.

13. Resources 1985-86:

PYs:	Prof.:	Vice Powell	1.0
		Singh	0.3
	Tech.:	Schultz	1.0
	Term/Student:		0.5
	Total:		2.8

O & M: $4,000

Capital: Nil

14. Signatures:

T Singh
Investigator

Program Director

Investigator

Regional Director

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CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 24, 1985

1. Project: Wetlands, Climate, and ENFOR

2. Title: Development of integrated biomass prediction equations for Western & Northern Region

3. New: Cont.: X 4. No.: NOR-28-05 (NOR-34-183)

5. Study Leader: T. Singh

6. Key Words: Biomass, regional and national forest statistics, energy, inventory, simulation, prairies region, prediction equations, mathematical models

7. Location of Work: Western and Northern Region

8. Study Objectives:

   1. To synthesize the available biomass data for the regionally important tree species for predicting biomass.

   2. To develop and test regional biomass equations, for their accuracy and bias, in a pilot-scale demonstration for converting a conventional forest inventory to a biomass inventory.

9. Goals for 1984-85:

   1. Publish journal paper on the ovendry wood density of ten prairie tree species. (Carried over from 1983-84).

   2. Publish Information Report on the biomass prediction equations of the major tree species of N.W.T. (Carried over from 1983-84).

   3. Publish FMN on the weight tables for the major tree species of NWT. (Carried over from 1983-84).

   4. Complete and publish journal paper on the wood density of the major tree species of N.W.T.

   5. Present paper on the energy potential of aspen and other hardwoods in the prairie provinces accepted for ENERGEX an International Energy Conference in Regina in May 1984.

6. Publish FMN on conversion of biomass volume to biomass weight. (Carried over from 1983-84).

7. Prepare and complete review for the Information Report on comparative predictability of biomass equations derived from the prairies and N.W.T. field data. (Carried over from 1983-84).

8. Analyze field data and prepare a note on fine fuel weights of three coniferous tree species of N.W.T.

9. Prepare for review a report on wood density of tree species in the non-inventoried areas of Manitoba (extension from ENFOR P-255).

10. Complete analysis of specific gravity samples of tree species collected form non-inventoried areas of Saskatchewan, Alberta, and N.W.T., and consider incorporating with Manitoba data (goal 9) for reporting.

11. Prepare note on "wood and energy".

Added Goal:

12. Prepare a poster paper on the energy potential of major coniferous tree species of the prairie provinces.

10. Accomplishments in 1984-85:

1. A paper on the variation in the ovendry wood density of ten prairie tree species was finalized and published in the Forestry Chronicle.

2. An Information Report on the biomass equations for six major tree species of the Northwest Territories was completed and published.

3. A Forest Management Note on the weight tables for important tree species in the Northwest Territories was completed and published.

4. A paper entitled "Variation in the basic and ovendry wood densities of six major tree species in the Northwest Territories" has been prepared, reviewed, and is being submitted to the Canadian Journal of Forest Research.

5. A paper on the energy potential of aspen and other hardwoods in the prairie provinces of Canada was presented at the Global Energy Forum, University of Regina, Saskatchewan, during May 1984. The paper was published in the proceedings of ENERGEX '84.

6. A Forest Mangement Note on conversion of tree volume to biomass in the prairie provinces was completed and published.

7. Literature review and search for a suitable statistical package were undertaken to comply with the review requirements; the manuscript is in the review process at present.

8. Derivative-free nonlinear models were run on the BMDP statistical package for the biomass of large and small green branches, dead branches, and the bark and wood components, for jack pine, black spruce, and white spruce. Although excellent fit was possible on an entire tree basis, the fine biomass equations require further improvement by using more appropriate nonlinear modelling software when available. The equations obtained so far have been summarized in tables for the three species with all the required statistical parameters. (ENFOR P-169)

9. A report on the wood densities in the non-inventoried boreal forest of western Canada was prepared and has received the first review.

10. No further extension of the laboratory analysis of the samples from the non-inventoried areas of the prairie provinces was contracted to the University of Alberta.

11. Data on the heat of combustion values of ten tree species has been collected to provide the basis for a paper on the energy from major tree species of Manitoba.

12. A paper on the energy potential of coniferous tree species of the prairie provinces was published in the proceedings of the Bioenergy R & D Seminar.

11. Goals for 1985-86:

1. Publish journal paper on variation in the wood densities of major tree species of the Northwest Territories.

2. Complete statistical analyses and finalize Information Report on comparative predictability of biomass equations derived form the prairies and N.W.T. data.

3. Complete analysis of the fine biomass data of the coniferous tree species of N.W.T. and prepare a note incorporating the derived equations.

4. Finalize the review on the note on wood densities of tree species from the non-inventoried areas of the prairie provinces.

5. Analyze the heat of combustion data on the tree species of Manitoba and prepare a paper on wood for energy.

6. Undertake review of the contractor's report for publishing the compiled information on biomass and energy potential of Manitoba.

12. Publications 1984-85:

Micko, M.M., B.S. Bains, and E.I.C. Wang. 1984. Wood density of prairie provinces and N.W.T.; data acquisition. Contract Report OISG KH 505-3-0035. 49 p.

Micko, M.M., E.I.C. Wang, and B.S. Bains. 1984. Wood densities of prairie provinces and N.W.T.; statistical analyses. Contract Report OISG KH 505-3-0035.

Singh, T. 1984. Variation in the ovendry wood density of ten prairie tree species. For. Chron. 60(4):217-221.

Singh, T. 1984. Conversion of tree volume to biomass in the prairie provinces. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. For. Manage. Note 28.

Singh, T. 1984. Energy potential of coniferous tree species in the prairie provinces of Canada. 5th Canadian R & D Seminar. Elsevier Applied Science Publishers, London. p. 85-88.

Singh, T. 1984. A model for nutrient cycling in forestry. National Woodlands 7(5):19.

Singh, T. and M.M. Micko. 1984. Energy potential of aspen and other hardwoods in the prairie provinces of Canada. Energy developments: New forms, renewables, conservation. Pergamon Press, Oxford. p. 215-218.

13. Resources 1985-86:

PYs: Prof.: Singh 0.6

Tech.: Nil

Term/Student: Nil

Total: 0.6

O & M: Nil)
) Funds to be provided from HQ ENFOR budget
Capital: Nil)

14. Signatures:

T Singh
Investigator

Program Director

C. D. Hunt
Regional Director

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CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 24, 1985

1. Project: Wetlands, Climate, and ENFOR

2. Title: An assessment of the energy potential of forest biomass in the prairie provinces and the Northwest Territories

3. New: Cont.: X 4. No.: NOR-28-06 (NOR-34-180)

5. Study Leader: J.M. Powell

6. Key Words: Biomass, energy, fuels, climate, productivity, availability, harvesting, simulation models, resource data, impacts

7. Location of Work: Western and Northern Region

8. Study Objectives:

   1. To develop and test biomass prediction equations for regional tree species and lesser vegetation and demonstrate their integration with resource inventory programs.

   2. To investigate the impact of biomass removal on site quality, nutrient status, silvicultural option and long-term site productivity on selected sites in the prairie provinces.

   3. To determine production and delivery costs of biomass under various operation conditions and to provide a basis for evaluating the feasibility of using various forms of biomass for energy.

   4. To develop and operate a computerized biomass data bank and information retrieval system to provide for more effective use of information and technology transfer.

9. Goals for 1984-85:

   1. Publish Information Report "Impact of climatic variation on boreal forest biomass through the use of tree ring analysis" (P-149) (Scientific Authority: J. Powell). (Carried over from 1983-84.)

   2. Complete review, edit, and publish summary report on "Analysis of integrated utilization of aspen for wood and energy" (P-207) (Scientific Authority: W. Ondro). (Carried over from 1983-84.)

3. Review contract report on "Determination of nutrient and biomass status of aspen ecosystems in north-central Alberta" and prepare for publishing (P-205) (Scientific Authorities: L. Brace, I. Edwards). (See also NOR-12-06.)

4. Provide advice as required for the completion of the second phase of national project (P-273) to determine quantitative areas of non-inventoried forest land, by stratum, for the prairie provinces (Scientific Authority: W. Moore).

5. Complete and publish Information Report on computer mapping system for biomass using four regional maps as examples (Scientific Authority: W. Moore) (extension of P-148, see also NOR-22-06). (Carried over from 1983-84.)

6. Prepare and submit for review a report on "Fuel loadings in central Alberta forest covertypes" (P-23) (Scientific Authority: T. Singh). (Carried over from 1983-84.)

7. Prepare, review, edit, and publish Information Report if warranted, on "A stand growth model for trembling aspen in the prairie provinces" (P-102) (Scientific Authority: I. Bella). (Carried over from 1983-84.)

8. Continue coordination of NoFRC ENFOR projects ensuring their completion and publication; act as establishment representative on national committees; and assist FSSB in completing biomass inventory information as required. Attend Bioenergy Seminars, FORCYTE short courses, and submit reports to Bioenergy Council, NRC Bioenergy Program, etc., as required (J. Powell; also L. Brace, I. Edwards, T. Singh, and S. Malhotra).

Added Goals:

9. Undertake a contract to "Determine the biomass and energy potential of the main tree species in Manitoba" (P-315) (Scientific Authority: T. Singh).

10. Undertake a contract for "Forested land area statistics update for non-inventoried portions of parklands and prepare strata for prairie provinces using Landsat imagery" (P-316) (Scientific Authority: W. Moore).

11. Undertake a contract for "Chemical analysis of plant and soil samples from selected forestry plots" (P-323) (Scientific Authority: I. Edwards).

12. Initiate a contract for "Adaptation of FORCYTE for Alberta aspen stands" (P-314) (Scientific Authority: I. Edwards).

13. Initiate a contract on "Winter harvesting of aspen for integrated utilization--case study report (P-324) (Scientific Authority: D. Boylen).

14. Initiate an ENFOR-related contract for "Dendroclimatic reconstructions based on tree rings from Duck Mountain, Manitoba", an extension of work carried out under P-149 (Scientific Authority: J. Powell).

10. Accomplishments in 1984-85:

1. The Information Report "How climate affects tree growth in the boreal forest" (P-149) was published, NOR-X-255, (Scientific Authority: J. Powell). Abstract published in ENFOR Review, Vol. 5, No. 1, p. 17.

2. The summary report on "Analysis of integrated utilization of aspen for wood and energy" was completed as a service contract by Woodland Resource Service, the original contractor for the work. Report is being edited for publication (P-207) (Scientific Authority: W. Ondro).

3. The report on "Determination of nutrient and biomass status of aspen ecosystems in north-central Alberta" (P-205) was not completed as originally required under the contract as the contractor was unable to comply. A literature review was supplied along with copies of the original data which have been put on the NoFRC computer. Some further plant and soil sample analysis has been undertaken (see goal 11 below), while a contract to complete the original goals for the study and to initiate the next stage in the work is about to be initiated (see goal 12 below). An abstract was published in the Proceedings of the 5th Canadian Bioenergy R & D Seminar.

4. Work for P-273 was completed and the reports supplied to FSSB, including an expansion of the original goal (Scientific Authority: W. Moore).

5. An Information Report by W. Moore and W. Chow on the use of a geographic information system for converting forest inventories to biomass inventories using four regional maps as examples was completed and a revised draft is under review by provincial representatives and others (Scientific Authority: W. Moore) (extension on P-148, see also NOR-04-06).

6. A report on "Downed-dead fuels in central Alberta forest covertypes" was prepared and is under editorial review (P-23) (Scientific Authority: T. Singh).

7. A manuscript was prepared by the original contractors on "A stand growth model for trembling aspen in the prairie provinces" but a decision was made that it didn't warrant further consideration for publishing as an Information Report (P-102) (Scientific Authority: I. Bella).

8. Attended two meetings of the national technical committee on behalf of the Centre and coordinated the program throughout the year. Edwards, Powell, and Singh attended the 5th Canadian Bioenergy R & D Seminar, while several attended the FORCYTE course in Vancouver and Edwards also visited PNFI for discussions on FORCYTE-related studies. Brief reports were provided by Singh and Powell for the US-based Bioenergy

Council for publication in their Directory. A Forestry Report on "Growth, Yield, and ENFOR" (No. 29) was published during the year and sent to the Swedish Forest Energy Secretariat who subsequently published four of the articles under a Canada heading in Forest Energy Newsletter No. 2, 1984 (J. Powell, also L. Brace, I. Edwards, T. Singh).

9. The contract to "Determine the biomass and energy potential of the main tree species in Manitoba" (P-315) is nearing completion (Scientific Authority: T. Singh).

10. The contract for a "Forested land area statistics update for non-inventoried portions of parklands and prairie strata for prairie provinces, using Landsat imagery" (P-316) was completed and the reports provided to FSSB. A FMN on "PROCOM-2 mapping technique for forest depletion monitoring", using P-316 as an example, is ready for review (Scientific Authority: W. Moore).

11. The contract for "Chemical analysis of plant and soil samples from selected forestry plots" (P-323) is nearing completion and will complete the analysis of all samples obtained under P-205. These will now be used in the P-314 study and subsequently for phase II of the study (Scientific Authority: I. Edwards).

12. A contract for the first phase of "Adaptation of FORCYTE for Alberta aspen stands" (P-314) is being contracted for completion by March 31, 1985 (Scientific Authority: I. Edwards). During 1984 the study plots for phase II of the study were prepared through the assistance of Environment 2000 employees. These consist of 18 plots in three age classes, located south of Kinuso (12) or north of Calling Lake (6). In each age class there are 2 control, 2 conventional harvest, and 2 whole-tree harvest plots.

13. A contract to prepare a brief report on "Winter harvesting of aspen for integrated utilization" based on one phase of P-207 has just been requested (P-324). This will complete all reporting from P-207 (Scientific Authorities: J. Powell, D. Boylen).

14. A report on "Dendroclimatic reconstructions based on tree-rings from Duck Mountain, Manitoba" was completed by Forintek Canada Corp. (Scientific Authority: J. Powell).

11. Goals for 1985-86:

1. Publish summary report on "Analysis of integrated utilization of aspen for wood and energy" (P-207) (Scientific Authority: W. Ondro).

2. Complete review and publish report on "Use of geographic information system for converting forest inventories to biomass inventories" (P-148 and extension) (Scientific Authorities: W. Moore and W. Chow).

3. Publish report on "Downed-dead fuels in central Alberta forest covertypes" (P-23) (Scientific Authority: T. Singh).

4. Oversee completion of contract to "Determine the biomass and energy potential of the main tree species in Manitoba" and prepare for publication (P-315) (Scientific Authority: T. Singh). Consider whether similar studies should be undertaken for Alberta and/or Saskatchewan.

5. Oversee completion of contract for "Chemical analysis of plant and soil samples obtained under P-205", (P-323), and provide them for contract under P-314 (Scientific Authority: I. Edwards).

6. Oversee completion of phase I of contract for "Adaptation of FORCYTE for Alberta aspen stands" (P-314). Initiate phase II of the study including overseeing of field instrumentation on established plots (Scientific Authority: I. Edwards).

7. Publish the summary report on "Winter harvesting of aspen for integrated utilization--a case study" to complete reporting under P-207, (P-324) (Scientific Authority: D. Boylen).

8. Continue coordination of NoFRC ENFOR projects ensuring their completion and publication; act as establishment representative on national committees. Attend Bioenergy Seminars, FORCYTE courses, and submit reports on the program as required (J. Powell; also I. Edwards, T. Singh, M. Apps).

12. Publications 1984-85:

Edwards, I. 1984. Aspen as an energy source--problems ahead? Page 6 in J.K. Samoil and G.B. Turtle (eds.). Growth, Yield and ENFOR. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. For. Rep. 29. (Also published under the title "Aspen as an energy source" in Swedish Univ. Agric. Sci., Forest Energy Secretariat, Garpenberg. Forest Energy Newsletter No. 2, 1984. p. 13).

Jozsa, L.A., P.A. Bramhall, and S.G. Johnson. 1984. Biomass productivity of white spruce in Alberta and Manitoba. Forintek Can. Corp., Western Lab., Vancouver, B.C. Contract No. 80-56-011, CFS Contract No. 27. 27 p.

Jozsa, L.A., M.L. Parker, P.A. Bramhall, and S.G. Johnson. 1984. How climate affects tree growth in the boreal forest. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Inf. Rep. NOR-X-255.

Jozsa, L.A., E. Oguss, P.A. Bramhall, and S.G. Johnson. 1984. Dendroclimatic reconstructions based on tree rings from Duck Mountain, Manitoba. Forintek Can. Corp., Western Lab., Vancouver, B.C. Contract No. 80-68-619. 28 pp.

Moss, A. 1984. Report on determination of biomass and nutrient content in trees, ground vegetation, and soil of aspen stands in Alberta. (Abs.). In S. Hasnain (ed.) Fifth Canadian Bioenergy R & D Seminar. Elsevier Applied Science Publishers, London. p. 81.

Ondro, W. 1984. Harvesting aspen for energy may be economic. Page 8 in J.K. Samoil and G.B. Turtle (eds.). Growth, yield and ENFOR. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. For. Rep. 29. (Also published under the title "Aspen for energy" in Swedish Univ. Agric. Sci., Forest Energy Secretariat, Garpenberg. Forest Energy Newsletter No. 2, 1984. pp. 16-17).

Ondro, W. and I. Bella. 1984. Integrated utilization makes aspen an economic resource. Page 5 in J.K. Samoil and G.B. Turtle (eds.). Growth, yield and ENFOR. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. For. Rep. 29.

Powell, J.M. 1984. ENFOR studies at NoFRC. Page 6 in J.K. Samoil and G.B. Turtle (eds.). Growth, yield and ENFOR. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. For. Rep. No. 29. (Also published under the title "ENFOR studies at Northern Forest Research Centre, Edmonton, Alberta" in Swedish Univ. Agric. Sci., Garpenberg. Forest Energy Newsletter No. 2, 1984. p. 12).

Powell, J. and L. Jozsa. 1984. Determination of annual stem-wood biomass productivity. Page 7 in J.K. Samoil and G.B. Turtle (eds.). Growth, yield and ENFOR. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. For. Rep. 29.

13. Resources 1985-86:

PYs:	Prof.:	Edwards	0.2
		Singh	0.1
	Tech.:		Nil
	Term/Student:		Nil
	Total:		0.3

O & M:)
) From HQ ENFOR budget to support contract and in-house
Capital:) R & D/management

14. Signatures:

J.M. Powell
Investigator

Program Director

G.D. Hunt
Regional Director

NOR-33

TECHNOLOGY TRANSFER AND INFORMATION

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 29, 1985

1. Project: Technology transfer and information

2. Title: Scientific and technical editing and publishing

3. New: Cont.: X 4. No.: NOR-33-01 (NOR-33-146)

5. Study Leader: J.K. Samoil and G.B. Turtle

6. Key Words: Editing, publishing, printing, information reports, journal articles, scientists, resource managers, industrial managers

7. Location of Work: Region wide

8. Study Objectives:

To provide relevant and timely information to all of NoFRC's user clientele (scientific, technical, and public) at a reasonable cost using the complete range of communication techniques and information at our disposal.

9. Goals for 1984-85:

1. Assist the research staff, through the provision of editing and publishing services, in the preparation and publication of approximately

   a. 20 Information Reports

   b. 7-10 Forest Management Notes

   c. 3 Forestry Reports

   d. 2 Pest Leaflets, and

   e. 40 Journal Articles and miscellaneous publications. (J.S., G.T.)

2. Assist in the preparation of two special technical reports (possibly as Information Reports) on insects of the prairie provinces and Diseases of the prairie provinces. (J.S., G.T.)

3. Prepare and publish the Program Review 1983-84 of the Northern Forest Research Centre. (J.S., G.T.)

4. Prepare NoFRC post cards to be used as reprint request cards and general message cards. (J.S.)

5. Oversee the revision and reprinting of 22 pest leaflets. (J.S.)

6. Oversee printing and reprinting of locally published scientific and technical information. (J.S.)

7. Continue responsibility for the production and printing of the monthly NoFRC Forestry Newsletter. (J.S., G.T.)

8. Continue responsibility for the distribution of NoFRC publications, maintaining the mailing list, responding to requests for scientific and technical information, and carrying out the necessary correspondence. (J.S., G.T.)

9. Continue to respond to requests from the public for general information and specific publications. (J.S., G.T.)

10. Continue responsibility for display equipment. (J.S., G.T.)

Added Goals:

11. Oversee the reprinting of the NoFRC Ecotours. (J.S.)

12. Revise, redesign, and arrange printing of the NofRC publicity cube. (J.S., R.N.)

13. Design and arrange for the production of printed NoFRC seedling bags. (J.S.)

14. Arrange installation of and training on the AM Varityper phototypesetter. (J.S.)

15. Implement revised procedures involving the new AES word processing system and the phototypesetter for the production of publications. (J.S., G.T.)

10. Accomplishments in 1984-85:

1. Assisted the research staff, through the provision of editing and publishing services, in the preparation and publication of:

   a. 11 Information Reports (plus two reprintings)

   b. 2 Forest Management Notes

   c. 2 Forestry Reports

   d. 22 Pest Leaflets (revisions)

   e. 57 Journal Articles and miscellaneous publications.

2. Advice was provided regarding the two special technical reports on insects of the prairie provinces and diseases of the prairie provinces, the first being in the review stage and the second in the initial draft stage.

3. Prepared and published the Program Review 1983-84 of the Northern Forest Research Centre.

4. Prepared NoFRC post cards to be used as reprint request cards and general message cards.

5. Oversaw the revision and reprinting of 22 pest leaflets, 260,000 in total.

6. Wrote specifications for and monitored the printing and reprinting of locally produced scientific and technical publications. Rewrote the specifications for and implemented another standing offer agreement for printing.

7. The NoFRC Forestry Newsletter was prepared and printed monthly throughout the year.

8. Continued responsibility for the distribution of NoFRC publications, maintaining the mailing list, responding to requests for scientific and technical information, and carrying out the necessary correspondence.

9. Continued to respond to requests from the public for general information and specific publications.

10. Responsibility for display equipment was transferred to NOR-33-02.

Added Accomplishments:

11. Oversaw the reprinting of Ecotour publications: 40,000 English and 10,000 French of Calgary-Regina; 40,000 English and 10,000 French of Calgary-Golden; and 10,000 French of Regina-Winnipeg.

12. The NoFRC publicity cube was revised, and 500 copies were printed.

13. Arranged design and production of 100,000 printed seedling bags.

14. The AM Varityper phototypesetting equipment was installed the last week of March 1984, and Dawn Adams and Elaine Schiewe received a one-week-long in-house training course the first week of April.

15. New procedures were devised to handle the communications link between the word processor and the typesetter and to accommodate the need for paste-up of the typeset copy.

11. Goals for 1985-86:

1. Assist the research staff, through the provision of editing and publishing services, in the preparation and publication of approximately:

   a. 20 Information Reports

   b. 7-10 Forest Management Notes

c. 3 Forestry Reports

d. 2 Pest Leaflets, and

e. 40 Journal Articles and miscellaneous publications. (J.S., G.T.) (33-11)

2. Assist in the preparation of three special technical reports: insects of the prairie provinces by W.G.H. Ives, diseases of the prairie provinces by Y. Hiratsuka, and common forest plants of west-central Alberta by I. Corns. (J.S., G.T.) (33-11)

3. Prepare and publish the Program Review 1984-85 of the Northern Forest Research Centre. (J.S., G.T.) (33-12)

4. Oversee printing and reprinting of locally published scientific and technical information. (J.S.) (33-13)

5. Continue responsibility for the production and printing of the monthly NoFRC Forestry Newsletter. (J.S., G.T.) (33-14)

6. Continue responsibility for the distribution of NoFRC publications, maintaining the mailing list, responding to requests for scientific and technical information, and carrying out the necessary correspondence. (J.S., G.T.) (33-16)

7. Provide editorial, typographical, and printing assistance for public information activities, including the NofRC Open House. (J.S., G.T.) (33-11, 33-13)

8. Write and produce a brochure outlining the activities of the Northern Forest Research Centre and its District Offices. (J.S.) (33-15)

12. Publications 1984-85:

INFORMATION REPORTS

Addison, P.A.; Kennedy, K.A.; Maynard, D.G. 1984. Effects of sour gas processing on a forest ecosystem in west-central Alberta. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-265.

Drouin, J.A.; Wong, H.R. 1984. Birch leaf-mining sawflies in Alberta (Hymenoptera: Tenthredinidae). Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-260.

Hall, R.J. 1984. Use of large-scale aerial photographs in regeneration assessments. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-264.

Hiratsuka, Y.; Loman, A.A. 1984. Decay of aspen and balsam poplar in Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-262.

Johnstone, W.D. 1984. Influence of stand edge on planted white spruce and lodgepole pine. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-256.

Josza, L.A.; Parker, M.L.; Bramhall, P.A.; Johnson, S.G. 1984. How climate affects tree growth in the boreal forest. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-255.

Moody, B.H.; Cerezke, H.F. 1984. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba, and the Northwest Territories in 1983 and predictions for 1984. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-261.

Muldrew, J.A.; Ives, W.G.H. 1984. Dispersal of Olesicampe benefactor and Mesochorus dimidiatus in western Canada. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-258.

Ondro, W.J.; Williamson, T.B. 1984. The forest industry in the economy of Manitoba, 1979-80. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-263.

Singh, T. 1984. Biomass equations for six major tree species of the Northwest Territories. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-257.

Walker, N.R.; Sims, H.P. 1984. Jack pine seed dispersal from slash and seedling performance on prepared seedbeds. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-259.

JOURNAL/SYMPOSIA ARTICLES

Addison, P.A. 1984. Quantification of branch dwelling lichens for the detection of air pollution impact. Lichenologist (Oxf.) 16(3):297-304.

Addison, P.A.; Bliss, L.C. 1984. Adaptations of Luzula confusa to the polar semi-desert environment. Arctic 37(2):121-132.

Addison, P.A.; Malhotra, S.S.; Khan, A.A. 1984. Effect of sulfur dioxide on woody boreal forest species grown on native soils and tailings. J. Environ. Qual. 13(3):333-336.

Alexander, M.E. 1984. Prescribed fire behavior and impact in an eastern spruce-fir slash fuel complex. Can. For. Serv. Res. Notes 4(1):3-7.

Bernier, P.Y.; Plamondon, A.P. 1983. Estimating net short-wave radiation with the Bellani pyranometer. Agric. Meteorol. 30:175-184.

Cerezke, H.F.; Borden, J.H.; Trott, T.N. 1984. Field tests with semiochemicals for the mountain pine beetle in the Cypress Hills, Alberta. Can. For. Serv. Res. Notes 4(2):16-18.

Cody, W.J.; Scotter, G.W.; Zoltai, S.C. 1984. Additions to the vascular plant flora of the Bathurst Inlet region, Northwest Territories. Can. Field-Nat. 98(2):171-177.

Corns, I.G.W.; Pluth, D.J. 1984. Vegetational indicators as independent variables in forest growth prediction in west-central Alberta, Canada. For. Ecol. Manage. 9:13-25.

Delorme, L.D.; Zoltai, S.C. 1984. Distribution of an arctic ostracod fauna in space and time. Quat. Res. 21(1):65-73.

Hall, R.J.; Crown, P.H.; Titus, S.J. 1984. Change detection methodology for aspen defoliation with LANDSAT MSS digital data. Can. J. Remote Sensing 10(2):135-142.

Hiratsuka, Y. 1984. New leaf spot fungus, Marssonina balsamiferae, on Populus balsamifera in Manitoba and Ontario. Mycotaxon 19(1):133-136.

Hogan, G.D.; Wotton, D.L. 1984. Pollutant distribution and effects in forests adjacent to smelters. J. Environ. Qual. 13(3):377-382.

Kakishima, M.; Hiratsuka, Y.; Shibata, H.; Sato, S. 1984. Cronartium blister rust on Pinus densiflora having Pedicularis resupinata var. caespitosa as an alternate host. Trans. Mycol. Soc. Jpn. 25:315-318.

Maruyama, P.J. 1984. A new host and distribution record of a larch needle blight, Meria laricis Vuill., in Alberta. Can. Plant Dis. Surv. 64(1):19.

Maynard, D.G.; Addison, P.A.; Kennedy, K.A. 1983. Impact of elemental sulphur dust deposition on soils and vegetation of Pinus contorta stands in west-central Alberta, Canada. Aquilo Ser. Bot. 19:314-325.

Maynard, D.G.; Stewart, J.W.B.; Bettany, J.R. 1984. Sulfur cycling in grassland and parkland soils. Biogeochem. 1:97-111.

Ondro, W.J. 1984. Pruning. Pages 85-105 in K. Higginbotham, editor. A compendium of papers on "An ecological construct towards rational silviculture." University of Alberta, Department of Forestry, Edmonton, Alberta.

Pluth, D.J.; Corns, I.G.W. 1983. Productivity of conifers in western Canada boreal forests in relation to selected environmental factors. Pages 101-111 in IUFRO symposium on forest site and continuous productivity. U.S. Dep. Agric., For. Serv., Pac. Northwest For. Range Exp. Stn. Gen. Tech. Rep. PNW-163.

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13. Resources 1985-86:

PYs:	Prof.:	Samoil	1.0
		Turtle	1.0
	Tech.:	Adams	1.0 (functional only)
	Term/Student:		1.0
	Total:		4.0 (1 functional only)

O & M: $80,000

Capital:

14. Signatures:

J Samoil
Investigator

J.M. Powell
Program Director

J Turtle
Investigator

G. D Tiet
Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 29, 1985

1. Project: Technology Transfer and Information

2. Title: Technology transfer and public information

3. New: X Cont.: 4. No.: NOR-33-02/03/04

5. Study Leader: R.G. Newstead

6. Key Words: Technology transfer, communications, public relations, public information, library, photography

7. Location of Work: Throughout region

8. Study Objectives:

   1. Co-ordinate and promote the planning and delivery of an effective regional technology transfer program.

   2. Promote increased public awareness and understanding of CFS and NoFRC initiatives in the forestry sector, inform designated publics of the benefits of the forest resources to the people of the region and the nation; and provide a range of public and media relations services.

   3. Enhance internal CFS and NoFRC communications opportunities to exchange information, solicit feedback, study and identify concerns or issues warranting attention.

   4. Provide a full range of library and photographic support services to NoFRC personnel.

9. Goals for 1984-85:

   1. Coordinate NoFRC role, activities, and expenditures within National Forest Week (NFW) program with CFS - HQ, Manitoba Forestry Association (MFA), Saskatchewan Forestry Association (SFA), Alberta Forestry Association (AFA). To include NoFRC "Open-house" coordination - 1985.

   2. Participate in development and coordinate exhibition of NoFRC public education and awareness displays as scheduled.

   3. Investigate and evaluate opportunities to produce public information and awareness brochures, pamphlets, publications and other educational materials or media.

4. Develop and implement forestry relation/public information program plan(s), including ceremonial functions, under approved regional development agreement(s).

5. Initiate a technology transfer plan to convey NoFRC research and development program initiatives or results via demonstration sites/facilities, seminars, workshops-to cooperating agencies and industries involved in regional development agreements.

Goals Added:

6. Establish and supervise a newly-established Technology Transfer and Information project at NoFRC.

7. Maintain library and photographic services in support of the scientific programs (transferred from NOR-51, 803, and 805)

10. Accomplishments in 1984-85:

1. Coordinated NoFRC activities with respect to regional National Forest Week program including acquisition of literature, posters, and other materials for distribution to the public; preparation and monitoring of contracts with MFA, SFA, AFA, and U of Alberta for NFW activities; coordination of NoFRC activities with CFS - HQ and other CFS regional establishments; and preparation of final report on NFW program and activities throughout the region.

   Accepted designation as NoFRC Open House Committee Chairman and have convened and reported on two committee meetings to date. Open House organizational responsibilities have been delegated to several staff members, production schedule has been developed, exhibits and display spaces have been planned, 50,000 Colorado blue spruce seedlings germinated, and budgets allocated.

2. Contracted out the purchase, design, and creation of four Dantrade 10-panel displays in time for National Forest Week presentations in Manitoba, Saskatchewan, and Alberta. A total of 12,000 public contacts were achieved during NFW throughout the region. An additional 22,000 public contacts were achieved during the balance of the summer exhibition season at the Red River Exhibition, Calgary Stampede, Lloydminister Agriculture Exhibition, Prince Albert Exhibition and the Muttart Conservatory Open House, Edmonton. There were also a significant number of public contacts as a result of school visitations, NoFRC tours, Career Days presentations, and responses to written inquiries from the public. All staff scheduling, service and support functions were readily accommodated with the full and dedicated support and cooperation of NoFRC and District Office research and development personnel and could not have been accomplished otherwise.

3. To date all required public information materials have been supplied from CFS - HQ, thereby minimizing the need for in-house productions. Some effort has been directed towards the creation of public information brochures under the Manitoba and Saskatchewan Development Agreements in accordance with prepared Communications Sub-committee activities. A contract with the University of Alberta resulted in publication of the "Alberta Trees of Renown" booklet on behalf of the Alberta Forestry Association. Feature articles on a forestry theme were prepared by the Winnipeg and Prince Albert District Offices for circulation to regional daily and weekly newspapers.

4. Coordinated the responsibilities of the various federal and provincial government participants involved in the signing of three federal-provincial forestry agreements in Manitoba, Saskatchewan, and Alberta. Participated in the organization and preparation activities associated with the Ministerial visit to Edmonton and NoFRC. Attended the Canadian Public Relations Society conference in Ottawa and compiled a detailed report on same. Participated in the development of communications plans and sub-committee activities directed towards implementation of public information sub-programs under the Manitoba and Saskatchewan agreements. Participated in a CFS Public Information Planning (synectics) workshop in Toronto.

5. Contact has been established with the Technology Transfer Unit of the USDA Forest Service, Washington, D.C. Copies of the US Technology Transfer Planning Guide will form the basis for a concerted T.T. planning effort in 1985-86. Organized, under the auspicies of the Canada-Manitoba agreement, a joint meeting of forestry interpretation specialists and the Manitoba Forestry Association to initiate plans for an expanded and enhanced forestry interpretation and demonstration program at the Hadashville Forest Interpretive Centre. Served on the School Education Committee of the A.F.A., the Canada-Sasktchewan FRDA Communications sub-committee, the Canada-Manitoba F.R.A. Communications Sub-Committee (Keeling) and as Chairman of the NoFRC Library Committee.

6. Established the Technology Transfer and Information Project and Coordinated budget, planning, administrative, and staffing activities associated with this project, including Scientific Editing and Publishing, Technology Transfer and Public Information, Library and Photographic Services.

7. Maintained library and photographic services in support of scientific and regional development programs.

11. Goals for 1985-86:

1. Coordinate technology transfer and information services and activities within NoFRC including public information, public relations, scientific and technical information, extension services, library and photographic services. (R.N.) (33-2)

2. Serve as NoFRC Open House Committee Chairman (R.N.) others serve in functional role (A.K., H.S., P.D.). Evaluate and report on the outcome of this event. (R.N.) (33-3)

3. Serve on in-house regional, national and N.G.O. working/advisory committees as required. (R.N., A.K.) (33-4)

4. Participate in the development, implementation and evaluation of communications plans under the Manitoba, Saskatchewan and Alberta F.R.D.A.'s (see NOR-36) (R.N., A.K., H.S.) (33-1)

5. Oversee development and maintenance of a photographic records classification system and library. (H.S.) (33-5)

6. Develop and implement an annual public information plan to organize and conduct public information exhibits including major regional exhibitions, National Forest Week events, Federal Information Fairs, and other invitational events such a U of A Woodsmen's Competitions, Hampco '85, Forestry Capital of Canada and the like. (R.N., A.K., H.S.((33-7)

7. Develop public information and media materials and presentations including media releases, feature articles, backgrounders, exhibits, brochures, pamphlets and other promotional materials. (R.N., A.K.) (33-9)

8. Review existing documents and activities relating to CFS/NoFRC technology transfer efforts, participate in planned CFS national technology transfer workshop, and establish personal contact with USDA Forest Service Technology Transfer Unit in Washington D.C. (R.N.) (33-6)

9. Act as NoFRC focal point for internal and external communications with the public and media, by responding to inquiries for information, tours, presentations and the like; and by coordinating research and technical staff representations to the public and the media. (R.N., A.K., H.S.) (33-8, 33-10)

10. Provide a full range of library services including ordering, purchasing, cataloguing, and filing reports, journals and books. Assist NoFRC staff and authorized visitors in literature retrievals profiles and searches. Maintain contact and inter-library loan priviledges with HQ and other associated libraries. (D.R.) (33-17)

11. Investigate and report on opportunities and costs associated with the implementation of computerized library functions and data bases access. (D.R.) (33-18)

12. Investigate and report on short-term and long term NoFRC library space allocation, facilities, and storage requirements. (D.R., R.N.) (33-19)

13. Provide photographic and advisory services to NoFRC research and regional development projects including processing, printing, photo enlargement/reduction, specialized photography, and layouts, and/or monitor the performance of contract services for same. (P.D.) (33-20)

14. Requisition, inventory, and maintain photographic and other audio-visual equipment. (P.D.) (33-21)

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs:	Prof.:	Newstead	1.0
		Robinson	1.0
	Tech.:	Stewart	1.0
		Hopp	1.0
		Debnam	1.0
		Vice Logan	1.0
	Term/Student:		2.0
	Total:		8.0

O & M: $70,000 (TT & I $30,000, Library $27,000, Photography $13,000)

Capital: not assigned.

14. Signatures:

Investigator

J. M. Powell
Program Director

Regional Director

NOR-36

DEVELOPMENT AGREEMENTS

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Canada/Manitoba Forest Renewal Agreement

3. New: Cont.: X 4. No.: NOR-36-01 (NOR-36-198)

5. Study Leader: J. Davidson

N.B. See also separate study statements for:

i)	Insect and disease management	(NOR-36-04)
ii)	Stand tending/regeneration demonstrations	(NOR-36-05)
iii)	Fire management	(NOR-36-06)
iv)	Silviculture guidelines for white/black spruce management	(NOR-36-07)
v)	Jack pine seed orchard development	(NOR-36-08)
vi)	Site classification	(NOR-36-09)
vii)	Nursery development	(NOR-36-10)
viii)	Forest economics	(NOR-36-11)
ix)	Forest inventory	(NOR-36-12)
x)	Tree improvement	(NOR-36-13)

6. Key Words: Forest renewal, intensive management, resource data base, fire protection, nursery construction, public information, agreement, administration, evaluation, job creation, economic development

7. Location of Work: Winnipeg District Office, Manitoba; and Manitoba wide

8. Study Objectives:

1. To manage and coordinate the implementation of federally-funded initiatives and monitor the use of federal funds related to the Canada/Manitoba Forest Renewal Agreement by:

   a. assisting in the development and maintenance of timber supplies sufficient to ensure the long-term viability of the forest industry in Manitoba;

   b. promoting the efficient utilization of the forest resource in Manitoba; and

c. contributing to the economic development of the Manitoba forestry sector, including the improvement of employment opportunities in the sector.

2. To provide regional liaison for all CFS activities related to the Canada/Manitoba Forest Renewal Agreement.

3. To coordinate the implementation of sectoral forestry employment stimulation programs in Manitoba.

4. To facilitate the maximization of funding available to the forestry sector in Manitoba from other federal agencies.

5. To represent the Canadian Forestry Service in matters related to federal and provincial governments, industry and the general public.

9. Goals for 1984-85:

1. Supervise and coordinate federal direct delivery programs under the Canada/Manitoba FRA.

2. Coordinate and supervise the implementation of projects under the Environment 2000 program.

3. Initiate the expansion of the Winnipeg district office.

4. Assist in the development of work plans related to the Canada/Manitoba Agreement.

5. Initiate the staffing process required under the expanded Winnipeg district office.

6. Provide assistance and input from Manitoba regarding forestry relations activities.

10. Accomplishments in 1984-85:

1. Federal direct delivery projects were implemented through Abitibi-Price, Manfor, Moose Lake Indian Band, and through in-house staff. (See Agreement status report for December 31, 1984 for details).

2. Coordinated and supervised the implementation of 11 projects under the Environment 2000 program -- budget of $0.7 million resulting in 136 new jobs (one additional CFS staff hired).

3. Continued efforts to secure new office accommodation in Winnipeg through Public Works Canada.

4. Developed work plans for 1984-85 as well as 1985-86 in cooperation with provincial personnel (see Agreement status report for December 31, 1984).

5. Initiated staffing action for 13 of the 14 positions acquired for Agreement implementation.

6. Provided input to Agreement related forestry relations activities as well as to non-Agreement Forestry Week activities.

11. Goals for 1985-86:

1. Forest Renewal and Intensive Management - Review, approve and monitor reforestation and stand-tending projects developed by industry (Manfor and Abitibi); negotiate two or three contracts with Indian Bands for forest renewal or intensive management work; fund and monitor seedling growing contracts to meet industry and, where applicable, Band requirements in relation to Agreement reforestation activity. (Supervisor: FO-2, Renewal and Intensive Management).

2. Agreement Management - In cooperation with the Provincial Program Manager, organize, document, and follow-up meetings of the Agreement Directorate, the Interdepartmental Advisory Group for the Agreement, the Agreement Public Information Subcommittee and such other ad hoc committees of federal, provincial, industry and/or NGO representatives as are required to facilitate implementation of Agreement Subprograms.

3. Resource Data Base - Ensure federal acquisition, on behalf of the Province, of the hardware required in accordance with federal purchasing procedures for major capital items (including liaison with DSS and interested NoFRC and CFS-HQ staff). Also monitor development and implementation of Province's short and medium-term action plans for inputting provincial forest inventory data.

4. Fire Protection - Ensure federal acquisition and where applicable installation of equipment identified by the Province within approved funding levels for the Agreement, in accordance with federal purchasing procedures (including liaison with DSS and interested NoFRC staff). Also monitor Provincial experience in using that equipment (see also Study Statement NOR-36-06 for involvement in research activity).

5. Nursery Development - Ensure completion of the Clearwater construction projects (greenhouses and seeding line building) undertaken in 84/85 by PWC on behalf of the CFS as well as development/implementation by PWC of the Tree Improvement construction program at Hadashville in 85/86 (see also Study Statement NOR-36-08 for related work on jack pine seed orchard development. Supervisor: FO-2, Renewal and Intensive Management).

6. Public Information - Ensure continued implementation and revision, as required, of the Pubic Information Strategy approved in 84/85 by the Agreement Directorate, including liaison with DSS, appropriate NoFRC/FEDC Office staff, contractors, and provincial representatives.

7. Evaluation - Ensure development funding and implementation of projects pursuant to Directorate approval of an evaluation framework based on 84/85 consulting contract document. Also, implement such procedures as are necessary at the District Office to ensure collection of required data at the appropriate source.

8. Administration - Direct District staff and coordinate functional direction from NoFRC (as outlined in other Winnipeg based study statements), ensure respect of applicable federal financial and administrative regulations as identified by financial authorities, manage the District Office budget and ensure the processing of project authorization/claim forms, compliance with Agreement reporting requirements and provision of accommodation, equipment (including micro computer) and other District and NoFRC needs.

9. Continue to provide coordination, liaison and supervision (if required) for any federal forestry-related job creation program in Manitoba.

12. Publications 1984-85:

Canada/Manitoba Forest Renewal Agreement
Canada/Manitoba Forest Renewal Agreement - Policy and Procedures Manual

Unpublished Reports:

Canada/Abitibi-Price Inc. - Letter of Understanding (for implementation of activities under the Agreement)
Canada/Manitoba Forest Resources Ltd. - Letter of Understanding

13. Resources 1985-86:

(see breakdown of all Agreement resources attached)

PYs: Agreement: 6.9
A-base: 1.0

Total: 7.9

O & M: $68,500 + $11,000 A-base

Capital: $556,000

Contracts: $170,050

Grants & Contributions: $743,000

14. Signatures:

Investigator

Program Director
(Development)

Regional Director

CANADA/MANITOBA FOREST RENEWAL AGREEMENT
Breakdown of Resources
1985/86

	PYs	O & M	Contracts/ Supplies	G & C	Capital
NOR-36-01:					
Forest renewal	1.9	$ 7,600	$50,000	$200,000	-
Intensive management	2.0	$25,200	$30,000	$543,000	-
Fire protection/GIS	0.0	-	-	-	$215,000
Nursery development	-	-	-	-	$341,000
Public information	-	-	$49,200	-	-
Evaluation	-	-	$40,850	-	-
Administration	4.0	$35,700	-	-	-
NOR-36-04:					
Insects & diseases/ forest environment	1.0	$ 8,000	-	$66,000* $76,000*	-
NOR-36-05:					
Stand tending/ regeneration demonstration	0.1	$ 5,000	$20,000	$50,000*	-
NOR-36-06:					
Fire management	1.0	$11,700	-	-	-
NOR-36-07:					
Silviculture	1.0	$11,000	-	$2,500*	-
NOR-36-08:					
Jack pine seed orchards	2.0	$35,000	$66,000	$229,000*	$522,000
NOR-36-09:					
Site classification	1.0	$12,500	-	$75,000*	-
NOR-36-10:					
Nurseries	0.0	-	-	-	-
NOR-36-11:					
Forest economics	1.0	$10,000	-	$80,000*	-
NOR-36-12:					
Forest inventory	0.0	-	-	$40,000*	-
NOR-36-13:					
Tree improvement	0.0	-	-	$5,000*	-

* These are cost-shared projects funded 50/50 by the federal and provincial governments. Cost-shared research projects were approved by the Agreement Directorate based on the recommendations of the Memorandum of Understanding (MOU) Committee. Development of the appropriate Project Authorization Forms (PAFs) is the responsibility of the province.

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Canada/Alberta Forest Resource Development Agreement

3. New: Cont.: X 4. No.: NOR-36-02 (NOR-36-197)

5. Study Leader: S. Price

6. Key Words: Canada/Alberta Forest Resource Development Agreement, reforestation, forestry research, demonstration, hardwood development, public information, administration, evaluation, job creation, economic development

7. Location of Work: Northern Forest Research Centre, Edmonton, Province of Alberta

8. Study Objectives:

1. To manage and coordinate the implementation of federally-funded initiatives and monitor the use of federal funds related to the Canada/Alberta Forest Resource Development Agreement by:

   a. ensuring that economically accessible timber supplies, especially softwoods, are available to meet the long-term requirements of the forest industry in Alberta;

   b. ensuring that the available timber supply, with emphasis on hardwoods, is utilized in the most efficient manner possible; and

   c. contributing to the economic development and diversification of the provincial economy and to the improvement of employment opportunities in the forest industry.

2. To review socio-economic events, regionally, nationally, and internationally and assess impacts in terms of CFS mandate and programs in relation to regional development in the forestry sector.

3. To coordinate the development, implementation and administration of forestry employment stimulation programs in the prairie provinces and NWT as required.

4. To provide effective administration and financial control and technical support services for the Regional Development Program.

9. Goals for 1984-85:

1. Monitor and coordinate the contribution application and project approval processes for the Canada/Manitoba Forest Renewal Agreement.

2. Develop standards and procedures for the Canada/Manitoba Forest Renewal Agreement.

3. Initiate staffing action to fill 14 positions dedicated to implementation of the Canada/Manitoba FRA and establish and expanded district office in Manitoba

4. Coordinate the development of work plans for the first two years of the Canada/Manitoba FRA.

5. Finalize, sign, and begin implementation of the Canada/Saskatchewan FRA.

6. Monitor and coordinate the contribution application and project approval processes for the Canada/Saskatchewan FRA.

7. Develop and execute project evaluation procedures to determine the effectiveness of use of contributions from the Canada/Saskatchewan FRA.

8. Develop standards and procedures for the Canada/Saskatchewan FRA.

9. Initiate staffing action to fill P/Y positions dedicated to implementation of the Canada/Saskatchewan FRA and establish an expanded district office in Saskatchewan.

10. Develop work plans for the first two years of the Canada/Saskatchewan FRA.

11. Negotiate, finalize, and sign and implement the Canada/Alberta Forest Agreement.

12. Continue to provide technical input to the Natural Resources sub-agreement under the Canada/NWT Economic Development Agreement.

13. Continue to provide input into program development for other federal initiatives related to forest resources (i.e. hardwood utilization agreement, sawmill modernization program, Manfor upgrading, native forestry programs).

14. Continue to manage and administer the Environment 2000 program in the region and to implement the program in Alberta and the NWT.

15. Monitor regional, national, and international socio-economic developments and trends in relation to their impact on the forest industry and relate such developments to regional development needs and opportunities.

10. Accomplishments in 1984-85:

1. Monitored the contribution application and project approval processes for the Canada/Manitoba Forest Renewal Agreement in cooperation with the new District Manager, Winnipeg (see NOR-36-01).

2. Developed standards and procedures manual for Canada/Manitoba Forest Renewal Agreement through Environment Canada, Operations and Systems Consulting Branch (see publications NOR-36-01).

3. Assisted with initiation of staffing process for positions required to implement the Manitoba Agreement.

4. Provided assistance as required to the District Manager, Winnipeg, in the development of work plans for the Canada/Manitoba FRA (see NOR-36-01).

5. Canada/Saskatchewan Forest Resource Development Agreement was signed in June 1984.

6. Monitored the contribution application and project approval process for the Canada/Saskatchewan FRDA in cooperation with the Acting District Manager, Prince Albert (see NOR-36-03).

7. No activity as yet other than procedures identified in Canada/Saskatchewan FRDA policy and procedures manual.

8. Developed standards and procedures manual for the Canada/Saskatchewan FRDA through Environment Canada, Operations and Systems Consulting Branch and the Acting District Manager, Prince Albert (see NOR-36-03).

9. Assisted with the initiation of staffing process for positions required to implement the Canada/Saskatchewan FRDA.

10. Assisted the acting District Manager, Prince Albert, as required to develop work plans for the Canada/Saskatchewan FRDA.

11. Canada/Alberta Forest Resource Development Agreement signed September 1984.

12. Transferred to NOR 3.

13. Provided input as required to federal initiatives related to forest resources including the federal land forestry program.

14. Provided guidance and assistance as required to the Environment 2000 coordinator and Program Director, Regional Development. A total of 18 projects implemented in Alberta-budget $1.4 million resulting in 317 jobs. A total of 2 projects implemented in NWT-budget $0.25 million resulting in 41 jobs.

15. In cooperation with other Regional Development personnel monitored regional and national developments impacting on the forest industry including provincial employment programs, federal provincial forestry agreements, and IRDP.

11. Goals for 1985-86:

a. Alberta Agreement:

1. Develop standards and procedures for the Canada/Alberta Forest Resource Development Agreement.

2. Manage the implementation of federal activities under the Canada/Alberta FRDA.

b. Development general:

1. Continue to provide assistance in the staffing of positions under the Manitoba, Saskatchewan and Alberta Agreements.

2. Provide staff functions as required to District Managers in Winnipeg and Prince Albert in the implementation of the Canada/Manitoba FRA and Canada/Saskatchewan FRDA.

3. Review and recommend for approval all project authorization forms under the Manitoba and Saskatchewan Agreements and make recommendations re: Agreement implementations to the Program Director, Regional Development.

4. Continue to manage and coordinate regionally the implementation of any federal forestry-related job creation programs.

5. Provide regional Agreement and job creation information summaries to CFS-HQ as requested.

12. Publications 1984-85:

Canada/Alberta Forest Resource Development Agreement, Oct. 25, 1984.

13. Resources 1985-86:

PYs: Agreement: 10.0
A-base: 1.0

Total: 11.0

O & M: $1,059,000 + $6,000 A-base

Capital: $60,000

Grants & Contributions: $500,000

14. Signatures:

Investigator

Program Director
(Development)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Canada/Saskatchewan Forest Resource Development Agreement

3. New: Cont.: X 4. No.: NOR-36-03 (NOR-36-199)

5. Study Leader: J. Farrell

6. Key Words: Canada/Saskatchewan Forest Resource Development Agreement, renewal, growth enhancement, technology transfer, public information, job creation, forest relations, economic development, liaison

7. Location of Work: Prince Albert District Office, Saskatchewan; and Saskatchewan-wide

8. Study Objectives:

   1. To manage the implementation of federally-funded initiatives and monitor the use of federal funds related to the Canada/Saskatchewan Forest Resource Development Agreement by:

      a. assisting in the development and maintenance of timber supplies sufficient to ensure the long-term viability of the forest industry in Saskatchewan;

      b. assisting in the efficient utilization of the forest resource in Saskatchewan; and

      c. contributing to the economic development of the Saskatchewan forestry sector, including the improvement of employment and human resource development opportunities in the sector.

   2. To provide regional liaison for all Canadian Forestry Service activities related to the Canada/Saskatchewan Forest Resource Development Agreement.

3. To coordinate the implementation of sectoral forestry employment stimulation programs in Saskatchewan.

4. Represent the Canadian Forestry Service in Saskatchewan within the federal and the provincial governments, industry, and general public.

5. To facilitate the maximization of funding available to the forestry sector in Saskatchewan from other federal agencies.

9. Goals for 1984-85:

1. Provide assistance, information, and support for negotiations of the Canada/Saskatchewan Forest Resource Development Agreement.

2. Supervise and coordinate direct delivery programs under the agreement.

3. Coordinate and supervise the implementation of projects under the Environment 2000 program.

4. Undertake and complete and expansion of the Prince Albert district office in response to the initiation of the agreement.

5. Initiate the staffing process required under the expanded Prince Albert district office.

6. Provide assistance and input from Saskatchewan regarding forestry relations activities.

10. Accomplishments in 1984-85:

1. Signed the Canada/Saskatchewan Forest Resource Development Agreement, $28 MM between 1984-89.

2. With provincial cooperation, drafted an approved work plan for 1984-85 and have initiated implementation in all federal direct delivery program areas.

3. Coordinated and supervised the implementation of 35 forestry projects under the Environment 2000 program--a budget of $1.1 million resulting in 225 new jobs (hired one additional staff).

4. Negotiations with Public Works Canada for expanded accommodation is almost complete.

5. Staffing process by year end will have identified approximately 10 of the 12 new positions for agreement implementation (a hiring freeze still in effect on this date, has caused some delay).

6. Have participated in public information efforts at a number of Saskatchewan expositions throughout the year, particularly through National Forest Week--these efforts will be renewed in 1985 since Prince Albert and district has been named Forestry Capital of Canada. Have developed a CFS public information, 5-year strategy for Saskatchewan and a 1984/85 work plan is being implemented.

11. Goals for 1985-86:

1. Continue 1985-86 implementation of work plan for Canada/Saskatchewan F.R.D.A., including:

Program 1.0 Forest Renewal
- 1.3 Federal Lands, Private Woodlots and Industrial Leasehold ($281,000), continued implementation of operational projects
- 1.4 Nursery Development - Capital development will continue on pumphouses and cold storage/packing facilities at the Big River and Prince Albert Provincial Tree Nurseries, ($2.0 M)
- 1.5 Regeneration Surveys - to be delivered by Forestry Division, (DPRR), and cost-shared ($160,000.00)

Program 2.0 Growth Enhancement and Stand Tending - project implementation will continue on industrial leasehold, federal and private lands ($234,000.00)

Program 3.0 Technology Advancement and Transfer
- 3.1 Technology Transfer - Joint Committee for Forest Research, (MOU) will finalize plans for forestry research and PY's, and funding will be dedicated accordingly, ($402,000.00)
- 3.2 Enhanced Forest Protection - additional fire weather equipment and computer hardware will be purchased for provincial fire control branch, ($237,000.00)
- 3.3 Opportunity Identification - continued analysis of opportunities in forestry in Saskatchewan (Hardwood Utilization study should be complete), total funding available for year $80,000.00
- 3.4 Forestry Data Base - purchase of a G.I.S. for DPRR, and initial loading--a portion of capital purchase costs will be borne by F.R.D.A. ($1.2 M)

Program 4.0 Administration, Evaluation and Public Information - public information activities include signage, display material, promotion related to Forestry Capital of Canada and National Forest Week - ($80,000.00)

2. Continue to provide coordination, liaison and supervision (if required) for any federal forestry-related job creation program and sectoral job creation program in Saskatchewan.

3. Complete the relocation, expansion, equipping and furnishing of an expanded CFS district office in Prince Albert.

4. In consultation with NoFRC, coordinate and formalize the administrative procedures of the Prince Albert office vis-a-vis NoFRC regarding finance, purchasing, delegation, communications, and general administration.

5. Complete the staffing of the 12 persons associated with implementing the F.R.D.A. and provide direction and initial orientation for staff members.

6. Continue to provide assistance, advice, coordination and consultation on all regional-based forestry development and relations activities having an impact on Saskatchewan.

7. Continue liaison with all federal departments, provincial authorities, industries, associations, Indian bands and the general public having an interest in the Canadian Forestry Service and its activities.

12. Publications 1984-85:

Canada/Saskatchewan Forest Development Agreement - signed June 20, 1984.

Canada/Saskatchewan F.R.D.A. - Policy and Procedures Manual, November 1984.

Unpublished Reports:

Canada/Saskatchewan F.R.D.A. - Canadian Forestry Service Public Information Strategy in Saskatchewan 1984-1989 and 1984-85 Work Plan.

Canada/Saskatchewan F.R.D.A. - 1984-85 Work Plan for Agreement-funded activities, August 27, 1984 - $3.276 Million--amended November 29 - $1.66 M.

Canada/Prince Albert Pulpwood Ltd. - letter of understanding (for implementation of activities under the agreement and subsequent funding).

13. Resources 1985-86:

PYs: Agreement: 12.0
A-base: 2.0

Total: 14.0

O & M: $379,000 + $11,000 A-base
Capital: $2,770,000
Grants & Contributions: $785,500

14. Signatures:

Investigator

Program Director
(Development)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Forest pest management and damage appraisal (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-04

5. Study Leader: Vacant (Insect and Disease Specialist)

6. Key Words: Damage appraisal, impact, hosts, forest pests, sampling methods, management, mortality, growth loss, forest renewal

7. Location of Work: Winnipeg district office, Manitoba-wide

8. Study Objectives:

   1. To develop methods for predicting short and long term impacts of pest(s) including damage appraisal on forest resource uses, values, management plans and operations.

   2. To determine how and to what extent pest damage affects forest resource users and management plans.

   3. To intensify and improve the general pest detection and damage surveys and to conduct special surveys of particular forest pests or of designated areas.

   4. To evaluate or develop methods to manage pest-susceptible forest and pests populations to limit forest damage to tolerable levels by use of silvicultural, chemical and biological techniques.

   5. To provide diagnostic and advisory services regarding tree and shrub insects and diseases.

9. Goals for 1984-85:

   1. Establish new study, and run a workshop for provincial foresters.

10. Accomplishments in 1984-85:

   1. New study established, and a workshop on forest pests will be held in Winnipeg on February 27, 1985.

11. Goals for 1985-86:

1. Under functional guidance of Project Leader, NOR-1: measure and evaluate growth loss and mortality caused by the spruce budworm in plots already established.

2. Establish permanent plots in young stands or plantations of jack pine and white spruce to develop methodology to estimate tree mortality/volume loss.

3. Conduct surveys of forest pest conditions and their damage.

4. Provide pest control advisory service and technology transfer.

5. Represent NoFRC and CFS on various provincial forest insect and disease committees and advisory groups.

12. Publications 1984-85:

New study

13. Resources 1985-86:

PYs: Prof.: Vacant 1.0

Tech.: Nil

Term/Student: Nil

Total: 1.0

O & M : $8,000

Capital: Nil

Grants & Contributions: CFS $33,000/$33,000 MFB
CFS $38,000/$38,000 MFB (Environment project)

14. Signatures:

Investigator

Supervisor

Technical Advisor

District Manager

Signatures Cont.

Program Director
(Forest Protection)

Program Director
(Development)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Yields of Managed Stands. 1. Establishment of stand tending and regeneration demonstrations. (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-05-1

5. Study Leader: N. Walker and K. Froning

6. Key Words: Jack pine, white spruce, thinning, planting, release cutting

7. Location of Work: Winnipeg district office, Pine Falls, Sandilands Forest Reserve, Interlake, Duck Mountain, Manitoba

8. Study Objectives:

   1. To establish demonstration areas that reflect successful silviculture management techniques for the establishment of jack pine and white spruce stands.

   2. To remeasure demonstration areas and prepare appropriate reports on treatments and results obtained for use by practicing foresters and whenever possible for the general public.

9. Goals for 1984-85:

   Nil - new study

10. Accomplishments in 1984-85:

    Nil - new study

11. Goals for 1985-86:

    1. In close cooperation with the Manitoba Forestry Branch, NoFRC research staff, and Program Directors, and based on recommendations contained in Johnson Forestry Services' review of Manitoba-Saskatchewan R & D plots established between 1904 and 1970, select suitable field plots for use as demonstration areas.

2. Remeasure, as appropriate, selected demonstration areas and prepare appropriate short reports (1-2 pages in length) outlining treatments and updated results.

3. In cooperation with the Manitoba Forestry Branch and the Forestry Relations officer (NoFRC) erect appropriate signage.

4. Ensure that the selected demonstration areas are duly recorded by the Manitoba Land Titles Branch and prepare appropriate maps at suitable scales indicating plot locations(s).

5. If time permits complete and publish FMN on ten year performance of containerized seedlings.

6. If time permits assist in the field measurement of a cooperative planted seedling performance study. (1 week)

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

PYs: Prof.: 0.0

Tech.: Walker 0.1

Term/Student: 0.1 (Contract student)

Total: 0.2

O & M: $5,000 (+ $20,000 for contracts & supplies - includes salary and O & M for 1 student)

Capital:

Grants & Contributions:

14. Signatures:

Investigator

Investigator

Technical Advisor

Program Director
(Development)

Supervisor

District Manager

Program Director
(Forest Resources)

Regional Director

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	Total $
1.	Select appropriate demonstration areas, remeasure and prepare summary report. Erect signage. (see 10-5MA)	Continue and terminate.			
Total:	$20 K F	$30 K cs			$20 K F $30 K cs
PY:					
O & M:	$5K F	$5K F			$10K F

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Yields of Managed Stands. 2. Releasing white spruce from trembling aspen. (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-05-2

5. Study Leader: I. Bella (see NOR-4-01)
R. Yang (see NOR-4-05)
R. Waldron

6. Key Words: Releasing white spruce, biological response, economics, inventory, growth, cost/benefit, aspen

7. Location of Work: Manitoba

8. Study Objectives:

1. To assess growth following release of white spruce from aspen in a range of stand conditions using a variety of release techniques.

2. To assess the costs of various forms of releasing white spruce from aspen including herbicides, manual and moto-manual techniques.

3. To carry out an inventory to locate stands of mixed white spruce and aspen suitable for releasing white spruce using a variety of release techniques.

4. To hold a workshop on stand tending in jack pine and mixed white spruce-aspen stands.

9. Goals for 1984-85:

Nil - new study

10. Accomplishments in 1984-85:

Nil - new study

11. Goals for 1985-86:

Act as Scientific Authority for a R&D contract designed to assess the growth response of white spruce following release from trembling aspen. Plots to be utilized include those which form an old release study in Manitoba and Saskatchewan - MS - 153. A number of other related studies will be reviewed by the contractor. (Yang, Waldron)

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

PYs:	Prof.:	0.0
	Tech.:	0.0
	Term/Student:	0.0
	Total:	0.0

O & M:

Capital:

Grants & Contributions: CFS $25,000/$25,000 Manitoba

14. Signatures:

Investigator

Supervisor

Investigator

District Manager

Technical Advisor

Program Director
(Development)

Program Director
(Forest Resources)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Fire management (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-06

5. Study Leader: Vacant (Fire Specialist)

6. Key Words: Fire management, technology transfer, decision-aid models, computer systems, allocation, cost effectiveness, fire behavior, fire environment, fuels

7. Location of Work: Winnipeg district office; Manitoba-wide

8. Study Objectives:

   1. To provide information transfer in fire research management to the Province of Manitoba to ensure state-of-the-art practices are utilized in the conduct of fire business.

   2. To research and develop relevant decision-aid models and to introduce appropriate new information summarizing technologies using management science and computing systems designed to assist fire management agencies in optimizing the allocation and use of available resources during demanding or multiple fire occurrence situations.

9. Goals for 1984-85:

   Nil - new study

10. Accomplishments in 1984-85:

    Nil - new study

11. Goals for 1985-86:

    1. Maintain liaison with Project Leader, Fire Research and staff to provide technology transfer information.

    2. Develop fire management expertise through short courses and other in-house experience.

3. Initiate a program for effective communication, cooperation and understanding between researchers and fire managers aimed at improving the protection and use of Manitoba's forests through efficient fire management systems and guidelines.

4. Provide information transfer through participation on committees or through personal contact.

5. Begin to develop a plan to provide resource and data bases for a comprehensive program of daily decision-aid models for fire managers.

6. Compile fire weather and fire report data for calibration and performance of Canadian Forest Fire Weather Index System in Manitoba.

7. Assist District Manager and Fire personnel in federal acquisition and where applicable installation of equipment identified by the Province within approved funding levels for the Agreement, and help monitor experience in using that equipment (see NOR-36-01).

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

PYs:	Prof.: Vacant	1.0
	Tech.:	0.0
	Term/Student:	0.0
	Total:	1.0

O & M: $11,700

Capital: Nil

Grants & Contributions:

14. Signatures:

Investigator

Supervisor

Technical Advisor

District Manager

Signatures Cont.

J. M. Powell

Program Director
(Forestry Extension)

Program Director
(Development)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Regeneration. 1. Guidelines for the management of white and black spruce. (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-07-1

5. Study Leader: V.S. Kolabinski and J. Ball

6. Key Words: Shelterwood, alternate strip, and clear cutting, scarification white spruce, black spruce, natural regeneration including stocking, age, and condition

7. Location of Work: Winnipeg district office; Riding, Duck and Porcupine Mountains, Manitoba; Porcupine Mountain and Pasquin Hills, Saskatchewan

8. Study Objectives:

   1. To remeasure and publish the results of selected R & D studies carried out in Manitoba and Saskatchewan between 1955 and 1965 on the effects of harvesting and scarification techniques to induce the natural regeneration of white spruce and black spruce.

   2. To prepare silviculture guidelines for the management of white spruce and white spruce-aspen stands to induce natural regeneration of white spruce utilizing various harvesting and scarification techniques.

9. Goals for 1984-85:

   1. Act as Scientific Authority for a R & D contract designed to review the potential of old Manitoba-Saskatchewan research studies for further remeasurement, preparation of forest managed prescriptions and demonstration. (Waldron)

10. Accomplishments in 1984-85:

   1. A report reviewing 300 old R & D studies carried out in Manitoba-Saskatchewan between 1904 and 1970 was received from Johnson Forestry Services. In-house discussions have led to recommendations for the remeasurement of Studies MS 211, 216 and 228.

11. Goals for 1985-86:

1. Remeasure MS 182 "Cutting methods for the management of black spruce, Duck Mountain Forest Reserve, Manitoba" by:

   a. Preparing a remeasurement plan including the assessment of residual stand growth and mortality; regeneration stocking, age, condition, and growth (both on scarified and non-scarified areas by moisture regime) and on a net treatment basis.

   b. Preparing a data analysis plan to ensure a comprehensive reporting on the results obtained.

   c. Publishing a report based on the remeasurement

   d. Selecting suitable areas to be used as future demonstration sites and preparing an appropriate summation report.

2. Prepare a remeasurement and data analysis plan for a) MS 216 "Clear cutting alternative strips and scarifying in white spruce-aspen stands to induce white spruce regeneration, Manitoba and Saskatchewan", b) MS 211 "Clear cutting alternate strips and scarifying in white spruce stands to induce white spruce regeneration, Manitoba and Saskatchewan", c) MS 228 "Shelterwood cutting and mechanical seedbed treatment in white spruce-trembling aspen stands to induce white spruce regeneration, Manitoba and Saskatchewan" and d) Haig's "Operational harvesting and scarification techniques to induce white spruce regeneration - Riding Mountain Forest Experimental Area, Manitoba" to:

   a. Assess residual stand growth and mortality; regeneration stocking, age, condition, and growth (both on scarified, non-scarified by moisture regime) and on a net treatment basis.

   b. Carry out field assessments of individually treated areas, analyze the data, and prepare appropriate reports and publications.

   c. Select suitable areas to be used as future demonstration sites and prepare appropriate summation report(s).

12. Publications 1984-85:

Johnson Forestry Services. 1985. A review of forest research studies conducted by the Canadian Forestry Service in Manitoba and Saskatchewan to 1970. Unpublished.

13. Resources 1985-86:

PYs: Prof.: 0.0

Tech.: Kolabinski 1.0

Term/Student: 0.3 (Contract student)

Total: 1.3

O & M: $11,000 (includes salary and O & M for 1 student)

Capital:

Grants & Contributions:

14. Signatures:

T. S. Kolabinski
Investigator

Ball
Supervisor

Investigator

District Manager

Program Director
(Forest Resources)

Program Director
(Development)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Regeneration 2. Hare damage assessment and technology transfer (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-07-2

5. Study Leader: L. Brace (See NOR-10-03)

6. Key Words: Hare damage, stand susceptibility ratings, workshops, technology transfer.

7. Location of Work: Winnipeg, throughout Manitoba

8. Study Objectives:

   1. To act as a Scientific authority for a R&D contract designed to assess stand susceptibility to hare damage of planted and natural seedlings

   2. To hold workshops designed to permit technology transfer in the fields of silviculture with special emphasis on natural and artificial regeneration

9. Goals for 1984-85:

   Nil - new study

10. Accomplishments in 1984-85:

    Nil - new study

11. Goals for 1985-86:

    1. A meeting of the CFS's Regional Reforestation Technical Committee will be held in Brandon, Manitoba in June 1985. The focus of this workshop is plantations of spruce and pine established in the Spruce Woods and Turtle Mountain Forest Reserves between 1904 and the present.

12. Publications 1984-85:

    Nil - new study

13. Resources 1985-86:

PYs: Prof.: 0.0

Tech.: 0.0

Term/Student: 0.0

Total: 0.0

O & M: 0.0

Capital: 0.0

Grants & Contributions: CFS $1,250/$1,250 Manitoba

14. Signatures:

Investigator

Supervisor

Technical Advisor

District Manager

Program Director
(Forest Resources)

Program Director
(Development)

Regional Director

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	Total $
1.	Hold a workshop on regeneration through the auspices of CFS's Regional Reforestation Technical Committee (see 10-3MA).	Continue.	Continue.	Continue and Terminate.	
	$2.5 K CS	$2.5 K CS	$2.5 K CS	$2.5 K CS	$10 K CS
2.			Act as a Scientific authority for a R&D contract to assess stand susceptibility to hare damage of natural and artifical seedlings (see 10-1MA).	Continue and Terminate	
			$60 K CS	$60 K CS	$120 K CS
Total:	$2.5 K CS	$2.5 K CS	$62.5 K CS	$62.5 K CS	$130 K CS

345

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Establishment of jack pine seed orchards in Manitoba

3. New: X Cont.: 4. No.: NOR-36-08

5. Study Leader: A. Nanka and K. Froning

6. Key Words: jack pine, seed orchards, breeding districts, cross pollination, mass selection, rearing, plantations.

7. Location of Work: Winnipeg District Office, Birds Hill, Swan River, Interlake and Northern Regions (The Pas), Hadashville nursery, Manitoba.

8. Study Objectives:

   1. To establish jack pine seed orchards for the Eastern and Central (Duck and Porcupine Mountains) Breeding Districts utilizing improved jack pine material development by J. Klein under study NOR-12-03 since 1968 and cross-pollination techniques.

   2. To establish jack pine seed orchards for the Interlake and Northern Regions of Manitoba using mass selection techniques developed by J. Klein under study NOR-12-03.

   3. To prepare a complete and comprehensive establishment report for each of the jack pine seed orchards to facilitate their development and utilization by the Manitoba Forestry Branch (MFB) beyond the 1989 termination of the Canada-Manitoba Forest Renewal Agreement.

9. Goals for 1984-85:

   Nil - new study

10. Accomplishments in 1984-85:

    Nil - new study

11. Goals for 1985-86:

1. In close cooperation with the Manitoba Forestry Branch and Canada DPW monitor the construction of the research greenhouse complex comprising a common headerhouse and two greenhouses (1 - CFS and 1 - MFB) at the Pinelands Forest Nursery near Hadashville, Manitoba. Initiate greenhouse start up and develop work schedules in cooperation with MFB tree improvement personnel.

2. Eastern Breeding District - collect and store seed obtained from controlled breeding carried out in 1984 on selected trees in family test plantations. Repeat controlled breeding in 1985 on selected trees which lacked sufficient flowering in 1984. Initiate irrigation system at Birds Hill.

3. Northern Region - initiate and complete cone collections from selected jack pine pine stands, process seeds, and begin rearing planting stock as part of the establishment of two mass selection seed orchards. Planting sites for the seed orchards will be selected and developed during 1985 with planting scheduled for the spring of 1986.

4. Central Breeding District - remeasure family-test plantations. Record survival and development of grafts in the holding area at PFN.

5. Birds Hill "mass selection" seed orchard - Tend seed orchard; ensure that cone collections are carried out by MFB and the seed utilized for rearing stock for use in eastern Manitoba. Along the same lines MFB should be actively encouraged to utilize seed from identified plus jack pine stands in the vicinity of the Marchand forestry office to obtain a 15% gain over random seed collections.

6. Prepare special reports of maps and source lists of jack pine breeding plantations.

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

P/Ys:	Prof:	0.0
	Tech: Nanka	1.0
	Seasonal Staff:	1.0
	Term/Student:	
	Total:	2.0

O & M: $35,000 (+ 66,000 contracts and supplies)

Capital: $522,000

Grants & Contributions: O&M - CFS $35,000/$35,000 Manitoba
Capital - CFS $79,500/$79,500 Manitoba

14. Signatures:

Investigator

Investigator

Technical Advisor

Program Director
(Resources)

Supervisor

District Manager

Program Director
(Development)

Regional Director

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	
Northern Breeding District					
1.	Select jack pine stands, collect cones and begin rearing	Complete rearing of seedlings and plant	Tend seed orchards	Tend seed orchards	Approach based on "mass selection" from 20 source stand. Grow 40,000 seedlings 30-cm tall Plant 10,000 seedlings/ha in 2 seed orchards. Thin in 1989-90 (?) removing ½ of the trees. Genetic gain 15%.
2.	Select and develop seed orchard sites including fencing				
Central Breeding District					
1.	Tend existing grafts at Pineland Tree Nursery	Tend existing grafts	Tend existing grafts Graft additional stock based on selected families	Plant and tend seed orchard	See Eastern Breeding District notes.
2.	Remeasure family test plantations				
3.			Select and develop seed orchard sites including fencing		

OPERATIONAL PLANS*
1985-1989

Goals Eastern Breeding District	1985-86	1986-87	1987-88	1988-89	
1.	Mate selected trees (i.e. cross pollination)	Collect cones and process seed, begin rearing	Complete rearing, plant seedlings and tend orchard	Tend seed orchard	Selection based on 40 best families at 10 years. Grow 10,000 seedlings 1-m tall. Plant 400 seedlings/ha @ 5-m spacing 2000 trees in final orchard to produce approximately 2 million seeds annually in 1995 Genetic gain 30%.
2.	Purchase vehicle. Erect greenhouse	Purchase seed orchard maintenance vehicle			
3.	Initiate irrigation system - Birds Hill	Clear, level and fence Birds Hill planting site	Complete irrigation system		
4.		Remeasure family test plantations			
5.	Tend jP mass selection seed orchard at Birds Hill	Continue	Continue	Continue	
6.	Prepare special Reports of maps and source list of jP breeding plantations.				

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	
Interlake Breeding District					
1.			Select and initiate development of seed orchard sites.	Complete site development including fencing.	See Northern District breeding note.
2.				Select jack pine stands, collect cones process seed, and begin rearing Seedlings.	
All Breeding Districts				Prepare a complete and comprehensive establishment report for each of the jack pine seed orchards for MFB.	

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	
$					
FEDERAL					
Capital	$522 K	$24 K	--	--	$546 K
O&M-Travel	$ 35 K	$30 K	$35 K	$30 K	$130 K
-Contracts & -Supplies	$ 66 K	$62 K	$15 K	$43 K	$186 K
Cost shared					
Capital	$159 K	--	--	--	$159 K
O & M	$ 70 K	$93 K	$110 K	$22 K	$295 K
Total:	$852 K	$209 K	$160 K	$95 K	$1316 K

* Technical advise on program - see 12-6MA

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Forest site classification (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-09

5. Study Leader: Vacant

6. Key Words: Site classification, forest management, forest inventory, site productivity, silviculture prescriptions, ecology, soils

7. Location of Work: Manitoba District Office, Province of Manitoba

8. Study Objectives:

   1. To develop a forest site classification for Manitoba which adequately reflects significant differences in site productivity and for which meaningful silviculture and other forest management prescriptions can be developed.

   2. To direct and supervise a contractor who will undertake the necessary office and field work to assess and classify ecoregions, ecozones, and ecotypes according to the proposed site classification scheme.

9. Goals for 1984-85:

   Nil - new study

10. Accomplishments in 1984-85:

    Nil - new study

11. Goals for 1985-86:

    1. Following a detailed review of appropriate literature and discussions with staff of the Manitoba Forestry Branch, the CFS (NoFRC), the Manitoba Soils Survey and others, develop a framework for a forest management site classification system (incorporating geomorphology, surficial geology, soils, climate, vegetation, biotic and edaphic features) acceptable tot he province of Manitoba to which meaningful interpretations of productivity, silviculture prescriptions, and other forest management concerns can be applied.

2. Supervises the preparation of maps and reports containing appropriate information relevant to the zonation of the province based on the feature outlined in goal 1 at the ecoregion and ecozone level using existing and new information collected by an appropriate contractor.

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

PYs:	Prof.: Vacant	1.0
	Tech.:	0.0
	Term/Student:	0.0
	Total:	1.0
O & M:		$12,500
Capital:		Nil

Grants & Contributions: CFS $37,500/$37,500 Manitoba

14. Signatures:

Investigator

Supervisor

Technical Advisor

District Manager

Program Director
(Forest Resources)

Program Director
(Development)

Regional Director

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	Total $
1.	Review appropriate literature, discuss with province and technical experts, and prepare a proposed forest site classification for forest management in the Province of Manitoba for approval.(see 10-2MA)	Obtain formal approval for the proposed site classification system. Undertake field work as appropriate.	Undertake appropriate field work and prepare reports.	Undertake appropriate field work and prepare reports. Terminate.	
2.	Act as Scientific authority for a R&D contract designed to collect existing data and other information for input into the design of a Man. site classification system.(see 10-2MA)	Act as a Scientific authority for a R&D contract designed to collect field data for the development of the approved Man. forest site classification system.	Continue.	Continue and Terminate.	
Total:	$75 K cs	$105 K cs	$105 K cs	$130 K cs	$415 K cs
PY					
O&M	$7 K	$7 K	$7 K	$7 K	$28 K

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Forest Nurseries (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-10

5. Study Leader: I. Edwards (see NOR-12-06)
E. Harvey (see NOR-12-04)

6. Key Words: Nursery management workshop, accelerated growth, seedling prescriptions.

7. Location of Work: Pineland Forest Nursery (Hadashville), and Clearwater Forest Nursery (The Pas), Manitoba.

8. Study Objectives:

1. To hold a forest nursery management workshop to discuss specific Manitoba nursery problems.

2. To let and supervise a R & D contract to carry out research in order to devise seedling specifications for out planting on sites with severe vegetation competition.

9. Goals for 1984-85:

Nil - new study

10. Accomplishments in 1984-85:

Nil - new study

11. Goals for 1985-86:

Nil - first work to be undertaken in 1986-87

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

PYs: Prof.: 0.0

Tech.: 0.0

Term/Student: 0.0

Total: 0.0

O & M: 0.0

Capital: 0.0

14. Signatures:

Investigator

Supervisor

Investigator

District Manager

Technical Advisor

Program Director
(Forest Resources)

Program Director
(Development)

Regional Director

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	Total $
1.		Forest nursery management workshop (see 12-4MA) $10K CS			$10 K CS
2.		Provide technical advice to MFB for a contract to carry out research on the accelerated growth of white spruce for outplanting on difficult sites (see 12-5MA) $70 K CS	Continue. $70 K CS	Continue and Terminate. $70 K CS	$210 K CS
Total		$80 K CS	$70 K CS	$70 K CS	$220 K CS

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Forest Economics (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-11

5. Study Leader: Vacant/D.M. Boylen

6. Key Words: Northern employment development; economics of intensive forest management; cost effectiveness; damage appraisal; regulations and incentives; industrial structure; harvest scheduling.

7. Location of Work: Winnipeg District Office, Manitoba

8. Study Objectives:

   1. To identify meaningful employment opportunities which can be provided by the forestry sector for residents of northern Manitoba.

   2. To develop and implement an economic assessment framework for the purpose of providing guidelines to forest managers to ensure the most cost-effective use of funds in intensive forest management.

   3. To implement a damage appraisal and valuation system for the purpose of assessing values at risk and post fire economic impact.

   4. To assess the effect of various existing and potential incentives and regulations upon the forest industry within Manitoba.

   5. To determine the current size, structure and economic impact of the primary wood-using industries in Manitoba.

   6. To provide technology transfer in the application of recently developed procedures and techniques regarding decision-making aids designed to improve forest and timber management.

9. Goals for 1984-85:

   N/A, new studies

.../2

10. Accomplishments 1984-85:

N/A, planning meetings only

11. Goals for 1985-86:

1. Initiate contract work with socio-economic consultant to define size, scale and scope of northern Manitoba forestry work opportunities and community development, as well as assess applicable studies.

2. Begin to develop an interdisciplinary economic assessment framework, and work plan (in co-operation with Manitoba Natural Resources (MNR) and GLFRC, as required).

3. Review previous work done by MNR and national fire economist. Develop study proposal.

4. Initiate contract work with consultant on incentives and regulations which affect the efficient utilization of the forest resource.

5. Develop terms of reference for contract work. Tender contract. Consultant to finish field survey and initial complilation of data.

6. Initiate preliminary work with consultant (U of A) to determine feasibility of transferring decision making model procedures and techniques to MNR using Manitoba data.

7. Maintain liaison with Project Leader, Resource Economics and Statistics and staff to provide socio-economic, forestry, statistical and technology transfer information to various user groups.

12. Publications 1984-85:

N/A

13. Resources:

PY's : Prof. 1.0

O & M : $10,000
Capital : 0

Grants and Contributions: CFS $40,000/$40,000 MFB

.../3

14. Signatures:

Investigator

District Manager

Technical Advisor

Program Director
(Development)

Regional Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Forest Inventory (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-12

5. Study Leader: I. Bella (see NOR-4-01)

6. Key Words: Yields, permanent sample plots, growth models, natural stands, managed stand.

7. Location of Work: Winnipeg, throughout Manitoba

8. Study Objectives:

   1. To devise techniques for forecasting future yields in natural stands.

   2. To establish permanent sample plots (PSPs) to obtain ongoing growth data.

   3. To evaluate growth models, both for natural and damaged stands, to satisfy Manitoba's needs in yield forecasting and change data programs.

9. Goals for 1984-85:

   Nil - new study

10. Accomplishments in 1984-85:

    Nil - new study

11. Goals for 1985-86:

    1. To provide technical advise to Manitoba on the establishment of PSPs; and on the evaluation of growth models for both natural and managed stands.

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

PYs: Prof.: 0.0

Tech.: 0.0

Term/Student: 0.0

Total: 0.0

O & M: 0.0

Capital: 0.0

Grants & Contributions: CFS $20,000/$20,000 Manitoba

14. Signatures:

Investigator

Supervisor

Technical Advisor

District Manager

Program Director
(Forest Resources)

Program Director
(Development)

Regional Director

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	Total $
1.			Provide advise on forecasting yields for natural stands (see 4-5MA).	Continue and Terminate.	
			$60 K P	$60 K P	$120 K P
2.	Provide advise on establishing and measuring PSPs to obtain growth data. (see 4-5MA)	Continue.	Continue.	Continue and Terminate.	
	$10 K CS	$10 K P	$10 K P	$10 K P	$10 K CS $30 K P
3.	Provide advise on evaluating growth models for natural and managed stands. (see 4-5MA)	Continue.	Continue.	Continue and Termiante.	
	$30 K CS	$30 K P	$30 K P	$25 K P	$30 K CS $85 K P
Total	$40 K CS	$40 K P	$100 K P	$95 K P	$235 K P $ 40 K CS

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Development Agreements

2. Title: Tree Improvement (Manitoba)

3. New: X Cont.: 4. No.: NOR-36-13

5. Study Leader: J. Klein (see NOR-12-03)

6. Key Words: Tree improvement workshops, rooted cutting systems, white spruce, jack pine.

7. Location of Work: Pineland Forest Nursery (Hadashville)

8. Study Objectives:

   1. To hold two workshops on tree improvement techniques.

   2. To act as Scientific Authority for a R & D contract to carry out research on rooted cuttings systems for white spruce and jack pine.

9. Goals for 1984-85:

   Nil - new study

10. Accomplishments in 1984-85:

    Nil - new study

11. Goals for 1985-86:

    1. Conduct a workshop on tree improvement techniques with MFB tree improvement group.

12. Publications 1984-85:

Nil - new study

13. Resources 1985-86:

PYs: Prof.: 0.0

Tech.: 0.0

Term/Student: 0.0

Total: 0.0

O & M: 0.0

Capital: 0.0

Grants & Contributions: CFS $2500/$2500 Manitoba

14. Signatures:

J I Klein
Investigator

J. K. Edwards
Supervisor

Technical Advisor

District Manager

Program Director
(Forest Resources)

Program Director
(Development)

G. D. Tait
Regional Director

OPERATIONAL PLANS
1985-1989

Goals	1985-86	1986-87	1987-88	1988-89	Total $
1.	Conduct a workshop on tree improvement techniques (see 12 - 1MA).		Conduct a workshop on tree improvement techniques (see 12 - 1MA).		
	$5 K CS		$5 K CS		$10 K CS
2.		Act as Scientific authority for a contract to investigate rooted cutting systems for jack pine. (see 12 - 3MA)	Continue and Terminate (see 12 - 3MA)		
		$55 K CS	$55 K CS		$110 K CS
Total:	$5 K CS	$55 K CS	$60 K CS		$120 K CS

NOR-53

COMPUTING AND DATA PROCESSING SERVICES

375

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 29, 1985

1. Project: Computing and Data Processing Services

2. Title: Computing and data processing services

3. New: Cont.: X 4. No.: NOR-53-01 (NOR-53-804)

5. Study Leader: W. Chow

6. Key Words: Computer, data processing, programming, system analysis, graphics, mapping, statistical analysis, information retrieval, GIMMS, MARS, RAMS, database, PDP, VAX, word processors, telecommunications, personal computers, office automation, networking, local area networking

7. Location of Work: Edmonton

8. Study Objectives:

   1. To provide an up-to-date computer service, including data processing, programming, system analysis, computer modelling, mapping and graphics, information retrieval, personal computer evaluation, word processing evaluation and telecommunications evaluation, and to provide assistance with office automation.

9. Goals for 1984-85:

   1. Prepare yearly report on computer usage by individual researcher.

   2. Write or adapt programs and systems as required and provide documentation.

   3. Maintain and expand as necessary the stores system.

   4. Continue to develop, expand and maintain programs and systems as needed.

   5. Provide training and assistance as required with in-house courses.

   6. Provide keypunch and data entry services and backup and restore services as required by various projects.

7. Install, expand and maintain a local area network using the in-house telephone system if possible.

8. Install and assist as required with the personal computers; set up the personal computers in the local network when not being used by the owners.

9. Assist with the setup and networking of the word processors as required.

10. Install the VAX computer when received; attend training courses on the operation and management of the VAX; give in-house courses to potential users of the new system.

11. Investigate the word processing needs of the regional district offices and assist with the necessary networking so the lab, district offices and headquarters can all communicate with each other.

12. Attempt to keep current with all aspects of computing, word processors, personal computers and telecommunications by attending workshops, trade shows and reading trade magazines and literature and by attending meetings of the local computer groups (CIPS, DECUS, ACM).

13. Assist with the upgrading of the MARS mapping system; write programs as required for report generation; assist with the evaluation of proposals regarding usage of the mapping system by outside users; evaluate proposals for obtaining other mapping or image analysis systems.

14. Assist with the ENFOR project when required; assist with the purchase and modification of a visual editing terminal; install the terminal in the local network with an auto-dial modem; provide assistance and training in the use of the modem and terminal as required.

15. Install DATAPAC - a network for computing communications - and test.

16. Assist users with DATATRIEVE, MINITAB and RUNOFF as required for data bases, statistics and document editing respectively.

17. Attempt to increase the speed of data transfer from the PDP 11/03 and Nuclear Spectrometer to 9600 baud from 300 baud.

18. Construct a system for use with the vehicle section so they can get a report on vehicles as to servicing, reservations, mileage, etc.

10. Accomplishments in 1984-85:

1. Prepared yearly report for computer user meeting.

2. Wrote and adapted programs and systems as required and provided documentation.

3. Maintained and expanded the stores system.

4. Developed, expanded and maintained programs and systems as needed.

5. Provided training and assistance as required with in-house courses. Developed and gave the Rainbow PC course several times at NoFRC, Prince Alberta and Winnipeg. Arranged and attended the course to introduce staff to to the rollup program - PY's and issues.

6. Provided keypunch and data entry services and backup and restore services as required by various projects.

7. Installed, expanded and maintained a local area network using the in-house telephone system.

8. Installed and assisted with personal computers as required; developed and gave two PC courses - Rainbow and PRO 350. The PCs were so well used that we were unable to test them in the network and will add this to the goals for next year.

9. Assisted with the setup and networking of the word processors.

10. Installed the VAX computer; attended courses on the operation and management of the VAX; gave assistance with in-house computer-aided courses to potential users of the VAX. Attended the AFMAS and FACS courses at NoFRC. Attended a GIS meeting in Prince Albert as an advisor for the Agreements. Attended a SAS (statistics) course in Petawawa. Attended the fall US DECUS meeting to keep current with new releases. Attended the ITAC meeting for Computer Centre Managers.

11. Investigated the work processing needs of the district offices, but were forced to accept Rainbow PCs for their use. Installed the Rainbows in the district offices and set up telephone connections (by modem) so they could access the VAX or DATAPAC.

12. Attempted to keep current with all aspects of computing, word processing, personal computers, graphics, telecommunications, mapping systems and GIS by attending workshops, trade shows, by reading trade magazines and literature and by attending meetings of the local computer groups (CIPS, DECUS, ACM).

13. Wrote programs as required for MARS (mapping system) as required for report generation; assisted with the evaluation of proposals for use of the mapping system by other users; evaluated proposals to obtain other mapping or image analysis systems.

14. Assist with the ENFOR projects as required; assisted with the purchase and modification of a visual editing terminal which was later returned and a PC purchased as an alternative; provided assistance in the use of the PC and modem and a terminal in the new network; designed and installed a switch box for the terminal so it could access the VAX or the modem.

15. Acquisition of DATAPAC was put on hold until new guidelines are established by CFS headquarters and/or AgCan.

16. Assisted users with the various systems available on the VAX.

17. Speed increase was not required as the project was put on hold.

18. This goal was carried forward to next year.

- Courses on the VAX were attended by various computing centre staff.

- Several days were spent attending demonstrations and evaluating the many personal computers available. Single board PC's were looked at as an in-house alternative for the district offices and recommendations as to what is needed was prepared.

- Assistance was supplied to set up data bases for several researchers. Advice was given as to the merits of various PC's and peripherals; the Columbia PC's have been given a good workout and are in constant demand; the Rainbow PC's were tested and one is now in Prince Albert one in Winnipeg while the other remains at NoFRC.

- The use of the white phone system for local area networking has proceeded quite smoothly and with very little disruption to staff.

- The VAX 11/750 was installed with BASIC FORTRAN DATATRIEVE and MINITAB; the operating system is VMS 3.7. New versions of the system and languages have been received and installed.

- A prototype remote passive 8-channel data logger was designed and built. A production model was started and will be completed in the next year. Sensors for various readings - temperature, soil nutrients etc. - were made and evaluated; a computer system to control the data logger was developed as well - for NOR 28/03.

- We were quite involved with the workplan rollup system and spent 4 person-weeks getting the data gathered, corrected and entered for both the 1985-85 and 1985-86 years. There were errors in the program from Ottawa and this required 2 updates, so far, with another in the near future. When the updates were installed the system then had to be rerun. The Rainbow PC was borrowed from the agreements section for the work. We found the Rainbow and/or the system to be quite slow.

11. Goals for 1985-86:

1. Prepare yearly report on computer usage by individual researcher. Prepare the annual EDP report for headquarters and various other reports needed by AgCan. Assist users buying EDP products with the new AgCan justification statements. Maintained first line communications with the CFS senior coordinator in Ottawa using Agrinet and electronic mail. (53-5)

2. Write or adapt programs and systems as required and provide documentation Develop, expand and maintain programs and systems as needed. (53-3, 53-10, 53-11)

3. Maintain and expand as necessary the stores system. (53-13)

4. Continue with the study plan rollup and enter year end corrections. (53-5)

5. Provide training and assistance as required with in-house courses. (53-1)

6. Provide keypunch and data entry services and backup and restore services as required by various projects. (53-2)

7. Expand and maintain the local area network using the in-house telephone system. (53-9)

8. Install and assist as required with the personal computers; set up either a 'bridge' system on the VAX to emulate Rainbow PC's or an IBM compatible PC in the network with suitable terminals so several users can use the one PC; or both alternatives. (53-8)

9. Attend training courses for the VAX and language utilization and on the operation and management of the VAX; give in-house courses to potential users of the new system. Assist users with U of A computing needs as required. Keep current with new releases, with all systems - DEC, HP, AMDAHL. (53-1, 53-4)

10. Continue with assistance to the district offices regarding personal computers, data processing, word processing and telecommunications. Assist with the necessary networking so the lab, district offices and headquarters can all communicate with each other. (53-9)

11. Attempt to keep current with all aspects of computing, word processors, personal computers and telecommunications by attending workshops, trade shows and reading trade magazines and literature, by attending meetings of the local computer groups (CIPS, DECUS, ACM) and by attending courses as appropriate on the VAX. (53-4)

12. Involvement with the mapping system depends on funding being found. Assist with the upgrading of the MARS mapping system; write programs as required for report generation; assist with the evaluation of proposals regarding usage of the mapping system by outside users; evaluate proposals for obtaining other mapping or image analysis systems. Attend meetings and advise as needed regarding the GIS systems which may be purchased through the agreements. (53-7)

13. Assist with the ENFOR project when required. Continue with the construction and installation of the 8 channel data logger (NOR-28-030 (53-6)

14. Continue with the evaluation of national data transfer systems such as DATAPAC and ENVOY 100; meet with other computer centre managers from CFS to decide which type of network, if any, is needed in CFS. (53-9)

15. Assist users with DATATRIEVE, MINITAB and RUNOFF as required for data bases, statistics and document editing respectively. Help users with BASIC and FORTRAN as required. (53-1)

16. Assist, when needed, with the software packages for the various personal computers. Assist with installation of both the finance sections's new IBM PC system and personnel's terminal; both systems require outside connections and connections to the VAX. (53-8)

17. Construct a system for use with the vehicle section so they can get a report on vehicles as to servicing, reservations, mileage, etc., maintain contact with GLFRC as what they are developing for their fleet maintenance system and see if we could use their system. (53-13)

12. Publications 1984-85:

Nil

13. Resources 1985-86:

PYs:	Prof.:	Chow	1.0
		Tan	1.0
		Irwin	1.0
	Tech.:	Hai	1.0
	Term/Student:		0.9
	Total:		4.9

O & M: $75,000

Capital: Nil

14. Signatures:

Bill Chow
Investigator

J. M. Powell
Program Director

Regional Director

NOR-54

MANAGEMENT OF REGIONAL DEVELOPMENT PROGRAM

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1985-86

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1985

1. Project: Management of Regional Development Program

2. Title: Management of Regional Development Program

3. New: Cont.: X 4. No.: NOR-54-01 (NOR-54-128)

5. Study Leader: M. Heit

6. Key Words: Management, common support, economic development, agreements, prairie region

7. Location of Work: Western and Northern Region

8. Study Objectives:

   1. To manage the delivery of NWT, Manitoba, Saskatchewan, and Alberta Agreements and other sundry programs such as E2000.

   2. To facilitate and enable economics research.

   3. To partake in corporate management decisions for NoFRC as part of NoFRC Management Team.

9. Goals for 1984-85:

   1. Sign Canada-Alberta Agreement

   2. Sign Canada-Saskatchewan Agreement

   3. Implement Canada-Manitoba agreement as well as projects under the NWT agreement.

   4. Implement E2000 job creation programs.

   5. Direct economic research program.

10. Accomplishments in 1984-85:

1. Signed $23 million Canada-Alberta Agreement.

2. Signed $28 million Canada-Saskatchewan Agreement

3. Began the implementation of Canada-Manitoba Agreement as well as NWT, Saskatchewan and Alberta.

4. Delivered a $3.5 million job creation program which included creating 1100 jobs and 65 projects in forestry.

5. Established region wide economic needs through a Delphi panel of 100 participants, cleared up a number of outstanding obligations.

11. Goals for 1985-86:

1. To operationalize the Agreements into a federal-provincial delivery system and anticipated job creation programs.

2. To manage the portfolio contained under the Development Branch including the projects under the Agreements which are functionally directed elsewhere.

12. Publications 1984-85:

1. Canada-Saskatchewan Forest Resource Development Agreement and assorted Cabinet/Central Agency Documents.

2. Canada-Alberta Forest Resource Development Agreement and assorted Cabinet/Central Agency documents.

13. Resources 1985-86:

PYs: Prof.: Heit 1.0

Tech.: Nil

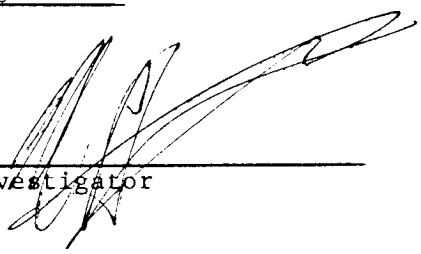
Term/Student: Nil

Total: 1.0

O & M: $25,000

Capital: Nil

14. Signatures:



Investigator

Regional Director