STUDY WORK PLANS

1989-90

NORTHERN FORESTRY CENTRE

FORESTRY CANADA

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EDMONTON, ALBERTA

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MARCH 1989

NORTHERN FORESTRY CENTRE

STUDY WORK PLANS, 1989-90

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CANADIAN FORESTRY SERVICE

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: Geographic Information Systems, Forest Inventory and Site

2. Title: Forest ecology and site productivity

3. New: Cont.: X 4. No.: NOR-02-01 (formerly NOR-10-06)

5. Study Leader: I.G.W. Corns

6. Key Words: GIS, Forest ecology, site productivity, forest soils, site modification, succession, ecological classification

7. Location of Work: Northwest Region

8. Problem:

The recent developments in GIS and remote sensing have presented on opportunity to use new and powerful tools to extend the applications of many of our forest research findings and to compare results from diverse disciplines within a common geographic framework. The increasing realization that many forest management opportunities and constraints are related to site type presents the possibility of their prediction and analysis using a site classification within a GIS, and in conjunction with remote sensing methods. Several aspects will be addressed by this study.

1. Recent GIS technology presents an opportunity to exploit GIS as a tool to relate site classification and other information (e.g., inventory, growth and yield) in a pilot project with a forest industry cooperator.

2. There is need for information on factors influencing forest growth and for new methodology for site evaluation and classification of boreal forest ecosystems.

3. Large scale pulpwood clearcuttng operations in Alberta foothills have resulted in large areas of young (25 yr.) forest. The rate and extent to which the productivity, structure and species composition of these forests is proceeding toward that of mature forest on similar situations is not well documented. An opportunity is thus available to increase our understanding of forest dynamics in the foothills. Such information can be used to interpret recently developed forest site classifications emphasizing mature forest vegetation.

4. Grass competition with white spruce seedlings in our region is recognized to be a major silvicultural problem. Mechanical site preparation is expensive and often not effective. Chemical methods have encountered resistance from environmental lobby groups. Reduction of grass competition by an alternative method may be attractive. (Carried over from NOR-10-06).

5. The importance of the major insect and disease agents upon lodgepole pine and jack pine survival and stand development on a variety of sites in western Alberta and southeastern Manitoba is as yet unknown. Such information should prove very useful in the management of such stands originating after clearcutting operations.

9. Study Objectives:

1. Quantification of site forest productivity relationships through multivariate analysis and GIS application.

2. To evaluate synthetic aperature radar (SAR) as a means to estimate tree biomass and discriminate and map site types.

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 evaluate MEIS imagery as a means to discriminate and map site types.

6. To determine the effect of site upon major insect and disease agents upon lodgepole pine and jack pine survival in west-central Alberta and southeastern Manitoba respectively.

7. To initiate a GIS - site classification pilot project with a forest industry cooperator in the Northwest Region.

8. To carry out technology transfer in site classification as it relates to forest management.

9. To provide leadership to the NOR-02 (GIS-FIS) project.

10. Goals for 1988-89:

1. Continue as Scientific Authority for Biogeoclimatic classification for Alberta Agreement. Terminate.

2. Supervise contract for the development and application of a forest site classification for Manitoba Agreement.

3. Prepare Journal article on characterization of highly productive white spruce sites in region. The study is focussing upon potentially manageable soil chemical and physical properties that might be modified on similar less productive sites.

4. Continue technology transfer related to field guide on Western Alberta Forest Ecosystems and their management.

5. Publish a journal article on forest succession 24 years after clear-cutting (Edson Forest). Terminate

6. Remeasure plots and prepare file report on study of effect of synthetic mulches to control grass. Initiated in Slave Lake Forest in 1987.

7. Serve as member of Alberta/Sask. Vegetation National Vegetation Working Group of Canada E.L.C. Committee.

8. Act as regional Scientific Authority for revised "Trees in Canada" book.

9. Cooperate with W. Ives in analysis of 1P mortality data on NOR-10-05 plots near Hinton.

10. Describe sites for remaining Fawcett Lake plots and provide input into data analysis as necessary.

11. Publish as member of editorial committee for SCALE, 13 papers in Forestry Chronicle including a paper authored by myself on the west-central Alberta site classification work.

12. Initiate a new study in cooperation with Canadian Centre for Remote Sensing using radar imagery to discriminate sites in Swan Hills Whitecourt area.

13. Prepare presentation on classification of aspen ecosystems for the Mixedwood Symposium in Edmonton, April 28, 1988.

14. Prepare presentation on aspen ecology for CIF annual meeting in Prince Albert, September 1988 and for subsequent publication in Forestry Chronicle.

Added Goals:

15. Prepare text for two interpretive signs for Huestis Demonstration Forest, Whitecourt, Alberta.

16. Prepare short course on Ecological Land Classification for Alberta Society of Professional Biologists, Calgary, September 29, 1988.

17. Chairman of Rocky Mtn. Section CIF Committee to evaluate the desirability of initiating a benchmark site project under CIF auspices with industry and provincial government cooperation.

11. Accomplishments in 1988-89:

1. Biogeoclimatic classification continued in Bow-Crow and Rocky-Clearwater forests. A draft field guide is due to be complete in July 1989.

2. Field work has been completed for the Manitoba site classification pilot project. Reporting for the second pilot area (Sandilands) will occur in Winnipeg in February (seminar) with final written report to be submitted in March.

3. No progress.

4. Several technology transfer activities were conducted in relation to the west-central Alberta field guide.

   a) Participated in the production of a video entitled "Ecological Site Classification - A Framework for Forest Management".

   b) Presented invited lecture to Silviculture 317 Class at University of Alberta. Topic was "Site classification systems in Canada.

   c) Presented invited lecture entitled "The importance of non-tree vegetation in forest management" to Environment Council of Alberta, Renewable Resources Committee.

5. Journal article was rejected by Can. J. For. Res. because reviewers thought it was too narrow in scope (i.e., results from only one site type). Plans are to revise and publish as information report or submit to another journal.

6. Seedlings at Slave Lake mulch plots were remeasured and statistical analyses are for 1988 measurements are nearly complete.

7. No activity.

8. Prototype formats were sent to "Trees in Canada" reviewers for comment. A meeting to review progress is planned for Ottawa during spring.

9. Little progress. Provided W. Ives with paper by J. Dumanski and J. Wright (Can. J. Soil Sci. 1973) which rated soil map units of Hinton area by productivity (based on permanent sample plots in mature pine forests). These soil groupings were subsequently used to stratify the pine mortality data. Other site-specific soil and vegetation data were provided to W. Ives. I believe there is still room for refinement of site-mortality relationships, possibly within a GIS framework.

10. Remaining Fawcett Lake white spruce release plots were classified and descriptions were provided to R. Yang and S. Lux.

11. The SCALE compendium of site classification work in Canada for Forestry Chronicle is still in preparation. Efforts were made to gather late contributions.

12. A new study was initiated in cooperation with F. Ahern, Canadian Centre for Remote Sensing. Air-borne radar imagery was secured and ground truthing done on about 25 plots in the Whitecourt- Swan Hills area.

13. A paper entitled "Site Classification and Productivity in the Boreal Mixedwood" was presented to the Mixedwood symposium in Edmonton, April 11-14, 1988.

14. A paper entitled "Ecosystems with potential for aspen management" was presented to the Ecology and Silviculture Working Groups session at the CIF Annual National Meeting in Prince Albert, September 1988, and published in the Forestry Chronicle, February 1989.

15. Prepared text for two interpretive signs for Huestis Demonstration Forest, Whitecourt.

16. Presented short course on Ecological Land Classification for Alberta Society of Professional Biologists, University of Calgary, September 19, 1988.

17. Was nominated chairman of Rocky Mtn. Section CIF Committee to evaluate the desirability of initiating a benchmark site project under CIF auspecies with industry and provincial government cooperation. The committee met in January to identify gaps and recommend a course of action to CIF council.

12. Present Status of Study:

The present study carries many goals over from NOR-10-06 and includes new goals appropriate to the NOR-02 project, including administrative duties related to project leadership. Research related to site classification and its technology transfer to clients will be central. A GIS pilot study with a forest industry cooperator is planned and once implemented, will help integrate other studies within NOR-02 as they address different aspects of a common problem.

13. Goals for 1989-90:

1. Prepare journal article or information report on characterization of highly productive white spruce sites in the region.

2. Publish paper in Forestry Chronicle: "Forest Site Classification in Alberta - Its Evolution and Present Status" to be included in compendium compiled by For. Can. Site Classification Working Group.

3. Revise and publish paper on plant succession 24 years after clearcutting in Alberta foothills as information report or journal article. Terminate

4. Continue as Scientific Authority on FRDA contract on Biogeoclimatic classification and field guide development for Bow Crow and Rocky-Clearwater forest districts. Terminate.

5. Continue evaluation of remote sensing methods in site classification.

   a) Cooperative study with Canada Centre for Remote Sensing to use radar imagery to estimate stand biomass and discriminate site.

   b) Evaluation of MEIS imagery to discriminate sites.

6. Continue monitoring and seedling growth measurements in study of synthetic mulches to control grass competition in Slave Lake forest.

7. Continue to serve as advisory committee member on projects related to GIS:

   a) AFS, GIS site classification pilot project.

   b) Alberta Research Council - FRDA contract to determine a common platform for GIS in Alberta in cooperation with AFS and forest industry.

8. CIF committee involvement:

   a) Chairmanship of national CIF Ecology Working Group.

   b) Chairmanship of RMS-CIF Committee to evaluate the desirability of initiating a benchmark sites project within RMS.

9. Continue to act as regional Scientific Authority for revised "Trees in Canada" book.

10. Continue to serve as member of Alberta-Saskatchewan National Vegetation Working Group of the Canada Ecological Land Classification Committee.

14. Publications 1988-89:

Corns, I.G.W. 1988. Compaction by forestry equipment and effects on coniferous seedling growth on four soils in Alberta foothills. Can. J. For. Res. 18:75-84.

Corns, I.G.W. 1988. Site classification and productivity in the Boreal Mixedwood. In J.K. Samoil ed. Proc. Sympos. Management and Utilization of Northern Mixedwoods. Can. For. Serv., North. For. Cent., Edmonton, Alberta, Info. Rep. NOR-X-296.

Corns, I.G.W. 1988. Ecological site classification - A framework for forest managment. Video (22 min). ForCan, North. For. Cent., Edmonton, Alberta.

Corns, I.G.W. 1989. Ecosystems with potential for aspen management. For. Chron. 65:16-22.

Knapik, L.J.; Russell, W.B.; Riddell, K.M.; Stevens, N. 1988. Forest ecosystem classification and land system mapping pilot project Duck Mountain, Manitoba. Canada-Manitoba FRDA Report, Contract No. 01K45-7-0031.

La Roi, G.H.; Strong, W.L.; Pluth, D.J. 1988. Understory plant community classifications as predictors of forest site quality for lodgepole pine and white spruce in west-central Alberta. Can. J. For. Res. 18:875-887. (Outcome of PRUF contract to La Roi and Pluth).

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of the following clarifications given by by the study and project leaders, the committee concludes that no further screening action is required:

With respect to goal 4 for 1985/86 (soil modification during logging and site preparation) the study indicates that summer logging on several soil types in west-central Alberta has resulted in long lasting (24 years) soil bulk density increases (up to 48%). Seedlings grown in the greenhouse upon soils reconstructed to field bulk density levels showed significantly reduced growth compared to growth on soils with bulk densities approximately uncut controls. The study was reviewed by the NoFC environmental screening committee.

16. Duration:

Start: 1984 Completion:

17. Resources 1989-90:

A-base

Alberta FRDA'S

PYs: Prof.: Corns 1.0
Tech.: Allan 1.0

Total: 2.0

Term/Student: 0.3

O & M: $10.0 K 51.0 K

Capital: $9.5

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28 1989

1. Project: Geographic Information Systems, Forest Inventory and Site

2. Title: Interpretation and mapping

3. New: Cont.: X 4. No.: NOR-2-03 (formerly NOR-4-06)

5. Study Leader: W.C. Moore

6. Key Words: Inventory, ecosystem, remote sensing, mensuration, Alberta Forest Service (AFS), Canada Centre for Remote Sensing (CCRS), Geographic Information System (GIS), Forestry Canada (FC) and Research and Development Accomplishments (RDA)

7. Location of Work: Northwest Region

8. Problem Analysis:

Forest demand, ecological concerns, remote sensing technologies, and GIS developments to support decision-making have all increased in importance in the past decade. Public concerns with the first two factors appear to have generated requirements for the latter two for the efficient management of forest lands in particular. Forestry Canada remote sensing applications research is particularly appropriate for determining optimum means of producing up-to-date area information for GIS data bases, and for developing new information for the monitoring and appraisal of forest resources in cooperation with governments, industries and academic institutions.

9. Study Objectives:

1. To provide advice and prescriptions by analyzing, developing, coordinating and applying regionally unique forest interpretation and mapping methods for appraising and monitoring changes in the forest resource in an efficient manner in collaboration with NoFC colleagues, federal agencies, provincial governments, educational institutions and industries.

2. To support GIS and Site, Forest Ecology and Soils, Silviculture and Environmental Impacts research and development.

10. Goals for 1988-89:

1. Assist R. Newstead for one-half year in the development and completion of the Research and Development Evaluation Study.

2. Provide advisory services, seminars and presentations to colleagues and clients as required on remote sensing and mapping.

3. Co-author a journal paper with R. Hall on cutover analyses using Procom procom with satellite imagery, digitizer and microcomputer combination.

4. Publish a co-authored journal paper with R. Nesby on reconnaissance mapping of Aspen Parklands.

5. Co-author and publish journal paper on hardwood species differentiation from aerial photography based on contractor's report.

6. Evaluate TM and other sensors for a high level of stratification for the next phase of natural resources inventory.

7. Publish a journal paper on Landsat TM imagery band combinations for interpretation for forestry in the Region.

Added Goal:

8. Coordinate ER-2 high altitude aircraft demonstration flight over Alberta under the Canada-United States MOU for Forestry.

11. Accomplishments in 1988-89:

1. Bulk of the work in the R & D Evaluation study has been completed; the reporting stage has begun. Overall, researchers do not appear to rate their work as highly as do clients, and the estimated benefits for only a few accomplishments would cover all NoFC costs.

2. Coordinated very successful ER-2 high altitude aircraft presentation and training workshop by U.S. Forest Service experts for the AFS and others under Canada-United States MOU for forestry.
3. Procom-2 mapping of selected cutovers from Landsat imagery has been completed for the digitizer and microcomputer analyses by R. Hall.

4. Reconnaissance mapping of Aspen Parklands has been deferred.

5. Hardwood species differentiation with airphotos has been deferred.

6. Research emphasis for forest stratification evaluations has shifted from Landsat TM imagery to ER-2 systems applications.

7. Landsat TM imagery band combinations for forest interpretation, or stratification for inventory updates, to be combined with "6" above.

8. Arranged demonstration ER-2 flight under the Canada-Alberta FRDA and the Canada-United States MOU for Forestry.

12. Present Status of Study:

1a. Develop, demontstrate and transfer Procom-2 image interpretation and mapping system technology to Regional authorities for economic forest reconnaissance mapping and/or forest inventory area depletion updating in a timely and efficient manner.

Start: 1983 Completed (Revised): 1988

1b. Assist in the completion of NoFC research and development evaluation.

Start: 1987 Complete: 1989

2. Develop and transfer technology of NASA ER-2 aircraft operations for base map and natural resources (principally forest) inventory map updating as GIS inputs throughout the Region.

Start: 1988 Complete: 1992

Progress to 1988:

1. The hardware and software of ENFOR GIS at NoFC has been operationally used to digitize example forest inventory maps from each of the four political jurisdictions within the region; appropriate stand and stock tables were entered for biomass computations and mapping; and, paper, "Computer mapping for biomass inventories", was presented at the Sixth Iinternational Symposium on Automated Cartography in 1983. Information Report, NOR-X-285, "A mapping and analysis of resources system application", was published in 1987.

2. Initiated a GIS information exchange meeting for regional forest inventory authorities in Prince Albert with Regional Development Program support, which enhanced provincial GIS implementation for forestry.

3. Served on the GIS R&D Sub-Committee to the Alberta Energy and Natural Resources Ministerial Advisory Committee, and participated in the preparation of recommendations for the Final Report.

4. Completed ENFOR contract supervision for non-inventoried forest land sampling across the Region, and proposed/completed supplementary work for prairie forest land area determinations from Landsat imagery.

5. Demonstrated change monitoring techniques with Procom-2 Landsat imagery interpretation and mapping equipment at Alberta and Saskatchewan work-shops in Edmonton and Saskatoon, as well as presenting such techniques to international visitors at NoFC. Presentations in Winnipeg and Yellowknife followed (1987/88). Forest Management Note, No. 32, "Procom-2 mapping technique for monitoring forest depletion", was published in 1986.

6. Job creation through participation as a manager in the Environment 2000 Program provided a supervisor and eight assistants to reproduce Northwest Territories summary forest inventory maps and to provide manpower assistance for joint projects at AFS and NoFC.

7. Participated as an active member of both the ForCan Working Group on Remote Sensing and the Alberta Advisory Committee on Remote Sensing, which included serving on the Organizing Committee for the Tenth Canadian Symposium on Remote Sensing.

8. Paper, "Mapping of burned forest lands in the Northwest Territories", was presented to the 5th Annual Northwest Conference on Survey and Mapping at Whistler, B.C., in 1987; it is now a File Report at NoFC.

13. Goals for 1989-90:

1. Complete R & D Evaluation reporting with R. Newstead.

2. Coordinate ER-2 flying in the Region under the Canada-United States MOU as appropriate, and shift contracting responsibilities to Provincial/Territorial agencies as technology transfer.

3. Co-author and publish journal paper on hardwood species differentiation from aerial photography based on contractor's report.

4. Co-author a journal paper with R. Hall on cutover analyses using Procom with satellite imagery, digitizer and microcomputer combination.

5. Co-author and publish a journal paper with R. Nesby on reconnaissance mapping of Aspen Parklands.

6. Publish a journal paper on Landsat TM imagery band combinations for interpretation for forestry in the Region.

14. Publications 1988-89:

nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the Study Leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1983 Estimated Completion: 1992

PYs: Prof.: Moore 1.0
Tech.: 0.0

Total: 1.0

Term/Student: 0.0

O & M: $4,000

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: GIS, Forest Inventory and Site

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

3. New: Cont.: X 4. No.: NOR-02-04 (formerly NOR-4-07)

5. Study Leader: R.J. Hall

6. Key Words: inventory, mensuration, remote sensing, geographic information systems, pest damage, vegetation damage, yield, large-scale photography (LSP), aerial photography, photogrammetry, satellite imagery, digital image analysis, statistical analysis, technology transfer, microcomputers

7. Location of Work: Northwest Region and Yukon Territory

8. Problem Analysis:

Rising costs in acquiring inventory data for both mensuration and monitoring of pest damage, have resulted in a need to develop cost-effective systems or techniques, to replace or augment conventional ground surveys. This calls for the development, regional adaptation, and modification of systems, both hardware and software, to provide user agencies with the tools to more efficiently acquire and interpret resource inventory data. Remote sensing techniques, particularly the use of large-scale aerial photos and digital analyses, are playing increasing roles in inventory surveys. In addition, beyond investigations of image data from new resource satellites and airborne scanners, consideration needs to be given for possible integration into Geographic Information Systems (GIS). Challanges are in integrating systems design and adapting new techniques for regional inventory applications and technology transfer.

Progress and Achievements: Up to Prior Year

1. A computer-based, large-scale, aerial camera system has been developed. A second system was built for Yukon NAP and training & assistance was provided. The computer camera control system is now being marketed and the possibility of licensing is being pursued.

2. LSP applications development work have included regeneration assessments, timber inventory, slash volumes on cutovers, log pile volumes on millyards, and comparison of existing models for estimating dbh. Regeneration assessment methodology was adapted for Sask/Weyerhaeuser project, work on optimizing exposure/processing parameters has been undertaken, and preparations begun for evaluation of jack pine budworm damage appraisal.

3. Computer-based photo measurement system constructed and much measurement/analysis software has been written. Several programs have been transferred to client agencies upon request and summary reports are being prepared for publication. IBM PC compatible has been integrated into the Project.

4. Both analogue and digital image analysis techniques have been developed or applied to regional projects: pest damage (tent caterpillar), clearcut mapping, and broad forest covertype mapping. Special image enhancements using MEIS data for covertype discrimination has been completed, with adaptation for bpop/taspen initiated. There is increasing activity and enquiries for applications as these high technology developments continue.

5. There has been participation in numerous seminars, workshops, courses, symposia, and committees. Examples of committee participation have included the Forestry Working Group of the Canadian Advisory Committee on Remote Sensing, ForCan Remote Sensing Working Group, Scientific & Technical Committee of 9th Cdn. Symposium on Remote Sensing, and Organizing Committee of 10th Cdn. Symposium on Remote Sensing. 15 reports have been published and 5 file reports written.

6. Contribution made to the 3rd editon of Forest Inventory Terminology.

7. Comprehensive statistical evaluation of various remote sensing media for forest cutover mapping initiated with several cooperators (AFS, CCRS, Intera).

9. Study Objectives:

1. To assess, develop and apply new remote sensing & interpretation (digital image analysis, large-scale photo) techniques in the inventory and monitoring of forest resources in the region, with consideration for GIS integration.

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

3. To enhance and maintain a comprehensive image acquisition, image analysis, and GIS laboratory for cooperative studies.

10. Goals 1988-89:

1. LSP applications work with Alberta Forestry: Handle m/s reviews from paper "A comparison of existing models for dbh estimation from large-scale photos." From light meter project, complete data compilation/analysis, and prepare m/s on optimizing exposure/parameters for LSP.

2. M/S reviews from paper "Spectral classes and forest classification".

3. M/S reviews from paper "Accuracy of cutover areas from Landsat imagery", and extend same cutovers to evaluation of positional accuracy.

4. Camera system activity: handle m/s reviews of camera control system paper. Undertake 1 further week of training to Yukon on LSP camera system, and provide final year of troubleshooting as required. Maintain NoFC camera system, and transfer flight planning program to Commodore camera control system.

5. Prepare research proposal on modelling jack pine damage for Sask. Agreement Funding with J. Volney. Initiate project if funds approved under Canada-Saskatchewan Agreement: acquire LSP and conduct field work for estimating volume loss & stem analysis; order multidate Landsat TM data and prepare flight plan for contract aerial photography. This project is basis for PhD plans in 1989 - submit leave request to NoFC Program Director.

6. Analyze interpreter results and draft m/s on mixedwood forest cover discrimination with MEIS II data. Continue follow-through work for balsam poplar/trembling aspen discrimination if micro system approved.

7. Prepare Forestry Chronicle paper on results from Sask. regeneration project with Dendron Resource Surveys Ltd. Duplicate ground/LSP plots for NoFC record and conduct technology transfer if warranted.

8. Final preparations for LSP review paper with Spencer.

9. Provide advisory services in remote sensing and forest inventory to NoFC clients and colleagues as required.

10. Continue to write, update, and modify microcomputer programs for in-house use and for clients in ccoperative projects (e.g., modify LSP program for jack pine budworm project). Maintain photo measurement system [Inf. Rep. on programs in preparation but not high priority]

11. Accomplishments in 1988-89:

1. M/S "A comparison of existing models for dbh estimation from large-scale photos" completed internal review and submitted to journal. From light meter project, data compilation and

analysis completed and draft M/S " Determination of optimal exposure/processing parameters for LSP" prepared.

2. M/S "Spectral classes and forest classification" returned from journal. Reviews could not fault technical merits of proposed philosophy but requested a detailed sample application prior to acceptance. A mini-study with GIS/remote sensing application has therefore been initiated for TM classification in the Whitecourt Area in cooperation with AFS Forest Statistics Section. Accuracy analysis and statistics generation to be done using GIS and SAS with completion planned for March 31/89. Paper will then be revised and resubmitted.

3. Project extended to incorporate evaluation of positional accuracy. Analysis completed and results include areal errors of 8.8% for TM, 10.5% for MSS, and 11.6% for AFS methods. Mean boundary placement errors were -11.4m TM, -13.2m MSS, and -14m AFS. M/S "Statistical evaluation of cutover mapping accuracy from Landsat imagery" prepared and submitted to review.

4. Camera system activity: M/S "A microcomputer-based camera control system for aerial photography" completed and submitted to review. Due to change in camera operator for Yukon camera system, additional training and troubleshooting were provided. This effort expended 1 man-month of 0204 study time. NoFC camera system maintained as needed, and refinements were incorporated or identified. PNFI cameras and lenses were checked and some parts were used as necessary. Flight planning program not transferred to Commordore due to departure of Remote Sensing Technician. Camera system was employed for jack pine budworm project and for fire operation project with NOR-05-02 (Ogilvie) in cooperative work with GLFC in Ontario.

5. Research proposal prepared and Canada-Saskatchewan FRDA project through J. Volney (NOR 36-03) approved. LSP, aerial photos and multidate Landsat TM imagery acquired. Field work initiated with 25 paired photo-ground plots. 326 trees were sampled over the Torch River Provincial Forest of which 196 had evidence of dead tops. 52 trees were removed for stem analysis and determination of volume loss. Plot data will be used for both LSP work and as point data for GIS spatial modelling.

   Long-Term Training submission prepared and submitted. Approvals received from NoFC and ForCan HQ. Awaiting Treasury Board Response. University application for Ph.D graduate studies was also completed and submitted.

6. Two weeks of ground and aerial surveys were undertaken. Mixedwood enhancements of MEIS data completed but interpretation test procedure awaiting response from PNFI. Hardwood discrimination enhancements completed but preliminary results suggest birch separable from poplars and aspen/balsam poplar not separable. Due to upcoming PHD studies and delays from PNFI, methodology and

project results will be summarized and PNFI will be undertaking responsibility for M/S prep.

7. Selective ground/photo plots were duplicated for NoFC record. Results have been used in several presentations to discuss the current state of technology for regeneration survey purposes. M/S on Sask. FRDA regen survey results has not been completed due to work on other goals, particularly advisory services and set up of image analysis and GIS laboratory. Goal to be repeated and draft will be attempted by March 31, 1989.

8. LSP review paper with Spencer published and disseminated.

9. Advice and assistance provided to clients and colleagues as required, and 5 manuscripts for ForCan and Journal reviews were completed. Significant activities include:

- member of ForCan Remote Sensing Working Group;
- supervised Intera UP contract with CCRS (including methods, technical guidance) on "Evaluation of STAR-1 synthetic aperture radar imagery for mapping clearcuts";
- participated as member of AFLW micro-based GIS Benchmark Evaluation team;
- assistance and provision of technical information to Dr. S. Pickford, visiting scientist on STEP program with Fire Project;
- consultations, acquired imagery, and technical assistance to T. Williamson (NOR-3-03) on evaluation of Elan Fire;
- calculations, research, and advice to Silvacom on AFLW contract for photogrammetric implications of interpreting height class from 1:20 000 photos;
- Parks Canada Alta, BC, Sask: flight plan design, update photography, GIS/remote sensing integration (DIPIX-Tydac);
- conducted mini workshop with L. Brace for AFS and several Alta. Forest Companies on "Forest Inventory in Mixedwood Stands";
- consultations to Bercha & Associates and Itres Research on new instrumentation for remote sensing and inventory;
- gave invited presentation under Canada-Nova Scotia FRDA on future of aerial photography for Nova Scotia forestry to provincial managers and several forest companies;
- attended 2 courses: PC hardware maintenance and SAR with remote sensing applications;
- supervising Intera contract on "Evaluation of SPOT imagery for cutover mapping";
- reviewed GNWT PC and GIS capital request.

10. Acquisition of hardware and software for comprehensive image analysis and GIS laboratory. Due to the range of hardware components and software packages, significant efforts for operation and troubleshooting were needed. Organized Tydac GIS training course for several NoFC staff and attended PCI and PAMAP training courses. M/S "Two-way ASCII file transfers between HP and IBM microcomputers" prepared with term support and submitted to review. Inf. Rep. "A compendium of HP computer programs for remote

sensing and forest inventory" in preparation and draft slated for March 31, 1989.

12. Present Status of Study:

LSP camera system is being maintained and possibility of licensing is being evaluated by CPDL. Technical and logistical assistance is still being provided to Yukon NAP. LSP applications work: a comparison of existing regression models for estimating stem dbh has been complete for AFS; optimal photo exposure/processing parameters are being defined for AFLW; and a new study was initiated to determine the feasibility of estimating damage (length of dead tops, volume loss) from jack pine budworm. Rigorous statistical evaluations are being conducted in cooperation with the Canada Centre for Remote Sensing and Intera to define accuracy limits of various remote sensing media for mapping clearcuts (Landsat TM, MSS, airborne X,C band radar, SPOT). Digital image enhancements of high resolution MEIS imagery has been completed for forest cover interpretation with further progress and reporting pending contribution from PNFI. HP program reports are in preparation and a comprehensive remote sensing/GIS laboratory is being established. Credibility of Study has been enhanced with significant extension activities in the past year. Longer Term Training submission has been completed for pursuing a PhD in GIS and remote sensing integration for spatial modelling of pest damage.

13. Goals for 1989-90:

1. LSP activity: journal reviews for M/S "A comparison of existing models for dbh estimation from large-scale photos". Submit M/S "Determination of optimal exposure/processing parameters for LSP" to review.

2. Handle M/S reviews from paper "Statistical evaluation of cutover mapping accuracy from Landsat imagery" and final contract supervisory responsibilities of Intera SPOT contract for mapping cutovers.

3. Develop/maintain remote sensing/GIS laboratory, incorporate new project PC if approved and initiate phase-out of HP microcomputers Maintain photo measurement system. Complete M/S and handle reviews with Kruger on 2-way ASCII file transfers and HP computer program Inf. Rep.

4. Maintain NoFC LSP camera system and handle M/S reviews from paper "A microcomputer-based camera control system for aerial photography."

5. Start PHD program if LTT submission approved. Initiate jack pine budworm damage appraisal project - measure and process stem analysis data, conduct photo measurements, summarize field data, produce maps from aerial photos, initiate image analysis and acquire data for GIS analysis.

6. Provide advisory services in remote sensing, forest inventory and GIS to NoFC clients and colleagues as required.

7. Complete paper on results from Sask. regeneration project with Dendron if time permits.

8. Summarize MEIS enhancement methodology and project results for PNFI as they will be undertaking responsibility for M/S preparation.

9. Revise M/S "Spectral classes and forest classification" with results from Landsat TM and GIS analysis and resubmit to journal or revise as Inf. Rep. depending on time.

14. Publications 1988-89:

Spencer, R.D.; Hall. R.J. 1988. Canadian large-scale aerial photographic systems (LSP). Photogramm. Eng. & Remote Sensing 54(4): 475-482.

Intera Environmental Consultants. 1988. Evaluation of Star-1 Radar Imagery for Forestry Applications. UP No. I7-007.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1981 Estimated Completion: 1995

17. Resources 1989-90:

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

O & M: $ 20.0 K

Capital: $27.6 K

18. Signatures:

Ron Hall
Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: GIS: Forest Inventory and site productivity

2. Title: Ecological and site processes: modelling site productivity and the effects of different forest management alternatives.

3. New: X Cont.: 4. No.: NOR-02-05

5. Study Leaders: M.J. Apps, H. Grewal

6. Key Words: Ecosystem modelling, resource management modelling, nutrient cycling, nutrient dynamics, mixedwood, aspen, artificial intelligence, AI, GIS, biogeoclimatic, site productivity, site classification, climate change, Greenhouse effect, FORCYTE, STEMS

7. Location of Work: Northwest Region

8. Statement of Problem:

Preface: This is a new study incorporating many of the goals of NOR 12-07 (Ecosystem and nutrient cycling modelling) as well as some of NOR 04-02. While the former study was primarily focussed on the FORCYTE-11 model and the ecological factors included in that model, the new study more specifically addresses resource management questions based on these and other ecological factors within the framework of the new project of GIS: forest inventory and site productivity.

Regional background problem analysis:

A. The forests in the region served by NoFC are currently in a period of unprecedented change. This change introduces stresses which affect the biological, geological and climatic variables which in turn determine the future growth of the forest resource. The sources of these changes are both due to man's activities: the rapidly changing forest management practises has a direct affect, while the changes in the natural environment associated with the "enhanced greenhouse effect" are indirect.

a. With respect to changing management practises, this region has witnessed a continuing explosive forest sector growth over the past few months and years. This has been accompanied by, and partly due to, a **rapidly changing forest technology** (e.g. the two CTMP mills with the ability to process a wider range of species; the successful use of aspen in OSB plants). A consequent and simultaneous change in the **"paradigm" of the forest ecosystem resource** has occurred, as exemplified by the change in status of aspen from a "weed" to an "economic" species. These changes in our view of the forest resource are manifested as changes in

   - **utilization** - both in quality and quantity (e.g. aspen feed for both pulp and OSB plants in Alberta and the "whole forest" utilization plans in Saskatchewan),
   - **regeneration** approaches (e.g. the current debates over softwood, hardwood, and mixedwood areas); and
   - **silvicultural** strategies applied (e.g. intensively managed plantations and vegetation management).

   In each instance these changes in resource management practise **consequently affect the future growing conditions.**

b. With respect to potential changes associated with the "enhanced greenhouse effect", the region served by NoFC is potentially **more affected by the forcasted climate warming** than any in Canada: by the year 2030, at least one model predicts a 10 ^{0}C increase in mean temperature over the region and a decrease in soil moisture of up to 50%. Some predictions are even more dramatic. Even if these predictions eventually prove to be in error in magnitude or timing, their potential impact on the forests of the region are so significant that a synthesis of existing knowledge base (and where needed, development of new knowledge) must be started now to avoid potential "future shock".

B. The resultant effects on the growth on the future forest associated with the above will have major influence on a wide range of forestry management issues: including for example, policy issues such as AAC and sustainabilty, wood supply analysis in an uncertain future, wood quality under different management regimes, environmental questions of short- and long-term site productivity changes, operational and strategic plans for regeneration (species, methods, etc) and silvicultural practises - and many others.

As an aid to the decision maker faced with the changing future, **estimates of future forest productivity** under the postulated different future conditions (whether caused directly by forest management or indirectly by climatic or other "natural" variations) are needed. So armed with the best technical forcasts the current scientific knowledge base can provide, he will be in a better position to make the choices which better suit his particular goals, be it corporate or policy.

The underlying approach of this study is to use modelling of ecosystem processes to improve our ability to forcast changes in forest productivity under changing growth conditions. This will require the development of methods of dealing with changes in the various biogeoclimatic variables and the way they are reflected in forest growth. This will be done by building on the experience gained with FORCYTE-11. This model provides some of the necessary integration of scientific knowledge base by incorporating forest managment influences on site nutrient cycling and competition for light and forcasting the resultant changes in a range of forest productivity measures. Other driving variables which must be added include both temperature and moisture; variables which are influenced both by silvicultural and by the enhanced greenhouse effect.

The motivating objective in this work is to integrate these model concepts into user-friendly management tools which can be used to assist forest decision makers in choosing between alternative resource management strategies. To be effective, this will necessitate working closely with the targeted users in designing these tools. It is clear that these tools will therefore be intrinsically connected with, and make strong demands on, the new technologies of GIS and expert\artificial intelligence systems. It will therefore be essential that personnel within the study develop increased competency in both these areas.

9. Study Objectives:

1. To develop methods of integrating existing ecosystem knowledge to forcast changes in growth determining variables (nutrients, light, moisture, temperature, and others) which are caused by resource management and natural environmental changes.

2. To develop methods of relating the response of the forest ecosystem to changes in these variables, with particular emphasis on forest site productivity.

3. To assemble user friendly tools which translate these predictions into readily interpreted results for use in forest resource management decisions, by developing and maintaining expertise in the latest modelling technologies (including GIS and artificial intelligence systems).

10. Goals for 1988-89:

TRANSFERRED FROM NOR 12-07:

1. Participate in the Northern Mixedwood Symposium, Edmonton, April 11-14, 1988.

2. Attend IUFRO Conference on "Forest Growth: Process Modelling of Responses to Environmental Stress", Alabama, April, 1988.

3. Participate in International Symposium "Resource Technology 88: Advanced Technology in Natural Resource Management", Colorado, June, 1988.

4. Collaborate with ForCan users of FORCYTE and U. British Columbia (UBC) researchers in constructing a benchmark FORCYTE-11 model. Establish and closely coordinate contracts for the required development of the software components.

5. Upgrade the FORCYTE-10 Douglas Fir/Red Alder calibration data set to provide a coniferous development/demonstration data set for FORCYTE-11.

6. Arrange the documentation of processes and assumptions underlying the FORCYTE-11 benchmark model by establishing and monitoring a suitable contract(s) with Prof. J.P. Kimmins.

7. Continue the development of user friendly utilities for use with FORCYTE for both single and multiple run simulations.

8. Develop increased field and practical knowledge of current forestry management and research activities by assisting other NoFC scientists in their field work as circumstances allow.

9. Continue to maintain communication and collaboration where appropriate with other Canadian FORCYTE users.

10. Participate in IUFRO Symposium "Forest Simulation Systems", California, Nov 2-5, 1988

11. Continue to evaluate potential applications of ecosystem modelling (including FORCYTE) to regional forestry issues and to participate in such opportunities as they arise.

Added Goals:

12. Upgrade knowledge of Geographic Information Systems by attending a GIS Training course. (Apps)

13. Upgrade skills in the use of computer models for adaptive management by attending training course: "Computer Models in Resource Mangement". (Apps)

14. Participate in seminars on Global Climatic change due to the Enhance Greenhouse effect and its effect on forestry in the region. (Apps)

15. Participate in the CPC-10 field trip and workshop "Research Strategies for Long-term Site Productivity". (Apps)

16. Organize and participate in the second ForCan FORCYTE User's Workshop at PNFI September, 1988. (Apps, Grewal)

11. Accomplishments in 1988-89:

TRANSFERRED FROM NOR 12-07:

1. Participated in the Northern Mixedwood Symposium.

2. Participated in the IUFRO Conference on "Forest Growth: Modelling of Responses to Environmental Stress".

3. Presented a poster paper entitled "Simulating the Consequences of Today's Management Decisions for Tomorrow's Forest Ecosystems on a Microcomputer" at the International Symposium "Resource Technology 88".

4. Contract established with UBC. A prototype benchmark version of FORCYTE-11 was subjected to initial technical evaluation at the FORCYTE User's workshop at PNFI in September, 1988. A final version of the model is expected to be released for detailed testing prior to March 15, 1989.

5. A Douglas fir/red alder calibration is being completed under contract at UBC and a preliminary report was recieved in early summer of 1988. A final data set is expected to be completed by 15 March 1989.

6. A contract was established with Prof. J.P. Kimmins. A draft Users Guide for FORCYTE-11.4 has been recieved and several conference/journal papers submitted or published.

7. This goal has been met with a new release of PROBE and the structural development of an output results and display manager for FORCYTE analysis.

8. Opportunties to assist other NoFC scientists with their field work to gain practical experience did not arise: however participation in a number of valuable field trips did occur including: a three day field trip to forests of Vancouver Island and Northwestern Washington with a group of ecologists of the CPC-10 group (Long-term Site Productivity - see goal 15), a tour of the PNFI experimental plots at Petawawa (associated with the Advances in Forestry Research Seminar), a tour of the Scott paper logging operations and pine plantations (part of the Forest Growth conference - goal 2), and a tour of several of the new operations in the Whitecourt and Hinton areas (including the new Whitecourt CTMP mill)

9. A number of meetings and workshops were held as well as the establishment of an EMAIL network between the various ForCan, UBC and other FORCYTE users.

10. Two manuscripts were submitted for the proceedings and two poster presentations made at the IUFRO Symposium "Forest Simulation Systems", Berkeley , Sept 1988:

a. "Using a Traditional Growth and Yield Model (STEMS) to Drive a Management Simulator (FORCYTE-11)", H. Grewal, M. Apps, and D. MacIsaac

b. "Predicting the Yield and Economic Returns of Forest Management in a Changing and Uncertain Future: The Hybrid Simulation Approach and its Representation in FORCYTE-11", J.P. Kimmins et al. (M. Apps, one of the co-authors).

11. A series of interviews with various forest resource decision makers and planners were held as part of a contract with Western Ecological Services to ascertain the potential role of FORCYTE-11 as a management tool in the region. A contractors report entitled "Boreal Mixedwood Forest Management Challenges: Do Ecosystem models such as FORCYTE-11 Have a Role?" has been reviewed and an ENFOR Report is in preparation.

12. Completed a one week SPANS training course at NoFC.

13. Completed one week training seminar "Use of Computer Simulation Models in Resource Management" at the Banff School of Management, Dec 11-17, 1988.

14. Participated in the workshop "Climatic Change Information Exchange Meeting" at UBC, October 1988, and made a presentation "Greenhouse Effect and Climatic Change" at a similar meeting at NoFC, Dec 1988.

15. Participated in the CPC-10 ("The Nutritional Consequences of Intensive Forest Harvesting on Site Productivity") field trip to Vancouver Island and Northern Washington State and the first 2 days of discussion.

16. Organized and participated in a 4 day workshop at PNFI attended by all ForCan and active Canadian users of the FORCYTE model. Proceedings are in preparation for publication as an ENFOR report (Editor M.J. Apps).

12. Present Status of Study:

This is a new study: its relationship to the earlier study (NOR 12-07) is discussed in the preface to section 8.

13. Goals for 1989-90:

1. Participate in the 6th Canadian Bioenergy R&D Seminar at Ottawa in April. Five poster abstracts have been submitted based on the FORCYTE-11 model; as follows:

Grewal, H.; Apps, M.J.; MacIsaac, D.A.
MacIsaac, D.A.; Apps, M.J.; Kurz, W.A.
Peterson, E.B.; Apps, M.J.
Sachs, D.; Kimmins, J.P.; Apps, M.J.
Kimmins, J.P.; Scoullar, K.A.; Apps, M.J.; Kurz, W.A.

Papers based on these posters will be prepared for the proceedings. (Apps/Grewal, Continued from NOR 12-07)

2. Participate in the Forest Modelling Symposium, Sasakatoon, 14 - 15 March, 1989. (Apps/Grewal)

3. Coordinate technical evaluation of FORCYTE-11 at NoFC, PFC, and NeFC by organizing and participating in User's group Workshop(s) (PNFI, April; TBA, Sept), and performing sensitivity analysis relating to the three regional calibrations of the model. Prepare report on results for publication as an ENFOR Report and/or Journal manuscript. (Apps/Grewal) (Continued from NOR-12-07. ENFOR funded; see NOR 28-06)

4. Continue the adaptation of a mixedwood FORCYTE-11 model (using STEMS*) and evaluate its application to regional forest management issues. (Grewal/Apps, ENFOR funding; see NOR-28-06)

5. Participate in an informal study group to develop understanding of, and strategy for dealing with, regional forestry issues associated with climate warming and variabilty. The emphasis is to be on ways to forcast the impacts of assumed potential climate changes on the forests (and therefore on forestry in the region) and methods to predict the interaction of these impacts with different management strategies. (Apps/Zoltai/Grewal/Maynard/Swanson/Volney/Lee..?)

6. Prepare Information Report on STEMS as related to stand tending of jack pine and aspen. (Grewal, continued from NOR-04-02)

7. Perform biomass productivity assessment on 5-year-old cutovers near Calling Lake and Slave Lake. Correlate results with 1986 measurements (Grewal , 1988) and prepare draft of manuscript for publication as journal or Information Report. (Grewal/Apps)

14. Publications 1988-89:

Apps, M.J.; Kimmins, J.P.; Kurz, W.A.; Scoullar, K.A. 1988. Simulating the Consequences of Today's Management Decisions for Tomorrow's Forest Ecosystems on a Microcomputer: in Proc. Int'l Symposium Resource Technology 88, 20-23 June 1988, Ft. Collins, Colorado.

Apps, M.J.; Kurz, W.A.; Kimmins, J.P.; Scoullar, K.A. 1988. User Friendly Applications of the FORCYTE Ecosystem Model on a Microcomputer. Pages 263-269 in: Forest Growth Modelling and Prediction, Ed. A.R. Ek, S.R. Shifley, T.E. Burk. USDA For. Serv. North Central For. Exp. St. Gen. Tech. Rep. NC-120.

Grewal, H. 1988. "Biomass Productivity in Two-Year-old Aspen Cutovers Near Calling Lake and Slave Lake, Alberta", Pages 124-128 In: Proc. Sixth Canadian Bioenergy R&D Seminar, Richmond, B.C., 16 -18 Feb., 1987, Ed. C. Granger, Pub: Elsevier, reissued by B.C. Research, Canada.

Grewal, H.; Apps, M.J.; MacIsaac, D.A. 1988. Using a Traditional Growth and Yield Model (STEMS) to Drive a Management Simulator (FORCYTE-11). In Abstracts of papers for IUFRO International Conference on Forest Simulation Systems, Berkeley, CA, November 2-5, 1988.

Kimmins, J.P.; Scoullar, K.A.; Apps, M.J.; Kurz, W.A.; Comeau, P.G.; Tsze, K.M.; Haley, D. 1988. Predicting the Yield and Economic Returns of Forest Management in a Changing and Uncertain Future: The FORCYTE Approach, in Abstracts of papers for IUFRO International Conference on Forest Simulation Systems, Berkeley, CA, November 2-5, 1988.

Kimmins,J.P.; Scoullar, K.A.; Comeau, P.G.; Kurz, W.A.; Apps, M.J.; Chatarpaul, L. 1988. FORCYTE-11: An Example of the Hybrid Simulation Approach to Predicting the Consequences for Production, Yield, Economics, Soil Fertility, Nutrient and Organic Matter Reserves, and Energy Efficiency of Alternative Crop Production Systems. Pages 2305-314 in: Forest Growth Modelling and Prediction, Ed. A.R. Ek, S.R. Shhifley, T.E. Burk. USDA For. Serv., North Central For. Exp. Stn., Gen. Tech. Rep. NC-120.

Kurz, W.A.; Apps, M.J.; Chan, Y.H. 1988. PROBE: a Program to Facilitate the User Friendly Gaming with FORCYTE. Pages 160-164. in: Proc. of Sixth Bioenergy R&D Seminar, 16 -19 Feb 1987, Richmond, Ed. C. Granger, Pub: Elsevier, reissued by B.C. Research, Canada, pg. 160 - 164.

Kurz, W.A.; Apps, M.J. 1988. PROBE Users Manual (draft version 2.00C), 32 pages (includes software.)

Chan, Y.H.-; Peterson, N.M.; Kabzems, R.D.; Kimmins, J.P. 1988. Calibration of Forcyte-11 Growth Simulation Model for Aspen Ecosystems in Alberta, Canada, Peterson, E.B. Pages 151-154. in Canadian Bioenergy R&D Seminar, Richmond, B.C., 16 -18 Feb., 1987, Ed. C. Granger, Pub: Elsevier, reissued by B.C. Research, Canada.

Western Ecological Services Ltd. 1988. Boreal Mixedwood Forest Management Challenges: Do Ecosystem Models Such as FORCYTE-11 Have a Role?, Contractor's report in preparation as an ENFOR report, Ed. M.J. Apps.

Western Ecological Services Ltd., 1988. Boreal Mixedwood Forest Management Challenges: a Synopsis of Opinions From 1988 Interviews, Contractor's report in preparation as an ENFOR Report, Ed. M.J. Apps.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Starting Date: Completion date: 1994 (?)

17. Resources 1989-90:

PYs: Prof.: Apps 0.8
Grewal 1.0
Tech.:
Term/Student: 0.3

O&M: Nil
Capital: Nil

18. Signatures:

H. Grewal
Investigator

Program Director, Resources

Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 2, 1989

1. Project: Forest Resource Economics and Statistics

2. Title: Forest Resource Economics and Statistics Research and Coordination

3. New: Cont.: X 4. No.: NOR-3-01

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, NFEP, FORSTATS

7. Location of Work: Northwest Region, Ottawa

8. Study Objectives:

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

   3. To co-ordinate ForCan forest economics research activities in the region, as well as promote and develop support and cooperation for forest economics and statistics programs.

9. Goals for 1988-89:

   Scientific Authority for Contract Research

   1. Complete activities associated with 5 research contracts, e.g., appropriate publications, seminars.

   Regional Development Analysis, Policy and Planning, Evaluation Documentation

2. Provide socio-economic and statistical data, analysis and documentation for policy and program development for new forestry development agreements in Manitoba, Saskatchewan, Alberta and NWT.

3. Continue to participate in evaluation task forces as requested.

4. Provide comments/reviews, as requested, on proposals for the Western Diversification Office.

Economic Research, Reports and Publications

5. Provide regional input to ForCan national study on Canada's timber supply.

6. Prepare monthly reports for ForCan on Impact of the 15% Export charge on Northwest Region producers.

Reviews, Comments, Briefings

7. Continue to provide reviews/comments of journal articles, reports, proposals as well as briefings.

Project Co-ordination

8. Continue to act as Project Leader for NOR-3.

Added Goals:

9. Develop and initiate a study contract to determine farmer production costs and analyze investment potential of a farm woodlot program.

10. Design, co-ordinate and participate in a report on forestry Perspectives for the Northwest Region.

11. Develop a verification of and listing for a second publishing of the Alberta Secondary Wood-using Directory.

12. Act as Scientific Authority for Saskatchewan FRDA contract on: An Economic Investigation of Interrelationship between Transportation and Silvicultural Expenditures in Forest Management.

10. Accomplishments for 1988-89:

Scientific Authority for Contract Resource

1. Contract for a Socio-economic, Attitudinal Survey of Alberta Bush Owners was completed. A seminar was given to NoFC and AFS management, as well as a graduate seminar at U. of Alberta by the contractor.

2. A research paper on the above study was written and presented to economists at the annual meeting of Can. Assn. of Forest Economists, Baddeck, N.S.

3. Attended presentations, reviewed and monitored activities of the second year of the project/contract: An Uncertainty Model and Evaluation Framework for Intensive Forest Management Decisions. A demonstration/paper was given by the contractor at the Forest Modelling Symposium in Saskatoon.

4. Two reports, Alberta Economic Timber Supply and Forest Products Demand in the Pacific Rim were reviewed, comments incorporated and published by the Alberta Agreement.

5. Research papers based on work from the Alberta Economic Timber Supply and Non-Market Benefits in a Value-At-Risk Framework for Fire Management (PRUF) were started.

Regional Development Analysis, Policy and Planning, Evaluation Documentation

6. Provided socio-economic and statistical data, analysis as requested for various reports/proposals for new forestry developments in Manitoba, Saskatchewan, Alberta and NWT. Potential projects were developed and listed for work under new Manitoba and Saskatchewan agreements.

7. Provided comments/reviews of the draft Saskatchewan and Alberta Agreements evaluation reports.

8. Initiated discussions with Alberta Timber Management Branch on a farm woodlot program strategy for Alberta.

9. Incorporated comments from third review and published Information Report: Saskatchewan's Forest Industry, 1985.

Economics Research, Reports and Publications

10. Prepared Phase 1 Draft of Saskatchewan's Timber Supply for regional input into the ForCan national study on Canada's timber supply.

11. Prepared monthly reports for ForCan on impact of 15% Export Charge until May, 1988 and monitored thereafter.

12. Prepared numerous briefings on forestry issues/developments, especially pulp and paper events in Alberta.

Reviews, Comments, Briefings

13. Numerous report and paper reviews/comments/requests for information as well as briefings were provided for Forestry Canada, U. of Alberta personnel as well as other government departments and the general public. Reviewed drafts of information reports: Manitoba's Forest industry, 1985 and Silviculture Statistics for Canada: an 11 year summary.

Project Co-ordination, Committees

14. Continued to act as Project Leader for NOR-3.

15. Continued to serve on Senior Economists', National Forest Economics Project, FORSTATS committees, as well as an external advisor on graduate student thesis committees at U of Alberta.

Added Accomplishments

16. Developed and contracted study on production costs and investment analyses for selected sample of Alberta bush owners.

17. Prepared draft material on Forestry Perspectives for Saskatchewan and NWT.

18. Preparations were made with Alberta Economic Development for a verification of and development of a new Alberta Secondary Wood-Using Directory.

19. Acted as Scientific Authority for Saskatchewan FRDA contract.

11. Goals for 1989-90:

Scientific/Project Authority for Contract Research

1. Complete activities associated with research contracts, which will include journal articles seminars.

Regional Development Analysis, Policy and Planning, Evaluation Documentation

2. Provide socio-economic and statistical data analysis and documentation for policy and program development for new forestry development agreements in Manitoba, Saskatchewan, Alberta and NWT.

Economics Research, Reports and Publications

4. Provide regional input to the ForCan national study on Canada's Timber Supply (in co-operation with ForCan HQ and MFC).

5. Prepare regional overview for and complete Forestry Perspectives for the Northwest Region (also see NOR-03-03; 03-04).

Reviews, Comments, Briefings

6. Continue to provide reviews/comments of journal articles, reports, proposals as well as briefings.

Project Coordination, Committees

7. Continue to act as Project Leader for NOR-3 and act as NoFC representative on national committees (Senior Economists; NFEP; FORSTATS).

8. Prepare two new five year regional strategies for economics and statistics (see NOR-03-02).

9. Co-ordinate and co-chair the 1989-90 annual meeting of Can. Assn. of Forest Economists to be held in Jasper.

12. Present Status of Study:

Objective 1: On-going discussion papers, legal agreements, and facilitating Cabinet and Treasury Board documents were prepared for the development, negotiation, and implementation of the Alberta, Manitoba and Saskatchewan forestry renewal agreements. A large number of reviews and comments were prepared for various policy, planning and development activities. Several articles and speeches prepared.

Objective 2: On-going study proposals for economic research projects under the Canada-Alberta, Canada-Manitoba and Canada-Saskatchewan research MOU committees have been developed and approved. They are being jointly implemented with NoFC and agreement staff. Some major projects under the three agreements which have been implemented are: the provincial forest industry reports, directories and forestry reports; evaluation frameworks for Agreements; and contracts on fire damage appraisals; economic timber supply determinations and PSP catalogue development.

Objective 3: On-going research study in forest resource economic needs for region was conducted with University of Alberta. Its recommendations are being implemented. The study was utilized for regional input into the planning of the ForCan National Forest Economics Program.

Three research projects under PRUF have been directly supervised, as well as other contracts with the University of Alberta. Three interdisciplinary studies have been started on fire economics, vegetation management and forest management practices.

An information report on a 11 year summary (1975-86) for silvicultural statistics in Canada has been completed.

Inventory data from the three prairie provinces for the national inventory of 1986 was collected, converted to national standards, and has been checked for quality control and aggregated.

13. Publications 1988-89:

Steele, T.W.; Boylen, D.M.; Baumgartner, A. 1988. Saskatchewan's Forest Industry, 1985. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-295.

Boylen, D. 1988. Saskatchewan's Timber Supply. Draft of regional input to National Wood Supply Project - Phase 1.

Boylen, D. 1989. Saskatchewan Profile - Forestry Perspectives. Draft copy.

Boylen, D. 1989. Northwest Territories Profile - Forestry Perspectives. Draft copy.

Gellner, Brett (compil.). 1988. Pacific Rim Markets for Forest Products in the 1990s: Economic Assessment of Demand and Supply. Ann. Conf. Resource Information Systems Inc. Canada-Alberta Forest Resource Development Agreement.

Beck, James, A. Jr.; Anderson, Richard, G.; Armstrong, Glen. W.; Farrow, Glenn H. 1988. Alberta Economic Timber Supply Analysis. Final Report. Canada-Alberta Forest Resource Development Agreement.

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

15. Duration:

Started: 1980 Completion: continuing

16. Resources 1989-90:

PYs:	Prof.:	Boylen	1.0
	Tech.:	Bohning	0.1
	Total:		1.1
	Term/Student:		0.3

O & M: $10,500
Capital:

17. Signatures:

Diana M. Boylen
Investigator

Steve Price
Program Director, Development

G. R. Hunt
Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 2, 1989

1. Project: Forest Resource Economics and Statistics

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

3. New: Cont.: X 4: No.: NOR-3-02

5. Study Leader: D.H. Kuhnke

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

7. Location of Work: Northwest Region; Petawawa NFI

8. Study Objectives:

   1. To develop and interpret forestry and socio-economic statistics at the stand, provincial, regional and national levels to further and improve forest management decision-making by resource managers and researchers.

   2. To assist in the development and implementation of project proposals, management information systems and evaluation frameworks for the forest resource development agreements.

9. Goals for 1988-89:

   1. Publish the 11-year national silviculture statistics Information Report, and participate in planning for the integrated silviculture and forest management expenditures reports.

   2. Initiate forest economics studies related to timber supply analysis modelling, economics of intensive forest management, and/or studies of forest products marketing trends and their impacts on the forestry sector and the general economy. These studies are particularly relevant in light of the forest idustry's rapid and substantial growth in Alberta. They may also involve use of geographic information systems.

3. Perform contract supervision and liaison for an extended PSP Catalogue project.

4. Perform functions related to and involving technical transfer and participate in preparing briefing notes, proposals, etc.

Added Goals:

5. Prepare a public information brochure based on the silviculture statistics information report.

6. Assume the role of Scientific Authority for a Canada-Alberta FRDA contract to purchase a study from George Carter and Affiliates of New Jersey titled "An investigation of the markets for medium and high density industrial overlays in the United States".

10. Accomplishments in 1988-89:

1. Published the 11 year national silviculture statistics Information Report. It features a more graphics-oriented style of presentation. Information content is enhanced through treated area and expenditure data for all federal-provincial forest economic and regional development agreements.

2. Designed a database to provide quick access to economic and production information on forest products companies in the region for general use by NoFC management and staff. Supervision of temporary staff in development of the database was involved. Information on 30 firms is currently available.

3. Completed contract supervision and liaison for the Forestry Data Bank project. This involved assisting in the development and refinement of Data Bank software (FORDAT), selection of studies to develop an initial FORDAT database, and testing the software in conjunction with selected NoFC staff members. The contract supervision also included assisting in revising the Microcomputer Permanent Sample Plot Catalogue software in response to client requests for greater speed and ease of use.

4. Revised an article for submission to the Journal of Forestry that chronicles the NoFC's PSP Catalogue Project.

   Fulfilled information and general requests such as i) developed a policy for the NoFC concerning terms and conditions for release of PSP and scientific data to the public, ii) reviewed a HQ proposal to prepare a booklet on silviculture terminology in Canada, iii) harvesting and regeneration information.

5. Published a public information brochure titled "Silviculture in Canada". This six page bilingual brochure condenses information in the silviculture statistics report into simple language supported by descriptive color graphics.

6. Received two copies of the three-volume report on the markets for medium and high density industrial overlays in the United States.

11. Goals for 1989-90:

1. Participate in planning and preparation of a joint CPPA/ForCan report combining silviculture and forest management expenditure statistics. This publication will probably be completed in 1990-91.

2. Prepare a regional strategy for FORSTATS in conjunction with NOR-3-01 intended to identify and fulfill Forestry Canada's information needs. The strategy is in response to ForCan's new departmental status.

3. Continue to improve and expand the regional forest industry database.

4. Expand the use and operation of the FORDAT forestry data system.

5. Resubmit article chronicling the development of NoFC PSP Catalogue Project.

6. Continue to serve on WESBOGY committee.

12. Present Status of Study:

1. The information for the silviculture statistics report became complete in February. The report is slated for publication early in February 1989.

   Planning for the joint CPPA/FORCAN (NoFC/GLFC) report is expected to get underway in the spring of 1989.

2. Design of the forest industry database was begun in May 1988, with a working version completed by early September.

3. The final version of the FORDAT software is ready for review and implementation by NoFC staff. The current contract, an extension of a 1987-88 contract, has documented and loaded at least 50 studies.

4. The subject of the PSP Catalogue journal article was judged as unsuitable by Forestry Chronicle editors. The article is being revised for submission to the SAF's Journal of Forestry (or one of its associated journals).

5. Policy re: PSP info to be completed.

13. Publications:

Kuhnke, D.H. 1989. Silviculture Statistics for Canada- An 11-Year Wrap-up. ForCan., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-301 and 301(F).

Kuhnke, D.H. 1989. Silviculture in Canada. ForCan., North. For. Cent., Edmonton, Alberta. Information brochure.

Carter, G. & Affiliates. 1988. An investigation into the markets for medium and high density industrial overlays in the United States. Canada-Alberta FRDA report. Contract #A001482.

Silvacom Ltd. 1988. MPC, Microcomputer PSP Cataglogue system - user's manual. Canada-Alberta FRDA report. Contract #A001406

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

15. Duration:

Start: 1984 Completion: Continuing

16. Resources 1989-90:

PYs:	Prof:	Kuhnke	1.0
	Tech:		0.0
	Total:		1.0
	Term/student:		0.3

	A-base	Alta FRDA
O&M:	$1,000	$30,000

17. Signature:

Dieter Kuhnke
Investigator

Steve Price
Program Director, Development

C. D. Hunt
Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 2, 1989

1. Project: Forest Resource Economics and Statistics

2. Title: Forestry development and fire management economics

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

5. Study Leader: T.B. Williamson

6. Key Words: Wildland fire management planning economics, cost plus net-value-change, market and non-market benefit assessment, forest sector supply and demand modelling, forest industry, socio-economic impact evaluation, strategic planning, regional perspective development, decision support systems.

7. Location of Work: Northwest Region, Ottawa

8. Study Objectives:

   1. To provide statistical data and analytical support for policy and program development of regional and national forestry research and development programs and policies.

   2. To provide input to working groups and study teams analyzing and reviewing forest sector related issues and policies at the national level.

   3. To assist in the development of guidelines and frameworks for use in the determination of wildland fire protection priorities in the region.

9. Goals for 1988-89:

   Scientific Authority for Contract Research

   1. Document the theory, procedures, results, and conclusions of the study: Commercial timber default values in Manitoba.

   Regional Development Analysis, Policy & Planning, Evaluation Documentation

   2. Provide socio-economic and statistical data, analysis and documentation for policy and program development for new forestry

development agreements in Manitoba, Saskatchewan, Alberta and NWT.

3. Prepare Alberta agreement report on the Secondary wood-using industry in Alberta.

4. Develop terms of reference and act as scientific authority for a small study of marketing opportunities for wood products from Saskatchewan's Cypress Hills Provincial Park.

Economics Research, Reports and Publications

5. Provide regional input to the Forestry Canada national study on Canada's timber supply.

6. Develop economic and fire effects models required for fire damage appraisal. Complete Elan fire study.

Reviews, Comments, Briefings

7. Continue to provide reviews/comments on journal articles, Forestry Canada reports, proposals, and briefings.

Added Goals:

8. Develop terms of reference, evaluate proposals, organize facilities, and manage a contract for an independent consultant to prepare for and provide a 3 day seminar on forest products and the forest industry in the prairie region. Also, undertake a post course assessment.

9. Administer and manage a contract to develop a micro-computer based data-base management system for fire damage appraisal purposes.

10. Serve as the federal project officer for two Canada-Alberta Forest Resource Development Agreement (FRDA) projects.

11. Review, in detail, the report: Manitoba's forest industry - 1985 for converting to Information Report status.

12. Provide input and advice to the Environment Council of Alberta concerning forest management and development. Information will be used as background for the ultimate development of an Alberta Conservation Strategy.

13. Respond to information requests from the public and client agencies on a wide variety of topics. Maintain a reference library containing various information sources.

10. Accomplishments for 1988-89:

Scientific Authority for Contract Resource

1. The final report documenting the results of the study "Commercial timber default values in Manitoba" has not been completed. (Williamson)

Regional Development Analysis, Policy and Planning, Evaluation Documentation

2. A report profiling the current forestry situation in Alberta was prepared. This report will be incorporated into the planning document Forestry Perspectives 88. (Refer to NOR-3-01 goal 5). (Williamson)

3. Two reports were prepared on Alberta's secondary wood-using industry; a technology transfer note and an article recently published in the Forestry Chronicle. (Bohning)

4. Guidelines re: the development of a small marketing study for forest products from Cypress Hills Provincial Park were provided to the Saskatchewan District Office. (Bohning)

Economics Research, Reports and Publications

5. A report entitled "Aggregate timber supply in Alberta: current status and future outlook" was prepared, reviewed, revised, and submitted to the project leader of part 1 of the National Timber Supply Study. (Williamson)

6. The Elan fire damage appraisal case study was completed and a report was forwarded with recommendations to the Saskatchewan Dept. of Parks, Recreation and Culture. (Williamson, Bohning)

Reviews, Comments, Briefings

7. Numerous technical reviews were provided and briefing notes were prepared. (Williamson, Bohning)

Added Accomplishments

8. A successful 3 day seminar on the forest industry was presented by Bowell Management to NoFC personnel. (Bohning)

9. The terms of reference were developed and a contract was let to Silvacom Ltd. Discussion regarding the design and development of the software system have been ongoing. (Williamson)

10. Initial discussions were held to assist in establishing the terms of reference for two Canada-Alberta FDRA projects including a mill residue study by Solutions Management Inc. and a two-year Field Trial study to assess a Chain Flail Delimber and Portable Chipper Operation by FERIC. (Bohning)

11. Final review comments on Manitoba's forest industry - 1985 have been provided to the scientific and technical editing and publishing group. The report will be published this fiscal year as a Forestry Canada Information Report. (Williamson)

12. Information regarding forestry in Alberta was provided to the Public Advisory Committee of the ECA for use in the continuing process to develop a conservation strategy for Alberta. (Williamson)

13. Numerous responses to requests for information from the public, Forestry Canada personnel and client agencies were provided. The Regional Development program reference library was established in cooperation with the NoFC library and maintained. (Bohning)

11. Goals for 1989-90:

Scientific/Project Authority for Contract Research

1. Complete the Canada-Manitoba File report "Commercial timber default values in Manitoba".

2. Evaluate the final software provided from the research contract with Silvacom to develop a computer based Fire Damage Appraisal System (FDAS). Develop a technology transfer strategy including determination of an appropriate publication medium.

3. Continue to provide input to and act as the federal project authority for various Canada-Alberta FRDA projects including a mill residue study by Solutions Management Inc. and a field trial study of a flail delimber portable chipping system by FERIC.

4. Continue to provide socio-economic and statistical data, analysis and documentation for policy and program development for new forestry development agreements in Manitoba, Saskatchewan, Alberta, and the NWT.

5. Continue to provide assistance to the Public Advisory Committee in developing the Alberta Conservation Strategy.

6. Prepare a publication outlining the procedures and results of the Elan Fire damage appraisal case study.

7. Continue to develop economic and fire effects models required for fire damage appraisal and in particular in support of satisfying the information requirements of the Fire Damage Appraisal System.

8. Continue to provide reviews/comments on articles, CFS reports, proposals, and to prepare briefing notes.

9. Continue to respond to requests for information from the public and to maintain the Regional Development reference library.

12. Present Status of Study:

Each of the three objectives stated in section eight continue to be relevant to the past and proposed activities undertaken within the sphere of study 03-03. Objective one captures those ongoing activities undertaken in support of program development (i.e., Federal-Provincial Agreements). Objective two relates to the provision of regional input into national level analyses such as Forestry Perspectives and the National Timber Supply Project. Objective three applies to activities related to the development of decision aids in wildland fire management. Activities related to this objective include: The Elan Fire damage appraisal study, the Manitoba commercial timber default values study, and the fire economics concept paper.

13. Publications 1988-89:

Heit, M.J.; Bohning, R.A. 1988. Secondary forest products industry in Alberta, 1986. For. Chron. 64 (6):461-463.

Heit, M.J.; Bohning, R.A. 1988. Secondary forest products industry in Alberta, 1986. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Tech. Transfer Note A-004.

Steele, T.W.; Williamson, T.B. 1989. Manitoba's forest industry, 1985. ForCan, North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-304.

Williamson, T.B. 1989. Forestry Perspectives 88. Alberta profile. Draft copy.

Williamson, T.B. 1988. Aggregate timber supply in Alberta: Current status and future outlook. Draft file report submitted as part 1 of the National Timber Supply Study.

Williamson, T.B. 1988. An appraisal of economic damage incurred by the Elan Fire, May 1987. File report submitted to the Sask. Dept. of Parks, Recreation and Culture.

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

15. Duration:

Started: 1980 Completion: continuing

16. Resources 1989-90:

PYs:	Prof.:	Williamson	1.0
	Tech.:	Bohning	0.9
	Total:		1.9

Term/Student: 0.3

O & M: $10,000
Capital:

17. Signatures:

Investigator

Program Director, Development

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 2, 1989

1. Project: Forest Resource Economics and Statistics

2. Title: Economic analyses of forest management practices.

3. New: Cont: X 4. No.: NOR-3-04

5. Study Leader: J.P. De Franceschi

6. Key words: Economics, interdisciplinary forest management, cost-effectiveness, risk:benefit, decision-making models, production costs, employment/economic impacts, silviculture.

7. Location of the work: Northwest Region, Ottawa.

8. Study objectives:

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

   2. To determine costs of silvicultural treatments in the region for a range of site or stand conditions. These costs to be determined through time studies of silvicultural operations.

   3. Based on cost information derived from this study, provide economic evaluation of silvicultural treatments to assist forest managers in allocating funds among competing treatments.

9. Goals for 1988-89:

   Economics Research, Reports and Publications

   1. Prepare an information report on labor requirements for mechanical (manual) release of white spruce from competing aspen. (Manitoba Agreement Silviculture Project 5.4; cost/shared)

   2. Initiate analysis of labor/machine productivity data from silvicultural treatments in Manitoba to determine costs for treating different sites. (Manitoba Agreement Economics Project 7.2; cost/shared)

3. Explore the possibilities of providing a two- or three-day workshop on the business aspects of operating a small silviculture contracting company. The workshop would be held in Manitoba and presented by a consulting firm. (Manitoba Agreement; Federal Direct Funding)

4. Provide regional input to the national study on Canada's timber supply (phase 1).

Added Goals

5. Complete a file report summarizing all labor and machine productivity measurements collected in Manitoba during the 1987 season. (Manitoba Agreement)

6. Prepare a provincial profile for Manitoba as part of Perspectives '88.

Reviews, Comments, Briefings

7. Continue to provide socio-economic and statistical data, analyses and documentation for policy and program development as required. Continue to provide reviews/comments on reports, proposals, briefings, etc.

10. Accomplishments in 1988-89:

Economics research, reports and publications

1. Labor productivity data for the release of white spruce from competing aspen has been analyzed. Models to estimate production from stand variables have been developed. Report preparation is underway.

2. Analyses has been initiated to estimate productivity for manual tree planting. (Some asistance for data processing provided by a contract funded by Manitoba Agreement in January-February 1989)

3. A two-day workshop was held in Winnipeg on Dec 8-9, 1988. The workshop attracted 19 people including silviculture contractors, Abitibi-Price staff, representatives of native Indian Bands, and government employees. The consultant who presented the course produced a manual entitled "Business Aspects of Operating a Forestry Contracting Firm". This manual was distributed to course participants.

4. A report on Manitoba's Timber Supply was prepared. The report was reviewed by Manitoba Forestry Branch staff and is now being revised. The report is part of the national timber supply project - Phase 1.

Added Accomplishments 1988-89:

5. A file report summarizing field data collected from silvicultural treatments in Manitoba during 1987 was completed. The report is

entitled "Labor and machine productivity for pre-commercial thinning, manual tree planting, and mechanical site preparation in Manitoba: 1987 data.".

6. A report describing the economic situation in Manitoba, and a brief description of Manitoba's forest resource and forest industry has been prepared. The report is intended as a provincial profile for inclusion in "Perspectives '88"

Reviews, Comments, and Briefings

7. Provided information, reviews, comments, etc as required.

11. Goals for 1989-90:

Economics research, reports and publications

1. Publish an information report on labor requirements for mechanical release of white spruce from competing aspen.

2. Analyze machine and/or labor productivity data for thinning, planting and mechanical site preparation to facilitate estimation of costs of silvicultural treatments.

3. Provide regional input as required to the national study on Canada's timber supply (phase 1). Finalize report on Manitoba's timber supply. (Cross-reference: NOR-03-01 and NOR-03-03)

4. Act as scientific authority on a two-year ENFOR project to determine economics of utilizing logging slash and fire-killed timber. Develop study proposal and select consultant(s) to conduct the study in various locations of the region. (Cross-reference NOR-28-06)

Reviews, Comments, Briefings

5. Prepare background documentation as required in support of negotiations for next set of agreements.

6. Continue to provide socio-economic and statistical data, analyses and documentation for policy and program development as required. Continue to provide reviews/comments on reports, proposals, briefings, etc.

12. Present status of the study:

To date labor and machine production rates have been measured for precommercial thinning using brushsaws and chainsaws, manual tree planting for bareroot and container stock, and mechanical site preparation using shear blades, disc trenchers, Bracke scarifiers and drum choppers. Labor production for releasing spruce from competing poplars was measured for brushsaws and chainsaws in 25- and 50-year old stands. Several reports have been prepared outlining field procedures and data summaries for each treatment sampled. A workshop on operating a silviculture business was conducted and a manual produced. Draft

reports have ben prepared on Manitoba's wood supply as an input document to the national wood supply project, and on forestry and the economy in Manitoba for inclusion in Perspectives 88.

13. Publications 1988-89:

Bax H. Business aspects of operating a forestry contracting firm. Manual for workshop held in Winnipeg Dec 8-9 1988. Canada-Manitoba Forest Renewal Agreement document.

De Franceschi J.P. Labor and machine productivity for pre-commercial thinning, manual tree planting, and mechanical site preparation in Manitoba: 1987 data. Canada-Manitoba Forest Renewal Agreement, Winnipeg, Manitoba. File Report May 1988.

De Franceschi J.P. Forestry Perspectives 88. Manitoba Profile. Draft copy.

De Franceschi J.P. Manitoba's Timber Supply. Draft of regional input to National wood supply project - phase 1.

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

15. Duration:

Start: 1985 Completion: 1992.

16. Resources 1989-90:

PYs:	Prof.:	De Franceschi	1.0
	Tech.:		0
	Total:		1.0
Term/Student			0.3

O & M: $3,000 (+ ENFOR $4,000)
Contracts: $50,000 ENFOR funding (Cross-reference NOR-28-06)
Capital:

17. Signatures:

J.P. De Franceschi
Investigator

Steve Price
Program Director, Development

G. Pelletier
Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Stand Productivity

2. Title: Analysis of growth and yield of important tree species in the prairie provinces (revised).

3. New: Cont.: X 4. No.: NOR-4-01

5. Study Leader: I.E. Bella

6. Key Words: Tree and stand growth and development, yield, thinning, tending.

7. Location of Work: Data originates from various locations in Alberta, Saskatchewan, and Manitoba

8. Problem:

As forestry activity and demand for wood fibre increases in the region, so does demand for information on growth and yield of the major commercial tree species, whether they are growing in old growth, fire origin stands or in second growth stands following harvesting. The most important problems include: predicting growth and yield in natural, unmanaged stands; predicting growth and yield of managed, planted, seeded stands that were spaced, thinned and possibly fertilized; the effect of insects, diseases and other agents on growth and yield; species selection for optimum growth and development on a given site; and synthesizing tree and stand growth information into suitable predicting models to be used for estimating Annual Allowable Cut (AAC).

Progress to 1987:

1. A series of PSPs were established to monitor growth and development of old growth stands of lP, jP, wS, and tA. Some of these plots date back to 30 years or more (see summary table in NOR-4-02). Many of these plots--most of them lP--are still intact, periodically remeasured and provide useful information. Data were analysed as became available, and yield tables published for jP, lP, wS and tA.

2. Thinning experiments and some growth monitoring plots in operational thinning trials, have been established in jP, lP, tA, and wS. Results

are published as became available, and the studies provide important information on managed stand yield. Thinning equipment performance trials were also conducted, analysed and published.

3. Spacing experiments have been established in jP, rP, lP, and wS. Results are published as became available, and the studies provide important information on managed stand yield.

4. At the request of the Alberta Government, intensive short term studies were conducted on regeneration standards, and tree growth response along seismic lines. Results were analysed and published.

5. Studies have been initiated to determine the impact of insects, diseases and other agents on growth and yield, particularly in stands following harvest. Preliminary results and recommendations have been presented at symposiums and/or published.

6. Over 20 reports and journal articles have been published on growth and yield, on thinning and spacing response and on related problems referred to above for jP, lP, rP, sP, and wS by Bella, I.E. and J.P. DeFranceschi, Cayford, J.H. Jameson, J.S., Johnstone, W.D., Steneker, G.A., and Wilson, G.M. between 1950 and 1986.

9. Study Objectives:

1. Provide project leadership, advice and technical transfer to project and regional development staff, clients and the Growth and Yield Cooperative in growth and yield R & D activities.

2. Develop and evaluate yield models for natural and managed stands of the major commercial tree species in the region. Obtain managed stand growth and yield information from related spacing, thinning and fertilization experiments.

3. Prepare treatment prescriptions for different species for use by the forest manager.

4. Conduct intensive short-term studies on urgent problems as required by clients.

10. Goals for 1988-89:

1. Provide project leadership functions to NOR-04 staff and functional guidance to Regional Development staff in Manitoba and Saskatchewan District Offices and to the Alberta and Saskatchewan Agreements' mensurationist; provide advice to colleges and clients on mensurational problems and carry out technology transfer in thinning, growth and yield and stand modelling; yield forecasting; act as a scientific authority on related contracts as required.

2. Cooperate with the Alberta Agreement Mensurationist to develop managed stand yield tables for lP and wS.

3. Provide technical input and leadership in the regional Growth and Yield Coop.

4. Publish a paper in the CJFR on "Western gall rust dynamics and impact in young lP stands in Alberta", I.E. Bella and S. Navratil.

5. Publish an Information Report on guidelines or prescriptions for spacing/thinning lP in Alberta, combining all results from lP spacing/thinning studies following consultation with clients.

6. Initiate and plan lP and wS spacing trials for a range of conditions, in cooperation with the forest industry in Alberta.

7. Provide advice and guidance to PDF on (a) refining a mortality model for lP; (b) analysis of height growth suppression; and (c) development of a preliminary yield model for old growth stands. Cooperate as coauthor in preparing manuscripts for publication.

8. Assess the usefulness of the Swan River, Manitoba aspen pruning study 20 years after establishment and remeasure disease conditions if warranted.

Added Goals:

9. Cooperate with L. Brace and R. Waldron in preparing a paper on spruce-aspen stand development, growth and yield for the "Mixedwood Symposium" Edmonton, Apr. 1988.

10. Worked with T. Szabo and S. Navratil in organizing the Canadian Poplar Council Annual Meeting and Field Tour, Edmonton and Edson, Oct. 1988.

11. Cooperate with S. Navratil in writing and presenting a paper on aspen management at the Canadian Poplar Council meeting.

11. Accomplishments 1988-89:

1. Provided project leadership functions to NOR-04 staff and functional guidance to Regional Development staff in Manitoba and Saskatchewan District Offices and to the Alberta and Saskatchewan Agreements' mensurationist; provide advice to colleges and clients on mensurational problems and carry out technology transfer in thinning, growth and yield and stand modeling; yield forecasting; act as a scientific authority on related contracts as required.

2. Cooperated with the Alberta Agreement Mensurationist to develop managed stand yield tables for lP and wS. Details presented under NOR-04-10.

3. Provided technical input and leadership in the Western Boreal Growth and Yield (WESBOGY) Coop. Organized two meetings and developed preliminary plans to assess the effects of stand density and yield assumptions in AAC estimates in Alberta.

4. A paper on "Western gall rust dynamics and impact in young lP stands in Alberta" by I.E. Bella and S. Navratil has been accepted for publication by the CJFR.

5. Information Report as guidelines or prescriptions for spacing/thinning lP in Alberta has been deferred partly because of slow response from clients.

6. Discussions were held with forest industry and AFS representatives on initiating spacing trials for lP and wS. It seems that this initiative may best be persued under WESBOGY Co-op coordination.

7. Provided advice and guidance to PDF on (a) refining a mortality model for lP, (b) analysis of height growth suppression; and (c) development of a preliminary yield model for old growth stands. A manuscript in a mortality model for lP by V. Zakvzewski and I.E. Bella has been prepared and submitted to the CJFR for publication.

   A preliminary yield model for old growth stands has been developed and demonstrated to clients. It is being revised to improve its accuracy. Some exploratory analysis has been done to devise a model to predict the yield of understocked natural stands using inventory data input.

8. Visited and relocated the aspen prunning study with S. Navratil at Swan River, Manitoba, and formulated some tentative plans to wind up this work.

9. Cooperated with L. Brace and R. Waldron in preparing a presentation on spruce-aspen stand development, growth and yield, for the Mixedwood Symposium in Edmonton, Apr. 1988.

10. Cooperated with T. Szabo, Alberta Economic Development, and S. Navratil in organizing the Annual Meeting and Field Tour of the Canadian Poplar Council, Edmonton and Edson, Oct. 1988.

11. Cooperated with S. Navratil in writing a paper and giving a talk on "Regeneration, development and density management in aspen stands" at the Canadian Poplar Council meeting.

12. Present Status of Study:

    1. Leadership function and technical transfer are important and continuing activities under this study, with an added new trust being initiated through the Regional Growth and Yield Cooperative.

    2. Most work in growth and yield model evaluation and development is currently centered on our effort to develop managed stand yield tables (models) for lP and wS through Can.-Alta. agreement funding.

    3. Treatment prescriptions, particularly for spacing and thinning, are developed as data becomes available and are passed to the user through workshops, field tours and printed form.

4. Under intensive short term studies, note current efforts in evaluating the effect and impact of various damaging agents and climatic factors. Several symposium and journal papers have been published recently on these problems.

13. Goals for 1989-90:

1. Provide project leadership functions to NOR-04 staff and functional guidance to Regional Development staff in Manitoba and Saskatchewan District Offices and to the Alberta and Saskatchewan Agreements' mensurationist; provide advice to colleges and clients on mensurational problems and carry out technology transfer in thinning, growth and yield and stand modeling; yield forecasting; act as a scientific authority on related contracts as required.

2. Provide technical input and leadership as required in the WESBOGY Co-op.

3. Cooperate with C. Cieszewski to:

   a) publish journal article on 1P height growth and SI model,
   b) prepare the final draft of a report on the new 1P model.

4. Cooperate with V. Zakrzewski in preparing a manuscript on modeling old growth stand yield, and a manuscript on developing SI models.

5. Write a journal note on the 10-year results after mechanical thinning young, overdense 1P with three different implements in the Rocky-Clearwater Forest.

6. Prepare or act as a scientific authority for the preparation of a spacing - thinning guide for 1P.

7. Publish a coauthored journal paper with V. Zakrzewski on mortality modeling 1P.

8. Develop plans for the final assessment of the aspen thinning/prunning study at Swan River, Manitoba.

14. Publications 1988-89:

Bella, I.E.; Navratil, S. 1988. Western gall rust dynamics and impact in young lodgepole pine stands in west-central Alberta. Can. J. For. Res. 18:1437-1442.

Brace, L.G.; Bella, I.E. 1988. Understanding the understory: dilemma and opportunity. Pages 69-86 in Proc. "Management and utilization of northern mixedwoods" Edmonton, AB., Apr. 1988. Can. For. Serv., Edmonton, Alberta Inf. Rep. NOR-X-296.

Navratil, S.; Bella, I.E. 1988. Regeneration, development and density management in aspen stands. A paper presented at the Canadian Poplar Council Annual Meeting, Edmonton, Oct. 1988.

Tait, D.E.; Cieszewski, C.J.; Bella, I.E. 1988. The stand dynamics of lodgepole pine. Can. J. For. Res. 18:1255-1260.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1986 Completion: 1991

17. Resources 1989-90:

PYs:	Prof.:	Bella	1.0
		Zakrzewski	1.0
	Tech.:	Vice Kolabinski	1.0
	Total		3.0
	Term/Student		0

O&M: $ 9,000

Capital: Nil

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Stand Productivity

2. Title: Data base development for growth and yield of important forest types in the prairie provinces.

3. New: Cont.: X 4. No.: NOR-4-02

5. Study Leader: R.C. Yang

6. Key Words: Computerized database, tree and stand growth, treated and untreated stands, thinning, spacing, site yields, stocking, models, aspen, jack pine, black and white spruce, red pine, lodgepole pine.

7. Location of Work: Manitoba, Saskatchewan and Alberta

8. Problem Analysis:

Growth and yield information is required for the efficient management of forest resources in the prairie provinces. Such information is needed for both treated and untreated stands. Silvicultural options and treatments can be evaluated by establishing and periodically re-examining permanent sample plots in the important forest types in the region. Growth and yield information thus obtained will form the basis of developing and improving growth and yield forecasting models both for old growth and managed stands. Computerizing such data bases increases their usefulness in-house and to clients.

9. Study Objectives:

1. Continue to monitor existing permanent sample plots as well as to establish new ones where necessary for studying the effect of stand treatments in the important forest types in the prairie provinces.

2. Develop and maintain a computerized database of regional forest productivity data.

3. Analyze and interpret growth and yield data and to publish appropriate information reports and forest management notes.

10. Goals for 1988-89:

1. Remeasure Pelly, Saskatchewan thinned aspen PSPs in the spring of 1988 before growth is initiated.

2. In the autumn of 1988 remeasure 20 PSPs (MS-189) associated with a merchantable selection thinning in jack pine east of Piney, Manitoba, and the red pine, jack pine, and white spruce spacing experiments at Moodie, Manitoba (64, variable size plots).

3. Analyze data collected in 1987 and draft a FMN on spacing lodgepole pine at Teepee Pole Creek, and analyze the results of the 1986 remeasurement of the 1964 Gregg Burn lodgepole pine spacing study.

4. Analyze data collected in the autumn of 1987 and prepare a FMN on thinning jack pine (MS-154) in the Sandilands Forest Reserve.

5. Publish an Information Report on management guidelines on the use of STEMS in single species stands.

6. Analyze all data collected to date on mechanical strip thinning of jack pine in the Sandilands Forest Reserve between 1964 and 1988. Draft a FMN for peer review.

7. Maintain a computerized data base of regional forest productivity PSPs in cooperation with D. Kuhnke.

Added Goals:

8. Remeasure aspen strip thinning plots in Hudson Bay, Saskatchewan.

9. Remeasure the Swan Lake mechancial thinning trail plots in 1P.

11. Accomplishments in 1988-89:

1. The Pelly aspen multiple thinning plots was remeasured; data analysis has been completed. A report on multiple thinning in aspen is currently under preparation.

2. The remeasurements of Moodie plantation spacing trials and merchantable selection thinning in jack pine in Sandilands Forests, Manitoba were completed.

3. Data analysis of the 1964 Gregg Burn lodgepole pine spacing trial has been completed; report preparation is in progress. Data analysis of the Teepee Pole Creek spacing trial is in progress.

4. Data analysis of the jack pine multiple thinning in the Sandilands Forest Reserve (MS 154) has been postponed to 1989-90.

5. The planed Information Report on management guidelines on the use of Stems in single species stands has not been published.

6. Data analysis of mechanical strip thinning of jack pine in the Sandilands Forest Reserve is postponed to 1989-90.

7. Assistance was provided to D. Kuhnke with respect to the maintenance of a computerized PSP data base of regional forest productivity data.

8. Aspen strip thinning plots in Hudson Bay, Saskatchewan were remeasured.

9. The Swan Lake mechanical thinning trial plots in lP were remasured; data analysis completed.

12. Current Status of Study:

1. A series of permanent sample plots were established for monitoring old growth stands in lP, jP, wS, and tA. Many of these plots, some date back more than 30 years - are still periodically remeasured and provide useful information. Thinning (in jP, lP, tA, and wS) and spacing (in jP, rP, lP, and wS) experiments were established and these studies provide useful information on managed stands (see summary table). Progress and accomplishments on these studies were previously mentioned under NOR-04-01.

2. A regional PSP catalogue containing ForCan as well as provincial and industrial PSPs has been developed and distributed to clientel by D. Kuhnke (NOR 03-02). In addition individual tree and plot information has been computerized to ensure effective utilization by CFS staff and clients.

3. Appropriate reports - both Information Reports and Forest Management Notes - are published as information relating to additional remeasurement becomes available or new analytical techniques come on stream.

13. Goals for 1989-90:

1. Remeasure the McKay lP thinning plots and the Gregg Burn spacing trial established respectively in 1954 and 1984.

2. Remeasure the aspen thinning/prunning study plots in Porcupine Mountain, Manitoba.

3. Prepare and submit for review a report on the Pelly multiple thinning in aspen (Yang).

4. Prepare and submit for review a FMN on the 1964 Gregg Burn spacing trial. Complete data analysis of the Teepee Pole Creek spacing trial, draft a report (Yang).

5. Complete data analysis of the jack pine multiple thinning in the Sandilands Forest Reserve (MS 154) and draft a report.

6. Complete data analysis of mechanical strip thinning of jack pine in the Sandilands Forest Reserve.

14. Publications 1988-89:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1948 Completion: Ongoing

17. Resources 1989-90:

PYs	Prof: Yang	0.2
	Tech: Lux	0.4
	Total:	0.6
	Term/Student:	0.3

O&M: $7,200

Capital: $ 5 K

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

SUMMARY OF ACTIVE THINNING, SPACING AND YIELD STUDIES IN CONIFERS
1988

Location	Soil and Site	Stand age at establishment	Date of establishment	Date of remeas.*	No. of plots	Plot size (acres)	Treatment: Method	Treatment: Intensity
Alberta	Varied	Varied	1951 1952 1953	1961 1974 1984 (1994)	100	0.1 0.5	N.A.; these are permanent growth and yield plots	
Sandi-lands, Man.	Stratified sand and gravel outwash; moist	15	1952	1957 1962 1967 1971 1977 1983 Spr. 1987 A (1993 Spr.)	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
Sandi-lands, Man.	Medium sand; fresh	40	1958	1963 1968 1973 1978 1983 Spr. 1988 A (1993 Spr.)	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
Sandi-lands Forest Res., Man.	a. Sand, fresh (Tougas Rd.)	9	1964	1965 1968 1973 1978 1983 Spr. 1987 A 1998 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 (1996 A)	5	.002 - .007	Mechanical Strip-thinning	Thinned 1-way 5 plots

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SUMMARY OF ACTIVE THINNING, SPACING AND YIELD STUDIES IN CONIFERS
1988 (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 (Central Rd.)	9	1964	1965 1968 1973 1978 1983 Spr. 1987 A (1998 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 (1996 A)	5	.002 - .007	Mechanical Strip-thinning	Thinned 1-way: 5 plots
		e. Sandy till, fresh (Badger)	13	1965	1967 1970 1974 1979 1984 A (1994 A)	10	.002 - .007	Mechanical Strip-thinning	Control: 5 plots Thinned 1-way: 5 plots
		f. Sandy till, fresh (west of Piney)	17	1966	1968 1970 1975 1980 A 1985 A (1995 A)	10	.002 - .007	Mechanical Strip-thinning	Control: 5 plots Thinned 1-way: 5 plots
		g. Sand, dry (Badger)	13	1965	1967 1970 1974 1979 1984 A (1994 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 plo 2.4m spacing: 3 plots 3.7m spacing: 1 plot

SUMMARY OF ACTIVE THINNING, SPACING AND YIELD STUDIES IN CONIFERS
1988 (continued)

y	Location	Soil and Site	Stand age at establishment	Date of	Date of remeas.	No. of * plots	Plot size (acres)	Treatment Method	Treatment Intensity
	Sandi-lands, Forest Reserve	Sand, fresh	3 y.o seedlings planted	1963	1973 1978 1983 1988 A (1993 A)	32	Variable	49 trees in a 7x7 matrix at 4x4, 6x6, 8x8 10x10 ft. spacing plus a 2-row surround. Four replications.	
S	Sandi-lands	Sand, fresh	3 y.o seedlings planted	1963 1962	1973 1978 1983 A 1988 A (1993 A)	32	variable	as above	
a.1	Gregg Burn	three site types	7	1964	1966 1971 1976 1981 1986 A (1991 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 (1992 A)	30	variable	100 trees in a 10x10 matrix at densities 200, 400, 800, 1600, 3200 stems/ac.	
a.	Sandi-lands	N/A	N/A	1980	1985A	6x4		Control: 20x20m 1. Control, 2. 8'x8', 3. 10'x10' 4. 12'x12' Treated: 30x30m	
b.	Belair	N/A	N/A	1981 (tr) 1982 (co)	1985A 1985A	4	2(20x20 m) 2(10x10 m)		
c.	Hadash.	N/A	N/A	1981	1985A (1990A)		20 x 20 m	3 areas; in each 1 control, 1 thinned.	

SUMMARY OF ACTIVE THINNING AND OTHER GROWTH STUDIES IN ASPEN
1988 (Concluded)

Study No.	Location	Soil and Site	Stand age at establishment	Date of establishment	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 1986A (1991A)	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 1986A (1991A)	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 1986A (1991A)	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. (1989A)	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.

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Stand Productivity

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

5. Study Leader: Terminated

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. Problem Analysis:

Soils of the foothills are suspected of being deficient in N-S-P. A fertilizer study was initiated on two common soil types of the area supporting various aged stands of lodgepole pine. Fertilizer responses (N, S and P) in both soils and stands have been monitored over a 10-year period.

Progress to 1988

The response of the two Luvisols to fertilization was markedly different. Both Physical and chemical properties of the soils had a marked influence on the distribution pattern of N, S, and P observed. The differences in soil chemistry of the soils were seen in the retention of nutrient within the profile. While certain complex organic substances containing essential nutrients are taken up by roots, available nutrients predominantly are found in the mineral fractions of the soil. Results have been presented in 2 published reports and 4 - file reports.

9. Study Objectives:

1. To determine the influence of soil physical and chemical properties on the transformation of N, P and S fertilizers and the accumulation and distribution of these in the various inorganic and organic soil fractions.

2. To determine the association, if any, of a specific nutrient fraction with growth.

10. Goals for 1988-89:

1. Termination of study. Completion of all reports.

11. Present Status:

Both physical and chemical properties of these soils have influenced the transformation of added N, P and S, their accumulation and distribution both within the soil profits and the arbitrarily designated nutrient fraction. Soil properties such as hydrated Al and Fe oxides silicate clay contents, C/N ratios, soil O.M. contents and mineralization rates, ratios between inorganic and organic nutrient sources, etc. play a role in stand and soil responses to fertilization. Thus far, these properties showed a greater impact in the Podsolic Gray Luvisol (Mercoal) than that in the Orthic Luvisol (Coalspur). Study terminated following retirement of Dr. Baker and his documentaiton of the results.

12. Accomplishments in 1988-89:

1. Study terminated following retirement of Dr. Baker. Results of study documented in a series of file reports as listed last year including "An approach to balanced applications of N, P, and S in the fertilization of lodgepole pine in the foothills". C.P.D.L. considered the patent application for a constant-level-constant temperature water bath to have limited marketability thus did not pursue further.

13. Goals for 1989-90:

Nil - terminated

14. Publications 1988-89:

Nil

15. Environment Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of the information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1972 Completion: 1988

17. Resources 1989-90:

Nil - Terminated

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Stand Productivity

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

3. New: Cont: x 4. No: NOR-4-05

5. Study leader: R. C. Yang

6. Key words: Nutrition, fertilizer, thinning, growth

7. Location of Work: Hinton, Alberta; Saskatchewan, Manitoba

8. Problem Analysis:

Although fertilizing has been found to improve lodgepole pine productivity, information on nutrient requirements of this species remains sparse. Knowledge on the mechanism of the species responding to thinning and fertilization treatments is especially limited. A correct diagnosis of nutrient requirements is often cited as a pre-requisite to effective fertilization along with the density control of the stand. The latter is particularly important in young lodgepole pine, which often grows in over-dense stands. Previous study results (NOR-4-04) showed improved diameter and volume growth of two 30-year-old stands after fertilization; stand growth response, however, was obscured by high and variable mortality associated with excessive stand density. This suggests that fertilizer should be applied in combination with thinning to improve stand productivity.

9. Study Objectives:

1. To assess the effect of thinning and N fertilization on growth of semi-mature lodgepole pine.

2. To quantify the effect of thinning, fertilization and their combined effects on nutritional status in trees and soils and to establish relationships between tree growth response and nutrient status.

3. To develop a diagnostic technique for fertilizer prescription of lodgepole pine from the above relationships.

4. To obtain growth response information to fertilization for other regional commercial tree species as warranted by available data sources.

10. Goals for 1988-89:

1. Publish the manuscript entitled "Effects of fertilization on wood density and tracheid length of 70-year-old lodgepole pine in west-central Alberta" (4-15).

2. Continue sampling for soils, ground vegetation and foliage to monitor nutritional and dimensional changes following fertilization and thinning; conduct data analyses (4-19).

3. Sample Interprovincial Fertilization Trial plots in Slave Lake, Alberta and Candle Lake, Saskatchewan to assess changes in stem bole form following fertilization (4-40).

4. Carry out analysis on the South of Mercoal plot samples to verify N,P, and S effects on growth of 70-year-old lodgepole pine by the Solonius method (4-61).

5. Prepare and submit a research note on nutrient status of 40-year-old lodgepole pine needles for journal publication (4-61).

6. Provide advice and carry out technology transfer on mensurational problems relating to forest fertilization (4-18).

Added goals:

7. In cooperation with W. Ondro, prepare a manuscript on fertilizing preharvest lodgepole pine to present at a forest fertilization workshop.

8. Remeasure aspen fertilization plots in Hudson Bay, Saskatchewan, established by the Interprovincial Fertilization Program.

11. Accomplishments in 1988-89:

1. The journal article entitled "Effects of fertilization on wood density and tracheid length of 70-year-old lodgepole pine in west-central Alberta" has been published (4-15).

2. Scheduled sampling for soils and foliages to monitor nutritional and dimensional changes following fertilization and thinning has been completed. Laboratory analyses to determine nutrient concentrations in soils and foliages are in progress (4-19).

3. The planned sampling of Interprovincial Fertilization Trial plots in Slave Lake, Alberta and Candle Lake, Saskatchewan to assess possible changes in stem bole form following fertilization was postponed.

4. Statistical analysis to determine fertilization effect on 70-year-old lodgeple pine using Solonius method was completed. Results from the Solonius method are closely consistent with results using traditional methods.

5. The proposed note on nutrient status of 40-year-old lodgepole pine needles was postponed due to insufficient data. Results of this analysis will be included in publication based on results from fertilization and thinning study.

6. Provided advice on statistical methods for determining nutrient status in soils to AFS.

7. An article entitled "Fertilizing preharvest lodgepole pine: costs, revenue, and returns " was presented at post-session of Forest Fertilization Workshop held March 2-3, 1988 in Richmond, British Columbia.

8. Remeasurement of the aspen installation established by the Interprovincial Fertilization program in Hudson Bay, Saskatchewn was completed; data analysis is in progress.

12. Present Status of Study:

This study was initiated in 1984. Seventy-two 0.03-ha circular plots were established and half of plots were thinned; all plot trees were tagged and tallied at establishment. Nitrogen at four levels (0, 180, 360 and 540 kg/ha) along with 40 kg/ha each of P, and S were applied in the fall, 1985. Foliar, ground vegetation, and soils were sampled in 1985 prior to fertilization and 1986, 1987, 1988 for nutrient analyses. Laboratory analyses of pre-fertilization and 1987 samples have been completed and determinations of 1988 samples are in progress.

Dimensional changes in current needles in thinned and fertilized plots become visually noticeable two years after treatment. The information on needle length and weight in combination with nutrient status in soil and foliages following treatment provide needed data for predicting growth response and diagnosing nutrient requirement of lodgepole pine.

13. Goals for 1989-90:

1. Continue sampling for soils, ground vegetation and foliages to monitor nutritional and dimensional changes following fertilization and thinning; conduct data analyses.

2. Complete data analysis of growth response of aspen to fertilization. Prepare manuscript if results warrant publication.

3. Prepare a manuscript on soil and foliar nutritional changes following fertilization and thinning.

4. Provide advice and carry out technology transfer on mensurational problems relating to forest fertilization.

14. Publications 1988-89:

Yang, R.C.; Wang, E.I.C.; Micko, M.M. 1988. Effects of fertilization on wood density and tracheid length of 70-year-old lodgepole pine in west-central Alberta. Can. J. For. Res. 18:954-956.

15. Environment Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of the following clarifications provided by the study leaders, the committee concludes that no further action is required:

- The treated area is only 1.5 ha.
- The terrain is flat and there are no creeks in the area. As a result there is no possibility of the fertilizer moving off-sites into nearby water bodies.
- The fertilizer is applied by manually-operated cyclone spreaders.

16. Duration:

Started: 1984 Estimated Completion: 1996

17. Resources 1989-90:

PYs:	Prof.:	Yang	0.6
	Tech.:	Lux	0.6
	Total:		1.2

Term/Student: 0.0

O & M: $4.0 K
Capital:

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Stand Productivity

2. Title: Economic evaluation of intensive forest management practices

3. New: Cont.: X 4. No.: NOR-4-08

5. Study Leader: W. Ondro

6. Key Words: Financial and economic returns, financial, economic and marginal evaluation and analyses, costs, benefits, financing, investment, decisions, cost effectiveness, pruning, spacing, conifer release, tree improvement, thinning, fertilization

7. Location of Work: Northwest Region

8. Problem Analysis:

Biological responses to intensive forest management practices are fairly well documented and understood, but we are lagging behind in economic analyses of such treatments. This study is to fill that gap.

9. Study Objectives:

1. Determine economic returns from increased growth after spacing, fertilization and other intensive management practices.

2. Evaluate cost-effectiveness of different intensity, mix and sequence of forest management treatments.

3. Evaluate the utilization and market potential of poplars.

10. Goals for 1988-89:

1. Publish information report on the financial returns from fertilizing 70-year-old lodgepole pine.

2. Publish information report on present utilization of poplars in Alberta. (see also NOR-28-06)

3. Complete review and publish information report on economics of spacing in naturally regenerated lodgepole pine.

4. Prepare and present poster on costs and financial returns from fertilizing pre-harvest lodgepole pine at the workshop on "Improving forest fertilization decision-making", Vancouver, B.C.

5. Continue R&D study on the cost-benefits of spacing in naturally regenerated jack pine. Prepare information report.

6. Initiate discussion and develop a plan of approaches to cost/benefit study of releasing white spruce from aspen.

Added Goal:

7. Prepare a manuscript on present trends and future prospects for poplar utilization in Alberta.

11. Accomplishments in 1988-89:

1. The manuscript on financial returns from fertilizing 70-year-old lodgepole pine was revised and submitted for publication to the Forestry Chronicle.

2. An Information Report on present utilization of poplars in Alberta is going through final editing.

3. A report was prepared on the cost/benefit of spacing dense naturally regenerated lP. It will be ready for review by Feb. 28, 1989.

4. A poster paper on costs and financial returns from fertilizing preharvest lodgepole pine was prepared and presented in Vancouver, B.C. at workshop on improving forest fertilization decision-making.

5. A draft report on cost/benefits of spacing naturally regenerated jack pine was prepared.

6. A plan of approaches to cost/benefit study of releasing white spruce from aspen was prepared.

7. A manuscript on present trends and future prospects for poplar utilization in Alberta was prepared and submitted for reviews.

12. Present Status of Study:

1. Completed financial returns from fertilization in mature lP stand. Evaluation of returns from increased growth after spacing lP and jP is in progress.

2. Evaluated cost-effectiveness of different fertilization treatments in lP. Assessment of cost-effectiveness of lP and jP spacing is in progress.

13. Goals for 1989-90:

1. Publish a journal article on financial returns from fertilizing 70-year-old lodgepole pine.

2. Publish an Information Report on present utilization of poplars in Alberta (ENFOR).

3. Publish an Information Report on cost/benefits of spacing naturally regenerated lodgepole pine.

4. Prepare final draft and publish information report on costs/benefits of spacing naturally regenerated jack pine.

5. Conduct a problem analysis on cost/benefits of white spruce release from aspen.

6. Prepare a final draft and publish a journal article on present trends and future prospects for poplar utilization in Alberta.

14. Publications 1988-89:

Ondro, W.J.; Yang, R.C. 1988. Fertilizing preharvest lodgepole pine in Alberta; costs revenues and returns. Pages 61-70 in J.D. Lussier (editor). "Improving forest fertilization decision-making in British Columbia". Proc. Workshop, March 2-3, 1988. Vancouver, B.C. Min. For. Lands, Victoria, B.C.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leaders, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1985 Completion: continuing

17. Resources 1989-90:

PYs:	Prof.: Ondro	1.0
	Tech.:	0.0
	Total:	1.0
	Term/Student:	0.0

O & M: $3,000

Capital: Nil

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Stand Productivity

2. Title: Stand tending techniques in the Mixedwood Forest Section

3. New: Cont.: X 4. No.: NOR-4-09

5. Study Leader: R. C. Yang

6. Keywords: Stand tending, stand development, yield, growth models

7. Location of Work: Manitoba, Saskatchewan and Alberta

8. Problem Analysis:

Spruce-aspen is one of the most important cover types in the Mixedwood Forest Section (B.18a) of the Boreal Forest Region. Aspen, a vigorous pioneer species, usually forms the upper canopy for at least the first 50 to 60 years of the life of the stand. Often the spruce in the understorey is subjected to severe suppression, and mechanical injury from the dominating aspen. The aspen competition results in reduction of height and diameter growths of the white spruce and losses in volume production.

Foresters have long realized the impact of aspen on white spruce growth. Experimental improvement cuttings to favor the white spruce in mixedwood stands in Manitoba were first carried out in 1936 (Duck Mountain). A series of experimental release cuttings were made in 1951- 54 in 15- to 60-year-old stands in Manitoba and Saskatchewan (MS-153), to determine the effects of partial and complete removal of aspen upon the development of white spruce. A similar experiment was also carried out in Slave Lake area, Alberta (A-13).

9. Study Objectives:

1. To prepare silvicultural prescriptions for releasing white spruce from trembling aspen in mixedwood stands based on ecological factors and mensurational growth responses derived from experiments and operational trials carried out in this region.

2. To assess the impact of white spruce release in terms of potential increase in wood production in mixedwood forests in the region.

3. To assess growth and yield of spruce-aspen mixedwood stands following stand tending treatments and to develop tending techniques to improve productivity of the cover type.

10. Goals for 1988-89:

1. Revise and submit the manuscript entitled "Growth of white spruce following release from aspen competition" for journal publication (4-72).

2. Revise and publish Information Report " Growth response of white spruce to release from trembling aspen competition in spruce-aspen mixedwood forest" (4-63).

3. Continue analyses on wS-tA release data and prepare ms for information report on silvicultural prescription for releasing white spruce from aspen in mixedwood stands based on ecological factors and mensurational response derived from experiment and operational trials carried out in this region (4-72).

4. Continue data analysis on growth and yield of wS-tA stands in releation to silvicultural, mensurational and ecological variables and provide data, if requested, for Mixedwood Symposium (4-31).

Added goal:

5. Contribute to a study to preserve white spruce understory by various logging equipment and techniques in mature aspen stands.

11. Accomplishments in 1988-89:

1. The manuscript entitled "Growth of white spruce following release from aspen competition" (A-13) has been internally reviewed and will be submitted to a journal for publication shortly.

2. Information Report " Growth response of white spruce to release from trembling aspen competition in spruce-aspen mixedwood forest (MS-153) is in the final stage of preparation for publication and will be published in February 1989.

3. Data analysis on wS-tA release has been completed; preparation of an Information Report on silvicultural prescription for releasing white spruce from aspen in mixedwood stands based on ecological factors and growth response from experimental and operational trials in this region is in progress.

4. Provided white spruce growth data following release from aspen compeition for an article entitled "Understanding the understory: dilemma and opportunity" presented at the Mixedwood Symposium held April 11-14, 1988 in Edmonton, Alberta.

5. Participated field work and developed a computer program to compile study plot in operational trials of wS-tA stand harvesting.

12. Present Status:

This study is based on data from experiments on releasing white spruce from aspen competition established in early 1950's in Manitoba and Saskatchewan (MS-153) and Alberta (A-13). Plots were remeasured 5 and 10 years following release. Four reports were published.

Another remeasurement of release response has been initialized in 1985, 35 years after establishment. Data analysis on individual tree release in Slave Lake, Alberta (A-13) has been complete. Three reports (two manuscripts have been prepared and under review) will provide needed information set forth in the study objectives.

13. Goals for 1989-90:

1. Publish an Information Report entitled "Growth response of white spruce from trembling aspen" (MS-153).

2. Publish a journal article on "Growth of white spruce following release from aspen competition" (A-13).

3. Draft an Information Report on silvicultural prescription for releasing white spruce from mixedwood stands.

4. Contribute to the study on wS release by operational harvesting of aspen in mixedwood stands.

5. Initiate the development of a microcomputer-based expert system on management of mixedwood stands in boreal forests.

14. Publications in 1988-89:

Nil

15. Environment Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leaders, the committee has concluded that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1985 Estimated Completion: 1991

17. Resources 1989-90:

PYs:	Prof.:	Yang	0.2
	Tech.:		0.0
	Total:		0.2

Term/Student: 0.0

O & M: $1.0 K

Capital:

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Stand Productivity

2. Title: Managed stand yield tables for lodgepole pine and white spruce

3. New: Cont.: X 4. No.: NOR-4-10

5. Study Leader: C.J. Cieszewski

6. Keywords: Seeded or planted stands, second growth, site framework, AAC calculations

7. Location of Work: Alberta

8. Problem Analysis:

With the continued and accelerating forest harvest in Alberta, there are ever increasing areas of second growth coniferous stands that are established through either natural regeneration or by planting. Even casual observations reveal substantial differences between various characteristics of this regeneration--especially in stocking density--compared to regeneration of fire origin. these differences cause related differences in tree growth and stand development, and thus in the length of time required to grow the next merchantable crop, i.e., rotation. Yield tables are available to forecast yields of old growth stands, but no yield tables are available for second growth stands. For these, any quantitative information is rather scarce and even potential data for Alberta is limited to the first 30 years of growth. therefore, related mensurational research is urgently needed to remedy this situation by developing suitable yield predicting systems for second growth lodgepole pine and white spruce stands.

9. Study Objectives:

To develop a growth and yield prediction system for second growth lodgepole pine and white spruce--i.e., new stands that follow harvest and are being established through either natural regeneration or planting--within an appropriate and available site classification framework. Yield estimates thus obtained should be suitable input for timber management system models (e.g., TIMPLAN) for AAC calculations.

10. Goals for 1988-89:

1. Complete the development of a stand level density-based model using diameter-density relationship, differential diameter growth and height-diameter regression sub-models, diameter distribution sub-model and volume regression sub-model.

2. Develop individual tree diameter, height growth, and mortality sub-models for SPS and initiate its calibration and testing for 1P.

3. Develop new height growth curves for 1P based on stem analysis data using the two point principle. Also include elevation and density influence.

4. Publish journal paper (Tait, Cieszewski, Bella) on stand level model; continue refinements and testing of this model.

5. Prepare draft for journal paper on improvement of regression analysis techniques (Cieszewski, Bella).

6. Give talks and demonstrations on 1P managed stand yield models to the Growth and Yield coop and other clients, and solicit their input.

Added Goals:

7. Develop new height growth and site index curves for 1P using stem analysis data and prepare a manuscript for journal publication.

8. Incorporate the new height and SI models in the new 1P yeild tables.

11. Accomplishments in 1988-89:

1. Completed the development of the stand level diameter-based variable density growth model with differential diameter growth and height-diameter regression sub-models, diameter distribution sub-model and volume regression sub-model.

2. The work on the PSP model development has been postponed pending the release of an updated and improved version.

3. Initiated work on the two point principle height curves for 1P, and on including elevation and density affects in 1P height growth models.

4. Published a journal paper on stand dynamics of lodgepole pine (Tait, Cieszewski, Bella).

5. Prepared a rough draft for a journal paper on improvements of nonlinear regression analysis techniques as relates to stand modeling.

6. Gave talks and demonstrations on 1P managed stand yield models to the Growth and Yield Co-op and other groups and clients, and solicited their input.

7. Developed new height growth and site index curves for lP from stem analysis data, prepared a coauthored ms (Cieszewski and Bella) and submitted to a journal.

8. Incorporated new height and SI models in the new lP yield tables.

12. Present Status of Study:

The first cut of a stand level model based on the Reineke mean qudratic diameter and trees/ha relationship had been finished. Present efforts concentrate on testing the model and report writing. Plans have been made to develop a second version of the model which would be based on the density-volume relation.

13. Goals for 1989-90:

1. Test and calibrate the lP model with thinning data to relistically simulate thinning response.

2. Publish a journal paper on the new height and SI curves.

3. Complete report writing and publish a coauthored (Cieszewski and Bella). Info. Report on the new lP growth model.

4. Develop a lP stand model based on the volume/density relationship as opposed to the diameter/density relationship of the present model. This model would be based on the -3/2 power law.

5. Prepare final draft for journal publication on improvements of nonlinear regression analysis techniques for stand modeling.

6. Investigate the possibility of adapting the latest version of Arney's SPS (version 2) for lP in Alberta.

7. Prepare a journal paper on mathematical height model formulation.

8. Develop new height growth curves for lP based on the two point principle.

9. Test the effect of elevation and stand density on height growth.

10. Give talks and demonstrations on lP managed stand yield models to the Growth and Yield Co-op and other groups and clients and solicit their input.

14. Publications 1988-89:

Tait, D.E.; Cieszewski, C.J.; Bella, I.E. 1988. The stand dynamics of lodgepole pine. Can. J. For. Res. 18:1255-1260.

15. Environment Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leaders, the committee has concluded that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1986 Completion: 1989

17. Resources 1989-90:

PYs: Prof.: Cieszewski 1.0 Alberta Agreement
Tech.:

Total: 1.0
Term/Student: 0.3 (Agreement)

Salary: $38.0 (Alberta Agreement)
O & M: $28.0 (Alberta Agreement)
Capital:

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 14, 1989

1. Project: Fire Management Research

2. Title: Fire behavior in boreal forest fuels

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

5. Study Leader: Z. Chrosciewicz

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

7. Location of Work: Northwest Region

8. Problem:

Intensive fire management requires improved methods of assessing and forecasting fire danger for all major fuel types over a wide range of weather and site conditions. A good start in the development of such methods was made with the introduction of the new Canadian Forest Fire Weather Index tables in 1970. The main index as well as the component codes are designed to summarize and rate the important weather variables that affect the ignition and spread of forest fires. In its daily rating of fire danger, the system uses primarily weather-dependent scales, and so it does not really provide means for rating fire behavior and effects in specific fuels. A thorough knowledge of fuel types, their characteristics and their ultimate interactions with fire is, therefore, essential for both proper control and proper use of fire on problem areas.

Specifically, the research in this study is aimed at (a) developing suitable techniques for assessing spatial distribution and loading of dimensionally categorized total biomass in any forest ecosystem, (b) delineating basic relationships between weather, moisture codes, and actual moisture contents of various dead components of that biomass, (c) documenting seasonal changes in moisture content, dry-weight content, chemical content, and heat content of some more important living biomass components present, (d) determining microclimatic differences between major forest ecosystems and the open in terms of solar radiation, temperature, relative humidity, wind speed, and rainfall, (e) measuring and analyzing various fire-behaviour parameters, and fire effects, over a range of diverse forest weather, fuel, and landform conditions, (f) devising seasonally differentiated fire-hazard rating for major forest

ecosystems in the region, and (g) testing and formulating ecologically sound and economically feasible methods for securing adequate postcut forest reproduction by the use of controlled burning and various supplementary treatments including seed-tree systems, direct seeding and planting. The work is of both fundamental and practical nature.

9. 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.

10. Goals for 1988-89:

1. Conclude publication of a journal article on "Regressions between weather-based moisture codes and actual moisture contents of mor humus on a clear-cut jack pine site, central Saskatchewan".

2. Conclude publication of a journal article on "Metric roundwood classification and dry-weight regression equations in jack pine stand biomass studies, central Alberta".

3. Conclude publication of an Information Report on "Fire behavior and effects in semimature jack pine stands, central Alberta".

4. Conclude publication of a journal article on "Regressions between weather-based moisture codes and the actual moisture contents of mor humus under diverse forest conditions, central Alberta".

5. Prepare a report on "Microclimatic differences between the open and four diverse forest ecosystems in central Alberta."

6. Prepare a report on "Regressions predicting silvicultural effects of burning on jack pine cutovers".

7. Prepare a report with "Tables for silvicultural burning prescriptions on jack pine cutovers".

8. Remeasure postburn jack pine stand growth on seven 0.04-ha plots within the seed-tree area in central Saskatchewan.

9. Initiate preparation of a report on "Jack pine stand recovery from severe browsing by snowshoe hares in central Saskatchewan".

10. Provide advisory services as required.

Added Goals:

11. Commence preparation of an invited paper on "Postcut burning and black spruce regeneration" for the 1989 IUFRO SI.05.12 Symposium in Gander and Grand Falls, Newfoundland.

12. Plot by computer sets of regressions re. raw humus sorption, desorption, and equilibrium moisture contents over a wide range of temperature and humidity permutations.

11. Accomplishments in 1988-89:

1. The journal article on (new title) "Prediction of forest-floor moisture content on jack pine cutovers" was prepared, revised, and accepted for publication.

2. The journal article on (new title) "Dimensional roundwood classification and forest biomass studies" is nearing completion.

3. Analyses of data and all supporting material for inclusion into an information report on "Fire behavior and effects in semimature jack pine stands, central Alberta" were completed.

4. The journal article on (new title) "Prediction of forest-floor moisture content under diverse stand on site conditions" was prepared and submitted for publication.

5. Sets of regressions were computer-plotted for inclusion into a journal article on (new title) "Predictions of wind speed and available rainfall under diverse stand and site conditions".

6. Sets of regressions were computer-plotted for inclusion into a journal article on (new title) "Prediction of postburn forest-floor conditions on jack pine cutovers".

7. "Tables for silvicultural burning prescriptions on jack pine cutovers" were computer-printed.

8. Jack pine stand growth within the burned seed-tree area in central Saskatchewan was measured as planned.

9. The growth data for inclusion into an information report on "Jack pine stand recovery from severe browsing by snowshoe hares in central Saskatchewan" were analysed.

10. On request, provided advisory services, and also critically reviewed five manuscripts for publication by other authors.

11. Completed a preliminary review of literature and submitted for review to the IUFRO Symposium Organizing Committee an abstract of the proposed paper.

12. Sets of regressions re. raw humus sorption, desorption, and equilibrium moisture contents in relation to temperature - humidity permutations were computer-plotted for publication. About 400 individual regressions were involved.

12. Present Status of Study:

The new Canadian Fire Weather Index was introduced to the Region in 1970 through a series of training sessions for the user agencies. Since then, fire behavior and fire effects were studied by means of experimental burning on a number of cutover sites and in uncut stands.

Varying in area from 0.09 to 33.35 ha, the tests included: 2 burns of black spruce slash, plus 17 burns of jack pine slash in Manitoba; 31 burns of jack pine slash in Saskatchewan; and 22 burns of lodgepole pine slash, 2 burns of undisturbed black spruce stands, plus 20 burns of undisturbed jack pine stands in Alberta.

While this work was nearing completion, variations in moisture content, dry-weight content, chemical content, and heat content of green conifer foliage (jack pine, black spruce, white spruce and balsam fir) were studied in Alberta to determine their seasonal lows and highs that may contribute substantially to the incidence and the spread of crown fires.

Postburn treatments such as seed-tree systems, direct seeding, and planting were routinely tested in conjunction with all experimental fires on cutover areas to provide authentic prescription data for silvicultural purposes.

Other work included development of methods for fuel classification, stand biomass assessments, stand fire hazard ratings, and microclimate studies in diverse forest ecosystems.

In all this, results are being published as they become available. About 30 journal articles, in-house reports, and notes have been published on the basis of this study. The specific contributions by the objectives listed can be summarized as follows:

Objective #1. Fire spread and intensity values were determined for (a) lodgepole slash (22 burns), (b) undisturbed black spruce stands (2 burns), and (c) undisturbed old jack pine stands (8 burns). Further fire spread and intensity values will be forthcoming for (d) undisturbed semimature jack pine stands (12 burns).

Objective #2. Fuel reduction values and information on plant succession, including forest regeneration, were provided for (a) black spruce slash (2 burns) and (b) jack pine slash (48 burns). In addition, fuel reduction values alone were provided for (c) lodgepole pine slash (22 burns), (d) undisturbed black spruce stands (2 burns), and (e) undisturbed old jack pine stands (8 burns). Further fuel reduction values will be forthcoming for (f) undisturbed semimature jack pine stands (12 burns).

Objective #3. Explicit guidelines were published for postcut disposal of fuels as well as for formulation of specific prescriptions in preparation of favorable seeding and planting sites by fire. Further 24 regressions and readout tables will be forthcoming for more precise setting up of silvicultural burning prescriptions over a wide range of jack pine-black spruce cutover sites.

Objective #4. Fire control agencies, silviculturists, educators, and all those willing to listen were instructed on the use of available guidelines. This was done by means of personal contacts, through various handouts, and through a series of some 18 more or less formalized, often illustrated lectures, seminars, and workshops. The process of instruction will continue.

It is expected that the incumbent will retire during 1989-90 and will seek a part-time status in order to complete a number of publications including a manual on "Controlled burning prescriptions for postcut regeneration of jack pine and black spruce".

13. Goals for 1989-90:

1. Conclude publication of a journal article on "Prediction of forest-floor moisture content under diverse stand and site conditions".

2. Complete preparation of a journal article on "Dimensional roundwood classification and forest biomass studies".

3. Carry out a followup regeneration and growth survey on burned in 1967 lowland black spruce cutovers, southeastern Manitoba.

4. Prepare and present a paper on "Postcut burning and black spruce regeneration" at the forthcoming IUFRO Symposium, August 12-20, 1989, central Newfoundland.

5. Provide advisory services as required.

14. Publications in 1988-89:

Chrosciewicz, Z. 1988. Jack pine regeneration following postcut burning under seed trees in central Saskatchewan. For. Chron. 64:315-319.

Chrosciewicz, Z. 1988. Forest regeneration on burned, planted, and seeded clear-cuts in central Saskatchewan. Can. For. Serv., North. For. Cent., Edmonton, Alta. Inf. Rep. NOR-X-293.

Chrosciewicz, Z. 1988. Burning for black spruce regeneration on a lowland cutover site in southeastern Manitoba (a summary). Can.-Man. Econ. Reg. Dev. Agreement, Winnipeg, Man. For. Manage. Demo. Note No. 9.

Chrosciewicz, Z. 1989. Prediction of forest-floor moisture content on jack pine cutovers. Can. J. For. Res. 19 (in press).

Chrosciewicz, Z. 1989. Site conditions for jack pine seeding. Pages .... in W.D. Towill (compiler). Towards prime site management. Symposium proceedings. Ont. Min. Nat. Resour. (in press).

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1970. Estimated Completion: 1983. Revised: 1990.

17. Resources 1989-90:

PYs:	Prof.:	Chrosciewicz	1.0
	Tech.:		0.0
	Total:		1.0
	Term/Student:		(Manitoba Agreement)

O & M: $5.0 K

Capital: Nil

18. Signatures:

Investigator

J. M. Powell
Program Director, Environment

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 14, 1989
Amended: February 27, 1989

1. Project: Fire Management Research

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

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

5. Study Leader: C.J. Ogilvie

6. Key Words: Aerial patrols, lookouts, detection, storm tracking, wildfire mapping, remote sensing, retardants, combustion lab, air tankers, suppression, fire control, fire planning, foam

7. Location of Work: Northwest Region

8. Problem:

Each year fire starts number at least 2000 in the prairie provinces and Northwest Territories. Many of these fires become unmanageable resulting in costly suppression and mop-up activities. The objective of this study is to improve fire detection, surveillance and suppression methods. It is oriented towards the immediate needs and requests of the client agencies and so provides an excellent opportunity to improve operations which will reduce total fire losses and minimize fire suppression costs.

Many of the results achieved in this study have already been implemented, and the prospects of further findings being put to practical use are excellent.

The following general course of action is being followed:

1. Discussion with respective user agencies to define and outline the problems to be solved.

2. On-site evaluations of existing installations and analysis of available data.

3. Formulation of objectives to be met by new systems or equipment.

4. Design of new systems or modification of existing systems in order to achieve optimum returns under given local conditions and accepted restraints.

5. Assistance to user agencies during implementation including solving day-to-day problems that have a bearing on systems design and operation.

9. Study Objectives:

1. Develop techniques and equipment 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. Develop fire suppression production information for a variety of methods and conditions.

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

10. Goals for 1988-89:

1. Prepare and publish a Fire Management Report Note on: Real-time observation and analysis of large prescribed burns using digitized infrared scanner.

2. Complete co-authored report on 1986 Daedalus line scanner trials for publication.

3. Complete and publish a Technology Transfer Note on the application of the U.S. Operational Retardant Evaluation study to Canadian conditions.

4. Prepare and publish a Fire Management Note on The Water Misters.

5. Initiate preparation of a report on procedures for fire tower seen-area mapping.

6. Initiate work to develop methods of using infrared technology operationally for optimum placement of air tanker loads and at the same time evaluate retardant effectiveness under operational conditions. Load placement effectiveness can probably be doubled using infrared information which provides a clear view of the fire and the retardant drop. In addition, effectiveness information on the applied retardant will provide basic data for use in upgrading the materials composition and rates of application. This goal is to be conducted in cooperation with PNFI, the Canada-Saskatchewan Forestry Development Agreement and the province of Saskatchewan.

7. In cooperation with GLFC and contractor further develop methods of observing wild and prescribed fires to study rates of spread, fire intensity, fire spotting, fire whirlwinds and other aspects of fire behavior.

8. Act as technical representative for detection study contracts of Manitoba and Saskatchewan.

9. Provide technical services and training to client agencies.

11. Accomplishments in 1988-89:

1. Paper entitled "Real time observation and analysis of prescribed and wildland fires using digitized infrared imagery" has been submitted to USFS Management Notes.

2. The report on the 1986 line scanner trials was combined with the report on the 1985 trials and has been published.

3. This report is being revised to include experience gained in 1988 while working with the U.S. Forest Service Operational Retardant Evaluation team in California.

4. A report on the water mister was submitted to the periodical "smoke signals" and is in press.

5. A report on procedures for fire tower seen-area mapping has been initiated.

6. A field trial was conducted in the LaRonge district of Northern Saskatchewan in June. The Canada-Saskatchewan development agreement supplied funding to rent an infrared scanner and the province of Saskatchewan provided air transportation. The two member (PNFI and NoFC) evaluation team accompanied a Regional Initial Attack Control Team to a number of fires. One member of the evaluation team made ground measurements of drop length, width and effectiveness while the other operated the infrared scanner from the air. Enough experience was gained to show that using infrared to assist in tanker load placement and material effectiveness assessment is a viable concept.

7. The camera pod and radar altimeter developed for R. Hall (NoFC) was integrated into the Airborne Infrared Data Management and Analysis System (AIDMAS). The pod allows for a fast and neat installation of the system on any Bell 206B helicopter and the radar altimeter greatly improves the accuracy of ground measurements. In addition a 76 degree lens was used on the AIDMAS scanner which allowed a lower (5000') observation altitude with the same field of view.

   Two fires in the Timmins, Ontario area were imaged with good results showing ignition patterns, spread rates, intensities and a whirlwind. Funding for the Ontario work was provided by the Canada-Ontario development agreement and the Ontario Ministry of Forests.

Funding was also obtained from the Canada-Alberta FRDA to image experimental fires in Alberta, however, due to wet weather the project was put on hold for 1989.

8. The detection study for Manitoba has been completed to their satisfaction.

   The Saskatchewan study was extended into the spring of 1989 to allow Saskatchewan to provide the necessary data to the contractor.

9. Provided technical services and liaison as follows:

   a) Will be attending the GIS workshop in Vancouver in March, 1989.
   b) Attended an international fire foam workshop in Kamloops in April.
   c) Gave a presentation on the Airborne Infrared Data Management and Analysis System (AIDMAS) at the CCFFM Fire Equipment Subcommittee meeting in Quebec City in October.
   d) Assisted in the preparation of and attended the Interior West Fire Council meeting in Kananaskis in October.
   e) Participated in the in-house R&D evaluation.
   f) Attended the Western Region fire weather meeting in March.
   g) Made a presentation on the AIDMAS to a group from the N.W.T.
   h) Attended a regional foam workshop in November and made a presentation regarding the US For. Service Operational Retardant Evaluation program.
      As follow up to the workshop helped develop an action plan to evaluate foam effectiveness and co-authored a Technology Transfer Note entitled "Interim guidelines for aerial application of foam on forest fires", which is under review for publication before the next fire season.
   i) Took part in a FLIR demonstration flight in Edmonton in May.
   j) Assisted the AFS detection section in an evaluation trial of a new infrared detection system in Rocky Mountain House in May/June.
   k) Reviewed 3 publications.

12. Present Status of Study:

1. The use of hand-held infrared scanners for forest fire mop-up was initiated and methods developed for their use.

   A "scan-extender" designed to expand the capabilities of hand-held infrared scanners was conceived, built and tested.

   An "area estimater" designed to measure ground distances from the air was developed and built.

   A large capacity battery and charging system capable of powering various instruments for long periods was developed.

   An inexpensive portable lookout fire finder was developed.

   Equipment for gathering and analyzing infrared imagery of large prescribed burns has been identified, modified and tested.

Development is ongoing and the Aerial Infrared Data Management and Analysis System (AIDMAS) has proven to be an essential part of the fire behavior analysis of large prescribed fires.

2. Detection appraisal studies have been completed for Manitoba (1987), Riding Mountain National Park, (1981), Saskatchewan (1978), Prince Albert National Park (1978), Wood Buffalo National Park (1978), Northwest Territories (1975), and Yukon (1974).

   An attempt was made to integrate the LLP system and the For Can scan extender to improve the ability to locate holdover fires. This met with limited success due to inaccuracies in the LLP system at that time and the lack of a reliable lightning fire prediction model.

   Data was collected at the source of lightning ignitions in support of a lightning fire prediction model.

   Nine detection tower sites have been evaluated for effectiveness, following recommendations made in the detection appraisal studies in Saskatchewan.

   Extensive tests were conducted to determine the suitability of the Daedalus 1260-1268 line scanner for detecting holdover fires.

   Tests were also conducted to compare the For Can scan extender AGA scanner combination, The Barr and Stroud scanner and the Daedalus line scanner.

3. The apparatus and methods were developed for doing comparative evaluations of retardants in the combustion laboratory.

   An orientation trip were made to California to become familiar with the retardant evaluation program.

   Preliminary trials have been made to develop methods of guiding the air tanker operation and evaluating drops using infrared technology.

4. The University of Alberta has been conducting fireline production work which started in 1986 with a PRUF grant. The work continued in 1987 and 1988 under a Canada/Alberta FRDA contract and will be extended through 1989. Several papers have been published or are in progress covering production rates for both crews and equipment. An interim report and a Bulldozer Use Manual have been received.

5. Information dissemination takes up an estimated 25% of the PY time in this study and is ongoing.

13. Goals for 1989-90:

1. Co-operate with the Alberta Forest Service, and Government Northwest Territories, Dept. of Renewable Resources, and possibly other agencies within the region to evaluate forest fire foam. The evaluation will employ ground observations and measurements as well as airborne infrared to determine foam effectiveness under operational conditions.

Reporting will be in the form of immediate information dissemination such as through TT Notes and a Fall follow up workshop. The TT Note by Ogilvie, et al. entitled "Interim guidelines for aerial application of form on forest fires" will be published.

2. Expand the AIDMAS capability to include a video down link and conduct trials in cooperation with GLFC, NoFC (05-05), PFC, and Compuheat Canada.

3. Obtain and become proficient in the use of a digital video analysis system which will then be used to analyze the AIDMAS imagery.

4. Publish the revised Tech. Transfer note on the application of the U.S. Operational Retardant Evaluation study to Canadian conditions.

5. Act as technical authority for the Saskatchewan detection study contract.

6. Provide technical services and liaison to client agencies.

Publications 1988-89:

Ogilvie, C.J.; Young, R.W. 1988. Daedalus line scanner trials in Alberta, 1985-86. Forestry Canada, North. For. Cent., Edmonton, Alberta, Inf. Rep. NOR-X-298.

Ogilvie C.J. 1988. Using a blower mister for fighting grass fires. Nat. Res. Council. Can. Com. on For. Fire Management, Smoke Signals (in press).

Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

Duration:

Start: 1971. Completion: 1994

Resources 1989-90:

PYs: Prof.:
Tech.: Ogilvie 1.0
Total: 1.0

Term/Student: 0.0

O & M: $ 7.0 K
Capital: $5.2 K

18. Signatures:

Investigator

G M Powell
Program Director, Environmen

Regional Director General

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NOR-5-03

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 14, 1989

1. Project: Fire Management Research

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: Terminated 4. No.: NOR-5-03

5. Study Leader: Terminated

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

7. Location of Work: Northwest Region

8. Problem:

Within broad climatic limitations, fire has been the most important single, natural influence on vegetation throughout the region for about the past 10,000 years. Areal and temporal patterns of burning have varied along with fire intensity. Fire has played a significant role in influencing the physical-chemical environment; in regulating dry-matter accumulation; in controlling plant species and communities, in determining wildlife habitat patterns and populations; in controlling forest insects, parasites, fungi, etc.; in controlling major ecosystem processes and characteristics such as nutrient cycles and energy flow, succession, diversity, productivity and stability. The "natural" fire regime has been obscured by man"s intervention and the long-term consequences of fire suppression are now becoming clear.

Resource management problems are developing which require an understanding of the historical role of fire, the effects of fire on a variety of landscapes, the alternatives available to resource managers and approaches required to implement alternatives.

9. 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.

10. Goals for 1988-89:

1. Supervise completion of all pending publications.

2. Remeasure Vermillion Pass plots with Parks Canada and University, Boreal Institute or other personnel.

3. Complete project continuation assessment and formulate recommendations for future direction of study including personnel recommendations.

4. Present recommendations to senior management for approval prior to next FY planning cycle.

Added Goal:

5. Complete summarization of Nahanni National Park and Wood Buffalo National Park fire data.

11. Accomplishments in 1988-89:

1. The three publications arising from Delisle's thesis that were "in press" last year were all published during the year, as a Can. J. For. Res. paper b) Occasional Forestry Note of U. of Alberta, and c) For. Management Note.

2. Remeasuring of Vermillion Pass plots with Parks Canada was postponed until possibly 1989.

3. Some discussions about the future of study area were discussed with PNFI and others. Felt that much could be accomplished by cooperating with other groups which had the expertise in forest ecology especially the university, but no final decision was made.

4. Recommended that this area of work be put on hold until a need is identified and resources are made available. Study will be terminated.

5. Data for the Nahanni and Wood Buffalo National Parks were transferred to D. Dubé for summarization.

12. Present Status of Study:

Reports from field work in Jasper National Park have been published. Efforts are underway to clean up other summarization reports for Wood Buffalo and Nahanni National Parks. If work goes ahead with remeasuring the Vermillion Pass plots in 1989 this will be reported under another study, NOR-05-07. Study terminated.

13. Goals for 1989-90:

Study terminated; Ongoing active goals are transferred to NOR-05-07.

14. Publications 1988-89:

Delisle, G.P.; Woodard, P.M. 1988. Constants for calculating fuel loads in Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note 45.

Delisle, G.P.; Woodard, P.M.; Titus, S.J.; Johnson, A.F. 1988. Sample size and variability of fuel weight estimates in natural stands of lodgepole pine. Can. J. For. Res. 18(5):649-652.

Woodard, P.M.; Delisle, G.P. 1988. Biomass regression equations for common tree seedlings and shrubs in Jasper National Park, Alberta. Univ. Alberta, Dep. For. Sci., Edmonton, Alberta. For. Notes 1.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1974 Completion: 1989

17. Resources 1989-90:

Nil - Terminated

O & M:

Capital:

18. Signatures:

Investigator

J M. Powell

Program Director, Environment

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 14, 1989

1. Project: Fire Management Research

2. Title: Fire management systems and modelling

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

5. Study Leader: B.S. Lee

6. Key Words: Fire physics, fuels, fire line production, fire statistics, fire effects, decision models, fire management, computer systems, geographic information systems.

7. Location of Work: Northwest Region

8. Problem:

Fire management is becoming more complex every day. Increasing costs, changing values, higher risk, as well as hosts of other factors make any fire management decision difficult at best. At the same time we are entering into the age of "high technologies" which offer new opportunities for fire management decision support. Hence, it is becoming increasingly more important that Forestry Canada investigate the application of these "high technologies" to forest fire management problems. A significant research, development, and technology transfer role exists to develop new processes, conduct applications research, and provide support for the integration of the new technology into day-to-day forest fire management.

The application and integration of management science techniques such as numerical models (i.e., simulation and gaming), expert systems, and artificial intelligence into forest fire management emphasizes the development and technology transfer components of the innovation (research) process. Fire management needs computerized decision-aids, database management structures and/or systems, and associated technology transfer documents to operate effectively in today's environment. This role is well within the mandate of Forestry Canada and the capability of NoFC.

The maturing computer applications area of expert systems provides a new opportunity area for Forestry Canada. Such systems have the potential to provide enhanced day-to-day decision making for fire and natural resource managers. In future these systems will integrate factual information now

being derived from numerical models like the FWI and FBP systems with the knowledge and "expertise" of fire managers. They will add a new layer of information into the computer-assisted decision process and will provide better human - machine interfaces. Future expert systems will also automate the learning process, however such systems are probably 10 years away at this time.

9. Study Objectives:

1. To identify the key factors relating to the occurrence, behaviour, 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.

10. Goals for 1988-89:

1. Complete a M.Sc. thesis entitled "An evaluation of the application of expert systems for dispatching initial attack resources to wildfires". (B.L.)

2. Prepare and present a paper entitled "Use of advanced concepts in dispatching fire control resources" at the 1988 Interior West Fire Council Annual Meeting and Workshop, to be held at October 24-27, 1988 at Kananaskis Valley, Alberta. (B.L.)

3. Prepare and present a paper entitled "Application of computer-based information systems to fire management" at the 1988 Interior West Fire Council Annual Meeting and Workshop, to be held at October 24-27, 1988 at Kananaskis Valley, Alberta. (S.P.)

4. Prepare a report entitled "Implementing Ryan's WNDCOM model for predicting winds in mountainous terrain". (S.P.)

5. Revise version 1.1 of the FWI/PC program as per client requests and revise "A user's guide to FWI/PC: a computer program to calculate, report on, and archive Canadian Forest Fire Weather Index (FWI) System data". (B.L.)

6. Continue applied research in expert systems for initial attack dispatching by:

   a. Conducting field trials of a prototype expert system in Whitecourt Forest during the 1988 fire season.

b. Conduct knowledge engineering/acquisition in the provinces of Saskatchewan and Manitoba for similar prototype expert systems. (B.L.)

7. Prepare a paper on estimating winds in mountainous terrain for predicting fire behaviour for presentation at the Fourth West. Reg. Fire Weather Comm. Sci. Tech. Seminar. (S.P.)

8. Test the WNDCOM surface wind model prediction against observed surface winds at a site near 67 N, and determine its useability in the sub arctic. (S.P.)

9. Continue development of the Northwest Region Fire Weather Data Library by: (R.M.S.)

   a. capturing and archiving fire weather data from client agencies who voluntarily make their data available to the library.

   b. Preparing a File Report summarizing the fire weather stations, years of record, and quality of the data currently in the library.

10. Explore and initiate cooperative research and development opportunities with P. Kourtz at PNFI and the Manawaki Technology Transfer Centre in the area of Fire Management Systems. (B.L.)

11. Provide advisory services to client agencies, universities, and others as required. (B.L., S.P.)

11. Accomplishments for 1988-89:

1. Continued thesis work on the application of expert systems for dispatching initial attack resources to wildfires. Simulations of selected 1988 fires in the Whitecourt Forest provide the data set for the validation of the detection assessment expert system.(B.L.)

2. Prepared a paper entitled "Use of advanced concepts in dispatching fire control resources" at the 1988 Interior West Fire Council Annual Meeting and Workshop, held October 24-27, 1988 at Kananaskis Valley, Alberta. (B.L.)

3. This paper to be presented by Dr. S. Pickford following the termination of a S.T.E.P. assignment was cancelled due to family illness. (S.P.)

4. A paper entitled "Implementing Ryan's WNDCOM model for predicting winds in mountainous terrain" was prepared and is currently under review. (S.P.)

5. Version 1.21 of the FWI/PC program was released prior to the 1988 fire season. The user manual entitled "A user's guide to FWI/PC: a computer program to calculate, report on, and archive Canadian Forest Fire Weather Index (FWI) System data" was updated and is provided "on-disk". (B.L.)

6. The Intelligent Fire Management Information System (IFMIS) continued its evolution from expert system for initial attack to a full featured system for fire management planning, operations and training. IFMIS has been totally revised to accommodate client wishes and to eliminate problems identified during the 1988 Whitecourt Forest Field trials. The revised prototype will be put into operation in four locations for the 1989 fire season: Whitecourt Forest, Grande Prairie Forest, Prince Albert Region, and the AFS Provincial Headquarters. (B.L.)

   Features of the 1989 IFMIS version include:

   - Pre-suppression Planner: a daily pre-suppression planning tool.
   - Resource Blackboard: positioning and graphic display of fire control resources.
   - Appropriate Suppression Response Expert System: presents information on fire weather, fire behaviour potential, resource availability, initial attack times, and recommended suppression response.
   - FWI System: FWI calculation, spatial assignment of fire weather between stations using either interpolation or nearest neighbour analyses, FWI forecasting, FWI reporting, and frequency and display charts.
   - FBP System: manual FBP calculations, forest fuel data base calculations, fire intensity chart displays.
   - Map Display System: two dimensional geographic displays, user selected themes and map windows, color and black & white output, partial GIS implementation, browse files and map statistics.
   - DBMS Interface: data base management system interface.

7. A paper on "Estimating winds in mountainous terrain for predicting fire behavior" was prepared and presented at the Fourth West. Reg. Fire Weather Comm. Sci. Tech. Seminar. (S.P.)

8. Wind data was collected by the GNWT at a site near 67 N to determine the applicability of the WNDCOM surface wind model at high latitudes. These data have been forwarded to S.G. Pickford at the University of Washington for preliminary analysis. Subject to this analysis, the GNWT will consider collecting one more season (1989) of data in order to complete the field work component of this study. (S.P. & B.L.)

9. The Northwest Region Fire Weather Data Library received increasing interest by clients during the 1988-89 fiscal year.

   a. Over 80,000 daily fire weather records from the Province of Alberta were added to library as a result of a request for assistance from the Alberta Forest Service. (B.L., R.M.S)

      The 1987 and 1988 fire weather records for the Province of Saskatchewan were also processed in order to provide historical fire weather data for the IFMIS software. (R.M.S.)

b. On the reporting side, the newly developed IFMIS software permits both spatial display and interactive reporting of the data base. (B.L.)

10. A cooperative agreement was initiated with the Manawaki Technology Transfer Centre in the area of Fire Management Systems. The agreement provides for the exchange of information, software and expertise between NoFC, MTTC, and indirectly PNFI. NoFC will provide PC software to MTTC for distribution and long-term maintenance. The agreement also provides for NoFC access to the QNET fire management (computer) network, assistance from MTTC staff in the area of communications, and participation in cooperative programs which require applied fire management systems research. (B.L.)

11. Advisory and consultative services were supplied to client agencies, universities, and others as follows: (B.L.)

a. Fire and GIS applications presentation, Yellowknife, Jan, 1988.

b. Participation on the AFS Pre-suppression Preparedness Resource System (PPRS) Committee (three meetings).

c. Two manuscripts reviewed for AI in Natural Resource Applications and Can. J. of For. Sci.

d. Met with officials of the Govt. of the Northwest Territories to advise on strategies for implementing forest fuels inventories and an integrated fire management information system for the NWT (Feb. 22-24,1989).

12. Present Status of Study:

Fire Management in the Northwest Region is becoming increasingly more sophisticated. All clients in the region have deployed microcomputers at their HQ and forest level operations, with minicomputers being considered. Similarly, with the advent of this computing capability, is a new and budding demand for the so-called "high technologies". These technologies include mathematical programming, artificial intelligence, expert systems, computer graphics and GIS, along with others too numerous to mention. It would appear that the timing is right for this study to capitalize on applications research opportunities in these new technology areas.

Specific contributions by study objectives listed can be summarized as follows:

1. Knowledge engineering and systems analysis approaches with client agencies have served to identify key factors related to fire management as well as to develop conceptual models of fire management systems, both existing and in the future.

2. Computer-based decision aid models developed at NoFC such as the Initial Attack Planning Model, FWI/PC, the Intelligent Fire

Management Information System (IFMIS), and the Appropriate Suppression Response Expert System are being used by client agencies. Future initiatives in GIS along with new mathematical models for expert systems for deployment planning and fire effects will also contribute to fire management within the region, as well as nationally.

3. A large historical fire weather data library has been developed for clients of the Northwest Region. This data library has assisted clients in developing the data bases required to evaluate fire management effectiveness and will provide the data bases essential for future fire occurrence prediction models.

13. Goals for 1989-90:

1. Submit a M.Sc. thesis entitled "An evaluation of the application of expert systems for dispatching initial attack resources to wildfires" for committee approval during the 1989 summer quarter. (B.L.)

2. Present an interactive presentation entitled "Preparedness planning using the Intelligent Fire Management Information System" at the 10th Conference on Fire and Forest Meteorology, to be held April 17 - 21, 1989 at Ottawa. (B.L., PC-2)

3. Present an interactive presentation entitled "A geographic information systems approach to fire growth modelling" at the 10th Conference on Fire and Forest Meteorology, to be held April 17 - 21 1989 at Ottawa. (B.L.)

4. Present a paper entitled "Models for forest fire decision making" at the Forest Modeling Symposium, to be held March 13-15, 1989 at Saskatoon, Sask. (B.L.)

5. Present an interactive presentation entitled "The Intelligent Fire Management Information System - decision support for initial attack dispatching" at the Meeting Global Wildland Fire Challenges conference, to be held July 23-26, 1989 at Boston. (B.L.)

6. Present a paper entitled "IFMIS: the Intelligent Fire Management Information System", at the Canadian Prairie and Northern Section of the Air and Waste Management Association to be held May 17-18, 1989 at Edmonton.

7. Continue the applications research and system development to support the Intelligent Fire Management Information System (IFMIS) by:

- completing IFMIS documentation to include a system overview, user manual, software maintenance manual, and data dictionaries; (B.L., R.M.S., PC-2, Term/Contract)

- monitoring the implementation of the IFMIS software and the performance of the Detection Assessment Expert System in the

Grande Prairie and Whitecourt Forests of Alberta, Alberta PHQ, and Prince Albert Region, Saskatchewan; (B.L.)

- installing the IFMIS software in one region of the Province of Manitoba; (R.M.S., PC-2)

- continuing with IFMIS research and development in the areas of expert system applications, optimal resource deployment, containment modelling, and ground-based initial attack assessment; (B.L.)

- continuing with IFMIS research and development in the areas of automatic vehicle location, lightning data integration, surface wind modelling, and interpolation of fire weather and fire behaviour data; (PC-2, B.L.)

- continuing the development and enhancement of the IFMIS user interface, three dimensional modelling, GIS interface, communications, and multi-tasking. (B.L. Term/Contract)

8. Continue cooperative research program with PAMAP Graphics Ltd. in the area of fire and GIS applications. Initiate an information report on the potential applications of GIS for forest fire management planning and operations. (B.L., R.M.S., PC-2)

9. Prepare a file report on the application of the WNDCOM surface wind model in high latitudes. (S.P., PC-2, B.L.).

10. Continue to provide advisory services to client agencies, universities, and others as required. (B.L., PC-2, R.M.S)

11. Continue development of the Northwest Region Fire Weather Data Library by:

    a. capturing and archiving fire weather data from client agencies who voluntarily make their data available to the library. (R.M.S.)

    b. Preparing a File Report summarizing the fire weather stations, years of record, and quality of the data currently in the library. (R.M.S.)

    c. Initiate the preparation of a forest management note describing the Northwest Region Fire Weather Data Library. (R.M.S., B.L.)

14. Publications 1988-89:

Alexander, M.E.; Smith, R.M.; Mann, C.L. 1988. A diagrammatic guide to elliptical shapes of wildland fires. ForCan., North. For. Cent., Edmonton, Alberta, Tech. Trans. Note A-002, 4p.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1984. Completion: 1994.

17. Resources 1989-90:

PYs:	Prof:	Lee	1.0	
		vice Delisle	1.0	(Proposed PC-2)
	Tech:	Smith	1.0	
	Total:		3.0	
	Student:		0.3	
	Others:		1.0	(Contract-Alberta Agreement)

O&M: $8.5 K (Agreement $28.5 (Alberta) ?? Others)

Capital: 12.5 K

18. Signatures:

Bryan S. Lee
Investigator

J. M. Powell
Program Director, Environment

G. D. Hill
Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 14, 1989

1. Project: Fire Management Research

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

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

5. Study Leaders: M.E. Alexander and vice McAlpine

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

7. Location of Work: Northwest Region

8. Problem:

Embedded in nearly every fire management decision is the need to accurately evaluate fire danger and/or predict fire behavior for a variety of fuel types/topographic situations over a range of possible fire weather conditions. The goal of fire danger/fire behavior research should be to provide fire managers with simple, timely answers to the following questions given an actual or potential wildfire occurrence:

> What will be the head fire rate of spread? What will be the area, perimeter length, and forward spread distance at 1 hour, 2 hours, 3 hours and so no after it starts?
>
> Will it be a high-intensity or low-intensity fire? Will it be a crown fire or a surface fire? How difficult will it be to control? Will mechanical equipment and/or airtankers be required or can it be handled by a suppression crew?
>
> Is there a possibility of it "blowing-up"? If so, will it produce a towering convection column or have a wind-driven smoke plume? What will be the spotting potential? -- short- or long-range? Are fire whirls likely to develop? Is so, when and where?

The Canadian Forest Fire Danger Rating System (CFFDRS) represents the practical output of the continuing Forestry Canada (ForCan) fire

behavior research programme (i.e., experimental burning projects and wildfire investigations).

The CFFDRS is the national system of rating fire danger in Canada. The CFFDRS includes all guides to the evaluation of fire danger and the prediction of fire behavior such as the Canadian Forest Fire Weather Index (FWI) System and Canadian Forest Fire Behavior Prediction (FBP) System. This study formalizes the need for the continuing development, evaluation, interpretation, and application of the CFFDRS in the region serviced by the Northern Forestry Centre (NoFC) in order to further extend its usefulness in fire management planning and operational decision-making. Secondly, it recognizes the opportunity to formulate improved methods for the assessment and prediction of wildfire behavior in terms which are useful to fire management agencies by regional adaptation of existing and new knowledge, techniques, etc. The principal aim or thrust of Study NOR-5-05 is to develop practical systems or schemes for evaluating fire danger and predicting fire behavior for use in fire management and fire suppression programs. Note that this study is designed to compliment rather than duplicate some of the RD&A efforts covered under studies NOR-5-01 and NOR-5-04.

9. 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.

10. Goals for 1988-89:

1. Complete the publication of FMN on the "Relationship between the Fine Fuel Moisture Code and the Cladonia Fire Hazard Index". [M.E.A. & K.G.H.]

2. Continue to participate in cooperative activities of the national ForCan Fire Danger Working Group as outlined in the "Strategic and Operational Plan for Forest Fire Danger Rating Research and Development in Canada, 1987-92" (i.e., Completion of the first full edition of the FBP System). [M.E.A. & R.S.M.]

3. Complete the publication of IR on "Fire Behavior in Black Spruce-Lichen Woodland: the Porter Lake Project". [M.E.A.]

4. Continue to provide advice and services with respect to fire danger rating and fire behavior as required, including serving on the Central and Western Region Fire Weather Committees (e.g., compile/edit proceedings of the 4th WRFWC scientific and technical seminar). [M.E.A. & R.S.M.]

5. Complete the publication of IR on "Spring Fires in a Semi-mature Trembling Aspen Stand, Central Alberta". [M.E.A.]

6. Burn the remaining plots (7) associated with the Big Fish Lake experimental burning project and begin preparation of IR on the project for publication in 1989. [M.E.A. & R.S.M.]

7. Begin preparation of M.Sc. thesis on the acceleration of point source fires to equilibrium spread from ignition. [R.S.M.]

8. Complete the publication of IR on "Twenty-fire years of Canadian Forestry Service fire research in the prairie provinces and far north, 1962-1987: an annotated bibliography". [M.E.A. & R.S.M.]

9. Serve as program co-chairman of the 1988 Interior West Fire Council Annual Meeting and Workshop, including the compilation/editing of the proceedings as a IR. [M.E.A.]

II. Accomplishments in 1988-1989:

1. Draft manuscript of FMN on the "Relationship between the Fine Fuel Moisture Code and the Cladonia Fire Hazard Index" has been through first review and is currently being revised for second review. Recommend TT Note ('A' series) as publication outlet rather than FMN. [M.E.A.]

2. a) Attended two working sessions of the ForCan Fire Danger Group in 1988: Apr. 12-15, MDO, Winnipeg, Man. [M.E.A.] and Sept. 16-23, PNFI, Chalk River, Ont. [M.E.A. & R.S.M.]

b) Invited paper prepared for publication in the proceedings of the Conference on Bushfire Modelling and Fire Danger Rating Systems held July 11-12, 1988, in Canberra, Australia, (see Stocks et al. 1988) entitled "The Canadian system of forest fire danger rating." [M.E.A. & R.S.M.]

c) Manuscript entitled "The Canadian Forest Fire Danger Rating System: an overview" accepted for publication in the Forestry Chronicle. This effort was identified in the "Strategic and Operational Plan for Forest Fire Danger Rating Research and Development in Canada, 1987-92" which was approved by CORE in May 1988. [M.E.A. & R.S.M.]

d) Three publications related to the interpretation of the CFFDRS were produced (see Alexander and DeGroot 1988; Alexander et al. 1988; McAlpine and Alexander 1988). [M.E.A. & R.S.M.]

e) Manuscript entitled "Fire behavior and effects in aspen-northern hardwood stands", co-authored with R.W. Sando (Minnesota Dept. of Natural Resources), completed for the 10th Conference on Fire and Forest Meteorology. This paper is related to the development of the FBP System data base. [M.E.A.]

f) Manuscript entitled "Use of posters for interpreting fire behavior/danger research", co-authored with W.J. DeGroot (SDO), K.G. Hirsch (MDO) and R.A. Lanoville (GNWT Dept. of Renewable Resources), submitted to Fire Management Notes in advance of an

educational display to be presented at the International Conference on Meeting Global Wildland Fire Challenges, July 23-26, 1989, Boston, Massachusetts.

g) Prepared 1987 supplement to bibliography contained in the CFFDRS Users' Guide. [M.E.A.]

3. Draft manuscript of IR on the "Fire behavior in black spruce-lichen woodland: the Porter Lake Project", co-authored with B.J. Stocks (GLFC) and B.D. Lawson (PFC) submitted to NoFC editor August 2, 1988 for final editing based on two review drafts. Review of original manuscript resulted in the operational applications of the research being formulated into a wall poster at the request and in cooperation with GNWT Dept. of Renewable Resources (see Alexander and Lanoville 1988). [M.E.A.]

4. a) Attended the annual business meeting of the Western Region Fire Weather Committee (WRFWC) held Feb. 19 at NoFC. Coordinated the fourth WRFWC scientific and technical seminar held Mar. 1 at NoFC and made a co-presentation with T. Van Nest (AFS) entitled "Use of the Canadian Forest Fire Danger Rating System to predict wildfire behavior is grasslands: a case study". [M.E.A.]

b) Served as instructor at the seventh annual AFS Advanced Fire Behavior Course held at Alberta Forest Technology School (AFTS) in Hinton Apr. 5-8 (topics: chemistry & physics of forest fires, CFFDRS, extreme fire behavior: 1968 Lesser Slave Lake Fire, and fire behavior estimation: FBP System mechanics). [M.E.A.]

c) Continued to serve on the standing AFS Presuppression Preparedness Resource System (PPRS) committee and attended two scheduled meeting in 1988 in Edmonton (Mar. 17 and Sept. 27). [M.E.A.]

d) Consulted with Synder & Company on several occasions in 1988 with respect to a hold-over fire situation/wildfire near Westlock, Alberta. [M.E.A.]

e) Reviewed three manuscripts: (i) Fire behavior in mature jack pine by B.J. Stocks (Can. J. For Res.), (ii) Documenting wildfire behavior: an example from the 1988 Brereton Lake Fire, Manitoba by K.G. Hirsch (TT Note 'M' series and Fire Management Notes); and (iii) Interpreting the Canadian Forest Fire Weather Index (FWI) System by W.J. De Groot (CRFWC seminar proc.). [M.E.A.]

f) Served as technical consultant to AFTS with respect to "Canadianizing" an interactive videodisc/micro-computer course on intermediate fire behavior developed by Utah State University. Travelled to Logan, Utah Nov. 15-16 to work on this project. Subsequent follow-up required (e.g., local slides needed). Involvement has resulted in ForCan being acknowledged as a contributor to the Canadian version of the course. [M.E.A.]

g) Presented two lectures on the CFFDRS to undergraduate students enrolled in the forest fire management class at the University of Alberta (Feb. 9 and 16, 1989).

5. Draft manuscript of IR on "Spring fires in a semi-mature trembling aspen stand, central Alberta", co-authored with D. Quintilio (AFTS) and P.L. Ponto (Canalta Enviortech Ltd.), submitted to review board Feb. 3. [M.E.A.]

6. Only one successful experimental fire (ROS: 2.5 m/min) was completed at the Big Fish Lake study area during the 1988 fire season due to the abnormally wet weather. Presentation on status/future plans of the project made at AFS Fall Fire Conference in Rocky Mountain House, Nov. 22-23. Poster paper abstract co-authored with A.C. Ascher (NoFC) on the video tape "Mounting the Attack on Wildfire" for the proceedings of the first Interior West Fire Council annual meeting and workshop. TT Note ('A' series) prepared on the propane ignition torch used for the project (see Maffey 1988). [M.E.A., R.S.M. & M.E.M.]

7. M.Sc. thesis entitled "The acceleration of point source fire to equilibrium spread" approved December 1988 (see McAlpine 1988). Manuscript entitled "Temporal variations in elliptical forest fire shapes" submitted to Can. J. For. Res. for publication as a Note. Manuscript entitled CANADA vs. the USA: A test of two fire behavior prediction systems" completed for the 10th Conference on Fire and Forest Meteorology. Both of these proposed publications are results of the thesis research. [R.S.M.]

8. Draft manuscript of IR on "Forest fire research in western and northern Canada, 1962-1987: an annotated bibliography" submitted for editorial review (Author Bibliography portion). [M.E.A. & R.S.M.]

9. Served as the program co-chairman of the 1988 Interior West Fire Council Annual Meeting & Workshop held Oct. 24-27 at Kananaskis Village, Alberta, attended by 265 members. Organization of this event required numerous meetings, correspondence, etc. A 96-page "final program" booklet prepared, complete with abstracts of the formal presentations. Approximately 80% of the "editing" of the proceedings completed. Poster paper display and abstract (for proceedings) on "A Cartographic History of Forest Fires in Alberta" prepared for the meeting. [M.E.A.]

12. Present Status of Study:

The present project was initiated in early 1981 by M.E. Alexander who was joined in mid 1985 by R.S. McAlpine, on a part-time basis (0.5 PY at present), as a co-study leader (R.S. McAlpine will be transferring to PNFI in April 1989). M.E. Maffey serves as the study technician. Both study leaders are currently members of the ForCan Fire Danger Group. This group maintains liaison with regional, national, and international fire organizations, committees and agencies to ensure research,

development and applications of the CFFDRS continues in a timely and

relevant manner. The major accomplishments of the Group since 1981 have been:

- Production of an updated edition of the FWI System in 1984 (i.e., ForCan Forestry Technical Reports dealing with Tables and Equation/FORTRAN Program).

- Distribution of an interim edition of a user guide to the rate of spread component of the Canadian Forest Fire Behavior Prediction (FBP) System in 1984 which also includes a simple elliptical fire growth model.

- Development of a CFFDRS Users' Guide (i.e., a three-ring binder designed to house all national publications and associated material documenting the technical aspects of the (CFFDRS).

The study leaders have been involved directly or indirectly in the application of the CFFDRS in the "system" of several user agencies in the region (e.g., AFS, Alberta Parks, GNWT).

A point worth emphasizing is the fact that the data base used in the development of the FBP System does include the various experimental fires documented by NoFC staff between 1965-1978. The principal field research activities since 1981 have been concerned with two experimental burning project coordinated by NoFC but involving fire staff from the other ForCan research establishments:

i) 1982: Porter Lake, Caribou Range, N.W.T. - upland black spruce-lichen woodland (FBP System Fuel Type C-1); a cooperative project with Indian and Northern Affairs Canada (INAC).

ii) 1985-88: Big Fish Lake, Footner Lake Forest, Alta. -black spruce-Labrador tea-Cladonia fuel complex (FBP System Fuel Type C-2); a cooperative project with Alberta Forest Service (AFS).

Other notable achievements during the period 1981-88 include:

- Assistance with the regional implementation of spring Drought Code (DC) starting value determinations on a regular, yearly basis in 1981-82.

- Development of a 4-day advanced fire behavior course in cooperation with Alberta Forest Technology School and AFS Forest Protection Branch in 1982 (sustained participation has continued up to and including 1988). Fire management personnel from N.W.T., Manitoba and Parks Canada have also attended the course.

- Coordinated the development of a scientific and technical seminar series under the auspices of the Western and Central Region Fire Weather Committees beginning in 1983.

- Initiated and solicited support for a 3-yr. CFS-HQ sponsored PRUF (Program of Research of Alberta Meteorology Division) entitled "Climatology of Atmospheric Conditions Related to Extreme Forest

Fire Behavior in West-Central and Northern Canada" in 1984. This work is related to the prediction of blowup fire occurrences.

- Preparation of several user-oriented aids which have been immediately utilized by AFS and INAC. (e.g., procedures and an adiabatic chart for plotting helicopter soundings of temperature, dew-point (DP) tables for fire weather stations with ventilated thermometers, prototype chart/table for the fire intensity component of the FBP System); an excellent example of this is the AFS "Fire Behavior Officer Reference - 1986". The concepts currently incorporated into the WM-680 Wind Monitor produced by Forest Technology Systems Ltd. represents another practical example of an original study initiative.

- Production of a slide-rule device incorporating the existing information on the FBP System. The "Fire Growth Calculator" or FGC simply represents an alternative methods of calculating area, perimeter length, etc. in lieu of manual, table or computer calculation.

- A variety of fire-related programs (e.g., RH and DP computations from dry-and wet-bulb temperatures, spring DC starting value) written in BASIC have been prepared including present versions of the FWI and FBP Systems. The current application involves the NEC PC-8201A portable computer which is ideally suited to district level use and by a fire behavior officer on campaign fires.

- Increased the interest and set standard for wildfire case histories or studies in the Northwest Region of ForCan.

13. Goals for 1989-90:

1. Submit a manuscript entitled "Acceleration of point source fires to equilibrium spread" for publication in Forest Science. [R.S.M.]

2. Attend to any IR manuscripts currently in the "system" which may be returned by the NoFC editorial group. [M.E.A.]

   a) Fire behavior in black spruce-lichen woodland: the Porter Lake Project
   b) Spring fires in a semi-mature trembling aspen stand, central Alberta
   c) Forest fire research in western and northern Canada, 1962-1987: An annotated bibliography.

3. Submit the "edited" proceedings of the 1988 Interior West Fire Council Annual Meeting and Workshop to the NoFC editorial group by March 1 for publication as a IR. [M.E.A.]

4. Burn the remaining seven plots at the Big Fish Lake experimental burning study area and submit a summary report to the Alberta Forest Service and other ForCan cooperators (PFC, GLFC, PNFI). [M.E.A.]

5. Continue to participate in cooperative activities of the ForCan Fire Danger Group as outlined in the "Strategic and Operational Plan for Forest Fire Danger Rating Research and Development in Canada, 1987-1992" (e.g., complete assignments related to completion of the FBP System, submit manuscript entitled "Annotated bibliography on the Canadian Forest Fire Danger Rating System: 1969-88" to ForCan HQ for publication as a FTR). [M.E.A.]

6. Continue to provide advice and services with respect to fire danger rating and fire behavior as required (e.g., instructor at AFTS Advanced Fire Behavior Course in April, complete the 'A' series TT Note on the FFMC vs. CFHI, edit proceedings of Mar. 1988 Western Region Fire Weather Committee seminar for distribution). [M.E.A.]

7. Beginning September 1, undertake longer term training (LTT) towards the completion of a Ph.D. degree at the Australian National University while occupying a visiting researcher position with the CSIRO National Bushfire Research Unit, Canberra, A.C.T. [M.E.A.]

14. Publications:

Alexander, M.E.; De Groot, W.J. 1988. Fire behavior in jack pine stands as related to the Canadian Forest Fire Weather Index (FWI) System. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Poster (with text).

Alexander, M.E.; Lanoville, R.A. 1988. Predicting fire behavior in the black spruce-lichen woodland fuel type in western and northern Canada. For. Can., North. For. Cent., Edmonton, Alberta, and Gov. Northwest Territ., Dep. Renewable Resour., Territ. For. Fire Cent., Fort Smith, Northwest Territories. Poster (with text).

Alexander, M.E.; Smith, R.M.; Mann, C.L. 1988. A diagrammatic guide to elliptical shapes of wildland fires. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Technol. Transfer Note A-002. 4 p.

Maffey, M. 1988. Construction of a propane ignition torch for igniting experimental and prescribed burns and for backfiring. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Technol. Transfer Note A-006. 3 p.

McAlpine, R.S. 1988. The acceleration of point source fire to equilibrium spread. M.Sc. Thesis, Univ. Mont., Missoula, Montana. 130 p.

McAlpine, R.S.; Alexander, M.E. 1988. Recent developments in the Canadian Forest Fire Danger Rating System. Pages 19-57 in K.G. Hirsch, compiler and editor. Proceedings of the Fourth Central Region Fire Weather Committee Scientific and Technical Seminar (April 2, 1987, Winnipeg, Manitoba). Can. For. Serv., Man. Dist. Off., Winnipeg, Manitoba. Study NOR-36-03 File Rep. No. 3.

Stocks, B.J.; Lawson, B.D.; Alexander, M.E.; Van Wagner, C.E.; McAlpine, R.S.; Lynham, T.J.; Dube, D.E. 1988. The Canadian system of forest fire danger rating. in Proceedings of the Conference on Bushfire Modelling and Fire Danger Rating Systems (July 11-12, 1988, Canberra, A.C.T.). CSIRO Div. For. For. Prod., Natl. Bushfire Res. Unit, Canberra, Australian Capital Territory. (in press).

Stocks, B.J.; Lawson, B.D.; Alexander, M.E. Van Wagner, C.E.; McAlpine, R.S.; Lynham, T.J.; Dubé, D.E. 1989. The Canadian Forest Fire Danger Rating System: an overview. For. Chron. 65: (in press)

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1982 Estimated Completion: 1992

17. Resources 1989-90:

PYs:	Prof.:	Alexander	1.0
		vice McAlpine	0.5
	Tech.:	Maffey	1.0
	Total:		2.5
	Term/Student:		0.3

O&M: $10,000

Capital: $2.0 K

18. Signatures:

Martin E. Alexander
Investigator

J. M. Powell
Program Director, Environment

Investigator

Regional Director General

NOR-5-06

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 14, 1989

1. Project: Fire Management Research

2. Title: Prescribed fire in forest and rangeland management

3. New: Cont.: X 4. No.: NOR-5-06

5. Study Leader: vice McAlpine

6. Key Words: Prescribed fire, fire use, Canadian Forest Fire Danger Rating System, fire behavior, fuels, fire effects, decision models

7. Location of Work: Northwest Region

8. Problem:

An increase in the use of prescribed fire as a forest management tool is anticipated in the northern region where it is becoming a viable method of habitat management for wildlife, rangeland management, fuels management, site preparation, site conversion, and insect and disease infestation eradication.

This study has been created in an effort to provide better management guidelines in the use of prescribed fire for various purposes. Since many of the client agencies are now becoming involved in prescribed fire operations, it is an excellent opportunity to expand knowledge and design guidelines in response to user needs.

The results of the study will 1) Improve the ability with which prescribed fire is implemented by user agencies in the region through a better understanding of fuel and weather relationships; 2) Improve the implementation of prescribed fire for silvicultural uses, through a better understanding of prescribed fire effects and weather conditions necessary to achieve these effects; 3) Reduce losses due to wildfire through better guidelines for hazard reduction burning; 4) Increase wildlife population through improved habitat management.

Prospects for the findings from this study being put to practical use are excellent since specific study goals are based on user needs.

9. Study Objectives:

1. To determine fire use applications, problems and considerations for an array of management objectives and vegetative situations in the region.

2. To develop information and establish guidelines for the use of prescribed fire in various fuel types within the region.

3. To assess fire spread and intensity under various weather conditions for major fuel complexes appropriate for prescribed burning.

10. Goals for 1988-89:

1. Participate in cooperative projects of the Forestry Canada Prescribed Fire Working Group. (R.S.M., W.J.D.).

2. Continue development leave until July and complete field work and thesis preparation after that to obtain a masters degree in fire research at the University of Montana. (R.S.M.)

3. Provide advice and services with respect to prescribed fire. (R.S.M.)

Added Goal:

4. Act as secretary to the Regional Technical Subcommittee meeting discussing fire foam use within the Region. (R.S.M.)

11. Accomplishments in 1988-89:

1. Attended Prescribed Fire Working Group (PFWC) Meeting (Victoria B.C. April 26-28, 1988) (W.J.D.)

2. Completed development leave July 1, 1988, defended thesis Aug. 16, 1988, submitted final draft Sept. 1988, M.Sc. Degree granted Dec. 1988. (R.S.M.)

3. Conducted a series of hazard reduction and under burning prescribed fires in a ponderosa pine stand near Lolo, Montana. (R.S.M.)

4. Attended and acted as secretary for the Regional Technical Subcommittee meeting discussing fire foam in the region (Nov. 29-Dec. 1, 1988). Proceedings of agency presentations and subsequent discussions and resolutions, sent to chairman of committee for distribution. (R.S.M.)

12. Present Status of Study:

1. During the annual meeting of the PFWG the working groups terms of reference and strategic plan were discussed and finalized. Members presented the current status of their studies.

2. A total of 29 experimental laboratory fires were completed by April 1988. Subsequent analysis and refinement was completed by September 1988.

13. Goals for 1989-90:

1. Refill position vacated by McAlpine at end of March 1989 as soon as possible.

2. Participate in cooperative projects with the Forestry Canada Prescribed Fire Working Group as follows:

   a) Begin draft copy of national prescribed fire planning guide following review of all current agency planning guidelines. Identified as item #1 in the Operational Plan for the Forestry Canada Prescribed Fire Working Group (1988-1991).

   b) Assemble available information on inventory methods for non-slash fuels, preparing for subsequent development of a standardized system of fuel inventory. Identified as item 2.2 in the Operational Plan for the Forestry Canada Prescribed Fire Working Group (1988-1991).

   c) Evaluate Ontario Ministry of Natural Resources and British Columbia Ministry of Forests slash inventory handbooks for applicability within the region and prepare proposed amendments to the inventory process as might be required for the unique regional situation. Identified as item 2.1 in the Operational Plan for the Forestry Canada Prescribed Fire Working Group (1988-1991).

3. Reassess study goals in light of current client agency needs and requirements. Evaluation to be done through a series of discussions and on site meetings at operation prescribed burns.

4. Provide advise and services with respect to prescribed fire.

14. Publications 1988-89:

McAlpine, R.S. 1988. The acceleration of point source fires to equilibrium spread. Univ. Mont., Missoula, Mont. M.Sc. Thesis. 130 pp.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1985 Estimated Completion: 1995

17. Resources 1989-90:

PYs:	Prof: vice McAlpine	0.5
	Tech:	0.0
	Total:	0.5
	Term/Student:	0.0

O & M: $1,000
Capital: Nil

18. Signatures:

Investigator

G M. Powell
Program Director, Environment

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 14, 1989

1. Project: Fire Management Research

2. Title: NoFC Forest Fire Research Coordination

3. New: X Cont.: 4. No.: NOR-5-07

5. Study Leaders: vice Barney

6. Key Words: Fire Research, Fire Programs, Research Management, Fire Research coordination

7. Location of Work: Northwest Region

8. Problem:

The widespread nature of the fire research program at NoFC requires considerable effort in coordination and management. The problems, the size of the area which includes, Alberta, Saskatchewan, Manitoba and the NWT in itself presents severe coordination challenges, especially with the provincial/federal agreement program activities. The diverse nature of the fire problems, research program and wide variety of user needs all make for an extremely complex management task. The need to use existing funding, secure outside funding, extensive support and agency cooperation adds to the complex dimensions already encountered. There is a need for coordination to maximize productivity and wise use of all resources within the fire research project.

9. Study Objectives:

1. To coordinate NoFC fire research activities as an essential element of the overall forest fire management programs in the prairie provinces and NWT.

2. To enhance the regional, national and international perspectives of the Forestry Canada fire research program through participation on committees, task forces, review boards and other service activities aimed at improving the protection of Canada's forestry.

3. To promote the fire research program within the prairie provinces and NWT as well as nationally.

4. To develop support and coopertion for fire research programs through a wide array of activities, processes and action.

10. Goals for 1988-89:

1. Continue to provide advisory services to National Parks with emphasis on the management guidelines. (R.B.)

2. Supervise and coordinate the regional fire research program including that by the Fire Specialists in the District Offices. (R.B.).

3. Continue to provide technology, participation on committees, task forces etc. aimed at improving the protection and use of Canada's forests through efficient fire management. (R.B.)

4. Complete regional fire research strategy, including integration of studies under the Forestry Development Agreements and Memorandums of Understanding. (R.B.)

5. Conduct regional fire research technical subcommittee meeting. (R.B.)

6. Maintain cooperative relationships and studies with University of Alberta and other Canadian universities as appropriate. (R.B.)

7. Make presentations at academic institutions throughout the year as appropriate. (R.B. and others)

8. Provide technical services and training to client agencies. (R.B. and others).

9. Provide guidance and assistance to forest economist for studies in fire management economics. (R.B. and others)

10. Complete current International Assignment Agreement which expires July 1, 1988.

11. Make plans and develop process to replace the current project leader in a manner that meets long term goals and objectives of the Northern Forestry Centre and the fire research project.

12. Complete manuscripts currently in preparation prior to July 1, 1988.

a. Forest/Urban fire in the Prairie Provinces
b. The Fish Creek Provincial Park Challenge
c. Research - management relationships

11. Accomplishments in 1988-89:

1. Limited advisory services were provided to National Parks personnel.

2. The regional fire research program was supervised and coordinated by Dr. R. Barney before the completion of his 3-year International Exchange Assignment in June, and since by the Program Director in an acting role.

3. Involvement on various committees continued but on a reduced scale since the departure of Dr. Barney.

4. A document "Forest Fire Research - Planning Recommendations" was completed at the end of June by Dr. Barney. This has been used along with input from project staff for ongoing discussions about the future direction of the project. A document "Strategic Plan for Forest Fire Research, Northern Forestry Centre" was also updated and provided to Management and the Forestry Canada National Fire Advisor

5. No regional fire research technical subcommittee meeting was held this year. In its place it was agreed to encourage agency attendance at the Interior West Fire Council meeting at Kananaskis, October 24-27 (all agencies attended and some took a very active role), also a workshop was organized on the topic "Foam as a fire Suppressant". This three day workshop was well attended and most productive with an action plan developed (these aspects are covered elsewhere under NOR-05-02 and 05-06), and involved input from relevant staff at PNFI.

6. Cooperative activities were continued with the University of Alberta, although the Fire Project with the departure of Drs. Barney and S. Pickford no longer have an adjunct professor relationship. Good progress was made with the final year of the Canada-Alberta FRDA study on Fireline Productivity. A bulldozer manual "Production Rates and Guidelines for Constructing Fireguard in Boreal Forest Cover types" was completed and two of three earlier reports were published and the other was accepted by the journal. A paper entitled "Determining Production Rates of Initial Attack Crews" was also presented at the Interior West Fire Council meeting and will be in the proceedings.

7. The project leader was not involved with any presentations but other project staff participated in presentations at the University of Alberta and the Forest Technology School, Hinton.

8. Technical services and training was provided to client agencies by project staff (see separate studies). Major input was provided by the District Office Fire Specialists through STEP assignments. T. Van Nest, AFS spent 5 months at NoFC on a reverse STEP assignment to assist with aspects of NOR-5-04 and other areas of fire management.

9. Limited advice was provided by Dr. Barney before his departure to the forest economist. Assistance was provided by W. DeGroot for background material for Elan fire damage appraisal case study which was completed and submitted to the Saskatchewan Dept. of Parks, Recreation and Culture with eight recommendations.

10. The International Assignment Agreement was completed by Dr. Barney on June 30, 1988.

11. The vacant Project Leader position has been on hold pending Management decision to fill the position. The Program Director has acted in the position since June.

12. The paper on "Fire in the Boreal Forest-Enemy or Management Agent" was completed and presented to the IUFRO Working Party S1.05-12 Northern Forest Silviculture and Management 1988 Symposium in Harbin, Heilongiang Province, Peoples Republic of China. A seiminar on "Computer applications in Fire Management" was also presented. Work on the other papers was not completed for a variety of reasons, including unavailability of coauthors to provide input for papers b and c.

12. Present Status of Study:

Under this new study we have been able to expand support in several areas. Work associated with federal-provincial agreements has increased this past year. New and stronger ties are in place with the University of Alberta and greater cooperative efforts are under way. A short-term international agreement was developed with the USDA Forest Service, Intermountain Research Station, Forestry Fire Sciences Laboratory. Good progress is being made on all objectives.

13. Goals for 1989-90:

1. Fill the Project Leader position and realign the project as required, including assisting with filling of other vacant positions.

2. Supervise and coordinate the regional fire research program, including providing technical guidance for the Fire Specialists in the District Office.

3. Continue to provide technology transfer through, participation on committees, task forces, etc. aimed at improving the protection and use of Canada's forests through efficient fire management.

4. Conduct regional fire research technical subcommittee meeting and hold other special workshops as required including follow up to last year's "Foam as a Fire Retardant" workshop. (P.L. and others)

5. Maintain cooperative relationships and studies with University of Alberta and other centres including presentations at academic institutions as appropriate. (P.L. and others)

6. Provide technical and advisory services and training to client agencies with emphasis on fire management guidelines (P.L. and others)

7. Provide guidance and assistance to forest economist for studies in fire management economics (see NOR-3-03). (P.L. and others)

8. Plan and initiate research activities in area of fire management science expertise.

14. Publications 1988-89:

Anon. 1988. Fire suppression production rates - A new cooperative approach. Forest Fire News No. 25:21-22.

Barney, R.J. 1988. Fire in the Boreal Forest-Enemy or Management Agent. Paper to IUFRO Working Party SI-05-12 North. For. Silviculture and Management, Aug. 31-Sept. 11, 1988, Harbin, Heilongiang Prov., P.R.C.

Murphy, P.J.; Quintilio, D.; Woodard, P.M. 1989. Validation of an index system for estimating fireline production with hand tools. For. Chron. 65:(in press).

Ponto, R.L. 1988. Production rates and guidelines for constructing fireguard in boreal forest covertypes, Canalta Envirotech Ltd. Contract Rpt. 101 pp.

Quintilio, D.; Murphy, P.J.; Woodard, P.M. 1988. Production guidelines for initial attack hotspotting. USDA For. Serv., Fire Manage. Notes 49(3):24-27.

Quintilio, D.; Van Nest, T.A.; Murphy, P.J.; Woodard, P.M. 1988. Determining production rates of initial attack crews. Abs. Page 37 in Final Program: the Art and Science of Fire Management. Interior West Fire Counc. 1st Annu. Meeting and Workshop, Kananaskis, Alta., Oct. 24-27, 1988.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1987. Estimated Completion: Continuing.

17. Resources 1989-90:

PYs:	Prof: vice Barney	1.0
	Tech:	0.0
	Total:	1.0

Term/Student:

O & M: $3,000

Capital: Nil

18. Signatures:

Investigator

J. M. Powell
Program Director, Environment

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

January 17, 1989

1. Project: Environmental Effects of Chemical Substances and Vegetation management

2. Title: Assesment of air pollutant impact on forest systems and of industrial development in natural areas

3. New: Cont.: X 4. No.: NOR-7-01

5. Study Leaders: D.G. Maynard, S.S. Sidhu, S.C. Zoltai, J.C. Feng

6. Key Words: Environmental impact assessment, advisory, AR-NEWS, ICP-AES

7. Location of Work: Northwest Region, emphasis on Alberta

8. Problem Analysis:

Industrial development and emissions have potentially deterious effects on forest vegetation and soils. Several studies were completed within the Prairie region that looked at potential problems. Expert advice on the effects of air pollutants or northern development to forest systems is still required to answer specific concerns in relationship to environmental effects of chemical substances within the region. In addition, potential effects of acid deposition on forest ecosystems could go unnoticed until considerable damage to the forest has occurred. Maintaining an advisory role and carrying out all aspects of the chemical analyses of soil and plant materials in the Acid Rain-National Early Warning System (AR-NEWS) is essential to assure that any possible effects of acid depostion on the forest are detected. High quality analysis in a reasonable time is often required for this study and other studies within NoFC. Therefore, it is important for ICP-AES to be maintained with a minimum of down time.

All Projects/studies associated with NoFC (including contracts and FRDA funded projects) must be reviewed for environmental implications by the NoFC - Environmental Screening Committee. The purpose of such screening is to ensure that environmental effects are considered during the planning stages before any commitments or irrevocable decisions are made.

9. Study Objectives:

1. Provide consultative and advisory services to government agencies, industry and the public on environmental concerns in relationship to acid deposition (air pollution), herbicides, and northern development.

2. Provide reviews of projects/studies for environmental implications through the Environmental Screening Committee.

3. Participate in the monitoring of AR-NEWS plots in collaboration with NOR-11 (FIDS).

10. Goals for 1988-89:

1. Publish an Information Report on the results of resampling of monitoring plots and past findings in the vicinity of two sour gas processing plants. (Maynard, carried over from 1987-88)

2. Publish a baseline report on the chemical analysis of the soil and vegetation samples for the AR-NEWS plots for the prairie region. (Maynard, carried over from 1987-88)

3. Publish a journal article entitled "The effects of particulate elemental sulfur on vegetation" by K.A. Kennedy, P.A. Addison, and D.G. Maynard. (carried over from 1987-88)

4. 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 (includes involvement with the AR-NEWS sampling and analysis and the Quality Assurance working group). Attend workshops and symposia. (Maynard,Sidhu,Feng,Zoltai)

5. Maintain the inductively coupled plasma atomic emission spectrometer (ICP-AES) by preventative maintenance checks and replacement of worn parts. (Radford)

6. Review of Projects/studies for environmental implications by the NoFC - Environmental Screening Committee. (Sidhu, Maynard, Feng, Zoltai)

11. Accomplishments in 1988-89:

1. An Information Report entitled "Biomonitoring forests near two sour gas processing plants: A 5-year study" has been completed. The manuscript was reviewed through the NoFC review process and corrections were completed and with the editor by June. Additional comments provided by industry were included in September.

2. The first draft of an Information Report on the chemical anlaysis of the soil and vegetation samples for the AR-NEWS plots of the prairie region will be completed by the end of March 1989. Additional chemical analysis was required for several sites.

3. A journal article was published in Environmental Pollution.

4. Consultative and advisory services were rendered to a variety of government (federal and provincial) agencies, industry (forestry, energy, and consulting companies) and university researchers. Contributed two chapters on N and S analysis to a methods manual for the Quality Assurance Ad Hoc working group for Long Range Transport of Air Pollutant (LRTAP).

5. The ICP-AES has been maintained with very little down time. A general preventative maintenance was done by the company serviceman. Other than that there was virtually no down time. Approximately 60 000 analysis will have been run on the ICP-AES during 1988-90 including 25 000 for the Analytical Services Laboratory. All the samples were analyzed for NoFC associated projects.

6. Five studies were reviewed by the Environmental Screening Committee from April 1 to December 31, 1988. Two of the studies required 3 reviews for want of additional information on the proposals and search for information on chemicals to provide a thorough ESC (eg. busulfan for rabbit control).

12. Present Status of Study:

The final report of the study carried out in west-central Alberta has been completed and reviewed. It is with the editor for editing and publication as an Information Report. The consultative and advising services are on-going and requests have been dealt with as required. Four new studies plus one carried over from 1987 have been reviewed by the Environmental Screeening Committee. All the chemical analysis and vegetation analysis for the 12 AR-NEWS plots were completed. A draft of a baseline report is being prepared and will be completed by fiscal year end. No sampling or analysis is anticipated for 1989-90.

13. Goals for 1989-90:

1. Publish an Information Report on the soil analysis and vegetation cover of the AR-NEWS plots of the prairie region. (Maynard, Fairbarns, carried over from 1988-89)

2. Publish an Information Report entitled "Biomonitoring forests near two sour gas processing plants: A 5-year study" by D.G. Maynard.

3. 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 (includes involvement with the AR-NEWS sampling and analysis and the Quality Assurance working group). Attend workshops and symposia. (Maynard,Sidhu,Feng,Zoltai)

4. Maintain the inductively coupled plasma atomic emission spectrometer (ICP-AES) by preventative maintenance checks and replacement of worn parts. Upgrade the ICP-AES to reduce operating expenses and maintenance downtime and costs. (Radford)

5. Review of Projects/studies for environmental implications by the NoFC - Environmental Screening Committee. (Sidhu, Maynard, Feng, Zoltai, Brace)

14. Publications 1988-89:

Kennedy, K.A.; Addison, P.A.; Maynard, D.G. 1988. Effect of elemental sulfur on the vegetation of a lodgepole pine stand. Pollut. 51: 121-130.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leaders, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1970 Completion: on-going

17. Resources 1989-90:

PYs:	Prof.:	Feng, J.	0.1
		Maynard	0.2
		Sidhu	0.2
		Zoltai	0.1
	Tech.:	Radford	0.5
		Fairbarns	0.2
	Total:		1.3
	Term/Student:		0.0

O & M: $6,000
Capital:

18. Signatures:

Doug Maynard
Investigator

Program Director, Protection

Investigator

Regional Director General

Investigator

Investigator

FORESTRY CANADA

STUDY WORKPLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 17, 1989

1. Project: Environmental Effects of Chemical Substances and Vegetation Management

2. Title: Environmental impact and residue chemistry of forestry herbicides

3. New: Cont.: X 4. No.: NOR-7-04

5. Study Leader: S.S. Sidhu, J. Feng, C. Feng

6. Key Words: Herbicides, forest system, persistence, degradation, adsorption, desorption, environmental impact, residue chemistry

7. Location of Work: Northwest Region

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 ForCan 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 ForCan, 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 ecosystem. Available information on residue chemistry and environmental impact of forest herbicides under Canadian climatic conditions, particularly in the boreal forest, is very limited. Therefore, NoFC 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, NoFC 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 considered for study.

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, including mycorrhizal aspects.

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 1988-89:

1. Submit for review and publish a review article on hexazinone as an information report. A-Base. (Sidhu, Feng)

2. Publish a paper on the effect of hexazinone on mycorrhizae in pine and spruce under aseptic conditions. A-Base. (Sidhu, Chakravarty)

3. Publish a paper "Release of hexazinone from PRONONE 10G granules exposed to simulated rainfall under laboratory conditions" by J. Feng, and V. Stornes and R. Rogers of Pro-Serve Inc. A-Base. (Feng)

4. Publish a paper "Rate of hexazinone release from a granule formulation" by J. Feng, C. Feng and S. Sidhu. The work is related to the Grande Prairie field study using inoculated PRONONE granules. Alberta FRDA. (Feng, Sidhu)

5. Publish a paper "Distribution of PRONONE 10G granules from aerial and ground application" by J. Feng and S. Sidhu. The work is related to the size variation and distribution patterns of PRONONE granules in formulation and from a truck-mounted pellet applicator and a helicopter-mounted bucket spreader. Alberta FRDA.

6. Prepare and submit for review a paper "Distribution of PRONONE 10G granules in an operational aerial application by helicopter" by J. Feng, S. Sidhu and C. Feng. The work is related to a study on the operational (multiple swath) application of PRONONE (972 samples). Alberta FRDA.

7. Prepare and submit a paper on the soil sampling method for 0-time pesticide residues after field application, in collaboration with AFS. A-Base. (Feng)

8. Provide functional guidance and supervision in R&D projects initiated under agreements and prepare a report on the interim results for the Canada-Alberta Agreement study. A-Base. (Sidhu, Feng)

9. Continue post-herbicide treatment vegetation sampling (Grande Prairie plots), enter 1986-87 field data on computer and analyse. Synthesize 1987-88 data and prepare a status report. Alberta FRDA. (Sidhu)

10. Collect post-herbicide treatment field samples of soil leachates, surface water and sediments (in collaboration with Alberta Environ.), foliage and soils for herbicide residue analysis. Alberta FRDA. (Feng, Sidhu)

11. Prepare soil samples for bulk density determinations. Perform residue analysis on field soil samples hand-planted with inoculated Pronone 10G granules. A-Base. (Feng)

12. Perform residue analysis on foliage samples collected in the treated area of Method-II, and water and sediment samples collected in the vicinity of Method-II areas. A-Base. (Feng)

13. Streamline and develop analytical methods for specific herbicides. Initiate and maintain Quality Assurance programs. A-Base. (Feng)

14. Provide information and advice to federal, provincial and industrial managers in the region on environmental effects of the use of herbicides in forestry. Participate in various committees (ECW, ForCan Weed Management Committee, FICP). A-Base, Alberta FRDA. (Sidhu, Feng)

15. Provide hexazinone analysis for the AFS Log-application samples and interpret the data. A-Base. (Feng)

16. Participate in the National Check Sample Program as the coordinator for forestry herbicides, conduct check sample studies, and publish results. A-Base. (Feng)

17. Initiate the preliminary study on hexazinone behaviour (leachability and degradation) in intact soil profiles from the field under greenhouse conditions. A-Base, Alberta FRDA. (Sidhu, Feng)

18. Develop methods to determine hexazinone residues in vegetation and soils. A-Base. (Feng)

Additional Goals:

19. a) Publish an abstract on the cross-wind effect on aerial application of PRONONE 10G granules. Alberta FRDA. (Feng)

    b) For Technology Transfer (TT) purposes, address a conference and publish an abstract on the persistence of hexazinone in Alberta soils. Alberta FRDA. (Feng)

    c) For TT purposes, address a conference, publish an abstract, and prepare a journal paper on hexazinone residues and dissipation in soil leachates. Alberta FRDA. (Feng)

20. Prepare a paper on the performance of logarithmic sprayer (in collaboration with AFS) for publication. Alberta FRDA. (Feng)

11. Accomplishments in 1988-89:

1. The information report will not be prepared due to insufficient new information available since a brief on hexazinone was prepared by Sidhu. The relevant new information has been and will be included in specific publication.

2. The paper was prepared and will be submitted to European Journal of Forest Pathology by the end of March 1989 after the internal review is completed.

3. A paper "Release of hexazinone from PRONONE 10G granules exposed to simulated rainfall under laboratory conditions" by J. Feng, and V. Stornes and R. Rogers of Pro-Serve Inc. is published in J. Environ. Sci. Health B23(3):267-278.

4. A paper "Determination of hexazinone residues and its release from a granular formulation under forest conditions" by J. Feng, C. Feng, and S. Sidhu is accepted by Can. J. For. Res. and will be published in March, 1989. Based on the information in this paper, an abstract was published in ECW Res. Rep. and a speech was presented in a conference for TT purposes.

5. A paper "Distribution of granules of a blank hexazinone formulation from aerial and ground application" by J. Feng and S. Sidhu is accepted by Weed Tech. for publication in 1989-90. An abstract was published in ECW Res. Rep. and a speech was presented in a conference for Technology Transfer purposes.

6. Data is being analyzed and information will be included in the final FRDA-report due in March, 1990.

7. Postpone for 1 year due to priority change of collaborators (J. Feng and S. Navratil).

8. Provided functional guidance and supervision on study goals related to the Canada-Alberta Agreement. An interim report was prepared by Sidhu for the Development Section.

9. Completed vegetation density and cover sampling on the the 6 blocks of the Grande Prairie study. All the density and cover data for 1985-88 has been entered on computer. Analysis and synthesis are in progress.

10. Collected post-herbicide treatment samples from chemically treated and control plots for residue analysis in soil leachates, surface water and soils. Additional soil samples were collected by backhoe-trenching to greater than 2 m depth in 2 and 4 kg ai/ha plots (a one time sampling).

11. Soil samples collected in 1987 were air-dried, homogenized, sieved, and thier bulk density determined. Samples were analyzed for hexazinone residues (hand-planted and inoculated PRONONE granules).

12. Soil leachates and water samples were analyzed for residues. Processing of foliage samples is in progress (as of December 1988). About 80 samples have been analysed. Another 150-160 samples will be analysed by March 31, 1989.

13. Quality assurance programs for the analysis of soil leachates, surface water, vegetation and soil samples were maintained. (also see goal 18)

14. Consultations were provided to various government agencies, industries and other herbicide users. Participated in committees identified in Goal 14. Participated in a task force on herbicide carry-over in soils in the Expert Committee on Weeds-Western Canada Section. Submitted a report to the ForCan Vegetation Management Working Group.

15. Designed the experiment, analyzed deposit samples, performed statistical analysis, evaluated and interpreted data, and reported to AFS.

16. Continued to serve as coordinator for forestry herbicide in the National Check Sample Program, completed and reported a check sample study on the analysis of hexazinone and its metabolites in soils by gas chromatography, and participated in the transection of the Program from FICP to Canadian Association of Pest Control Officials (CAPCO) as the new sponsor.

17. This goal is not accomplished due to lack of funds and priority change.

18. Analytical methods by using new micro-column techniques were developed for hexazinone residues in soils and vegetation.

19. a) An abstract "Cross-wind effect on aerial application of granular hexazinone" was published in 1988 Expert Comm. Weeds West. Can. Sect. Res. Rep. 3:203.

b) A speech "Fate of hexazinone in Grande Prairie Project Area" was presented at the Expert Comm. Weeds, West. Can. Sect. Meeting, November, 1988, Winnipeg, Manitoba; an abstract "Persistence of hexazinone in Alberta soils" by J. Feng and C. Feng was published in 1988 Expert Comm. Weeds West. Can. Sect. Res. Rep. 3:182.

c) A speech "Leaching and dissipation of hexazinone in soil-free-water" was presented at the 1988 Conv. Chinese Can. Inst. Arts Sci., October, 1988, Toronto, Ontario. An abstract "Hexazinone residues and dissipation in soil leachates" by J. Feng, S. Sidhu, C. Feng and V. Servant was published in 1988 Expert Comm. Weeds West. Can. Sect. Res. Rep. 3:183. A paper of same title and authorship was accepted and will be published in J. Environ. Sci. Health B24(No. 2), 1989.

20. A paper "Deposition of hexazinone from a logarithmic sprayer" by J. Feng, G.B. Ehrentraut and T.J. Drew was prepared and under internal and external peer review for publication.

12. Present Status of Study:

The herbicide environmental Impact study has progressed well during the last 3 years. Vegetation, water, soil and sediment samples have been collected for the last two years afater the herbicide application in 1986. The residue analysis of all samples of water and sediments, 1987 soil samples and part vegetation samples has been completed. New methodologies for determining the hexazinone residues in soil and vegetation were developed. Four Journal papers on the distribution pattern of PRONONE 10G granules from aerial and ground applicators, release of hexazinone from granules under laboratory and field conditions and residues of hexazinone in soil leachates and water have been published. A status report on Environmental impacts of the vegetation management project (Canada-Alberta FRDA) and a journal paper on the effect of hexazinone on ectomycorrhizal development and seedling growth in lodgepole pine and white spruce under laboratory and field conditions were also prepared. A permit application has been made to apply PRONONE 10G to the crop release plots of the Grande Prairie study in spring 1989. The plots will be monitored for the herbicide deposition rates, off-site movement of herbicide and residues in soil, vegetation and water. The sampling of vegetation for stem density and cover (Method I) is scheduled for 1990/91. The final vegetation sampling of site preparation plots (Method II) is scheduled for 1991/92 (5th year); those of crop release plots (Method I) is scheduled for 1994/95 (5th year).

The wet chemistry laboratory (Room M109) had undergone a major renovation from October 1988 to January 1989 to upgrade the ventillation system and to improve the safety of working environment. Two bench top fumehoods (Class A) and new exhaust pipes and fans were installed.

Consultation and advice were provided to various provincial, federal and industrial agencies on a continuing basis. Under technology transfer, available information was communicated in the form of published papers, reports and presentations at professional meetings.

13. Goals for 1989-90:

1. Complete analysis of all samples of vegetation, soils, water and soil leachates collected in 1988 from the Grande Prairie Study (Method-II) plots by September 1989. Synthesize vegetation and residue data and prepare the final research report for the Canada-Alberta FRDA. Alberta FRDA (Sidhu, J. Feng, C. Feng).

2. Design a monitoring system and collect samples to monitor PRONONE 10G deposition, off-site movement and hexazinone rsidues in soil and vegetation from Method-I herbicide plots scheduled for Spring 1989 application. Alberta FRDA (Sidhu, J. Feng).

3. Prepare soil samples collected in 1988 for bulk density determinations. Perform residue analysis on field soil samples hand-planted with inoculated Pronone 10G granules. A-Base. (J. Feng, C. Feng)

4. Depending on the preliminary results (Method II) collect post-herbicide treatment field samples of soil leachates and surface water (in collaboration with Alberta Environ.), foliage and soils for herbicide residue analysis until residue level are reduced to non-detectable for two consecutive sampling periods. Alberta FRDA. (J. Feng, Sidhu)

5. Publish a paper "Deposition of hexazinone from a logarithmic sprayer" by J.C. Feng, G.B. Ehrentraut and T.J. Drew in J. Environ. Sci. Health. Alberta FRDA. (J. Feng)

6. Prepare and submit a paper on the soil sampling method for 0-time pesticide residues after field application, in collaboration with S. Navratil. A-Base. (J. Feng)

7. Complete the study and prepare a report on the hexazinone degradation in air-dried soil during cold storage. A-Base. (J. Feng)

8. Sample vegetation for cover and density on supplimentary plots, biomass in 32 plots and cover in 360 selected plots of the herbicide and mechanically treated plots of the site preparation area (Method-II) of the Grande Prairie study. Alberta FRDA. (Sidhu)

9. Participate in the National Check Sample Program as the coordinator for forestry herbicides, conduct check sample studies, and publish results (J. Feng). Modify and streamline analytical methods for herbicide residues. Initiate and maintain laboratory Quality Assurance programs. A-Base. (J. Feng, C. Feng)

10. Provide information and advice to federal, provincial and industrial managers in the region on environmental effects of the use of herbicides in forestry. Participate in various committees (ECW-Soil Residue Carry-over Committee, For. Can. Weed Management Working Group and other scientific committees). A-Base and Alberta FRDA. (Sidhu, J. Feng)

14. Publications 1988-89:

Journal:

Feng, J.C.; Stornes, V.; Rogers, R. 1988. Release of hexazinone from PRONONE 10G granules exposed to simulated rainfall under laboratory conditions. J. Environ. Sci. Health B23(3):267-278.

Feng, J.C.; Sidhu, S.S.; Feng, C.C.; Servant, V. 1989. Hexazinone residues and dissipation in soil leachates. J. Environ. Sci. Health B24(2):131-143

Feng, J.C.; Feng, C.C.; Sidhu, S.S. 1989. Determination of hexazinone residues and its release from a granular formulation under forest conditions. Can. J. For. Res. 19(3):378-381

Feng, J.C.; Sidhu, S.S.. 1989. Distribution of granular hexazinone from aerial and ground application. Weed Tech. 3(2):(in press)

Others:

Feng, J. 1988. Cross-wind effect on aerial application of granular hexazinone. Expert Comm. Weeds West. Can. Sect. Res. Rep. 3:203.

Feng, J.; Feng, C.C. 1988. Fate of hexazinone in a New Brunswick forest. Expert Comm. Weeds East. Can. Sect. Res. Rep. 2:682.

Feng, J.; Feng, C. 1988. Persistence of hexazinone in Alberta soils. Expert Comm. Weeds West. Can. Sect. Res. Rep. 3:182.

Feng, J.; Sidhu, S.; Feng, C.; Servant, V. 1988. Hexazinone residues and dissipation in soil leachates. Expert Comm. Weeds West. Can. Sect. Res. Rep. 3:183.

Sidhu, S.S. 1988. Progress report Canada-Alberta FRDA: Forest vegetation mangement R&D program - Environmental impacts and residue chemistry. 29 pp + appendices.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment. (For Environmental Implications of herbicide application, also see NOR-10 & NOR-36-02-01).

16. Duration:

Start: 1985 Completion: 1992

17. Resources 1989-90:

PYs:	Prof.:	Sidhu	0.7
		Feng, J.	0.9
		Feng, C.	1.0
	Tech.:	Fairbarns	0.8
	Total:		3.4
		Student:	0.6

O & M: $ 20 K
Capital: $ 4.8 K

Canada Alberta-FRDA

O & M: $ 41.4 K
$ 10.0 K (service contract PY)
$51.4 K

18. Signatures:

Investigator

Program Director, Protection

Investigator

Regional Director General

Investigator

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

January 17, 1989

1. Project: Environmental Effects of Chemical Substances and Vegetation management

2. Title: Nutrient cycling and dynamics, in relation to chemical substances and silvicultural practices.

3. New: Cont.: X 4. No.: NOR-7-05

5. Study Leaders: D.G. Maynard

6. Key Words: Nutrient cycling, nutrient uptake, herbicides, ecosystem stability, tree growth

7. Location of Work: Northwest Region, emphasis on Alberta

8. Problem Analysis:

Much of Canada's previously harvested forests are significantly understocked and the use of chemical control (eg herbicides) of weed species is seen as one of the major tools that can be used to establish a comercial forest. Environmental groups have expressed their concern about the spraying of herbicides and what effects may occur as a result. The forest industry and Provincial Regulatory Agencies would like to use this silivicultural tool but lack essential scientific information on either the direct effects on various ecosystem processes and components (e.g. decomposition of organic matter) or the long-term influence on fundamental ecosystem functioning (nutrient cycling and uptake). This information is essential if the forest resource is to be managed for sustained yields in an environmentally acceptable and ecologically stable manner.

Soil is fundamental to any forest management and productivity strategy. Present and future concerns will be the result of new technologies or of intensification of forest management in areas where relevant information is lacking. Management strategies such as whole tree harvesting, shorter rotations, and intense site preparation such as herbicide applications, are being proposed. Increased nutrient losses associated with harvest raises questions about adequate long-term soil supplies for future stands and hence productivity declines. At present we can not answer questions regarding long-term productivity of most sites. There are few appropriate analytical procedures, sampling is often inadequate and published estimates of soil supply are not always meaningful as the

information has been determined on unmanipulated, undisturbed stands. In addition, if the proposed scenario of increased temperatures within the next 50 to 100 years (climate change) occurs then many of our current management strategies with respect to nutrient dynamics will be inadequate. If the optimum management and protection of forest resources is to be assured, studies on the effects of climate change on nutrient cycles, especially their inorganic/organic transformations are required.

9. Study Objectives:

1. Determine the influence of herbicide applications on the decomposition of organic matter and nutrient cycling within forest soils.

2. Determine the transformations and fractionation of nitrogen, phosphorus and sulfur in relation to the cycling of these elements in forested ecosystems as affected by herbicide applications.

3. Provide federal, provincial, and industrial resource managers with advice on the environmental effects of the use of various silvicultural practices.

10. Goals for 1988-89:

1. Publish a report on the impact of silviculture practices on nutrient cycling. Continue to develop a model of nutrient cycling in forest systems using information from the literature and data collected. (Maynard, carried over from 1987-88)

2. A growth chamber study on the effect of hexazinone application to the cycling and transformations of nitrogen, phosphorus, and sulfur will be completed. Prepare and submit a journal article for review. (Maynard)

3. Monitor the soils, zero-tension lysimeters and litter fall collectors in the soil nutrient cycling field site following the application of the herbicide. Install litter bags to monitor the decomposition rate of fresh litter after the application of the herbicide. (Maynard)

4. Continue to monitor the nutrient status of the soils in the three treatments of Block 2 in the herbicide study area, Grande Prairie. Complete chemical analysis of the soil samples from 1986 and 1987. Prepare a status report on the soils data comparing pre-herbicide and post-herbicide nutrient concentrations. (Maynard - Alberta FRDA and A-base)

Added Goal:

5. Complete growth chamber study on Philom Bios phosphorus biofertilizer trial. Determine if the biofertilizer has potential for use in forestry and if additional work should be done.

11. Accomplishments in 1988-89:

1. A first draft of a report on the impact of silvicultural practices on nutrient cycling is in preparation. Completion of the report has been delayed because of the tremendous amount of information available on this subject, much of it contradictory. Any further work towards a model of nutrient cycling would require input from other studies. With the present resources and PY's in NOR-07-05 a nutrient cycling model is not possible.

2. The growth chamber study on the effect of hexazinone on the cycling and transformations of N, P, and S has been completed. The study ran for 22 weeks with 8 sampling times. The soils are presently being analyzed. The bioindicator (oats) showed that after 15 weeks, the active ingredient of the herbicide was no longer effective. This was due to either breakdown of the compound(s) within the soil or adsorption by organic colloids. A journal article will be prepared when the soil analysis is completed.

3. The herbicide was applied to the nutrient cycling field site May 25, 1988. Effects began to show within two weeks and by mid-summer there were obvious differences among treatments. Zero-tension lysimeters and litter fall collectors were maintained throughout the season and chemical analysis of the samples has been completed. Preliminary results indicate that the N, P, and S concentration of the litterfall from the herbicide plots (August) is significantly higher than the control (October). Litter bags were placed in the field over the summer and collected in October. Analysis of the litter bags to determine decomposition rates has started. Analysis of the soil is continuing.

4. Block 2 was sampled again in 1988. Chemical analysis of the soil samples taken in 1986 and 1987 have been completed for the LFH horizon. The data is being collated. To date, because of the large variability associated with the operational plots few differences have been found. The total S concentrations of the LFH, however, are consistent with the litterfall data. Total S in the 4 kg ha^{-1} plot was significantly higher than the 2 kg ha^{-1} and the control. Analysis of the mineral soils from 1987 and all the soils for 1988 are continuing. No further sampling of these sites will be done.

5. The growth chamber study was completed and all the analyses are done. The data has been analyzed and there was no effect of the added biofertilizer in terms of increased growth or P uptake. There were however; problems with application of the biofertilizer. A second growth chamber study is being considered depending upon the outcome of the results of a second study being done by I. Edwards.

12. Present Status of Study:

The operational herbicide study plots were sampled again in 1988. Analysis is almost complete for the 1986 and 1987 samples. An interim

report comparing pre- and post-herbicide nutrient concentrations will be prepared. The growth chamber study has been completed and analysis is continuing. The herbicide was hand applied in the spring of 1988 to the smaller nutrient cycling field plots. Effects were observed within 2 weeks of application and almost complete kill of the target vegetation occurred at the 4 kg/ha a.i. application rate. Monitoring and sampling of the soils was completed for the 1988 field season and analysis of the samples collected has begun. Significant differences among herbicide treatments have been observed in the litter fall nutrient concentrations (N, P, and S) and the moisture content of the surface organic soil horizon.

13. Goals for 1989-90:

1. Complete a report for publication as a journal article or Information Report on the impact of silviculture practices on nutrient cycling in mixed woods.(Maynard, carried over from 1988-89)

2. A journal article on the result of the hexazinone (Velpar) growth chamber study will be completed and submitted for publication. (Maynard)

3. Complete an interim report on the nutrient status of the soil, before and after herbicide application in the nutrient cycling plots. (Maynard)

4. Continue to monitor the soils, zero-tension lysimeters, and litter fall collectors in the nutrient cycling field site. Analysis of the litter bag samples, soils and foliage is on-going. (Maynard, Sidhu)

5. Complete the analysis of the soils collected from Block 2 of the operational field study and prepare an interim report. Further reporting will depend upon the results of this study plus information obtained in the growth chamber and smaller nutrient cycling field plots. (Maynard)

6. Prepare a file report on the results of the Philom Bios phosphorus biiofertilizer study. (Maynard in cooperation with I. Edwards)

7. Review information available on soil management and nutrient supply with respect to long-term site productivity in a mixed- wood forest. (Maynard)

14. Publications:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study

leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1986 Completion: 1992

17. Resources for 1989-90:

PYs: Prof.: Maynard 0.7
Sidhu 0.1

Tech.: Radford 0.3

Total: 1.1

Term/Student: 0.0

O & M $4,000
Capital: Nil

18. Signatures:

Doug Maynard
Investigator

Program Director, Protection

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

January 17, 1989

1. Project: Environmental Effects of Chemical Substances and Vegetation management

2. Title: Analytical Services Laboratory

3. New: Cont.: X 4. No.: NOR-7-06

5. Study Leaders: Y.P. Kalra, D.G. Maynard,

6. Key Words: Analysis, soils, vegetation, water

7. Location of Work: Northern Forestry Centre

8. Problem Analysis:

Many of the studies at NoFC require high quality analysis of soil, plant and water samples in order to meet their objectives. In some cases analytical techniques must be modified or developed to meet the specific requirements of the users. Maintaining a high quality analytical laboratory suitable to support ongoing research and the continuing improvement, modification and development of techniques are essential to meet the needs of the users at NoFC.

9. 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. Develop analytical techniques as required by user request.

10. Goals for 1988-89:

1. Provide analytical services to research scientists and cooperators as requested and approved by the Program Directors. (Kalra)

2. Submit for review an Information Report on the Analytical Methods used for soil, plant, and water analysis in the Analytical Services Laboratory. (Kalra, Maynard, carried over from 1987-88)

3. Prepare for review a journal article entitled "Microwave digestion of tree foliage for multi-element analysis" by Y.P. Kalra, D.G. Maynard, and F.G. Radford. (Kalra, Maynard)

4. Participate in inter-laboratory check sample programs on a national (Land Resource Research Institute, Ottawa and Long Range Transport of Air Pollutants, GLFC, Forestry Canada) and international (LABEX) program and interlaboratory comparison for the National Acid Precipitation Assessment Program of the U.S. Environmental Protection Agency level. (Kalra, Maynard)

5. Initiate a study to determine the changes in extractable S and other nutrient elements that occur with various storage practices. (Maynard, Kalra)

6. Maintain an active role in the activities of the Western Enviro-Agricultural Laboratory Association (WEALA). (Kalra)

7. Set up the continuous vacuum extractor system for the determination of cation exchange capacity. (Kalra)

8. Management and disposal of old chemicals. (Shuya)

11. Accomplishments 1988-89:

1. Provided analytical services to research scientists and cooperators in particular NOR-4,7,11,12, and 36. The estimated analysis are expected to be approximately 33 000 on 5 000 samples. (Kalra)

2. The first draft of an Information Report on methods used in the Analytical Services Laboratory is complete. Some revision and shortening are required prior to submitting it for review. (Kalra, Maynard)

3. A journal article entitled "Microwave digestion of tree foliage for multi-element analysis" by Y.P. Kalra, D.G. Maynard, and F.G. Radford was submitted to the Can. J. For. Res. in September.

4. Participated in inter-laboratory check sample programs on a national (Land Resource Research Institute, Ottawa and Long Range Transport of Air Pollutants, GLFC, Forestry Canada) and international (LABEX program and interlaboratory comparison for the National Acid Precipitation Assessment Program of the U.S. Environmental Protection Agency) level. Also participated in a provincial check sample program sponsored by the Alberta Institute of Pedology. This program, however; was set up with an agricultural bias therefore, we have discontinued our involvement in it.

5. Preliminary results from our work on extractable sulfate indicated that storage of air-dried organic (LFH) soil horizons at room temperature resulted in increased S concentrations. To further test the effects of sample storage on extractable nutrient concentrations both mineral and organic soils have been stored

moist and air-dried at -3 °C and -20 °C. The samples will be stored for various lengths of time to determine if time of storage could also alter nutrient concentrations. (Maynard, Kalra)

6. Maintained an active role in the activities of WEALA through the check sample program and attending their meetings and workshop. A restructuring of WEALA, however; will preclude further direct involvement in the organization. (Kalra)

7. The vacuum extractor system was successfully set up and has been used on a routine basis for the determination of cation exchange capacity and extractable cations. The system has improved throughput for these analysis and also requires the use of less sample and reagents. (Kalra)

8. Every Friday is given to laboratory safety related items. During March - December 1988, 1 200 L of organic solvents and 315 kg dry chemicals were disposed of according to the Transportation of Dangerous Goods (TDG) regulations. Chemicals were reorganized in the new storage facility to comply with the Workplace Hazardous Material Information System (WHMIS). Several seminars on the new WHMIS regulations were attended.

12. Present Status of Study:

The analytical services laboratory provides support services to NOR-4, 7, 11, 12, and 36 on an on-going basis. The laboratory will do approximately 30 000 analysis on 5 000 samples in 1988-89. Quality control has been maintained through participation in several check sample programs. Two major innovations with respect to analytical equipment and techniques involves the development of a microwave digestion technique (submitted for publication) and the set up of a continuous vacuum extrtactor system. Work continued on the effects of storage on extractable soil nutrients, a serious concern when samples are archived for analysis at a later date.

A major accomplishment has been the completion of a first draft of an Information Report on analytical methods. It is hoped that through the publication of this report and involvement with the quality assurance program of LRTAP that many of the methods used in forest soil laboratories (at least within Forestry Canada) will be standardized.

13. Goals for 1989-90:

1. Provide analytical services to research scientists and cooperators as requested and approved by the Program Directors. (Kalra)

2. Publish an Information Report (approx. 100 pages) on the Analytical Methods used for soil, plant and water analysis in the Analytical Services Laboratory. (Kalra, Maynard)

3. Publish a journal article entitled "Microwave digestion of tree foliage for multi-element analysis" by Y.P. Kalra, D.G. Maynard, and F.G. Radford.

4. Manage and arrange safe disposal of old chemicals. (Shuya)

5. Participate in inter-laboratory check sample programs on a national (Long Range Transport of Air Pollutants, GLFC, Forestry Canada) and international (LABEX program and interlaboratory comparison for the National Acid Precipitation Assessment Program of the U.S. Environmental Protection Agency level. (Kalra, Maynard)

6. Complete a study on the changes in extractable S and other nutrient elements that occur with various storage practices. Assess the results and determine if a report or journal article is warranted. (Maynard, Kalra)

14. Publications 1988-89:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1970 Completion: On-going

17. Resources for 1989-90:

PYs:	Prof:	Kalra	1.0
		Maynard	0.1
	Tech.:	Shuya	1.0
		Radford	0.2
	Total:		2.3
	Term/Student:		0.6

O & M $10,000
Capital:

18. Signatures:

Y. P. Kalra
Investigator

Program Director, Protection

Doug Maynard
Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1988-89

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: Mixedwood Silviculture

2. Title: Silvicultural investigations

3. New: Cont.: X 4. No.: NOR-10-03

5. Study Leader: L.G. Brace

6. Key Words: Mixedwoods, planning, free-to-grow, vegetation management, early stand development, mechanization, technology transfer

7. Location of Work: Northwest Region

8. Problem:

A sustained and even increased supply of economically usable timber is a key element in the long-term economic health of Northwest Region and of Canada as a whole. Timber supply is affected by many factors, including available capital, accessibility and marketability of different species, utilization standards, process technology and efficiency, land base and changes in land allocation, losses to insects, disease and fire scale and effectiveness of silvicultural practices and possibly major climatic shifts (greenhouse effect).

Changes in any of these factors can affect timber supply and the nature and extent of silvicultural problems.

Currently one of the most acute regional silvicultural problems revolves around the need to successfully establish and bring softwood (both pine and spruce) to a free-to-grow state on mixedwood sites. The scale of the problem has increased over the last decade with the increase of softwood nursery stock production from about 10 million to 70 million seedlings annually. Once these trees are planted or regenerated by scarification on mixedwood sites, brush and grass competition interfere with survival and growth. Mixedwoods constitute about 30 percent of productive forest land in the region (about 14,000,000 ha), often on the most productive softwood sites. In the period 1975 to 1985 white spruce related silviculture alone, mainly site preparation and planting, was carried out on about 239,000 ha of mixedwood land at a cost of about $143.4 million ($600/ha). This investment is increasing yearly and remains at risk in terms of

mortality as well as quality and growth reduction for periods of up to 80 years, with attendant yield losses of up to 30 or 40 percent, if proper silvicultural practices are not applied. These include adequate site preparation, use of high quality planting stock (properly planted) and control of competing vegetation up to the free-to-grow state. Risks to pine regeneration in mixedwoods may be even higher than spruce due to shade intolerance and consequent high mortality.

Future silviculture problems in the region could well be different as a result of a new emphasis on aspen utilization and in the long run possibly due to climatic shifts caused by the greenhouse effect, which predictive models now suggest may cause a substantial northward shift of boreal mixedwood boundaries (300-400 km by 2060 AD) with attendant increases in survival growth, insect, disease and fire control problems for the primary species. Until recently, aspen (which represents 96% of the hardwood inventory, which in turn represents over 1/3 of gross merchantable wood inventory in the region) was less than 10% utilized. Current plans for aspen utilization in conventional pulp, CTMP pulp, a paper mill, a sawmill and a number of Oriented Strand Board (OSB) plants will increase use substantially (up to 5.6 million m^3) by 1991.

In Alberta alone there were new or expanded industrial forestry projects with investment totalling $3.4 billion announced between October 1987 and December 1988, primarily in the mixedwood zone. The effect of this trend on silvicultural problem can be illustrated with respect to NSR. Traditionally, regional silvicultural problems have often been stated in terms of softwood NSR, which is estimated to total over 500,000 ha, of which 300,000 ha is in mixedwood burns and cutovers. The NSR problem would be significantly reduced if aspen became acceptable for regeneration, as many of these areas are already stocked with aspen. This situation generates a new set of problems. For example:

- How many softwood NSR areas are adequately stocked with aspen and how will this affect land base decisions, stocking standards etc?

- What constitutes adequate aspen stocking and how can aspen stocking be effectively controlled?

- How is mechanized site preparation implicated in aspen stocking control?

- What are the relative growth and yield trade-offs between spruce, pine and aspen on the same sites and should they be grown in pure or mixed stands?

- What are the regeneration, growth, and utilization prospects for associated balsam poplar and white birch in mixedwoods.

- What is potential role and need for R&D in the area of non-chemical competition control in future forest management/silviculture work to achieve "free-to-grow" standards?

Increased aspen utilization may also solve problems. For example, logging economics will improve with removal of larger volumes per unit of area,

reduced slash loads will make site preparation and softwood planting easier and cheaper, and make re-entry for tendency more efficient, and acceptance of aspen as regeneration improves reforestation options. In the near future balsam poplar and white birch utilization can also be expected to increase. If they are left unutilized and standing in cutovers they will seriously impede the development of a new healthy aspen forest from suckers.

The nature of silvicultural problems in the region is changing. ForCan recognizes that much of the information needed to address these changes is known and requires effective technology transfer. There is also a need for specific R&D initiatives, especially in the areas of mixedwood site preparation, stock quality, early tending response, relative performance, of both hardwood and softwood species and utilization, particularly of aspen, balsam poplar, and white birch.

9. Study Objectives:

1. To conduct silviculture R&D and publish scientific and technical reports of silvicultural interest, regionally and nationally, stressing early stand development, with particular emphasis on chemical and non-chemical means of competition control.

2. To provide liaison and input as required to relevant regional and national programs, such as the ForCan Vegetation Management Working Group, the Expert Committee on Weeds, and the mechanization of silviculture program (GLFC and FERIC), emphasizing biological aspects of silviculture mechanization, and to promote the development and dissemination of silvicultural knowledge through work with national, regional, and local committees, workshops and other related techniques.

3. Supervise research contracts and develop in-house research studies as an outgrowth of contracts where appropriate.

10. Goals for 1988-89:

1. Coordinate the regional forest vegetation management project in co-op. with NOR-7 and NOR-3. (10-03-01)

2. Remeasure silviculture R&D plots at Grande Prairie and prepare draft report on second-year results. Coordinate small mammal study under Wildlife Toxicology Fund (Alberta Agreement). (10-03-02)

3. Plan and initiate a multi-disciplinary mixedwood project in plantation establishment and management. (10-03-03)

4. Act as project leader NOR-10, including:

   a) Chair organize-coordinate 1988 field meeting (RRTC) in Manitoba and provide technology transfer and research priority review. (Brace)

b) Participate in ECW, LOG, FMG (CPPA) FERIC, National Vegetation Management Working Group and other committees as required. (Brace, Gorman)

c) Provide advice on silviculture investigations and vegetation management studies in Saskatchewan and Manitoba. (Brace) (10-03-04)

5. Continue on Scientific Authority on aspen suckers and seedlings. Navratil AFS. (Alberta Agreement). (10-03-05)

6. Cooperate with GLFC, FERIC and FRDA's in both small and large machine evaluations as appropriate. Plan mechanization of silviculture workshop for 1989-90 in Alberta (all regional agreements) (Gorman) (10-03-08).

7. Act as Scientific Authority for the intensive forest management demonstration project at Whitecourt (Heustis) AFS. (Alberta Agreement (Waldron) (10-03-10).

8. Prepare and present joint paper for mixedwood management symposium in April, 1988 with Waldron and Bella. (10-03-10)

9. Act on Scientific Authority on aspen cull study at Whitecourt (Alberta Agreement). (10-03-11)

10. Prepare and present paper to CPPA annual meeting on regional site preparation work (Gorman) (Alberta Agreement). (10-03-12)

Added Goals:

11. Provide advice to 10-04 (Navratil) on planning Rome disc project (see 10-04-88-04) (Gorman) (10-03-07).

12. Initiate co-operative field project on logging methods to protect understory white spruce during aspen overstory harvest with AFS, FERIC, Weldwood, Blueridge, and Pelican Spruce. (Alberta Agreement) (Brace/Gorman) (10-03-12).

13. Plan itinerary for field tour by US scientist member of U.S. mountain pine beetle work plan team Aug. 15 to 19, 1988 from Athabasca River South (Brace). (10-02-10)

11. Accomplishments in 1988-89:

1. Co-ordination role continued, with activities including project audit reports and presentation, summer field work including an additional herbicide permit under NOR-7 and preliminary work on 1989 permits and plans for final chemical and manual release treatments on the main test site at Grande Prairie.

2. Silviculture remeasurements on vegetation management plots on the main test site near Grande Prairie was completed and a two-year progress report prepared. The small mammal study was continued through funding

obtained from the Wildlife Toxicology Fund. This required active participation by NoFC staff.

3. The M-D mixedwood project planning document was completed by incorporating fall 1988 RRTC comments and holding a staff briefing session at NoFC. Implementation was initiated by incorporation of priority items into NOR-10 studies for 1989/90 and by diffusion of priority items into other project areas, as well as into FRDA related priorities in Saskatchewan and Manitoba.

4. Continued on project leader of NOR-10. A major change in project staffing and orientation is currently underway with movement of two RSc positions and one technician position to project NOR-02, and the development of new priorities for NOR-10 in the area of mixedwood silviculture.

   a. chaired RRTC meeting in Manitoba October 24-28, 1988 and presented the annual report to the SRAC.

   b. (i) Presented a report on the FRDA vegetation management project to the annual ECW (Western) meeting in Winnipeg on Nov. 29, 1988; (ii) presented abstracts of current vegetation management R&D to the ForCan Vegetation Management Working Group for inclusion in their R&D summary report for 1988; (iii) co-operated with FERIC (west) in development and execution of a logging trial aimed at assessing productivity of different logging systems employed in logging aspen and protecting understory white spruce in Alberta and (iv) provided cost information on equipment transport and use in Rome disc trial plans. (Navratil).

5. Acted as scientific authority on aspen sucker and seedling R&D until May 1988 when Navratil transferred to ForCan staff (NOR-10) and brought previous AFS contract responsibilities for the Alberta Agreement vegetation management work with him.

6. Attended FERIC fall meeting at Williams Lake, B.C., September 8, 1988. Consulted on tests of A-2 Forester scarifier tested near Grande Prairie under joint Canada-Alberta FRDA and CANFOR funding. Co-ordinated initial planning for a 1989 mechanization of silviculture workshop in Saskatchewan.

7. Scientific authority duties on the Heustis demonstration forest were assumed by R. Newstead and J. Mrklas and the continuing work on the project has been transferred to J. Mrklas.

8. A paper entitled "Understanding the understory - Dilemma and Opportunity", was prepared and presented at the Mixedwood Management Symposium in April 1988.

9. The final draft of the aspen cull study was reviewed in November 1988 and this work is now complete.

10. A paper was prepared and presented to the CPPA meeting in Montreal.

11. Advice and cost data were provided to Navratil (10-04) for use in planning a Rome disc trial as part of a new thrust in mechanical control of completing vegetation.

12. A large field trial of logging equipment and methodology aimed at reducing damage to understory white spruce during commercial logging of aspen overstory trees was initiated in June 1988. The work was initiated under the Alberta Agreement. The ForCan completed field inventories and detailed understory maps for 9 stands on 3 company limits and also contributed to a FERIC work plan to assess logging productivity and to report logging and silvicultural results jointly. The AFS provided preliminary stand selection and large scale color photography. Pelican Spruce completed the logging of 3 stands by early December 1988. Weldwood and Blueridge Lumber are currently finalizing logging plans for discussion with ForCan, AFS and FERIC prior to early spring 1989 logging. The committee responsible for this project is chaired by the ForCan, NoFC.

13. An itinerary involving Weldwood Canada, the Rocky-Clearwater and Bow-Crow Forests was set up and successfully followed. The USFS will now provide feedback to the Canadian members of the Canada-US MPB project regarding risk assessment in East Slope Forests.

12. Present Status of Objectives:

1. Silviculture R&D and reporting on regeneration silviculture has continued under the study to date, with the competition control emphasis primarily on mechanical site preparation. This approach was altered in 1985 by the addition of both manual and chemical control studies under the Alberta Agreement, which is co-ordinated through study 10-03. Future A-base work on competition control and early stand tending will lead to a focus on smaller equipment demonstrations for a variety of purposes, with less emphasis on site preparation with large equipment.

2. National program involvement in the CFRDP, through silviculture statistics reporting, and mechanization of silviculture, through NACMEC, are being reduced after 1987-88 because of changes in the focus and/or scope of these programs. NACMEC has been substantially de-emphasized with transfers of significant parts of the program to FERIC and our focus will switch to more involvement with FERIC west. New involvement is being initiated in the National Vegetation Management Working Group because of the continuing interest in vegetation management in this region.

   Regional committee activity continues to focus on technical committees like RRTC, which have taken on a more important role recently in R&D planning strategy in this region and contributions to the Expert Committee on Weeds (ECW) continue.

3. Contracts are a particularly important part of the FRDA programs, where substantial funding has been available since 1985, and contracts continue to be an important adjunct to staff R&D in this study.

13. Goals for 1989-90:

1. Co-ordinate the regional forest vegetation management project in co-operation with NOR-07 and NOR-03 (Brace) (10-03-01).

2. i) Continue silviculture measurements of efficacy and crop tree development on Grande Prairie Vegetation management site. Obtain permit and complete herbicide and manual release treatments on the Method I area. (Brace)

   ii) co-ordinate workshop in late 1989 or early 1990 on all aspects of the study to date (silviculture, environment, economics) and prepare final status report to the Senior Development Officer. (Brace) (10-03-02)

3. Continue integration of the multi-disciplinary mixedwood plan into current silvicultural studies at NoFC and encourage adoption of relevant priorities in other projects (e.g., growth and yield (NOR-04), GIS/FIS (NOR-02)) as appropriate. (Brace) (10-03-03)

4. Act as project leader NOR-10 and maintain related duties including (10-03-04):

   a. Chair and report to SRAC on 1989 RRTC meeting in Saskatchewan. (Brace)

   b. Participation in LOG, FMG, FERIC, ECW, Vegetation Management Working Group and other committees as required. (Brace, Gorman)

   c. Provide advice on silvicultural investigations and vegetation management studies in Saskatchewan (Gardner) and Manitoba (Ball). (Brace)

5. Continue protection of understory white spruce project under Canada-Alberta FRDA: (10-03-12)

   i) relocate and assess logging damage/stocking plots in 3 Pelican Spruce stands logged in late 1988 and prepare preliminary damage assessment report. (Gorman)

   ii) relocate and assess similar plots on Weldwood and Blueridge Millar Western area for stands logged in spring 1989, and prepare preliminary damage assessment report. (Gorman)

   iii) prepare and present a report on early results of study on protection of understory white spruce during commercial logging of aspen overstory at Northern Mixedwood Symposium, Fort St. John, B.C., September 1989. (Brace)

6. Co-operate with GLFC, FERIC, and FRDA's in silvicultural equipment evaluation as appropriate and with Saskatchewan office of ForCan in planning and reporting on a mechanization of silviculture workshop in 1989. (Gorman) (10-03-08)

7. Provide advice on adaptation and costs of silvicultural equipment for use in regional silviculture trials. (Gorman) (10-03-07)

14. Publications 1988-89:

Brace, L.G.; Bella, I.E. 1988. Understanding the understory: dilemma and opportunity. Pages 69-86 in J.D. Samoil (ed.). Management and utilization of northern hardwoods. Proc. Symp., April 11-14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

Gorman, R.J. 1988. Federal-provincial agreement site preparation trials on the prairies, 1984-87. Paper presented to Annual Meeting of CPPA, Montreal, PQ., March 27-31, 1988. Proceeding in press.

Brace, L.G.; Sidhu, S.; Boylen, D. 1988. Vegetation management research project, Grande Prairie, Alberta. Progress Report June 1988. Report prepared for audit of B.3 projects under the Canada-Alberta FRDA.

Navratil, S.; Lane, J. 1988. Control of aspen development on areas designated for softwood production - summary of satellite trials A, B, and C. Report prepared by AFS - Forest Research Branch for ForCan Scientific Authority, for use in audit of B.3 projects under the Canada-Alberta FRDA.

Penner, D.F. 1988. Effects of hexazinone on small mammals under field conditions: 1986 and 1987 investigations. Progress report on contract work on the Grande Prairie Vegetation Management site, funded by the Wildlife Toxicology Fund and the ForCan (Contractor D. Penner and Associates, Sherwood Park, Alberta).

Todd, P.; Brace, L.G. 1988. Establishment and progress report 1985-88, Grande Prairie forest vegetation management study. Report on silviculture component of Canada. Alberta FRDA vegetation management project.

Maier, B; Darrah, D. 1988. Decay levels in mature aspen stands - Whitecourt, Alberta. A report prepared by the Forest Measurement Section, Timber Management for Alberta FRDA.

Blake, P. 1988. Report on field performance of the Roto International Corp. Inc. A-2 Forester scarifier on the limits of CANFOR, Grande Prairie, Alberta. Assessment funded jointly by CANFOR and the Canada-Alberta FRDA.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1984 Completion: 1992

17. Resources 1989-90:

A-Base

PYs: Prof.: Brace 1.0
Tech.: Gorman 1.0
Total: 2.0

Term/Student: 1.0 (Todd-Term)

O & M: $12.3 K (Contracts 10,000 (wildlife))

Capital: $ 11.6 K

FRDA's

Alberta Saskatchewan

(see below)

1. Alberta - FRDA Details

a) Vegetation Management Project

PY		O&M
Brace	0.3 (Prof)	$20,000
	0.3 (student)	
Todd	0.7 (Term)	
AFS-R&R	0.1	9,500
	1.1	$29,500

b) Protecting understory white spruce

PY		O&M/G&C
Brace	0.4 (Prof)	
	*0.6 (Student)	
Gorman/Todd	1.3 (Tech)	
	2.3	
O&M:		50,000
G&C:	-FERIC	57,350
		$107,350

*only 0.6 student from agreement

2. Saskatchewan - FRDA

RRTC meeting in Cypress Hills area

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: Mixedwood silviculture

2. Title: Aspen silviculture in mixedwood and hardwood management

3. New: Cont.: Terminated 4. No.: NOR-10-04

5. Study leader: S.Navratil

6. Key words: Efficacy, crop tolerance, herbicides, vegetation management, growth performance, technology transfer

7. Location of work: Northwest Region

8. Problem:

Currently one of the most acute silviculture problems in the region is the control of brush, grass and herbaceous competition which hinder the survival and early development of new coniderous plantations: the problem becomes incresingly acute as seedling production and palnting increases (going from 10 to 70 million seedligns annualy between 1975 and 1987) and as investments in site preparaiton and early stand treatment increase.

In the period 1975 to 1985 white spruce regeneration in the region cost about $92 million for 239 000 ha (mainly site preparation and planting). A high percentage of this and subsequent investments is at risk due to competition for moisture, nutrients and light from associated plant species.

Herbicides have potential application for site preparation, early release and later non-commercial thinning in regional softwood plantations, and R&D on herbicides in a regional context is essential.

Concurrent with herbicide R&D there is a critical need to conduct studies on non-chemical methods of competition control in a regional context. This may become increasingly more improtant in the future if public opposition toherbicide use continues to grow.

9. Study objectives:

1. To contribute silviculture R&D on chemical and non-chemical means of competition control during establishment and early development of new

softwood plantations in the region, with emphasis on aspen suckers and seedling management techniques.

2. To act as Scientific Authroity on research contracts and to contribute to Resource R&D planning at NoFC.

10. Goals for 1988-89:

1. Publish Information Report on results of efficacy and crop tolerance experiments in Alberta and Manitoba.

2. Contribute to planning and initiation of multi-disciplinary project on plantation establishment and management.

3. Act as Scientific Authority on unsolicited proposal (UP) for an aspen monograph being done by Western Ecological Service Ltd.

4. Act as Scientific Authority on FRDA contract for report on aspen solid wood products (Alberta Agreement).

5. Continue field efficacy trials with FPMI priority-rated herbicides. Continue monitoring plots at 2, 3-5 and 10 years using ECW Protocols.

11. Accomplishments in 1988-89:

1. Report in final word-processing and typesetting stage.

2. Goal transferred to NOR-10-12.

3. Work on aspen monograph done by Western Ecological Services is on time and is being supervised by R. Waldron. (continued the goal transfered to NOR-10-12)

4. Contract for report on aspen solid wood products was supervised by R. Waldron.

5. No work was needed and the goal has been terminated.

12. Present status of study objectives:

The conduct of studies of chemcial and non-chemical means of competition control inititated in 1980 are largely completed. R&D on vegetation management which originated with the Alberta Agremeent in 1985 with emphasis on aspen sucker and seedling origin and control has been intensified and incorporated in the study NOR-10-12. The study is Terminated.

13. Goals for 1989-90:

Goals requiring continued work were transferred to NOR-10-12 (goals #5 and #11).

14. Publications 1988-89.

Nil

15. Environmental implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of the following clarifications provided by the study and project leaders, the committee concludes that no further screening action is required.

1. All experimental herbicide applications have been done under permits issued by Alberta Environment, Environmental Protection Services (Pollution Control Division), and the studies are registered with FICP.

2. Experimental plots are very small (1/10 acre).

3. Either the plots are distant from any water bodies or there was a buffer zone of 30-50 m between the plots and a water body.

4. No federal funding was incolved in herbicide applications or in locating the plots.

5. Plots are being monitored over long term to assess the effects of herbicide application on vegetation and forest crop species.

6. Methods of application included back pack spray, spot-gun spray or as grid balls. As a result, no aerial drift of herbicides was expected or observed.

16. Duration:

Start: April 1980 Completion: 1989

17. Resources 1989-90:

Nil - terminated

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: Febraury 28, 1989

1. Project: Mixedwood Silviculture

2. Title: Evaluation of mortality in stands of young trees in plantations and scarified areas

3. New: Cont.: X 4. No.: NOR-10-08

5. Study Leader: 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, technology transfer, juvenile tree survival and growth

7. Location of Work: Northwest Region

8. Problem:

In recent years there has been an increased awareness that Canada's forests are not going to last forever without assistance from forest managers. Many of the areas that are harvested, or have been burned do not naturally regenerate themselves with the desired tree species and density, and require site preparation or planting in order to provide satisfactory stocking levels. Whatever the procedure used, the operation is expensive, especially if it has to be repeated on the same site. Surveys are therefore conducted in order to determine whether or not the area under consideration is adequately stocked. However, the standards for making this decision are somewhat arbitrary because of the tree mortality that will occur between the time when the survey is conducted and when the tree is finally ready for harvesting. At the moment, a value of 80% stocking is considered to be adequate, but this is not necessarily valid for all sites. With jack pine and lodgepole pine especially, there is every reason to believe that the amount of mortality will vary between sites. some of this variability will be related to edaphic factors, but some will also be due to the differing effects of insect and disease attacks on trees in various sites.

What seems to be required, then, is an assessment of tree mortality from the time of establishment until crown-closure at age 25 to 35 years. An estimate of this mortality can be obtained by establishing plots in a number of different age classes, on a variety of sites, and assessing the

mortality for a relatively short period of time. This will allow a composite survival curve to be drawn up for each ecological site, possibly in about 5 years, which can be modified as more information becomes available. These curves should provide the information needed to determine what modifications, if any, of the stocking standards in relation to site class are required.

Each sampling unit will be a plot of 20 trees, and as many of these plots will be established in each area as in practical, typically 40 such plots per area. Several replicates will be established in a number of site and age classes. They will then be examined periodically to determine the amount and cause of mortality.

Insect and disease attack on jack pine and lodgepole pine are probably more important than in white spruce. Therefore, initial emphasis will therefore be concentrated on these two species.

9. 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.

10. Goals for 1988-89:

1. a) Co-ordinate the completion of plot maintenance in the 10 remaining lodgepole pine study areas near Hinton, Alberta.

   b) Assess seventh-year mortality in lodgepole pine plots near Hinton, Alberta.

   c) Collaborate with Dr. I. Corns to analyse accumulated data on growth and survival of lodgepole pine in the Hinton area to determine if they are related to the preliminary site classifications obtained in 1986.

   d) Prepare progress report on study to date.

2. Prepare progress report summarizing the results of the Manitoba studies.

11.. Accomplishments in 1988-89:

1. a) Plot maintenance was completed in 10 remaining lodgepole pine study areas near Hinton, Alberta.

   b) Seventh-year mortality in lodgepole pine plots near Hinton, Alberta was assessed.

   c) Little or no apparent progress was made in preparing preliminary site classifications for lodgepole pine study areas near Hinton,

Alberta, and the objective has been placed on "hold", due to Dr. Corn's other commitments. A crude classification, based on soils (and altitude) was used, and gave adequate results in preliminary analyses.

d) A progress report summarizing results to date was prepared.

2. A progress report summarizing results to data was prepared.

12. Present Status of Study:

Analyses of the data collected in the Hinton study indicate that continuing the study for another five-year period would be very worthwhile. The present data cover a 7-year period (1981-88), and therefore do not include a complete snowshoe hare cycle. These animals are apparently increasing in numbers at the present time, and fresh damage is starting to increase. Atypical hare damage to the basal stem of 25-year-old trees was common in three sample areas during the peak of the last cycle, but may be an unusual case. The trees in several widely spread out areas are now approaching the same age, and continuation of study would allow an evaluation of how common this type of damage is.

Also, present life table construction depends upon pooling data from a large number of areas in order to cover the desired range in age classes. Another five years data for most of the areas would allow construction of more life tables since the amount of pooling required for their construction would be reduced. No new plots have been established since 1984. A few plots should therefore be established in young regeneration, in order to provide an estimate of current mortality in young stands.

Analyses of the data on jack pine survival in Manitoba indicate that factors responsible for most of the mortality of lodgepole pine in Alberta are of minor importance for jack pine in Manitoba. The infrequency of examination precluded the construction of life tables for jack pine survival, but drought appears to be the most important factor. It is therefore suggested that these plantations be examined in 1989 and again in 1990. In 1989, consideration should be given to whether or not it is worthwhile to try to determine the cause of death for trees dying from unknown causes. If so, it is recommended that discs be collected from the base, mid-crown and upper crown for a sample of trees, and that soil pits be dug near each of these trees to determine the soil type (loam, sandy loam, fine sand, coarse sand, or gravel). These data should help to determine if drought was the probable cause of current mortality, and might allow determination of the cause for earlier mortality as well. If so, it might then be possible to construct life tables for the complete data set.

Mr. Rentz has been conducting all of the field work and data coding and editing for this study during the last five years. Mr. Ives will be retiring in March 1989. It is therefore recommended that Mr. Rentz should be elevated to the sole study leader. Mr. Ives will be available for advice on a part-time basis and should be able to prepare the information reports in 1991-92 if this is desirable.

13. Goals for 1989-90:

1. Establish plots in three areas cut between 1979 and 1982, one each in low, medium, and high productivity areas (McLeod I, Berland III; McLeod VI; McLeod IX; and Athabasca XIX; Marlboro III, Marlboro VII; Embarras III working circles respectively).

2. Earmark "excess" sample areas in older age classes that could be dropped from annual examination schedule if the work-load becomes excessive.

3. Assess eighth-year mortality of lodgepole pine in plots in the Hinton, Alberta area.

4. Code and edit 1988-89 Hinton survival data for computer input and storage, respectively.

5. Prepare summaries of 1987-88 mortality for lodgepole pine in the Hinton, Alberta area.

6. Participate in a seminar with other NoFC scientists to discuss problems encountered in the management of young lodgepole pine stands.

7. Assess 7-year mortality of young jack pine in the Sandilands Provincial Forest, Manitoba, plantations.

8. Participate in a short field trip during the summer of 1989 to discuss survival of young jack pine with Manitoba forestry officials.

9. Survival data of Manitoba jack pine is to be coded and edited for computer input and storage, respectively.

14. Publications 1988-89:

Ives, W.G.H.; Rentz, C.L. 1988. Life tables for juvenile lodgepole pine in the foothills of west-central Alberta: a progress report. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Unpublished Report.

Ives, W.G.H.; Rentz, C.L. 1988. Survival and growth of young planted jack pine in the Sandilands Provincial Forest, Manitoba: a progress report. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Unpublished Report.

Ives, W.G.H.; Rentz, C.L. 1988. Life tables for juvenile lodgepole pine in the foothills of west-central Alberta: a progress report addendum. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Unpublished Report.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1981 Completion: 1994

17. Resources 1989-90:

PYs:	Prof.: vice Ives	1.0
	Tech.: Rentz	1.0
	Total:	2.0
	Students:	0.9

O & M: $23,000

Capital: NIL

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: Mixedwood Silviculture

2. Title: Forest vegetation management techniques and tools for forestry

3. New: Cont.: X 4. No.: NOR-10-09

5. Study Leader: L.G. Brace (Cooperators: A. Gardner, J. Ball)

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: Northwest Region

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.

A recent problem analysis indicates that in the period 1975-85, approximately $92 MM was invested in site preparation and planting of 240,000 ha to white spruce or competition prone spruce sites in the region. If this investment is to be maintained some form of follow-up vegetation management - manual, mechanical, chemical or combinations of these - is essential. Failure to do so could result in softwood yield losses of 30 to 40 percent on there areas.

Recently there has been considerable emphasis on herbicides as a tool 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 NoFC, 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.

Forestry Canada has responded to the need for more herbicide research by initiating a National Forest Weeds Program with a Herbicide Sub-Program and a Forest Weeds Planning and Coordinating Committee. This Committee functions in a policy/coordinating role for Forestry Canada. The recent ForCan policy on forest pest management which addresses herbicides - is a major step forward in supporting vegetation management R&D in the ForCan.

The NoFC has recently increased its regional forest vegetation management R&D which began in 1980 with small scale rate and timing trials of selected herbicides in support of the herbicide registration program at FPMI (see study NOR-10-04). This work is now being extended through a combined program of R&D involving both A-base and Agreement related programs in the region to include larger scale experiments. The project is multi-disciplinary, involving work on silvicultural, environmental and economic aspects of a range of alternation vegetation management tools, including manual, mechanical, chemical and fire. The role of the regional program with aspect to FPMI can be illustrated as follows:

FPMI	NoFC
Selection and prescreeing of new herbicides and conduct of experiments in support of registration needs	Small scale efficacy tests in support of FPMI preregistration requirements

Registration Process:

Large-scale (benchmark) multi-factor studies of vegetation management alternatives in regional context. Studies include silvicultural, environmental and economic aspects.

The forest vegetation management project at NoFC is developing using A-base resources as a primary source of personnel and lab support and agreement resources for financial support. Both elements are critical to program success.

This project was subjected to national peer review in January 1985, November 1985, and June 1988.

9. Study Objectives:

1. Co-ordinate the development of a regional forest vegetation management R&D project plan and components incorporating. A-base and Federal-Provincial Agreement resources (3 provinces, NoFC and regional offices in Saskatchewan and Manitoba). The plan should incorporate components of project NOR-10 (Mixedwood Silviculture), NOR-7 (Environmental Impact and Residue Chemistry) and NOR-3 (Forest Resource Economics).

2. Conduct the silviculture R&D component of the forest vegetation management project plan, emphasizing efficacy, crop tolerance and crop growth aspects of alternative vegetation management techniques.

3. Maintain liaison with other related ForCan projects, national (FPMI) and regional, as well as related provincial and industrial projects (ECW, etc.).

4. Co-operate with other agencies in developing public consultation on herbicide use in forestry, contributing to procedural as well as factual aspects in this process.

10. Goals for 1988-89:

1. Continue to plan and coordinate regional A-base forest vegetation management R&D (particularly NOR-10 silviculture), NOR-7 (Environmental Impact) and NOR-3 (Economics) and in Manitoba and Saskatchewan.

2. Continue as co-ordinator of FRDA R&D (including project work in silviculture) and act as Scientific Authority on related contracts under FRDA as required.

3. Maintain liaison with Forestry Canada, other federal departments, provincial agencies and companies involved in vegetation management R&D in region (Brace, Gardner, Ball).

11. Accomplishments in 1988-89:

1. Continued planning and coordination role in vegetation management under Alberta FRDA the project to continue to 1989 under FRDA.

2. Continued in co-ordination role and as Scientific Authority on related contracts.

3. Liaison continued. Minimal vegetation management R&D outside FRDA's. Only active program outside Alberta was Gardner - Cracking River Trial and small continuing glyphosate trial on Weyerhaeuser area (NOR-36-03-2) and Ball's project for "ForCan-Abitibi-Price stock site trial", in Manitoba.

12. Current Status of Study Objectives:

See component studies.

13. Goals for 1988-89:

1. Continue to plan and coordinate regional A-base forest vegetation management R&D (particularly NOR-10 Silviculture), NOR-7 (Environmental Impact) and NOR-3 (Economics) and in Manitoba and Saskatchewan.

2. Continue as co-ordinator of FRDA R&D (including project work in silviculture) and act as Scientific Authority on related contracts under FRDA as required.

3. Maintain liaison with Forestry Canada, other federal departments, provincial agencies and companies involved in vegetation management R&D in region (Brace, Gardner, Ball).

14. Publications 1988-89:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of the following clarifications provided by the study and project leaders the committee concludes that no further screening action is required.

1. Field performance refers to the survival and growth of planted seedlings. It has no specific environmental impact implication. The Alberta project, on the Grande Prairie benchmark site, has been reviewed by Technical advisory Committee of the Alberta Environment Centre and by the Pesticides Chemical Branch of Alberta Environment. The project will require a permit from Alberta Environment before proceeding, so will be scrutinized again in early 1986. All other aspects of the study were screened under the studies in which they originated.

16. Duration

Start: 1985 Completion: 1990

17. Resources 1989-90:

PYs: Prof.: (See individual studies)
Tech.:
Total:
Term/Student:

O & M:
Capital:

18. Signatures:

Investigator

Program Director, Resources

Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: Mixedwood Silviculture

2. Title: Technology transfer in site classification and forest soils.

3. New: Cont.: Terminated 4. No.: NOR-10-11

5. Study Leader: Terminated

6. Key Words: Site classification, land classification, ecological land classification, SCALE, technology transfer

7. Location of Work: Northwest Region

8. Problem Analysis:

Forestry is the principal renewable resource industry in Canada, but the existing and economically accessible forest stands are being rapidly depleted. New forest crops take a long time to grow to commercial size. Operations to efficiently replace forest stands is a national problem with long-term payoffs that most land owners (i.e., the provinces) and forest industries cannot economically tackle alone. A detailed planning base, that is more than current forest inventories, is required. To accomplish this, a national program is required to consolidate and coordinate the expertise, time, effort and funding for site classification, interpretation, and land evaluation.

Among the SCALE activities, interpretation, productivity, and land evaluation are the most important. Site classification should be emphasized after we better understand land features that are important for forest management and productivity. Otherwise we may engage in an expensive and large scale site classification program only to discover that the mapping units cannot be accurately interpreted because they do not contain the information needed in forest land classification; e.g., the FEC program for the Ontario claybelt.

With funding and encouragement the Forestry Canada Working group can provide the focus and research leadership needed to relate land, soil, climate (i.e., growth factors and ecological characteristics) to productivity and forest management. The research must be done before the results can be applied. Because forestry is a long term and often tedious undertaking, it is imperative that we start today.

Continued support for the organization of SCALE activities is essential. Even though a number of SC systems are in place in Canada, none adequately relate site quality and productivity to mapping units. The soil surveys still retain their agricultural bias. Foresters need to know more detail of the forest resource being managed before they can learn to manage the forest land more effectively. Thus, we need to conduct research on land features that affect forest site quality and productivity, then demonstrate SC and mapping to the forestry clients, industry, and private sector who will be using it. After the detailed planning base (SC) is accomplished, policy and action plans can be instituted to provide still greater benefits from the forestry community as well as to the forestry community.

9. Study Objectives:

1. To analyze site classification problems in Canada and develop a plan, to address R&D and technology transfer needs in site classification within the ForCan.

2. Undertake a technlogy transfer program in forest soils and site classification in the Northwest Region.

10. Goals for 1988-89:

1. Prepare a work plan for review by NoFC staff re verification of the adequacy of Saskatchewan soil survey mapping (1:125:000) for use in site classification of the Saskatchewan forest inventory maps (1:12,500) and the relationship of mapping units to landform.

2. Publish an Information Report on the review of subsoil amelioration techniques in forestry.

3. Prepare for SCALE members a plan to apply GIS techniques to site classification, with emphasis on the relationship of Mapping Units to site classification and GIS techniques.

4. Provide technology transfer in forest soils and site classification to regional forest resource managers and SCALE members.

5. Write a chapter entitled "Mountain ecology and land classification" for inclusion Slaymaker and French's book "Canada's Northern and Mountain Environment".

11. Accomplishments in 1988-89:

1. Workplan prepared and made available for review.

2. Information report entitled "Boreal forest site improvement" is still under review, being handled by second author, D. Pluth.

3., 4., 5., No Progress; W. Holland retired May 1988. Work transferred to Project NOR-02 (GIS/FIS).

12. Current Status of Objectives:

1. SCALE chairmanship is terminated, but a commitment to the SCALE Working Group is continuing via a plan to apply GIS techniques to site classification, with emphasis on the relationship of Mapping Units to GIS. A literature review of soil amelioration techniques is in progress. An examination of suitability of the soil mapping for site classification will be made in 1988 on two pilot areas chosen by Weyerhaeuser in Saskatchewan.

2. Technology transfer activities are publications and meetings (see goals 10- 1, 2, 4, and 5). Unplanned technology transfer activities occur as a result of questions from clients (see goal 10-3).

3. Terminate study. Activities transferred to Project NOR-02.

13. Goals for 1989-90:

Nil - Terminated.

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

Site classification activities are expected to be beneficial to the environment because SC activities will provide:

- a planning base for forest investment, research, and management.
- a data base for preparing interpretations for future land use.
- data for development of land evaluation models.

15. Duration:

Start: 1986 Completion: 1988

16. Publications 1988-89:

Holland, W.D. 1988. SCALE, Forest Site Classification, interpretation, and land evaluation. In: Landscape Ecology and Management Symposium, May 19-22, 1987. Dept. of Geog., University of Geulph, Guelph, Ontario. In press.

7. Resources 1989-90:

Nil - Terminated

8. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 28, 1989

1. Project: Mixedwood management

2. Title: Aspen silviculture in mixedwood and hardwood management

3. New: X Cont.: 4. No.: NOR-10-12

5. Study leader: S.Navratil

6. Key words: Aspen regeneration, aspen silviculture, mixedwood silviculture, vegetation management, competition indices, growth trajectories, stand development, release treatments, site preparation, herbicides, technology transfer

7. Location of work: Northwest Region

8. Problem:

With dramatic increase in aspen utilization in the Prairie provinces successful renewal and management of hardwood and mixedwood stands becomes critical. In Alberta alone, annual harvest of aspen will reach 5.6 million m^3 in 2-3 years to satisfy the consumption of the current and newly announced forest industry.

Necessary knowledge and techniques are urgently required to develop aspen silviculture systems responsive to the objectives of intensive and extensive management and hardwood and softwood production. R&D and technology transfer on regeneration, stand establishment and stand development that

a) encourage aspen regeneration and promote hardwood growth
b) deter and control aspen competition for the benefit of softwood regeneration and resource on designated areas,
c) ensure the optimal growth of species and stand development in mixed stands

has become the most significant and pressing challenge.

NoFC has been in the forefront of R&D on aspen and vegetation management and the study in its present form combines current research needs and past experience. Foresters need tools, alternative to herbicide use, for controlling unwanted aspen competition. Non-chemical methods of aspen

control such as site preparation and mechanical release need to be tested more vigorously than in the past and their biological specifications developed. Similarly, pre-harvest,single-tree treatments are becoming more significant as environmentally safe methods. Trials in progress established under the Canada-Alberta FRDA Vegetation Management - Aspen control project reflect in part the above needs and new approaches are under development.

Industry and provincial governments have acknowledged the magnitude of regeneration and juvenile stand problems on mixedwood and softwood cover types. Competition assessments and free-to-grow projections to decide whether the renewal phase has been successful are in the forefront of current forestry issues. Particularly needed is information that will enable us to accurately estimate future growth, species composition, development and yield of new, largely mixed forest. In response the work on aspen ingress,competition , growth trajectories in aspen-pine regeneration and juvenile mixed stands has been expanded. This knowledge is a prerequisite for evaluating silvicultural treatments and for modelling and forecasting juvenile stand development. Its linkage with site classification and GIS will make possible to rank sites and stands for treatments and silviculture investments and to relate juvenile stand growth to wood supply projections and management planning.

Shortfalls in age class distribution and tree-sizes in some geographic areas will require research directed towards intensive silviculture, increased yield, shortened rotations and possibly improved stand and tree quality . Stand density management trials, including assessment of past experiments, and future planting of selected clones will be evaluated as potential components of intensive aspen silviculture.

9. Study objectives:

1. To develop silviculture systems, including opportunities for increased productivity, to manage the aspen resource in pure hardwood stands and as a component of mixedwood stands.

2. To conduct silviculture R&D on chemical and non-chemical means of aspen competition control for the maximum growth of conifer crop at pre-harvest, establishment and early development stage of softwood and mixedwood stands.

3. To assess aspen ingress, growth trajectories and juvenile stand development for formulation of silviculture treatments and management strategies for mixedwood and softwood cover types.

10. Goals for 1988-89:

1. Contribute to planning and initiation of multi-disciplinary project on mixedwood management.

2. Supervise R&D project on Aspen control under Canada-Alberta FRDA funding, negotiate cooperation with Alberta Forest Service and CanFor Co. and implement establishment and remeasurements of Satellite trials A, B, C and major trial at Grande Prairie.

3. Analyze data and prepare a progress report on Satellite trials A, B, C and major trials.

4. Initiate and supervise a study to assess aspen ingress and competition levels in mixedwood (aspen/pine) regeneration.

5. Design and supervise contracts on assessment of growth trajectories of juvenile pine and aspen and development of related software for data collection and data processing.

6. Initiate work on non-chemical methods of conifer release from aspen competition. Negotiate and initiate a cooperative trial with Alberta Forest Service.

7. Prepare and present in coauthorship with I. Bella a paper "Regeneration and density management in aspen stands" at the 1988 meeting of Poplar Council of Canada.

8. Prepare and present a paper "The state of the art in mycorrhizae research in Alberta and Saskatchewan" at the Can. Workshop on Mycorrhizae in Forestry, Quebec city.

9. Publish in coauthorship with I. Bella a paper "Western gall rust dynamics and impact in young lodgepole pine stands in Alberta" in Can. J. For. Res.

10. Analyze data and prepare a draft of paper "Aspen ingress of seed origin on lodgepole pine cutovers" (intended for For. Chron.).

11. Complete a computerized model and a file report on prediction of fall lifting window for bare-root stock at Pine Ridge Forest Nursery, AFS and provide consultation and instruction of AFS staff.

12. Prepare and present a technology transfer paper "Wood defects and internal quality of aspen" at Hardwood Decay Measurement Workshop, AFS Staff.

11. <u>Accomplishments in 1988-89</u>:

1. Contributed to planning of Multi-disciplinary project on mixedwood management.

2. Supervised R&D project on Aspen control, including establishment and remeasurements of Satellite trials A, B and C and major trial at Grande Prairie.

3. Analyzed data and prepared progress report on the item 1, Satellite trials A, B, C and major trial.

4. Initiated study to assess aspen ingress and competition levels in softwood and mixedwood (aspen/pine) regeneration. Data collection included Rocky-Clearwater Forest and FMAs of Procter & Gamble Co. and Weldwood Co.

5. Initiated and supervised contracts on growth trajectories of pine and aspen and related development of software.

6. Initiated work on development of non-chemical release methods for aspen control. Established a mechanical release trial in cooperation with AFS, Rocky-Clearwater Forest and developed proposals for further research in cooperation with forest industry and Saskatchewan District Office.

7. Prepared and presented in coauthorship with I. Bella a paper "Regeneration and density management in aspen stands" at the 1988 Poplar Council of Canada Meeting.

8. Prepared and presented a paper "The state of the art in mycorrhizae research in Alberta and Saskatchewan" at the Can. Workshop on Mycorrhizae in Forestry, Quebec City, published in Proceedings.

9. Published in coauthorship with I. Bella a paper "Western gall rust dynamics and impact in young lodgepole stands in Alberta", in Can. J. For. Res.

10. Prepared a draft of a paper (intended for Forestry Chronicle) "Aspen ingress of seed origin on lodgepole pine cutovers".

11. Completed a computerized model and a file report on prediction of fall lifting window of bare-root stock at Pine Ridge Forest Nursery, AFS and provided consultation to AFS staff.

12. Presented a paper "Wood defects and internal quality of aspen" at Hardwood Decay Measurement workshop, AFS-ForCan Edmonton,

12. Present status of study objectives:

Direction and scope of the study has changed and widened in response to the current R&D needs in mixedwood and hardwood management. The development of silviculture systems for aspen resource is a new, overall goal and the study objectives as listed in item 9 incorporate the new direction. Several study components are underway, others are planned in conjunction with the Mulit-disciplinary program of NoFC and will be gradually added.

The ongoing trials established under the Canada-Alberta FRDA Vegetation Management-Control of aspen project remain the main component of aspen control work. Satellite trials A,B,C and the major trial at Grande Prairie are progressing well and all were remeasured in 1988/89. However, the delayed establishment of the trials due to monatoria on herbicide use will extend their completion, and will require resources beyond the duration of Canada-Alberta FRDA.

Future research efforts will emphasize non-chemical means of aspen control and will concentrate on a better understanding of the stand renewal processes that create competition, growth responses of crop and unwanted species and needs for treatments.

Work on aspen ingress, interactive growth and juvenile stand development is planned to intensify, in part through acquisition of computerized data collectors and contracts for growth and stand development modelling.

13 Goals for 1989-90:

1. a) Supervise remeasurements of Satellite trials A,B,C and related work on the major trial site at Grande Prairie, analyze data and prepare a progress report on 3-yr-results from Satellite A and major trial.

   b) Prepare proposal and initiate a trial on single-tree treatments for control of aspen suckering, including wood and herbicide analyses, in cooperation with Pelican Mills, Drayton Valley and Alberta Research Council (B.4 FRDA funding).

2. a) Continue to assess aspen ingress, competition and growth trajectories in mixedwood regeneration (aspen/pine), extend study area to Canfor FMA, Grande Prairie and Pelican Mills, Drayton Valley.

   b) Initiate and supervise the work on growth trajectories and modelling of juvenile mixedwood stand development .

3. a) Assess post-treatment response of aspen to mechanical release in the NoFC-AFS trial, Rocky-Clearwater Forest.

   b) Initiate a field study (one site) of simulated mechanical release treatments; in the long-term develop a data base on aspen regrowth and specifications for optimum treatments.

   c) Prepare a proposal and initiate cooperation with ForCan Sask. (A. Gardner)

4. Participate in preparation and presentation of Vegetation Management Workshop, NoFC, Edmonton.

5. Continue to contribute to planning of Mulit-disciplinary project on Mixedwood management.

6. Prepare a paper Regeneration in Northern Mixedwoods for Northern Mixedwoods Symposium, Fort St. John, BC, Sept. 1989.

7. Prepare in coauthorship with I. Bella and E. Petersen a paper "Aspen silviculture and management in western Canada" for Second Symposium on the Aspen Resource, Duluth, Minnesota, USA.

8. Publish a paper entitled "Aspen ingress of seed origin on lodgepole pine cutovers", in Forestry Chronicle.

9. Provide technology transfer and consultation on aspen silviculture and management.

10. Prepare a draft of article entitled "Seed source variation in mycorrhizae formation of white spruce and lodgepole pine", (intended for Can.J.For.Res.).

11. Publish Aspen Monograph done by Western Ecological Services, supervised by R. Waldron.

14. Publications 1988-89.

Bella, I.; Navratil, S. 1988. Western gall rust dynamics and impact in young lodgepole pine stands in Alberta. Can. J. For. Res. 18:1437-1442.

Navratil,S. 1988. The state of the art in mycorrhizae research in Alberta and Saskatchewan. Pages 15-23 in Proceedings of Can.Workshop on mycorrhizae in forestry, (Ed.) M. Lalonde and Y. Piche, Quebec City.

Navratil,S.; Bella,I. Regeneration and density management in aspen stands. Proceedings of the 198 Ann. Meeting of Poplar Council of Canada, Edmonton, October 1988. (in press)

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

1. All experimental herbicide applications have been done under permits issued by Alberta Environment, Environmental Protection Services (Pollution Control Division), and the studies are registered with FICP.

2. Either the plots are distant from any water bodies or there was a buffer zone of 30-50 m between the plots and a water body.

3. Plots are being monitored over long term to assess the effects of herbicide application on vegetation and forest crop species.

4. Methods of application included spot-gun spray or single tree injections. As a result, no aerial drift of herbicides was expected or observed.

16. Duration:

Start: April 1988 Completion: 1998

17. Resources 1989-90:

			A-base	Alberta Agreement	related:
PYs	Prof.:	Navratil	1.0		
	Tech.:	Dendwick	1.0		1.0 (contract)

Total: 2.0

Student 0.9 0.8 (0.5 contract + 0.3 student)

O & M $ 36,000 (excluding FRDA) (B.3 FRDA including above contract, salaries, and other $67,700)
(B.4 FRDA $27,000 (+ 13,500 external contractors)

$94,700

Capital: $15.8 K

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

NOR-11-01

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 15, 1989

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

2. Title: Forest Insect and Disease Surveys

3. New: Cont.: X 4. No.: NOR-11-01

5. Study Leader: H.F. Cerezke and W.J.A. Volney

6. Key Words: Detection, appraisal, distribution, parasites, hosts, damage impact, predators, biological control, hazard, susceptibility, management, parks, symptoms, Geographical Information System, pest extension, pest depletion losses, FIDS/INFOBASE

7. Location of Work: Northwest Region

8. Problem:

Forest Insect and Disease Surveys (FIDS) and detection in Canada date back some 50 years. During this period of continuous operation, a wealth of information has accumulated that provides an historical record and knowledge base of native and introduced insect and disease species inhabiting forests and trees, their distributions, damage effects on trees, natural control agents, life cycle development and behavior within the Northwest Region. The data are gathered by a wide variety of established sampling, collecting and processing procedures that have been developed over a long period of time. Application of these procedures provides an efficient means of continually updating the knowledge of forest insect and disease infestations and other forest disturbances within the region, and to satisfy nationally directed surveys such as acid rain monitoring, pest outbreak prediction and plant quarantine concerns. The procedures also provide the basis for generating forest pest caused loss estimates, in assessing pest controls, and in implementing integrated pest management strategies. During the period, 1976 to 1980, FIDS data helped identify annual tree mortality loss estimates in Canada from insects and diseases to be of the order of 77 mil. m^3 per year, and additional losses in growth reduction to be of a similar magnitude.

The survey, identification, reporting and predition of losses due to insects, diseases and other damage agents forms an integral part of intensive forest management and other land use interests, and must be maintained on an annual basis because of the dynamic nature of pest populations, forest growth and development. Hence, the combined

objectives of the FIDS program are to assist in the overall protection, wise use and management of forests within the region.

The encorporation of sound pest management strategies within the region rely heavily upon an efficient and comprehensive FIDS operation. Its various functions therefore require a continual updating to encorporate new technologies such as insect pheromones and GIS systems for improvement of sampling methods and in data recording and processing.

9. Objectives:

1. To gain an improved and updated knowledge of forest insects and diseases in the region to help minimize their damage impact effects on trees and forests, provide an advisory service to regional and national management agencies and the public, contribute to FIDS national and provincial overviews of important pest conditions and FIDS/INFOBASE, and compile pest loss data to support FORSTATS.

2. To support research and plant quarantine activities with historical records, collections and observations.

3. To contribute to nationally directed surveys such as Acid Rain National Early Warning System (ARNEWS) and pinewood nematode.

4. To provide management agencies with pest identification, control and impact assessment services relating to effects of insects, diseases, climatic influences and pollutants on trees and other forest vegetation.

10. Goals for 1988-89:

1. Survey, map and report on major forest pests of the region.
   a. Mountain pine beetle in Alberta, Saskatchewan and Rocky Mt. national parks.
   b. Spruce beetle in Alberta;
   c. Spruce budworm regionwide;
   d. Jack pine budworm in Alberta, Saskatchewan and Manitoba;
   e. Forest tent caterpillar in Alberta, Saskatchewan and Manitoba;
   f. Other insect and disease organisms as identified by client agencies. (FIDS Staff)

2. Conduct special surveys:
   a. Dutch elm disease and its vectors as required;
   b. Parks Canada: general insect and disease surveys;
   c. Selected provincial parks: surveys, collections, identifications and technology transfer as required;
   d. Spruce budworm pheromone field trials;
   e. Insect and disease surveys in provincial forest tree nurseries;
   f. Other site specific or pest specific surveys as requested. (FIDS Staff)

3. Publish the 1986 and 1987 regional FIDS Information Reports, and provide regional pest information for 1987 to H.Q. for the national

FIDS report. Compile the 1988 FIDS data and summarize for the 1988 regional Information Report. (Cerezke, Emond)

4. Continue training of FIDS staff on procedures for data entry and digitizing of FIDS aerial survey maps, (in house and with PNFI staff); digitize all necessary grid base maps of the three prairie provinces and Northwest Territories; initiate summary of data on regional pest depletion losses for the period 1981-1986. (Volney)

5. Develop and implement protocols for digitizing FIDS map based information to be compiled for use by the geographic information system. (Volney)

6. Provide pest extension information and technology transfer to clientele as requested. (FIDS Staff)

7. Conduct pest surveys in designated plantations and high value conifer stands within the three prairie provinces, in close cooperation with provincial forestry staff and FRD Agreement staff. (FIDS Staff)

8. Arrange for pest identification and technology transfer workshops as required. (NOR-11 Staff)

9. Provide diagnostic and advisory services on tree and shrub pests in cooperation with other staff of NOR-11 and with FRDA staff. (FIDS Staff)

10. Represent Forestry Canada and NoFC on various national, regional and provincial forest pest and related insect and disease committee and advisory groups. (FIDS Staff)

11. Organize and conduct a Regional Insect and Disease Technical Advisory Committee meeting, and prepare a report of recommendations for presentation to the Senior Regional Advisory Committee. (Cerezke, other FIDS Staff)

12. Resurvey all ARNEWS plots in the region for presence of forest pests and tree damage. (FIDS Staff)

13. Serve as Project Leader of NOR-11 Project, as FIDS Head of NOR-11-01, and provide functional guidance and supervision on studies initiated under the Federal-Provincial FRDA's in the Northwest Region. (Volney, Cerezke)

14. Prepare chapter contributions for the proposed sequel to M.L. Prebble's book, "Aerial control of forest insects in Canada", as requested by J.A. Armstrong as follows:

    a. "Status of forest pest insects in the Northwest Region", intended for Volume I, Aerial Spray Research and Control;
    b. Chapter 2. Insects affecting immature forests; section on "Rootcollar weevils", intended for Volume II, Ground Control and Protection of Regeneration Forests. (Cerezke)

15. Review and prepare final draft of Information Report: "The forest insect and disease survey sampling methods and survey techniques, prairie provinces and the Nothwest Territories". (Moody)

Added Goal:

16. Collect live adult insect material and submit to Memorial University, Newfoundland (re Dr. Finney - Crawley contract) for examination and identification of potential pinewood nematode vectors.

11. Accomplishments in 1988-89:

1. Surveys were completed region wide for spruce budworm, jack pine budworm, aspen defoliators and bark beetles. Expansion of the spruce budworm infestation occurred in the Footner Lake Forest, while other infestations in the region changed little over last year. Special surveys were conducted with the Alberta Forest Service and Canada-Alberta FRDA to assess spruce budworm populations and damage in two infestation areas.

   Populations of the forest tent caterpillar increased in the three prairie provinces and fall egg band samples were completed extensively in Alberta and Saskatchewan to predict abundance in 1989.

   Surveys conducted for mountain pine beetle indicated endemic populations persisting in the Kananaskis area, Cypress Hills (slight increase over 1987), and in Waterton Lakes National Park. The outbreaks in Kootenay and Yoho National parks remained at levels similar to 1987.

2. a. Assistance was provided to Alberta Agriculture to monitor for DED and its vectors; none was found in Alberta.
   b. Surveys for general insect and disease conditions was completed in the Rocky Mt. National Parks.
   c. Surveys for spruce budworm, bark beetles, and various disease organisms were conducted in selected Provincial parks as requested; pinewood nematode, Bursaphelenchus xylophilus, was identified on dying balsam fir in one park in east-central Alberta.
   d. Pheromone traps to monitor spruce budworm moth population levels were placed in about 30 locations in the three prairie provinces as part of a national program. The moth counts are being correlated with defoliation, egg masses and L2 larvae, collected from each baiting site.
   e. No unusual pests were collected in provincial tree nurseries.

3. The publication of the 1986 FIDS Inf. Rep. has been put on hold (with Editor); the 1987 and 1988 annual FIDS reports are both with the Editor and are in the process of publication. Information required by H.Q. for the National FIDS reports has been submitted to H.Q. and PNFI.

4. Training of FIDS staff on procedures of data entry and digitizing FIDS aerial maps was continued, both in house and with instruction by staff at PNFI (Mr. L. O'Brian spent one week at NoFC). At present, G. Still, P. Amirault and B. Pope have received extensive training to adapt FIDS maps to GIS. In addition, J. Volney received training in California on the ARC/INFO software.

5. The protocols for digitizing FIDS map based information for use in the GIS have been developed, and a map archiving system has been developed.

6. Pest extension information was provided for about 2000 client inquiries, dealing with insects, diseases and other damage agents in nurseries, shelterbelts, forests, ornamental trees and shrubs. Other technology transfer items include the following:

- Several news media interviews were held (news paper, radio), mostly relating to forest tent caterpillar concerns;
- Field training was provided in Manitoba on plantation survey and pest identification;
- Various slide presentations were made to different client agency groups on tree and shrub pests;
- Lectures were given to forest entomology students at Univ. Alberta;
- An on site inspection was made of genetic tree plantations near Grande Prairie and report prepared;
- An on site inspection was made in the Cypress Hills, Sask. to identify tree pests and hazards; a report was prepared;
- A field training session was provided to staff at Weyerhaeuser Co. in Saskatchewan;
- An Insect and Disease Management Plan for the Northwest Territories was reviewed;
- A small scale ground application of Bt was applied on forest tent caterpillar to obtain first hand experience and to identify potential potency problems;
- A tour was made to Footner Lake and Peace River Forests to discuss insect/disease risk modelling analyses (NOR-28-07, T. Singh), and to select FMU's for further study; advised on insect outbreak information used by Monenco Consultants Ltd. in their report "Selection, modification and testing of an insect and disease model for forest yield prediction in the Boreal Forest Region of Alberta";
- Reviewed pest problems and their risks with Alberta Forest Service staff in Peace River and made on site inspection of McLennan Burn to assess for woodborer and bark beetle hazard;
- Investigated and mapped the pattern of trees killed by lightning in a circular patch of forest in west-central Alberta;
- Held meeting with provincial forest geneticist to review pest related problems in established tree improvement plantations of native and exotic tree species.

7. Surveys were conducted across the region and in cooperation with provincial forest agencies and FRDA, for pests and their damage effects in 124 conifer plantations and other high value stands. The

general results have been summarized and communicated to client agencies and are included in the 1988 FIDS report.

8. Pest identifications were handled by expertise mainly under Studies NOR-11-04, NOR-11-06, NOR-11-09 and NOR-11-10. Technology transfer workshop accomplishments are reported under Item #6 above.

9. Accomplishments summarized under Item #6 above.

10. The following meetings and committees were represented and reported to:
- Alberta Pest Control Advisory Committee
- Dutch elm disease meetings
- Saskatchewan Advisory Council on Insect/Disease Control
- National Forest Pest Control Forum
- Annual FIDS Heads Meeting
- Task Force on Alberta Plant Pest Response Plan
- Forest Tent Caterpillar Technical Committee
- In-house FIDS and Study review meetings

11. A Regional Insect and Disease Technical Advisory Committee meeting was organized in Winnipeg, with most designated member agencies represented. Recommendations were prepared and formally presented to the Senior Regional Advisory Committee for action. One of the recommendations acted upon concerned the development of MOU's between ForCan (FIDS) and each of the prairie provinces and Northwest Territories to define objectives and roles of responsibility. A draft MOU with Manitoba was prepared and circulated for review (Volney, Cerezke).

12. All 12 ARNEWS plots in the three prairie provinces were surveyed twice, once in June and again in late August. Data accumulated up to 1987 have been submitted to PNFI for national compilation and reporting.

13. Goal accomplished; J. Volney assumed Project Leader of NOR-11 April 1, 1988; H. Cerezke retained Head of FIDS for NOR-11-01.

14. a. Draft of Chapter prepared and submitted to Scientific Editor "Status of forest pest insects in the Northwest Region". (Cerezke, Volney)
b. Chapter on Rootcollar weevils in preparation (Cerezke, Pendrell-MFC).

15. Second draft of Information Report "The forest insect and disease survey sampling methods and survey techniques, prairie provinces and the Northwest Territories" in preparation, with added coauthor assistance. (Moody, Emond)

16. Some 40 vial samples containing over 200 live insects were sent to Dr. Finney-Crawley, Memorial University, Nfld., for examination of pinewood nematodes, as part of a nationally directed survey to identify insect vectors of the nematode.

12. Present Status of Study:

1. Regional FIDS activities were focused on detecting, monitoring and mapping current infestations of the major pest species (spruce budworm, jack pine budworm, forest tent caterpillar, mountain pine beetle, etc.). This information is updated annually, summarized in regional and national reports, and reported at the annual Forest Pest Control Forum meeting in Ottawa. The annual summary of data adds to the knowledge base of regional outbreak patterns, provides a basis for developing predictive models, and provides immediated useful information for major client agencies in developing pest management strategies.

   Special surveys were undertaken in support of national, regional and provincial requests, and in response to a variety client agencies.

   All permanently located ARNEWS plots are being maintained for long term monitoring of the effects of acid rain, as part of a nationally directed program.

   On an ongoing basis, FIDS regularly provides a vast array of information to regional client agencies in the form of extension calls, pest leaflets, lectures, field demonstrations, published information on life history, impact and control, pest identifications and recommendations on pest management.

13. Goals for 1989-90:

1. Survey, map and report on major forest pests of the region:
   a. Mountain pine beetle in Saskatchewan, Alberta and the Rocky Mt. national parks;
   b. Spruce beetle, mostly in Alberta;
   c. Spruce budworm region wide;
   d. Jack pine budworm in the three prairie provinces;
   e. Forest tent caterpillar in the three prairie provinces;
   f. Other pest and damage agents as requested or identified. (FIDS Staff)

2. Conduct special surveys:
   a. Dutch elm disease and vectors in Alberta and Manitoba as required;
   b. Parks Canada; general surveys as in previous years;
   c. Selected provincial parks; surveys, collections, identifications and technology transfer as requested;
   d. Spruce budworm pheromone field trials (pending review of past several years data);
   e. Insect and disease concerns in provincial forest nurseries;
   f. Other insect and disease problems as requested or identified. (FIDS Staff)

3. Publish 1987 and 1988 FIDS reports and submit to Editor the 1989 FIDS report. Urge publication of the 1986 FIDS report, now with Editor. (Emond, Cerezke, other FIDS Staff)

4. Continue training of FIDS staff on GIS system and map digitizing, and summarize data on regional pest depletion losses to 1989. Complete pest depletion loss exercise for period 1981-87. (Volney, Amirault, Cerezke, Mallett, FIDS Staff)

5. Provide pest extension services and technology transfer of information to regional clientele as requested, provide pest identification, diagnostic and advisory services on tree and shrub pests, and arrange for technology transfer workshops as required. (Staff of NOR-11)

6. Conduct pest surveys in designated genetic and tree improvement plantations and other high value stands as requested by client agencies and report. (FIDS Staff)

7. Represent Forestry Canada and NoFC on various national, regional and provincial forest pest and related insect and disease committees and advisory groups. (FIDS Staff)

8. Organize and conduct a Regional Insect and Disease Technical Advisory Committee meeting in Yellowknife, NWT, and prepare a report of recommendations for presentation to the Senior Regional Advisory Committee. (Volney, Cerezke, FIDS Staff)

9. Re-survey all ARNEWS plots in the region for presence of forest pests and tree damage. (FIDS Staff)

10. Serve as FIDS Head of NOR-11-01 (Cerezke), and provide functional guidance and supervision of studies initiated under the Federal-Provincial FRDA's in the Northwest Region. (Volney, Cerezke)

11. Complete any required editorial changes of two chapter contributions submitted to Dr. J.A. Armstrong for: "Aerial control of forest insects in Canada". (Cerezke, Volney, Pendrell-MFC)

12. Revise and submit for review for an Information Report: "The forest insect and disease survey sampling methods and survey techniques, prairie provinces and the Northwest Territories". (Moody, Emond).

13. Compile listing and stand inventory data on registered PSP's in Manitoba and identify which ones can be used for long term insect and disease monitoring and impact assessment. (Volney, Grandmaison)

14. Obtain from Alberta, in cooperation with Timber Management Branch, file data on all established provincial PSP's to identify selected locations for establishment of longterm insect and disease monitoring and impact plots. (Volney, Cerezke, FIDS Staff)

15. Conduct survey trials for pests in young high value conifer stands to test out a new survey sampling procedure now being developed under contract by Silvicom Consulting. (Amirault, FIDS staff)

16. Continue to develop an MOU with Manitoba and initiate similar MOU's with Saskatchewan, Alberta and the Northwest Territories. (Volney, Cerezke).

14. Publications 1988-89:

Cerezke, H.F.; Emond, F.J. 1989. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba and the Northwest Territories in 1987. For. Can., North. For. Cent., Edmonton. Inf. Rep. NOR-X-300.

Emond, F.J.; Cerezke, H.F. 1989. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba and the Northwest Territories in 1988 and predictions for 1989. For. Can., North. For. Cent., Edmonton. Inf. Rep. NOR-X-303.

Other Reports:

Amirault, P.; Pope, B.; Gates, H. 1988. Spruce budworm in the Footner Lake Forest - Updated Status Report. 6p.

Cerezke, H.F. 1988. Report to the Sixteenth Annual Meeting of the Forest Pest Control Forum, Ottawa, November 15-17, 1988. 11p.

Cerezke, H.F. 1988. Pest condition report contribution for the North American Forestry Commission, Study Group of Forest Insects and Diseases. Ottawa. 3p.

Cerezke, H.F. 1988. Important bark beetles of the region. FIDS Tech. Transfer Note, A-003, March, 1988. 2p.

Cerezke, H.F.; Volney, W.J.A.; Mallett, K.I.; Emond, F.J. 1988. Assessment of forest insect, disease and stand conditions in Cypress Hills Provincial Park, Saskatchewan. 9p.

Emond, F.J. 1988. Major forest insect pest conditions - 1988 predictions. FIDS Tech. Transfer Note, A-003, March 1988. 4p.

Emond, F.J. 1988. Pest situation report. FIDS Tech. Transfer Note, A-005,July, 1988.

Emond, F.J. 1988. Synopsis of two major insect pests of the region. FIDS Tech. Transfer Note. A-007, December, 1988. 3p.

Emond, F.J.; Gates, H. 1989. Synopsis of noteworthy insects, diseases and other damage agents in Waterton, Banff, Jasper, Kootenay, Yoho and Elk Island national parks, 1988. 24p.

Gates, H. S. 1989. Forest insect and disease conditions in the Northwest Territories in 1988. 17p.

Gates, H.S. 1989. Forest insect and disease conditions in Elk Island National Park in 1988. 6p.

Gates, H.S. 1989. Forest insect and disease conditions in northern Alberta in 1988. 27p.

Gates, H.S. 1989. Spruce budworm: Eaglesham outbreak. 23p.

Grandmaison, M. 1988. Forest insect and disease conditions in Manitoba in 1988. 35p.

Still, G.N. 1989. Forest tent caterpillar defoliation in southern Alberta, 1988 and forecasts for 1989. 5p.

Still, G.N. 1989. Spruce budworm in southern Alberta, 1988.

Still, G.N. 1989. Forest insect and disease conditions in southern Alberta in 1988. 8p.

Tidsbury, C. 1989. Insect and disease conditions in Saskatchewan tree nurseries, 1988. 2p.

Tidsbury, C. 1989. Forest insect and disease conditions in Prince Albert National Park, 1988 and annual tree assessment in the Acid Rain National Early Warning System (ARNEWS) plot - Namekus Lake. 2p.

Tidsbury, C. 1989. Spruce budworm conditions in Saskatchewan in 1988. 5p

Tidsbury, C. 1989. Forest tent caterpillar conditions in Saskatchewan in 1988. 6p.

Tidsbury, C. 1989. Other insects and diseases, Saskatchewan, 1988. 2p.

Volney, W.J.A.; Cerezke, H.F.; Mallett, K.I. 1988. Assessment of pest conditions in forest genetic installations in the vicinity of Grande Prairie, Alberta. 5p.

15. Environmental Implications:

The NoFC Environmental Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1936 Estimated Completion: Continuing

17. Resources 1989-90:

PYs:	Prof.:	Cerezke	0.6
		Volney	0.2
	Tech.:	Emond	1.0
		Gates	1.0
		Still	1.0 (Summer season Saskatchewan Dist. Off

Tidsbury	1.0
Total	4.8 (Plus 1.0 PY for Manitoba Office - Grandmaison)
Student	0.3

O & M: $38,800

Capital: $Nil

18. Signatures:

Investigator

Program Director, Protection

Investigator -

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 15, 1989

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

2. Title: Bionomics of important insects

3. New: Cont.: X 4. No.: NOR-11-03

5. Study Leader: H.F. Cerezke

6. Key Words: forest habitats, plantations, nurseries, damage impact, control, populations, behavior, bark beetles, woodborers, rootcollar weevils, regeneration pests, semiochemicals (pheromones)

7. Location of Work: Northwest Region

8. Problem:

The intent of this study has been to address forest entomological problems that arise within the region that often require investigative inquiry of 1 to 5 years duration. Typical examples have included woodborer hazard and impact in fire-killed timber, spruce bud midge impact in spruce regeneration, growth loss effects from partial girdling by rootcollar weevil, and control and damage impact assessment of insects in spruce seeds and cones.

In 1980, following the development of a mountain pine beetle (MPB) outbreak in Alberta and Saskatchewan, a major shift in research and survey effort was directed toward this beetle. Surveys were necessary to estimate tree losses and to map the annual spread and intensification of the beetle. Because large volumes of merchantable lodgepole pine were being killed, studies were undertaken to explore uses of aerial photography to map infestations, to estimate trees killed, and to assess potential spread.

Provincial forestry and parks agencies in Alberta and Saskatchewan commenced extensive programs to monitor and control the MPB and incorporated newly developed semiochemicals into the detection and control strategies in 1983. The program required coordination to help optimize bait placement, and to interpret results. Cooperative research studies were established with these provincial agencies, Simon Fraser Univ. and the Univ. of Calgary to assess bait effectiveness, MPB behavior, and to conduct additional field bioassay studies to test new

bait formulations. The field bioassay studies have helped identify new aggregative and antiaggregative materials for MPB and its predator, their field behavior response, and helped to improve bait deployment strategies. Coordination of MPB/lodgepole pine management and research/survey update was maintained through the activities of an MPB Technical Committee and under the general mandate of an MOU (CAN-US MPB Action Plan).

The spruce beetle, an endemic species throughout the region, caused severe losses to mature white spruce in northern Alberta between 1980 and 1984. This outbreak prompted interest in the development of methods to detect and assess population levels and high hazard stands. Developmental work on spruce beetle semiochemicals for commercial applications was subsequently initiated with the Univ. Calgary, Alberta Forest Service, B.C. Min. Forests and Crestbrook For. Industry.

In recent years and with increasing forest renewal emphasis across the region, damage by rootcollar weevils (esp. Hylobius warreni and H. radicis) has become common in pine plantations and other high-value pine stands. Surveys in 1987 and 1988 in the three prairie provinces indicate that H. warreni is one of the top three to five damaging agents of young planted lodgepole and jack pine stands, and was the primary damaging agent affecting up to 30% or more of planted genetically selected young lodgepole pine trees in westcentral Alberta. In addition, requests from other regions (eg., Maritimes and Pacific Forestry Centres in 1988) have also indicated similar concerns in plantations with H. warreni. There is a need to examine specific sites where problems have been identified and to investigate new strategies that may help in detection, impact assessment and control of these weevil species.

9. Objectives:

1. Undertake bionomic studies of important forest insect pests (mountain pine beetle, spruce beetle, rootcollar weevils) that can provide management strategies for reducing their risk and the losses they cause.

2. Provide technology transfer of pest information to regional clientele, specifically on bark beetles, woodborers, rootcollar weevils, nursery and regeneration pests, and seed and cone insects.

3. Develop and field test new pheromone techniques and applications for the management of important forest insects.

10. Goals for 1988-89:

Goals 1 to 5 transferred to NOR-11-10 (Langor).

6. Prepare and submit for review paper on: "Attack pattern and brood productivity of the MPB on three pine hosts".

7. Prepare revisions and submit to journal: "Mountain pine beetle attack density pattern on semiochemical baited and unbaited lodgepole pine in southwestern Alberta".

8. Prepare 1987 field trapped scolytid material for submission to Biosystematic Research Centre (BRC), Ottawa, for species identification.

9. Provide representation on MPB Technical Committee and CAN-US MPB Action Plan as required.

10. Complete analyses of 1987 field collected data on spruce beetle, in cooperation with Drs. Wieser and Dixon and A. MacKenzie at University of Calgary.

11. Participate in field experiments, cooperatively with AFS, BCMF, Crestbrook Forest Industries, University of Calgary and P. Amirault (NOR-36-02-4) to test and refine spruce beetle pheromone technology and application in Alberta and eastern B.C.

Added Goals:

12. Prepare and present paper on MPB semiochemical use in Alberta and Saskatchewan at CAN-US MPB Symposium.

13. Serve as an examiner for Ph.D. thesis defence for D. Langor at Univ. Alta.

14. Serve as an Associate Editor for Canadian Entomologist.

15. Complete update of references on Hylobius species.

11. Accomplishments in 1988-89:

(Accomplishments under Goals 1 to 5 described under NOR-11-10 Langor)

6. First draft of paper on "Attack pattern and brood productivity of the MPB on three pine hosts" to be prepared before March 31/89.

7. Reanalysis of data and revisions for final draft of a journal paper will be completed by March 31/89.

8. Field trapped scolytid material has been keyed out locally and several species confirmed at BRC. Some of the species appear to respond to the spruce beetle semiochemical baits.

9. Prepared a report summarizing the status of MPB in the region and submitted to Chairman of MPB Technical Committee.

10. All spruce beetle samples collected in northern Alberta and near Parson, B.C. in 1987 were examined, sorted, sexed and measured. Some of the data have been analysed and reported with cooperating agencies at University of Calgary.

11. New field experiments to test spruce beetle response to a variety of semiochemical bait formulations and release devices were conducted cooperatively with Univ. of Calgary, Crestbrook Forest Ind. and P. Amirault (NOR-36-02-4). The experimental sites were established in

Alberta and in the TFL area maintained by Crestbrook For. Ind. at Parson, B.C. In Alberta, sites were established in the Whitecourt, Slave, Grande Prairie, Peace River and Footner Lake Forest districts. Experiments conducted in B.C. included both tree and trap baiting, while those in Alberta involved only baited traps. All scolytid material collected in the traps at all sites have been sent to NoFC for sorting, identification, sexing and measurement, and this work is now in progress.

As a spin off from the various field results, a patent on the spruce beetle semiochemical bait has been applied for through the University of Calgary; named co-inventors are H. Wieser, E. Dixon, A. MacKenzie and H. Cerezke.

Added Accomplishments:

12. Attended Symposium on "The Management of Lodgepole Pine to Minimize Losses to Mountain Pine Beetle" sponsored by the Canada/US Mountain Pine Beetle Program, in Kalispell, Montana, July 12-14, 1988, and presented a paper summarizing semiochemical bait use in Alberta and Saskatchewan during 1983 to 1987.

13. Served as an examiner for Ph.D. candidate at U. of A.

14. Reviewed and processed about 10 Scientific papers for Can. Ent.

15. Conducted literature search, and compiled references published on Hylobius species since 1978.

12. Present Status (1988-89 Objectives):

In recent years this Study has focused on studies of the semiochemicals of the mountain pine beetle and the spruce beetle, to help develop and modify methodologies to improve detection, monitoring and control strategies. Much of this work has involved close cooperation with client agencies such as Parks Canada, Alberta Forest Service, Saskatchewan Parks, Recreation and Culture, Alberta Recreation and Parks, and the University of Calgary. These studies were conducted in southwestern Alberta, the Cypress Hills, east-central B.C. and in Kootenay National Park. The studies have helped to develop practical applications for MPB and SB semiochemical use, identified new attractants and inhibitors, resolved some field behavioral questions in beetle attraction, attack pattern and distribution, and identified predator response to synthetic and natural attractants.

A semiochemical bait formulation, superior to previously known baits for the SB, was developed and field-tested, and a patent has been applied for. Some further refinements are necessary to test the bait for its application in detection and monitoring and appropriate release devices.

Transfer of information to regional clientele has been an ongoing function.

Participation has been maintained on the MPB technical Committee and also representation on the Canada-US MOU Mountain Pine Beetle Action Plan.

13. Goals for 1989-90:

1. Prepare and submit to journal paper on "Attack pattern and brood productivity of the MPB on three pine hosts". Can. Ent.

2. Complete revisions and submit to journal paper on "Mountain pine beetle attack density pattern on semiochemical baited and unbaited lodgepole pine in southwestern Alberta". C.J. For. Res.

3. Analyse 1988 spruce beetle semiochemical data and contribute to two reports: a) Status report on spruce beetle semiochemical field studies during 1988, and b) "A successful pheromone blend for manipulating spruce beetles, (Dendroctonus rufipennis Kirby); (b) will be co-authored by MacKenzie, Wieser, Dixon, Cerezke, and Werner and presented at 72nd Can. Chem. Conf. and Exhibition, Victoria, B.C., June 1989.

4. Conduct a field-replicated experiment in central and northern Alberta to test the performance of best known spruce beetle semiochemical formulation and determine optimum release rates, in cooperation with chemists from the University of Calgary.

5. Conduct preliminary studies of the Warren rootcollar weevil in selected locations in western Alberta to establish experimental monitoring sites that can be used to identify:
   - methods for estimating populations of the weevil and their dispersal behavior;
   - pre- and post-harvest population sources;
   - distribution and attack pattern of the weevil in young planted or naturally stocked stands, and;
   - explore potential controlling agents and pest management strategies

6. Provide representation on MPB Technical Committee and CAN-US MPB Action Plan as required.

14. Publications 1988-89:

Cerezke, H.F. 1989. Mountain pine beetle aggregation semiochemical use in Alberta and Saskatchewan, 1983-1987. Presented at the Symposium on Management of Lodgepole Pine to Minimize Losses to Mountain Pine Beetle (Canada/US Mountain Pine Beetle Program), Kalispell, Montana, July 12-14, 1988.

Cerezke, H.F. 1988. Status report on 1988 activities on the mountain pine beetle; Alberta, Saskatchewan, and Rocky Mountain National Parks. Status Report, 4 p.

15. Environmental Implications:

The NoFC Environmental Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1960 Estimated Completion: 1992 for MPB and SB studies; 1995 for rootweevil studies.

17. Resources 1989-90:

PYs:	Prof.:	Cerezke	0.4
	Total:		0.4
	Term/student		0.3

O & M: $4,000
Capital:

18. Signatures:

Investigator

Program Director, Protection

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 15, 1989

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

2. Title: Forest insect diagnostic and biosystematic services

3. New: Cont.: Terminated 4. No.: NOR-11-04

5. Study Leader: Terminated

6. Key Words: Insects, larvae, damage, hosts, parasites, Tenthredinoidea, Symphyta, galls, seasonal occurrence, distribution, taxonomy, identification, reference collection, Nearctic Region, life history

7. Location of Work: Edmonton, Alberta and region

8. Problem:

Insects play a very important role in the forest ecosystem. They attack every part and stage of living and harvested trees. Prompt and accurate identification of the adult and larval stages is necessary to determine the economic status of the different species, kind and type of chemical or biological control necessary to combat them and the best time of application. A reference collection of mature and immature insects, which is an essential prerequisite to diagnostic and biosystematic work, must be maintained and upgraded each year.

Since most of the damage is caused by the immature stages and insect identification is based mainly on the adult stage, a rearing program is a necessity. The rearing program not only provides adults for the identification of the larvae, but also information on seasonal occurrence, hosts, parasites and diseases. It also supplies material for the adult and larval reference collections.

Difficulties are often encountered in diagnosing sibling species or those closely resembling one another either in the adult or larval stages. Life history studies are initiated when the opportunity arises to gain biological information, which will assist in separating these and other species in central Canada. The success of the diagnostic and biosystematic services are excellent provided experienced personnel, good

insect reference collections (adults, larvae and damage) and major taxonomic literature are available. Considerable time must be devoted to keeping abreast of the latest entomological literature and changes in nomenclature. To facilitate prompt and accurate diagnosis, keys must be devised not only to the adult and immature forms, but also to insect damage in the Canadian Prairies.

The material is provided by personnel of the Forest Insect and Disease Survey and by the investigator. The immature insects are reared in the laboratory at Edmonton and in the field. The adults obtained are submitted to specialists in Ottawa or elsewhere in North America or Europe for identification and the latest nomenclature. All adults identified by specialists and larva and damage associated with these adults are placed in the reference collection.

9. 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 for the FIDS/INFOBASE.

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

4. To maintain taxonomic expertise on sawflies of Canada at the national and international level.

10. Goals for 1988-89:

1. Train the new Taxonomist/Entomologist on the identification of forest insects especially immature forms, and the duties and functions of the taxonomist in the Forest Insect and Disease Survey.

2. Identify the remainder of Pristiphora from the James Bay area for the Canadian National Collection, Ottawa and the U.S. National Museum, Washington, D.C.

3. Retire.

11. Accomplishments in 1988-89:

1. Trained Dr. D.W. Langor, on the duties and functions of the taxonomist in the Forest Insect and Disease Survey.

2. Identified all of the 203 specimens of Pristiphora collected in the James Bay area for the Canadian National collection Ottawa and U.S. National Museum, Washington, D.C.

Added Accomplishments:

These are mentioned here for completeness as activities prior to Dr. Wong's retirement though some are reported under NOR-11-10.

3. The number of determinations of mature and immature insects was reduced this year due to the reduction in FIDS personnel and less emphasis placed on general collection of forest insects. Only a few hundred specimens were handled, but the number of enquiries (over 500) from in-service personnel, clients, outside agencies and scientists remained the same.

4. a) About 50 specimens determined by specialists in Ottawa and by myself have been incorporated into the reference collection.

   b) Over 150 specimens were pinned, spread, labelled or preserved for the reference collection.

5. Biological information and/or specimens were provided to:

   Dr. W.J. Turnock, Agriculture Canada, Winnipeg, Man.

6. A survey was made in 1988 for the following introduced insects, which have entered the region in the last twenty or more years.

   - The introduced pine sawfly which was first collected in Manitoba in 1983 reappeared at West Hawk Lake and Birds Hill Prov. Park.

   - The European spruce sawfly, present since 1969 was not collected in 1988.

   - The larch casebearer, which was observed since 1965 in Manitoba was observed at South Junction.

   - The mountain ash sawfly first recorded on Elder Street at Falcon Lake, Manitoba in 1984 was present again in 1988.

   - A single specimen of the Gypsy moth was collected at Sherwood Park, Alberta in 1985. Numerous pheromone traps set out by the Food Production and Inspection Branch throughout Alberta failed to capture any males in 1988.

   b) The European pine shoot moth present in Ontario and British Columbia was not collected in the Canadian prairies this year.

7. Identified over 300 larval and adult sawflies for clients and reviewed three manuscript for the Can. Ent., Ent. News and Proc. Ent. Soc. Wash.

12. Present Status of Study:

Each year, several thousand insect specimens in the mature and/or immature stages are determined and over a thousand inquiries handled for in-service personnel, clients, outside agencies and scientists. Curator of over

60,000 mature and immature insects including spiders and mites, which were obtained through rearings and collections mainly in the Canadian prairies. Recorded the spread of several introduced forest and shade tree insects into the Canadian prairies, and followed their progress each year.

Elucidated the life history of 9 forest insects in our area and published these findings in scientific journals. The author of over 100 reports and publications dealing with the biology, habits, behavior, distribution, and control of insects. Produced keys and guides to the identification of the following insects and mites in our area: common galls and abnormal plant growth to forest and shade trees, adult June beetles attacking coniferous plantations, insects in the club-tops of black spruce, literature guide to methods of rearing insects, some inset pests of forest nurseries, species of Proteoterus attacking shoots of Manitoba maple, and species of Petrova attacking the shoots of lodgepole pine.

Two new genera of sawflies have bene erected in North America and one in Eurasia. Twenty new species of sawflies have been described in North America, Mexico, China and Brazil. Keys were developed to separate adults and/or larvae of Pristiphora, Allantus, Pristola, Melastola, Anoplonyx, Sharliphora, Eitelius, larvae of different genera in the family Diprionidae in North America, strains of the larch sawfly, larvae defoliating birch in the Canadian Prairies, different genera of the tribe Pristolini, and genera of specialized Nematini. Reported the spread of three introduced sawflies defoliating conifers into the Canadian Prairies within the last decade. Identified several thousand species of sawflies for the Canadian National Collection, United States National Museum, and other institutions and clients.

The taxonomic duties have been transferred to NOR-11-10, and any further publications resulting for work of Dr. Wong during retirement will be listed under that study. Current study terminated.

13. Goals for 1989-90:

Nil - terminated

14. Publications 1988-89:

Wong, H.R.; Drouin, J.A.; Langor, D.W. 1989. The lodgepole terminal weevil, Pissodes terminalis Hopping (Coleoptera: Curculionidae) in Alberta. Inf. Report (in press).

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1947 Completed: 1988

17. Resources 1989-90:

Nil - terminated

18. Signatures:

Investigator

Program Director, Protection

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 15, 1989

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-11-05

5. Study leader: W.J.A. Volney

6. Key Words: Damage, appraisal, impact, hosts, forest pests, management, mortality, risk, growth loss, stand dynamics, population dynamics, benefit/cost, pest management.

7. Location of Work: Northwest Region

8. Background:

Sound pest management systems require information on the resource values threatened by pests. This information can only be obtained from an understanding of pest epidemiology and their effects on host stands. Two different time horizons are considered in developing these pest management systems. These are the short-term and the long-term horizons. They are related to the need for treatments under current pest conditions, and forecasting pest impacts on the timber supply in the integrated resource management system respectively. The basic scientific information required to design pest management systems is therefore embodied in a description of the interactions among pest population dynamics, stand dynamics and control strategies. This description permits an evaluation of the socio-economic impact of pests on resource values and the benefit/cost integration required to embed pest management systems in the integrated resource management system.

This study aims to provide the descriptions of the physical pest impacts and the information on pest population dynamics to make long-term and short-term predictions of their effects on stand yield. An attempt is also to be made to identify critical sources of pest generation mortality and natality so as to be able to manipulate populations effectively.

9. Study Objectives:

1. To develop methods to evaluate the significance of specific forest pests in terms of measured damage to trees and forest stands.

2. To develop or modify appraisal methods for assessment of losses caused by forest pests.

3. Design forest pest management systems which optimize the return from stand management activities.

10 Goals for 1988-89:

1. Prepare life table estimates for jack pine budworm data collected in Manitoba and Saskatchewan. (Volney)

2. Continue studies on jack pine budworm feeding and prepare paper on feeding performance. (Volney)

3. Continue studies on the interaction among the jack pine budworm, dwarf mistletoe and their host. (Volney)

4. Determine feasibility of using weather data and hydrological data in forecasting budworm outbreaks. (Volney)

5. Complete report on the impact of the mountain pine beetle in the three Rocky Mountain Parks. (Moody)

6. Complete literature review of the effects of the major forest pests of the region on stand productivity. (Moody)

7. Complete report on the effects of spruce budworm defoliation on forests of Manitoba. (Moody)

8. Compile maps and data on plots established to determine the combined effects of dwarf mistletoe and jack pine budworm on stand productivity and document status of these studies. (Moody)

9. Provide plot locations and reports on status of impact studies not yet completed. (Moody)

10. Revise as necessary paper entitled: "Analysis of historic outbreaks of the jack pine budworm in the prairie provinces of Canada".

Saskatchewan agreement

11. Complete report of Torch River Forest Impact Study. (Volney)

12. Complete report on stem analysis of trees from the Torch River Forest. (Volney)

13. Monitor 600 impact plots in the Torch River Forest for tree mortality. (Volney)

14. Sample the nine intensive study plots in the Nisbet, Torch River and Fort A La Corne Provincial Forests for jack pine budworm populations and defoliation. (Volney)

15. Continue development of pheromone trapping systems to assess their utility in predicting jack pine budworm population trends. (Volney)

16. Continue studies on the interaction of jack pine budworm and mistletoe infection on their host trees. (Volney)

17. Conduct studies into the causes of mortality in pine stands that have been defoliated by the jack pine budworm, through excavation and dissection of root systems, and stem analysis. (Mallett & Volney)

18. Develop proposal to use remote sensing procedures to assess the extent of defoliation and attempt to relate this to damage. (Hall & Volney)

Manitoba agreement

19. Determine volume loss in selected stands of severely defoliated jack pine stands in the Thompson area. Write report. (Volney & Mallett)

20. Attempt to determine causes of elevated mortality rates in these stands and write a report. (Volney & Mallet)

Added Goal's - A-base:

21. Implement G.I.S. and mapping system to assist in compiling depletion estimates.

22. Write and present paper at Northern Mixedwood Symposium.

23. Prepare and present poster at XVIII International Congress of Entomology.

24. Prepare review of "Biology, Population Dynamics, and Management of North American Spruce Budworms".

25. Prepare and present a paper on the spruce budworm in the Northwest Region at the Eastern Spruce Budworm Research Work Conference.

11. Accomplishments in 1988-89:

1. Data to prepare life table estimates have been collected and being summarized.

2. Studies on jack pine budworm feeding were terminated because of disease in the colony. Data on the concentration of mineral elements in foliage are being analyzed.

3. Studies on the interaction among the jack pine budworm, dwarf mistletoe and their host were continued. Data on the phenology of normal and dwarf mistletoe shoots have been compiled. (Volney)

4. Weather data from the A.E.S. Canadian Climate Centre have been acquired to determine their feasibility in forecasting budworm outbreaks. (Volney)

5. Report on the impact of the mountain pine beetle in the three Rocky Mountain Parks was drafted. (Moody)

6. Literature review of the effects of the major forest pests of the region on stand productivity is being revised. A new co-author (Amirault) has been added to assist. (Moody)

7. File report on the effects of spruce budworm defoliation on forests of Manitoba completed. (Moody)

8. Maps of the location of Jack pine budworm plots in Grand Rapids, Manitoba have been provided. (Moody)

9. Reports on impact studies in progress not yet completed. (Moody)

10. Paper entitled: "Analysis of historic outbreaks of the jack pine budworm in the prairie provinces of Canada" was published.

Saskatchewan agreement

11. Report of Torch River Forest Impact Study in preparation. (Volney)

12. Report on stem analysis of trees from the Torch River Forest postponed pending analysis of tree ring information. (Volney)

13. All 600 impact plots in the Torch River Forest for tree mortality were monitored. (Volney)

14. All nine intensive study plots in the Nisbet, Torch River and Fort A La Corne Provincial Forests were sampled for jack pine budworm populations and defoliation estimates. (Volney)

15. Trapping experiments were conducted to assist in the development of pheromone trapping systems to assess the utility of artificial attractants in predicting jack pine budworm population trends. These data were summarized and transmitted to Research Productivity Council. A draft of the report entitled "Development of a consistent trap bait and trapping system for jack pine budworm Choristoneura pinus pinus" was received from the contractor. (Volney)

16. Studies on the interaction of jack pine budworm and mistletoe infection on their host trees were conducted by assessing the phenological development of shoots and the variation of mineral elements in normal and infected shoots. (Volney)

17. Fifteen trees have been excavated and their stems analyzed to determine the nature of the interaction between jack pine budworm defoliation and root disease. (Mallett & Volney)

18. A proposal to use remote sensing procedures to assess the extent of defoliation and attempt to relate this to damage by the jack pine budworm was developed and funded. The aerial photography and satellite imagery have been acquired, and 40 ground check plots have been established. (Hall & Volney)

Manitoba agreement

19. Impact plots have been established in severely defoliated jack pine stands in the Thompson area to determine volume loss in these stands. Data on stand conditions and growth have been made machine readable. (Volney & Mallett)

20. Thirty six trees were dissected and sampled in an attempt to determine causes of elevated mortality rates in these stands and samples have been incubated to determine the insects and diseases associated with the damage. (Volney, Langor & Mallet)

Added Accomplishments - A-base:

21. Took course on ARC/INFO training, computer room reorganized for this purpose, maps catalogued and digitizer mounted on power base. Protocol for mapping regional pest outbreaks designed and implemented.

22. Paper entitled "Insects and diseases of the mixedwood forest: problems or opportunities?" was presented and published in Information Report NOR-X-296.

23. A poster entitled "Fire history and outbreaks of the jack pine budworm, Choristoneura pinus pinus Freeman (Lepidoptera: Tortricidae), in the Canadian prairie provinces" was prepared and presented at the XVIII International Congress of Entomology.

24. A review entitled "Biology and Dynamics of North American Coniferophagus Choristoneura Populations" was prepared and is in press.

25. A paper entitled "The spruce budworm in Western Canada" was prepared and presented at the Eastern Spruce Budworm Research Work Conference.

12. Present Status of Study:

A network of permanent impact plots in stands of different ages, growing under different densities and site conditions have been established in jack pine forests of Manitoba (240 plots) and Saskatchewan (ca. 600 plots). A latitudinal analysis of damage in these stands together with an analysis of historical records will permit an initial description of the impacts of jack pine budworm and other pest populations on these stands.

A network of intensive study plots were established in Manitoba (9 plots) and Saskatchewan (9 plots) in which population and defoliation

estimates were made. Studies conducted in these plots are aimed at developing efficient sampling techniques as well as descriptions of the dynamics of jack pine budworm populations.

1. The jack pine budworm has been selected as the pest on which to develop impact evaluation procedures. Techniques for assessing growth loss on individual trees, the incidence and amount of top kill in defoliated stands, and the incidence of mortality in affected stands are being developed and applied. Many of these techniques can be modified for defoliators attacking other hosts.

2. Appraisal methods are being developed for the losses caused by the jack pine budworm.

3. Observations on populations density and concomitant growth losses are being made on the jack pine budworm/host tree system. These studies will provide information for monitoring, treatment evaluation, and prediction technologies for managing jack pine budworm populations.

13. Goals for 1989-1990:

1. Monitor Jack pine budworm impact plots in Manitoba and Saskatchewan.

2. Complete file report on "Studies on the impact of the 1985/86 jack pine budworm outbreak on stand development in the Torch River Forest".

3. Prepare draft of Information Report entitled "Characteristics of jack pine budworm life table plots in Manitoba And Saskatchewan".

4. Complete file report entitled "The interaction of jack pine budworm and lodgepole pine dwarf mistletoe with jack pine".

5. Complete file report on "The relationship between root condition and damage to trees following jack pine budworm outbreaks" with K. Mallett.

6. Complete file report on "Studies on stand deterioration following the 1980's jack pine budworm outbreak near Thompson, Manitoba" with K. Mallett and D. Langor.

7. Prepare final report on "The Status of Insect and Disease Studies Conducted Under the Canada-Saskatchewan Forest Resources Development Agreement".

8. Participate on Committee to plan and draft a proposal for a multi-disciplinary study on the management of mixedwood forests.

14. Publications:

Volney, W.J.A. 1988. Insects and diseases in the mixed wood forest: problems or opportunities? Pages 99-109 in J.K. Samoil, ed. Management and utilization of northern mixedwoods. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

Volney, W.J.A. 1988. Analysis of historic jack pine budworm outbreaks in the prairie provinces of Canada. Can. J. For. Res. 18: 1152-1158.

Volney, W.J.A. 1988. Fire history and outbreaks of the jack pine budworm, Choristoneura pinus pinus Freeman (Lepidoptera: Tortricidae), in the Canadian prairie provinces. (Poster) Abstract Page 442 in Proc. XVIII Internat. Congr. Entomol., Vancouver, B.C. 3-9 July 1988.

Schaupp, W.C., Jr.; Volney, W.J.A.; Waters, W.E. 1988. Larval parasitoids of Choristoneura occidentalis and C. retiniana (Lepidoptera: Tortricidae) at epidemic and endemic host densities. (Poster) Abstract Page 441 in Proc. XVIII Internat. Congr. of Entomol., Vancouver, B.C. 3-9 July 1988.

Volney, W.J.A. 1989. The spruce budworm in western Canada. (Abstract) in Program & Abstracts of 13th Annual Eastern Spruce Budworm Research Work Conference, Fredericton, N.B. 24-26 January 1989.

Volney, W.J.A. 1989. Biology and dynamics of North American coniferophagus Choristoneura populations. Agricult. Zool. Rev. 3: 000-000. (In press.)

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1986 Estimated Completion: Ongoing.

17. Resources 1989-90:

PYs:	Prof.:	Volney	0.8
	Tech.:	vice-Szlabey	1.0
	Total:		1.8
	Term/Student		0.9

	A-Base	Sask. FRDA	Man. Prov. (Direct)
O & M:	$5,000	$3,000	$14,200

Capital: $12,000

18. Signatures:

Investigator

Program Director, Protection

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 15, 1989

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

2. Title: Research, diagnostic, and technical transfer services of forest tree rusts and other forest tree diseases

3. New: Cont: X 4. No.: NOR-11-06

5. Study Leader: Y. Hiratsuka

6. Key Words: Taxonomy, mycology, herbarium, culture collection, tree disease identification, Forest tree rusts, pine stem rusts, Cronartium, Endocronartium, western gall rust, biocontrol, mountain pine beetle, blue stain fungi, Ceratocystis spp., Armillaria root rot

7. Location of Work: Edmonton (NoFC--mycological herbarium, culture collection, laboratory, and greenhouse facilities), various field locations in the region and occasionally in other areas of the world.

8. Background Statement:

A. Disease identification and taxonomic service

Accurate and prompt diagnosis of tree diseases and identification of causal agents are essential to the disease surveys, pest extension services, damage appraisal studies, environmental assessment services, and consideration of possible control measures for tree diseases. Many non-pathogenic fungi in forest ecosystems also play important roles. Proper identification of mycorrhizal fungi, decomposing fungi, and hyperparasitic fungi of forest tree pathogens is important to many research studies and provides better understanding of forest ecosystems. Taxonomy and nomenclature of fungi are constantly being revised. Proper application of up-to-date information on taxonomy and nomenclature are important whenever names of fungi are used in reports or journal publications. To maintain and improve diagnostic and taxonomic service capabilities, it is necessary to maintain a high quality disease reference collection, a fungus culture collection, and a reference literature collection.

B. Western gall rust

Western gall rust has been identified as the most important disease in artificial regeneration and intensive management situations of lodgepole and jack pines in the region. It is essential that it be included in genetic improvement programs of hard pines.

C. Taxonomy, biology, and pathology of forest tree rusts

An estimate of the losses attributable to forest tree rusts in this region has not been obtained, but rusts have caused significant growth loss and mortality of major forest tree species of the region including lodgepole and jack pines, white and black spruces, aspen, balsam poplar, and alpine and balsam firs. In addition, several rust species endemic to the region have been recognized as serious pathogens or potentially dangerous pathogens in other areas where forestry practices are more intensive. It is important to clarify identity, life history, host range, cytology, damage potential, conditions of infection, and taxonomy of forest tree rusts of the region to cope with the present and future problems with this group of tree diseases.

D. Short-term investigation of selected forest tree diseases
Short-term research activities on selected tree diseases becomes necessary from time to time when diseases are identified as important in certain forest management practices in the region, recognized as important by the public or news media, or identified as suitable topics for joint research activities with outside agencies.

9. Study Objectives:

A. To conduct forest tree disease identification and taxonomic service, and to maintain and upgrade a disease reference collection (Mycological Herbarium) and a fungus culture collection.

B. To study biology, cytology, pathology, host-parasite relationship, inoculation techniques, and resistance screening methods of western gall rust to contribute to the genetic improvement programs and management of lodgepole and jack pines in the prairie provinces.

C. To study taxonomy, morphology, pathology, and life-cycle of forest tree rusts, especially those of pine stem rusts of Canada and related species elsewhere in the world, with the aim of compiling a definitive manual of forest tree rusts of Canada (or North America), and a monograph of pine stem rusts, and to contribute to the taxonomy, nomenclature, and terminology of rust fungi.

D. To conduct short-term investigations of selected forest tree diseases of the region such as Dutch elm disease, Armillaria root rot, and mortality caused by mountain pine beetle.

10. Goals for 1988-89:

A. Disease identification service and taxonomic service

1. Provide diagnostic and identification service for tree and shrub diseases.

2. Maintain and upgrade the disease reference collection (Mycological Herbarium), and a fungus culture collection.

3. Complete an information report entitled "Diagnosis and recognition of winter- and other climate-related damage of trees" with H. Zalasky and publish during 1988-89 fiscal year.

4. Start preparing an information report entitled "Compendium of aspen and poplar diseases of the prairie provinces".

5. Continue to work on the revision of an information report "Annotated checklist of tree and shrub diseases in the prairie provinces".

B. Western Gall Rust Study

6. Initiate western gall rust investigation, in conjunction with the ongoing jack pine genetics and tree improvement program, with J. Klein, and Manitoba provincial government personnel (MDNR--Forest Protection and Tree Improvement sections).

   (a) A draft copy of the proposal will be initiated by ForCan and will be sent to the Director of Forest Protection (MDNR) for evaluation and formal agreement of cooperation.

   (b) Several field-oriented activities (spore collecting, scion collecting, survey of heavily infested jack pine stands, and field evaluation of family plantings, etc.) will be conducted during 1988-89 field season.

7. Complete a comprehensive information report on western gall rust with Dr. P. Blenis of the University of Alberta to be published in 1989-90 fiscal year.

8. Cytological re-examinations of spores and germ tubes will be conducted to clarify the nature of nuclear events of the western gall rust, and the results will be prepared for publication.

9. Host-parasite interactions will be studied with a visiting fellow (NSERC), Dr. A.A. Hopkin, and a Ph.D. student, Mr. E. Allen (University of Alberta).

10. Publish a journal paper entitled "Mechanism and pattern of spore release by Endocronartium harknessii" with K.F. Chang and Dr. P. Blenis (Can. J. Bot.).

11. An attempt will be made to collect and study a gall rust in central Ontario on red pine. A non-sporulating specimen was collected in 1987. Red pine is generally known to be immune to western gall rust and may give interesting information on our ongoing resistance work of western gall rust. The rust may turn out to be a host-alternating Cronartium quercuum.

C. Taxonomy, biology, and pathology of forest tree rusts

12. Publish an information report entitled "Impact of pine stem rusts of hard pines" with Drs. J.M. Powell and A. Van Sickle (PFC).

13. Continue organizing The 3rd International Conference of IUFRO "Rusts of Pine" Working Party in Alberta in 1989 as the chairman of the organizing committee.

14. Prepare two invited symposium papers for presentation at the VIth International Congress of Plant Pathology to be held in Kyoto, Japan, in August 1988.

15. Publish two journal papers entitled "Ontogeny and morphology of teliospores (probasidia) in Uredinales and their significance in taxonomy and phylogeny" (Mycotaxon), and "Auriculariaceous 'rusts'" (Mycologia).

16. Compile a planning document for biological control of pine stem rusts with the new strategy of using free-moving organisms such as insects and mites as carriers of selected microbial hyperparasites.

D. Microbiological and pathological investigation of trees attacked by mountain pine beetle

17. Publish a journal paper entitled "Inoculation of blue stain fungi associated with mountain pine beetle monitored with heat-pulse velocity equipment" with Y. Yamaoka (visiting scientist) and R. Swanson (NoFC).

18. Publish a journal paper entitled "Inoculation experiments with Ceratocystis clavigera on Pinus contorta" with Y. Yamaoka.

19. Plan and conduct inoculation experiments with blue stain fungi with heat-pulse velocity instruments.

20. Collect MPB samples during adult flight in early summer and investigate fungi associated with insects.

E. Armillaria root rot investigation

21. Assist K. Mallett in taxonomical, cytological, and morphological examinations of prairie forms of Armillaria mellea complex to clarify the identity of this group of

pathogens in the region. All ongoing investigations of Armillaria root rot are transferred to a new study (NOR-11-09).

11. Accomplishments for 1988-89:

A. Disease identification and taxonomic service

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

2. Maintained and upgraded the disease reference collection (Mycological Herbarium) and fungus culture collection.

3. Rough draft of the information report entitled "Diagnosis and recognition of winter- and other climate-related damage of trees" with H. Zalasky has been prepared but was not completed because of postponement of publication schedule until 1989-90.

4. Started the preparation of an information report entitled "Compendium of aspen and poplar diseases of the Prairie Provinces".

5. Considerable information has been collected for the revision of an information report entitled "Annotated checklist of tree and shrub disease in the Prairie Provinces".

B. Western Gall Rust Study

6. Initiated western gall rust investigation in conjunction with the ongoing jack pine tree improvement program with J. Klein (NOR-12-03) and personnel from Manitoba Department of Natural Resources (MDNR Forest Protection and Tree Improvement sections).

(a) Proposal for intergovernmental cooperative work has been submitted and approved by ForCan and MDNR.

(b) Jack pine family plantations (216 families, 15 replications, about 6000 trees) have been examined for the presence of western gall rust.

(c) Two sets of inoculation experiments have been conducted with seedlings of 20 first cousins derived from controlled pollination among 40 best performers of family testing. The inoculation experiment with young seedlings (7 weeks old) was very successful but results from the inoculation experiment with older seedlings (1 year old) was not satisfactory.

7. Significant progress has been made to complete a comprehensive information report on western gall rust with Dr. P.V. Blenis, University of Alberta to be published in 1989-90.

8. Cytological re-examination of spores and germ tubes was conducted to clarify the nature of nuclear events of the western gall rust, and the results have been reported at the American Phytopathological Society Meeting in San Diego.

9. Host-parasite interactions have been studied with a visiting fellow (NSERC), Dr. A. A. Hopkin, and Ph. D. student, Mr. E. Allen. Several journal papers have been written and they are in various stages of review and preparation.

10. A journal paper entitled "Mechanism and pattern of spore release by Endocronartium harknessii" with K. F. Chang and Dr. P. Blenis is in press.

11. Collection of a red pine gall rust in Ontario was not made.

C. Taxonomy, biology, and pathology of forest tree rusts

12. An information report entitled "Impact of pine stem rusts of hard pines in Alberta and the Northwest Territories" has been published (NOR-X-299)

13. Continued organizing the 3rd International IUFRO "Rusts of Pine" Working Party Conference to be held in Banff on September 1989.

14. Gave two invited papers at the 6th International Congress of Plant Pathology in Kyoto, Japan. Titles of the presented papers are:
"Nuclear cycle, taxonomy, and nomenclature of autoecious pine stem rusts".
"Cytology as a tool for taxonomy and life cycle studies of tree rusts".

15. A journal paper entitled "Ontogeny and morphology of teliospore (probasidia) in Uredinales and their significance to taxonomy and phylogeny has been published in Mycotaxon. A paper entitled "Auriculariaceous 'rusts'" was sent back from a journal for revision and re-submission.

16. A preliminary investigation to explore a new strategy of biological control of western gall rust using rust feeding insects and mycoparasites with J. Volney has been initiated. A candidate insect(Epuraea obliquus) and a candidate mycoparasite (Scytalidium uredinicola) have been identified.

D. Microbiological and pathological investigation of trees attacked by mountain pine beetle

17. A journal paper entitled "Inoculation experiments with blue stain fungi associated with mountain pine beetle on Pinus contorta" with Y.Yamaoka (Visiting Scientist) and R. Swanson has been written and is under internal review.

18. A journal paper entitled "Inoculation experiments with Ceratocystis clavigera on Pinus contorta" with Y. Yamaoka and P.J. Maruyama has been written and is ready for internal review.

19. Ten trees were inoculated with various combinations of blue stain fungi in Nojack area to confirm pathogenicity. Heat pulse velocity instruments were not used.

20. Adults of MPB were collected in the field before attacking pine trees, and fungi associated with them were isolated and studied.

E. Armillaria root rot investigation

21. Assisted K.Mallett in morphological examination of sporophores of Armillaria species in the Prairie provinces.

12. Present Status of Study:

A. Disease identification and taxonomic services

1. Tree disease diagnosis and identification service has been provided for FIDS activities since the 1950s.

2. Disease reference collection (Mycological Herbarium) has been maintained and upgraded for many years, and now contains more than 22,000 catalogued specimens.

3. Fungus culture collection was established in the 1950s, and has been maintained and upgraded. The collection now contains more than 1000 cultures, including important isolates of wood decay fungi, Scleroderris canker, Armillaria root rot, Dutch elm disease, mycoparasites of pine stem rusts, and fungi associated with mountain pine beetle.

4. "Annotated checklist of tree and shrub diseases in the Prairie Provinces" was published in 1977, and an information report entitled "Forest tree diseases of the Prairie Provinces" was published in 1987.

5. Several new forest fungi have been described and published.

6. Because disease detection survey activities are less intensive, the number of samples for identification has decreased to less than 100 per year for the last several years but more collections of fungi from specific studies such as Armillaria root rot study, fungi associated with mountain pine beetle, mycoparasites of pine stem rusts have been identified and filed in the disease reference collection and fungus culture collection.

7. An information report entitled "Diagnosis and recognition of winter- and other climate-related damage to trees" with H. Zalasky is in preparation.

B. Western gall rust investigation

1. Morphology, life cycle, nuclear cycle, and taxonomy of the pathogen have been investigated and reported. Comparative studies of cytology and morphology resulted in a new explanation and interpretation of the western gall rust life cycle and the establishment of a new genus, Endocronartium.

2. Three aggressive hyperparasites (Monocillium nordinii, Cladosporium gallicola, and Scytalidium uredinicola) were discovered and investigated with A. Tsuneda (NSERC Visiting Fellow, 1982-84). Mode of parasitism and production of bioactive metabolites produced by these fungi were investigated and documented in journal publications.

3. Active investigations of host-parasite interaction, resistance testing techniques, axenic culture of the pathogen, and epidemiology of the disease are underway with the cooperation of P. Blenis (U of A), A. Hopkin (NSERC Visiting Fellow), E. Allen (Ph.D. student, U of A).

4. A new cooperative investigation with the province of Manitoba to test jack pine genetic improvement material has been started. Field surveys of genetic family plantations and inoculation experiments with selected full-sib families were conducted in 1988-89.

C. Taxonomy, biology, and pathology of forest tree rusts

1. Distribution, taxonomy, life cycle, morphology, cytology, damage, epidemiology, and control of pine stem rusts were compiled and published in a major, fully illustrated, publication entitled "Pine stem rusts of Canada" with J.M. Powell in 1977.

2. Incidence and identity of hyperparasitic fungi, rust-feeding insects, and animal damage to pine stem rusts have been recorded and published by J.M. Powell.

3. Organizing a IUFRO Working Party meeting in 1989 in Alberta is a major task.

4. Information for the monograph on pine stem rusts is being compiled.

5. A new approach to biocontrol of pine stem rusts has been proposed and preliminary investigation of selecting candidate organisms was conducted.

6. An information report entitled "Impact of pine stem rusts of hard pines" with J.M. Powell (NoFC), G.A. Van Sickle (PFC) was published in 1988.

D. Short-term investigation of selected forest tree diseases

1. Together with S. Takai of GLFC, host-parasite interaction of Dutch elm disease was investigated and a specific toxin of the disease (cerato-ulmin) was discovered.

2. Bioactive metabolites of forest fungi such as Gremmeniella abietina, Ceratocystis spp. associated with mountain pine beetle, and Stereum purpureum were investigated with W. Ayer (U of A).

3. Pathological and chemical investigations of fungi associated with mountain pine beetle have been jointly conducted by W. Ayer (U of A), R. Swanson (NoFC), and Y. Yamaoka (NoFC), and a significant discovery was made. A fungus that is both an effective colonizer and an agent that stops water flow in MPB-attacked trees was identified. Further experiments are in progress.

4. Aspects of distribution, biological species identification, detection method, and pathogenicity tests of Armillaria root rot have been conducted by K. Mallett (NoFC), M. Mugala (U of A), and P. Blenis (U of A). The Armillaria root rot investigations are transferred to the new study with K. Mallett (NOR-11-09), except for some aspects of taxonomy and morphology of the organism complex.

13. Goals for 1989-90:

A. Disease identification service and taxonomic service

1. Provide diagnostic and identification service for tree and shrub diseases.

2. Maintain and upgrade the disease reference collection (Mycological Herbarium), and a fungus culture collection.

3. Complete an information report entitled "Diagnosis and recognition of winter- and other climate- related damage of trees" with H. Zalasky and publish during 1989-90 fiscal year.

4. Act as one of the compilers of "Aspen-poplar decay identification and measurement manual" with AFS personnel.

5. Investigate etiology of aspen "black galls" in relation to decay caused by Phellinus tremulae.

B. Western Gall Rust study

6. Continue western gall rust investigation, in conjunction with ongoing jack pine genetics and tree improvement program with J. Klein, and Manitoba Department of Natural Resources.

(a) Examine and analyze results of inoculation experiments conducted in 1988 with 20 families resulting from crosses between 40 top performers in family planting experiments.

(b) Collect seeds(open pollinated) from selected families exhibiting resistance in family plantation surveys and conduct inoculation experiments.

(c) Survey family plantings in the western breeding district (Saskatchewan) for the incidence of western gall rust.

7. Complete an information report on western gall rust with Dr. P.V. Blenis of the University of Alberta and publish in 1989-90.

8. Prepare a journal paper on cytology and taxonomy of autoecious pine stem rusts.

9. Start co-operative work on western gall rust resistance evaluation of lodgepole pine in conjunction with tree genetics and improvement with AFS personel (Drs. Dhir and Sproule).

10. Serve as the scientific authority for a ForCan contract to Dr. P.V. Blenis (Univ. of Alberta) for the investigation of western gall rust control.

C. Taxonomy, biology, and pathology of forest tree rusts

11. Organize the 3rd International IUFRO "Rusts of Pine" Working Party Conference in Banff, Alberta (September 18-22).

12. Edit the proceedings of the IUFRO "Rusts of pine" conference with Dr. P. Blenis of the University of Alberta and publish in 1990-91 or 1991-92 fiscal year.

13. Re-submit a journal paper entitled "Auriculariaceous rusts" to Mycologia.

14. Investigate taxonomy and morphology of several groups of forest tree rusts with a group of Japanese scientists (Drs. S. Sato, K. Katsuya,and S. Kaneko) under a cooperative research project, and prepare two to three journal papers.

15. Continue to explore a new strategy of biological control of western gall rust using a rust feeding insect (Epuraea obliquus) and a mycoparasite (Scytalidium uredinicola) with J. Volney.

D. Microbiological and pathological investigation of trees attacked by mountain pine beetle

16. Publish a journal paper entitled "Inoculation of blue stain fungi associated with mountain pine beetle monitored with heat-pulse velocity equipment" with Y. Yamaoka and R. Swanson.

14. Publications 1988-89:

Hiratsuka,Y.; Powell, J. M.; Van Sickle, G. A. 1988. Impact of pine stem rusts of hard pines in Alberta and the Northwest Territories. Nor. For. Cent. Inf. Rep. NOR-X-299.

Hiratsuka,Y. 1988. Ontogeny and morphology of teliospores (probasidia) in Uredinales and their significance in taxonomy and phylogeny. Mycotaxon 31:517-530.

Hiratsuka,Y. 1988. Nuclear cycle, taxonomy, and nomenclature of autoecious pine stem rusts. (Abstract) Phytopathology 78:1534.

Chang,K. F.;Blenis,P.V.;Hiratsuka,Y. Mechanism and pattern of spore release by Endocronartium harknessii. Can. J. Bot. (In press)

Hopkin, A. A.; Reid,J.; Hiratsuka, Y.; Allen, E. 1988. Initial infection and early colonization of Pinus contorta by Endocronartium harknessii. Can. J. Pl. Path. 10: 221-227.

Allen, E.; Blenis,P. V.; Hiratsuka,Y. 1988. Histological evidence of resistance to Endocronartium harknessii in Pinus contorta. (Abstract) Phytopathology 78:1554.

Blenis,P. V.; Mugala,M. S.; Hiratsuka,Y.; Mallett,K. I. 1988. Soil type and host affect root rot caused by Alberta isolates of the Armillaria mellea complex. (Abstract) Can. J. Pl. Path. (In press)

Hiratsuka, Y. 1988. Nuclear cycle, taxonomy, and nomenclature of autoecious pine stem rusts. Proceedings Int. Congress of Plant Pathology, Kyoto, Japan.

Hiratsuka, Y. 1988. Cytology as a tool for taxonomy and life cycle studies of tree rusts. Proceedings 5th Int. Congress Plant Pathology, Kyoto, Japan.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

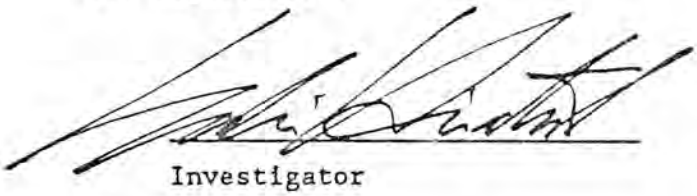
Started : 1970 Estimated Completion: Continuing

17. Resources 1989-90:

PYs:	Prof. : Hiratsuka	1.0
	Tech. : Maruyama	1.0
	Total:	2.0
	Term/Student	0.0

O & M: $ 8 K

18. Signatures :



Investigator

Program Director, Protection

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 15, 1989

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

2. Title: Operational research studies into economically important tree diseases.

3. New: Cont.: X 4. No.: NOR-11-09

5. Study Leader: K.I. Mallett

6. Key Words: Armillaria root rot, pine stem rusts, dwarf mistletoe, poplar diseases and decay, nursery diseases, seed and cone diseases, taxonomy, pathogenicity, control.

7. Location of Work: Northwest Region.

8. Background Statement:

For effective forest management, accurate and reliable methods of disease identification, damage, and loss assessment are necessary. As well, information on the biology of forest pathogens, and control measures must be available to the forest resource manager.

In the Northwest Region, the economically important tree diseases are Armillaria root rot, hard pine stem rusts, dwarf mistletoe, nursery diseases, poplar decay and deterioration, and seed and cone diseases.

Armillaria root rot, caused by the North American Biological Species (NABS) of the Armillaria mellea complex, has been identified as one of the most important disease problems in the region. Most recent work has centred on the identification of the NABS in the region, their distribution, and pathogenicity. Little is known about the impact of the disease on plantations or intensively managed conifer stands. Information regarding early detection and survey techniques are limited, and also information regarding the biology of the NABS in the region and control measures.

Pine stem rusts are thought to impact young conifer stands through mortality, growth and yield loss. Research to date has focussed on

biology of the hard pine rusts. Information on breeding for resistance, epidemiology, impact, and control measures needs to be developed.

Dwarf Mistletoe of jack and lodgepole pines is a highly destructive disease in region. Much information has been collected concerning the biology of dwarf mistletoe, but more information is required on impact and control, measures.

With the increase in Poplar utilization there is a greater demand for investigations into poplar diseases, and deterioration. Methodology is required to determine the amount of decay in poplar stands for inventory purposes. As old growth forests are used, and poplar regeneration and stand management become important, other poplar disease problems will arise. It is important that these problems be identified and the appropriate control measures be developed.

The use of planted stock is becoming increasingly important in intensive forest management. There is a need to study the diseases of conifer seedlings in forest nurseries in the region. Diseases, such as storage moulds of seedlings and damping-off, can cause large losses to nurseries. Little information is available to nursery personnel on the impact of these disease or their control.

Little is known about the seed and cone diseases of the region. More study is required to provide for nursery and breeding program personnel with accurate and reliable information on these diseases.

This study attempts to address the need to: develop impact information and survey techniques for the major disease causing agents for nurseries, plantations and natural stands; study the biology of the major disease causing agents and develop appropriate control strategies; advise forest managers and forest resource users on the major disease causing agents.

9. Study Objectives:

1. To study the taxonomy, distribution, ecology, and pathogenicity of important disease causing agents in Northwest Region.

2. To study the impact of disease causing agents in nurseries, plantations, and in natural stands.

3. To develop early detection, survey techniques, and control strategies for disease causing agents in nurseries, plantations, and natural stands.

10. Goals for 1988-89

1. Initiate studies to develop early detection and survey techniques for Armillaria root rot.

2. Continue studies on the distribution and taxonomy of the NABS of the Armillaria mellea complex in the region. Prepare an information

report on the Armillaria mellea complex in the region. Prepare two journal papers on vegetative incompatibiltiy in the A. mellea complex.

3. Continue studies on finding alternative fungicides for the control of damping-off in nurseries and establish experimental control trials in the greenhouse.

4. Continue collaborative studies on storage moulds of conifer seedlings.

5. Continue studies on the cultural characteristics of the Armillaria mellea complex in the region and prepare a journal publication entitled "The cultural characteristics of thethe A. mellea complex" for internal review.

6. Inoculation studies with Armillaria mellea complex species were transferred from NOR-11-06 will be analyzed.

7. Provide advice and technology transfer of information regarding forest diseases to NOR-11-01 personnel and client groups.

8. Continue as editor of "The Forest Insect and Disease Notes". (in cooperation with personnel from NOR-11).

Saskatchewan Agreement

9. Conduct studies into the causes of mortality in pine stands that have been defoliated by the jack pine budworm, through excavation and dissection of the root systems, and stem analysis. In conjunction with NOR-11-05 (Mallett & Volney)

Manitoba Agreement

10. Determine volume loss in selected stands of severely defoliated jack pine stands in Thompson area. Attempt to determine cause of elevated mortality rates in these stands and a write a report. In conjunction with NOR-11-05 (Volney & Mallett).

Added goal - A-base:

11. Attend a workshop on the identification of the pinewood nematode.

11. Accomplishments for 1988-89:

1. Continued to develop early detection and survey techniques for Armillaria root rot. Traplog plots were established in the Hinton Area. Cutblocks in the Swan Hills were surveyed for clonal size.

2. Continued studies on the distribution and taxonomy of the NABS of the Armillaria mellea complex in the region. Isolates of Armillaria from the region were collected and identified. An information report on the Armillaria mellea complex in the region is in

preparation. Prepared and published a paper entitled "The use of L-DOPA to enhance the visualization of the "black line" between species of the Armillaria mellea complex". Prepared and submitted a paper entitled "Vegetative incompatibility in diploid isolates of North American Armillaria biological species I and V".

3. Continued studies into finding alternative fungicides for the control of damping off in nurseries. Four fungicides were evaluated for phytotoxicity to 5 conifer species.

4. No studies were conducted on storage mould of conifer seedlings as storage mould was not found on seedlings at Pine Ridge Tree Nursery.

5. Continued investigations of cultural characteristics for the identification of the NABS of the Armillaria mellea complex of the region. Prepared a journal paper on the "Cultural characteristics of the Armillaria mellea complex". A paper on the "Morphology and cultural characteristics of Armillaria root rot pathogens in the prairie provinces of Canada" was pressented at the IUFRO Root and but rots working group meetings.

6. Continued inoculation studies of Armillaria mellea complex species on conifers. A journal paper was submitted to the Canadian Journal of Forest Research. An experiment to determine relative susceptibility of 5 conifer species to Armillaria root rot was begun.

7. Provided advice and diagnostic support to NOR-11-01 personnel. Technology transfer of information was provided through 2 workshop presentations, site visits, Advisory committees, and diagnostic service.

8. Three issues of "Forest Insect and Disease Notes" were edited and mailed out (In cooperation with other NOR-11 personnel).

Saskatchewan Agreement

9. Studies were conducted into the causes of mortality in jack pine stands that had been defoliated by jackpine budworm. 15 jackpine tree roots were excavated and measured. Fungi were isolated and identified. In conjunction with NOR-11-05 (Mallett & Volney)

Manitoba Agreement

10. Studies were conducted to determine volume loss in selected stands o severely defoliated jack pine in the Thompson area. Attempts were made to determine the cause of mortality in these stands. Fungi were isolated and identification was begun. In conjunction with NOR-11-05 (Mallett & Volney),

Added Accomplishment:

11. Attended a workshop on the identification of pinewood nematode at Biosystematics Institute, Ottawa.

12. Present status

Research studies were conducted on the taxonomy and distribution of the Armillaria mellea complex in the region. Specimen collections were made and are being identified with the aim at developing a distribution map for these species according to geographical region and host species. Identification methods for identifying the various NABS are being developed. Techniques for identifying Armillaria root rot centers in cutover areas have been initiated. The A. mellea complex species present in the region are being tested for their ability to kill native conifer species.

A study to find alternative fungicides for the control of damping off of conifer seedlings was continued. Four fungicides have been screened for efficacy of damping off control and phytotoxicity.

Studies into the cause of mortality of jackpine budworm defoliated jack pine in Saskatchewan and Manitoba were initiated.

13. Goals for 1989-90:

1. Continue studies to develop early detection and survey techniques for Armillaria root rot. Traplog plots will be evaluated. Several cutblocks will be evaluated to determine clonal size.

2. Continue studies on the distribution and taxonomy of the NABS of the Armillaria mellea complex in the region. Prepare an information report on the Armillaria mellea complex in the region. Prepare a journal paper on The Armillaria mellea complex in the prairie provinces of Canada. Revise if necessary, "Vegetative incompatibility in diploid isolates of North American Armillaria biological species I and V, submitted to Canadian Journal Botany.

3. Continue studies on finding alternative fungicides for the control of damping-off in nurseries. Candidate fungicides will be evaluated for phytotoxicity and efficacy in controlling damping off.

4. Submit a journal paper entitled "The cultural characteristics of the A. mellea complex" for internal review.

5. An inoculation experiment with Armillaria mellea complex species and 5 conifer species wil be evaluated.

6. Provide advice and technology transfer of information regarding forest diseases to NOR-11-01 personnel and client groups.

7. Produce 3 issues of "The Forest Insect and Disease Notes". (in cooperation with personnel from NOR-11).

Saskatchewan Agreement

8. Continue studies into the causes of mortality in pine stands that have been defoliated by the jack pine budworm, through excavation

and dissection of the root systems, and stem analysis. In conjunction with NOR-11-05 (Mallett & Volney)

Manitoba Agreement

9. A report will be written on studies to determine volume loss and the cause of the elevated mortality rates in selected stands of severely defoliated jack pine stands in Thompson area. In conjunction with NOR-11-05 (Volney & Mallett).

14. Publications 1988-89:

Blenis, P.V.; Mugala, M.; Hiratsuka,Y.; Mallett, K.I. 1988. Soil type and host species affect root rot caused by Alberta isolates of the Armillaria mellea complex. Can. J. Plant Path. (in press)

Mugala, M.; Blenis, P.V.; Hiratsuka,Y.; Mallett, K.I. 1989. Infection of lodegpole pine and white spruce by Alberta isolates of Armillaria. Can. J. For. Res. (in press).

Cerezke, H.F.; Volney, W.J.A.; Mallett, K.I.; Emond, F.J. 1988. Assessment of forest insect, disease and stand conditions in Cypress Hills Provincial Park. ForCan, Nor. For. Cent., Edmonton, Alta., File Report No.

Hopkin, A.A.; Mallett, K.I.; Blenis, P.V. 1989. The use of L-DOPA to enhance the visualization of the "black line" between species of the Armillaria mellea complex. Can. J. Bot. 67:15-17.

Mallett, K.I. (Compiler) 1988. Forest Insect and Disease Notes. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Tech. Transfer Note A-003, A-005, A-007.

Mallett, K.I. 1988. Morphology and cultural characteristics of Armillaria root rot pathogens in the prairie provinces of Canada. Proceedings of the seventh International conference on root and butt rots of forest trees. Vernon and Victoria, British Columbia, August 9-16, 1988.

Mallett, K.I. 1988. Forest insect and disease survey. Symposium on methods and techniques for plant disease survey. Phytopath. Soc. of Alberta Annual Meeting. Beaverlodge, Alberta.

Volney, W.J.A.; Cerezke, H.F.; Mallett, K.I. 1988. Assessment of pest conditions in Forest genetic installations in the vicinity of Grande Prairie, Alberta. ForCan, Nor. For. Cent., Edmonton, Alta., File Report No.

15. Environmental Implications:

The NoFC Environmental Committee has evaluated the proposed study activities. On the basis of the information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1987 Completion: ongoing

17. Resources 1989-90:

PY'S:	Prof.:	Mallett	1.0
	Tech.:		0.0
	Total:		1.0
	Term/student:		0.3

O & M: $ 5,000.00
Funding for goals 8 and 9 is included under NOR-11-05

Capital: $16 K

18. Signatures:

Investigator

Program Director, Protection

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 15, 1989

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

2. Title: Forest insect biosystematics

3. New: X Cont.: 4. No.: NOR-11-10 (now incorporates parts of NOR-11-03)

5. Study Leader: D. W. Langor

6. Key Words: Insects, adults, larvae, damage, hosts, predators, parasites, identification, taxonomy, reference collection, distribution, life history, terminal weevils, electrophoresis

7. Location of Work: Northwest Region

8. Background:

Insects constitute one of the most important biotic factors affecting forest ecosystems. Hundreds of insect species attack and damage every part and age class of the native and exotic tree species in this region. Prompt and accurate identification of mature and immature stages of insects is essential to insect surveys, pest extension services, damage appraisal studies, environmental assessment services and consideration of control measures for forest insect pests. Insect diagnostic and taxonomic services are important to many research studies and provide information which leads to a broader understanding of forest ecosystems. It is important to keep abreast of the taxonomy and nomenclature of insect taxa important to forestry so as to provide current scientific names for use in publications. To maintain and improve diagnostic and taxonomic service capabilities, it is necessary to maintain a reference collection of mature and immature insects as well as a reference literature collection.

Since the insect larval stage is the most destructive and insect identification is based mainly on the adult stage, a rearing program is a necessity to establish larval-adult association. The rearing program also provides information on phenology, parasites, predators, diseases and host associations as well as supplies material for the reference collection.

Species which closely resemble one another as adults and/or larvae are often encountered and are difficult to separate based on morphological characters. Biochemical methods (e.g., electrophoresis, RFLP, etc.) can often be used to discriminate between similar species. Additionally, life history studies also provide important biological information which assists in separating such species.

9. Study Objectives:

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

2. Maintain and improve the regional collection of insects and mites and provide data for the FIDSINFOBASE.

3. Undertake biosystematic studies of selected important forest insect taxa.

10. Goals for 1988-89:

Goals 1-5 transferred from NOR-11-03

1. Develop skills in diagnostic procedures for identification of the mature and immature stages of forest insects of the region.

2. Initiate biosystematic and ecological studies of the genus Pissodes of the the region.

3. Become familiar with the curatorial and maintenance procedures of the permanent insect collection at NoFC.

4. Become knowledgeable of procedures to enter, access, retrieve and process data stored in FIDSINFOBASE.

5. Provide maintenance and improvement of nursery stock for foliage and food materials for insect rearing.

6. Provide diagnostic and taxonomic services for determinations of mature and immature insects damaging forest and shade trees.

7. Maintain and improve reference collection of insects and mites by updating the current collection, adding new insect specimens and initiating a computerized catalogue for accessing the collection.

8. Provide advice, information and specimens to scientists engaged in taxonomic and biological studies and to clients.

9. Monitor the spread of introduced forest insects as well as their predators and parasites in the Canadian prairies.

Added Goals:

10. Present a scientific paper at the 18th International Congress of Entomology, Vancouver, July 3-9.

11. Set up a laboratory for starch-gel and polyacrylamide electrophoresis and develop electrophoretic protocols for Pissodes spp. in the region.

12. Initiate studies on insect communities associated with and contributing to the deterioration of jack pine killed by jack pine budworm in Manitoba (Volney,Langor).

13. Organize collection of slides of forest insects and initiate a computerized catalogue for accessing the collection.

11. Accomplishments in 1988-89:

1. Some training in the identification and taxonomy of some regional forest insects was received from H. R. Wong. Much time was spent studying the reference collection and insect material submitted for identification to increase familiarity with the local forest insect fauna.

2. Pissodes strobi and P. terminalis were reared to obtain specimens to be used in subsequent laboratory experiments. Predators and parasites were collected and a study was initiated to survey the fungi dessiminated by Pissodes species. The NoFC collection of Pissodes is being studied to find morphological characters to discriminate among species.

3. Familiarity with the curatorial and maintenance procedures of the insect collection was attained under the guidance of H. R. Wong.

4. Attended a workshop on forest pest management information systems at PNFI where procedures for entering, accessing, retrieving and processing data stored in FIDSINFOBASE were learned. Data from the 1988 enclosure slips are currently being entered into FIDSINFOBASE.

5. Nursery stock was watered and fertilized and maintained in excellent condition.

6. Fifty-four insect collections were identified for FIDS personnel as well as 17 collections (approx. 200 specimens) for NoFC personnel and clients. Five collections were sent to the Biosystematics Research Centre and four to other experts for identification or confirmation. Thirty collections of immature insects (500-600 specimens) were reared to adults to facilitate identification and obtain parasites.

7. The insect reference collection was moved to room 2053 and is undergoing re-organization and expansion to incorporate portions of the storage collections. About 800 new specimens were added to the collection. An updating of the names of all species in the

collection was commenced in preparation for creating a computerized catalogue.

8. Advice and information was given to 12 clients and NoFC personnel. Requests for insect specimens was received from 5 sources. Specimens (189) were donated to four individuals/institutions and 71 specimens were loaned.

9. A survey was made in 1988 for four introduced insects. The introduced pine sawfly was collected at four localities, the larch casebearer at one locality and the mountain ash sawfly at one locality in Manitoba. There were no significant range extensions. All specimens were reared to collect parasites. The European spruce sawfly was not collected.

10. Presented a paper titled "Host effects on the population genetics and dynamics of the mountain pine beetle, Dendroctonus ponderosae Hopkins (Coleoptera: Scolytidae)".

11. Have assessed equipment and supplies required to set up an electrophoresis laboratory and prepared a budget. Some supplies have been ordered. Pissodes specimens have been collected to be used in developing electrophoretic protocols. Relevant literature has been reviewed.

12. Logs were cut from 24 jack pine defoliated by the jack pine budworm near Thompson, Manitoba and returned to NoFC. To date approximately 400 insects, spiders and mites have been reared and are currently being identified.

13. Organization and catalogueing of the FIDS slide collection has started A coding system has been developed to aid in organization.

12. Present Status of Study:

Familiarity with curatorial and maintenance procedures of the insect collection has been achieved and development of diagnostic skills is continueing. Diagnostic and taxonomic services have been taken over from H. R. Wong. The insect reference collection is undergoing re-organization and scientific names of insects are being updated. Advice, information and insect specimens are provided to scientists and clients clients on request.

Basic familiarity with procedures for accessing and querying FIDSINFOBASE has been attained allowing entering, retrieving and processing of data as needs arise. Further development of skills for processing data are ongoing.

A study of the systematics and ecology of Pissodes species in the region has commenced. Pissodes terminalis and P. strobi have been collected and preparations for laboratory food choice studies and genetic analyses are underway. The creation of an electrophoresis laboratory to study genetic variability in Pissodes and other forest insects has started. The predators and parasites of the Pissodes species in our region are

currently being surveyed as are the fungi dessiminated by Pissodes. An examination of the morphology of Pissodes species in the region is underway to find characters to discriminate among species. About 400 papers on Pissodes have been compiled and are being read in preparation for research and for writing of an information report titled: "A Bibliography of Pissodes literature".

Organization of the FIDS photographic slide collection (10,000-15,000 slides) has started. A catalogueing system has been developed to facilitate more ready access to the collection.

For the last 5 years, H.R. Wong has been monitoring the spread of four forest insects (European spruce sawfly, introduced pine sawfly, larch casebearer, mountain ash sawfly) and their parasites in the prairie provinces. This study will be continued by D. Langor. Six collections of these species were made in eastern Manitoba in 1988.

13. Goals for 1989-90:

1. Continue to develop diagnostic skills for identification of the immature and mature stages of forest insects of the region.

2. Provide diagnostic and taxonomic services for determinations of mature and immature insects damaging forest and shade trees.

3. Maintain and improve reference collection of insects and mites by updating the current collection, adding new insect specimens and compiling a computerized catalogue for accessing the collection.

4. Provide maintenance and improvement of nursery stock for foliage and food materials for insect rearing.

5. Provide advice, information and specimens to scientists engaged in taxonomic and biological studies and to clients.

6. Enter, retrieve and process data from FIDSINFOBASE when necessary.

7. Continue organization of the FIDS photographic slide collection and compilation of a computerized catalogue for accessing the collection.

8. Continue biosystematic and ecological studies of the genus Pissodes of the region:

   a. Complete assembly of an electrophoresis laboratory and develop electrophoretic protocols for Pissodes species in the region.

   b. Initiate a genetic survey of the Pissodes species in the region

   c. Cross breed P. terminalis from jack pine and lodgepole pine to determine compatibility.

d. Set up permanent plots in the Whitecourt area of Alberta to monitor the effects of cutting the overstory on incidence of P. strobi attack on white spruce.

e. Search for populations of P. terminalis in boles of lodgepole pine and jack pine for comparison with populations in terminals.

f. Continue survey of predators and parasites of Pissodes.

g. Continue survey of fungi dessiminated by Pissodes.

h. Search for populations of Pissodes associated with witches broom on conifers.

i. Continue searching for morphological characters to discriminate among Pissodes species in the region.

j. Prepare a bibliography of Pissodes literature for publication as an information report.

9. Monitor the spread of introduced insects as well as their predators and parasites in the prairies.

10. Continue studies on insect communities associated with and contributing to the deterioration of jack pine killed by jack pine budworm in Manitoba (Volney, Langor).

Manitoba Agreement:

11. Initiate a study of P. strobi phenology in white spruce plantations in the Inter-lakes region of Manitoba.

12. Set up permanent plots in the Inter-lakes region of Manitoba to monitor the effects of cutting the overstory on incidence of P. strobi attack on white spruce.

14. Publications 1988-89:

Langor, D. W. 1988. The lodgepole terminal weevil. Pages 2-3 in K. I. Mallett (comp.). Forest Insect and Disease Notes, December, 1988. Can. For. Serv., North. For. Cent., Edmonton, Alta. Tech. Transfer Note A-007.

Langor, D.W. 1988. Host effects on the population genetics and dynamics of the mountain pine beetle, Dendroctonus ponderosae Hopkins (Coleoptera: Scolytidae). (Abstract) Page 431 in Proc. XVIII Internat. Congr. Entomol., Vancouver, B.C., Canada, July 3-9, 1988.

Langor, D. W. 1989. Host effects on the phenology, development and mortality of field populations of the mountain pine beetle, Dendroctonus ponderosae Hopkins (Coleoptera: Scolytidae). Can. Ent. 121: (in press).

Langor, D. W.; Raske, A.G. 1988. Mortality factors and life tables of the eastern larch beetle, Dendroctonus simplex (Coleoptera: Scolytidae), in Newfoundland. Environ. Entomol. 16:959-963.

Langor, D. W.; Raske, A.G. 1988. Annotated bibliography of the eastern larch beetle, Dendroctonus simplex LeConte (Coleoptera: Scolytidae). For. Can., Newfoundland For. Cent., St. John's Newfoundland, Info. Rep. N-X-266.

Langor, D. W.; Raske, A.G. 1989. The eastern larch beetle; another threat to our forests. For. Chron. 65: (in press).

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1988 Completion: Continuing

17. Resources 1989-90:

PYs:	Prof.: Langor	1.0
	Tech.:	0.0
	Total	1.0
	Term/Student	0.3

O&M: $8.0 K

Capital: $5.7 K

18. Signatures:

Investigator

Program Director, Protection

Regional Director General

NOR-12-01

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 31, 1989

1. Project: Nursery Management and Tree Improvement

2. Title: Forest tree seedling and seed physiology

3. New: Cont.: X 4. No.: NOR-12-01

5. Study Leader: I.J. Dymock

6. Key words: Tree seedling physiology, cold hardiness, dormancy, physiological and biochemical testing, phenology, bareroot and container stock production, accelerated growth, flowering, cone and seed production.

7. Location of work: Northern Forestry Centre, Edmonton, Alberta; locations within Northwest Region as may be required.

8. Problem:

Inadequate forest regeneration has recently been identified as a major problem area, and a limiting factor in achieving sustained yield forest management. This is apparent both in the Northwest Region, as well as across the country. With the greatly increased demand for conifer seedlings for reforestation, there has been a concomittant increase in the demand for good quality conifer seed, and demands on nurseries for increased production of high quality seedlings for planting purposes. The increased demand for both container and bareroot seedlings to meet the increasing needs of both government and private sector reforestation has been receiving considerable attention.

Earlier research efforts were often focussed on applied aspects of intensive container and bareroot stock production, with emphasis on the assessment of growth requirements (nutrient, lighting, temperature and watering regimes), conditioning of seedlings for overwintering, methods of assessing dormancy and freezing damage, determination of adequate winter storage conditions, preplanting conditioning, and assessment of field performance(growth and survival) following outplanting. Some effort has gone into determining the negative and positive effects of accelerated growth, and other rearing practices on field performance of seedlings. Various methods of physiological testing of seedling quality and condition have been devised.

What has been absent is an in depth analysis of the environmental factors that influence seedling growth and development in both container and bareroot seedling production situations. Phenology, the study of the interaction of climatic factors with any biological process, can yield an inordinate amount of valuable information pertaining to overall seedling quality or condition, that can be utilized in the development or improvement of nursery management and tree improvement practices.

Thus, there is a need for detailed, long term analyses of the phenology of early growth and development of each conifer species of economic importance. These must employ the specialized testing techniques for monitoring environmental parameters as well as assessing morphological, physiological and biochemical events that occur from seed germination through to early field performance. A better understanding of the events that occur in the environment in which the seedling grows, and within the seedling itself, would provide information that would be useful in the development of new methods and procedures to assist production nurseries in the intensive culture of improved forest seedling stocks.

The requirements for greater quantities of high quality seed or for more genetically improved seed stocks, warrant further analysis of cone and seed production strategies. This leads to the need for a re-examination of methods for promoting early and enhanced flowering in those species that are recalcitrant in flowering, and seed production. Analysis of current practices indicates that flower induction treatments for some species could be initiated much earlier than was previously reported. For some species, this could be as early as during the first six months of growth. The interactions between supplemental lighting sources, the photoperiod used, and the use of applied endogenous growth regulators must be more fully examined for each species of interest for tree improvement and reforestation purposes.

Results could readily be applied to tree improvement programs for the development of seed orchards. Retrospective testing of seed from genetically superior seed stocks, that have established family test plantation histories of ten to fifteen years, should be carried out under optimal conditions for accelerated growth. Where strong positive correlations exist between field trials and early screening for superior growth and form under accelerated growth conditions, then culling of inferior stock could occur much earlier in the growth cycle. Under optimal accelerated growth conditions, seedling stocks might also be screened at an early age for insect and disease resistance, cold hardiness, and drought resistance.

Research investigations under this study, thus examine the physiological basis of nursery management and tree improvement practices. This entails the planning, conduct, analysis and reporting of basic and applied research in the primary areas of: a) overwintering physiology of container-grown nursery stock, b) accelerated growth practices, and c) the promotion and enhancement of early flowering and cone and seed production in economically important conifer species.

9. Study Objectives:

1. Conducts investigations into the physiological aspects of: a) the growing, conditioning, and physiological testing of container and bareroot seedlings, b) the assessment of field performance of tested seedling materials; and c) the promotion and enhancement of early flowering and cone and seed production.

2. Analyses and interprets existing and new research data in support of nursery management practices for seedling production, seedling conditioning, physiological testing, and the assessment of early field performance; and tree improvement practices related to accelerated growth and the promotion of early and enhanced flowering for tree breeding and cone and seed production.

3. Provides consultative services to federal, provincial and industrial agencies concerning the physiological basis of seedling production, conditioning, testing and field performance, and all aspects of the physiology of flowering and cone and seed production.

4. Performs the duties of a seed analyst for certification of forest reproductive material from the Western and Northern Region moving in international trade.

10. Goals for 1988-89:

1. Seedling physiological research

a. Complete preparation and review process of a scientific journal article manuscript on: OVERWINTERING PHYSIOLOGY OF LODGEPOLE PINE SEEDLINGS. Submit to the Can. J. For. Res.

b. Initiate and complete preparation and review process of a scientific journal article manuscript on: COMPARATIVE OVERWINTERING PHYSIOLOGY OF BLACK AND WHITE SPRUCE SEEDLINGS. Submit to the Can. J. For. Res. Prepare and present an oral scientific report on: A COMPARISON OF COLD HARDINESS IN BLACK AND WHITE SPRUCE SEEDLINGS, at the joint 1988 Annual Meeting of the Canadian Society of Plant Physiologists with the Canadian Botanical Association, to be held from June 5-9, 1988, at the University of Victoria, in Victoria, B.C.

c. Complete final year of cold hardiness and dormancy tests on 1987 jP. Compile data with 1985 and 1986 jP data and analyze. Complete analyses of 1984, 1985, and 1986 rP data. (Dendwick)

d. Initiate microscopic analyses of preserved samples collected during overwintering studies from 1983-88. Conduct needle primordia counts. Conduct mitotic activity/index determinations on buds and root tips. (Dendwick)

e. Investigate feasibility of initiating biochemical analysis work on freeze-dried samples collected during overwintering studies

through collaborative and/or contract work with university researchers. Seek funding/person-year sources.

2. Cone and seed physiological research on accelerated growth and the promotion of early/enhanced flowering in conifers

   a. Continue study on 1P. Monitor fourth year of growth, flowering and cone/seed production of surviving outplanted 1984 1P. Complete light, photoperiod and growth regulator treatments on replacement 1P stock. Outplant in the NoFC nursery. Compile and analyse all data with the initial results. (Dendwick)

   b. Continue study on wS. Monitor third year of growth, flowering and cone/seed production of surviving outplant 1985 wS. Complete light, photoperiod and growth regulator treatments on replacement wS stock. Outplant in the NoFC nusery. Compile and analyse all data with the initial results. (Dendwick)

   c. Continue study on jP. Monitor second year of growth, flowering and cone/seed production of surviving outplanted 1986 jP. Compile and analyse all data with the initial jP results. (Dendwick)

   d. Continue study on bS. Monitor first year growth, flowering and cone/seed production of surviving outplanted 1987 bS. Compile and analyse all data with the initial results. (Dendwick)

   e. Initiate study on rP. Seed and transplant 1989 rP seedlings, and initiate light, photoperiod and growth regulator treatments and monitor seedling growth and development. (Dendwick)

   f. Prepare and present an invited, oral technical report on: OPTIMIZING LIGHT SOURCES AND PHOTOPERIODS TO GAIN THE MAXIMUM USE OF YOUR GREENHOUSE SYSTEMS, at the Canada-Manitoba Tree Improvement Workshop on "Rearing Conifer Plants in Containers for Tree Improvement Programs", to be held January 26-28, 1988 in Winnipeg, Manitoba.

3. Provide consultative services to NoFC staff and Forestry Canada regional clients on matters concerning tree physiology and the physiological basis of nursery management and tree improvement practices.

4. Perform duties as seed analyst as may be required.

11. Accomplishments in 1988-89:

1. Seedling physiological research

   a. Completed writing of the journal article: PHENOLOGY AND MONITORING MORPHOLOGICAL ATTRIBUTES, DORMANCY AND COLD HARDINESS IN OVERWINTERING CONTAINERIZED LODGEPOLE PINE SEEDLINGS. Submitted to Proj. Leader/Prog. Director for approval/signatures with routing form. In peer review. Prepared and presented a

summary technical report on the results of the five year lodgepole pine overwintering study to the 1988 joint meeting of the Western Forest Nursery Council, B.C. Forest Nursery Association, and the Intermountain Forest Nursery Association, held August 8-11, 1988 in Vernon, B.C. Manuscript to be published in a proceedings in 1989.

b. Completed data entry, summaries, statistical analyses and preliminary figures for scientific journal manuscript on: COMPARATIVE OVERWINTERING PHYSIOLOGY OF WHITE SPRUCE VS. BLACK SPRUCE SEEDLINGS. (Wasarab/Hai) Prepared an oral scientific report: A COMPARISON OF COLD HARDINESS IN BLACK AND WHITE SPRUCE SEEDLINGS, for presentation, at the 1988 Joint Meeting of the Canadian Society of Plant Physiologists with the Canadian Botanical Association at the University of Victoria, June 5-9, 1988. Cancelled registration and withdrew the paper following the 1987-88 Annual Appraisal by Management Committee on May 18, 1988.

c. Completed final year of cold hardiness and dormancy tests on 1987 jP. Compiled data with 1985 and 1986 jP data, and conducted preliminary statistical analyses. Completed data entry and statistical analyses of 1984-87 rP data. (Dendwick/Chapman/Wasarab/Hai)

d. Deferred initiation of microscopic analyses of needle primordia and mitotic activity/index determinations on stored preserved samples collected between 1983-88, to 1990-91 fiscal year, due to a lack of trained technical personnel available to perform the work.

e. Deferred continuation of methods/bioassays development and the initiation of any biochemical analyses to 1990-91. Initiated preliminary discussions with University of Calgary researchers on feasibility of collaborating on biochemical analyses on stored freeze-dried samples from 1982-88 overwintering study. Few funding sources presently available. No further progress.

2. Cone and seed physiological research on accelerated growth and the promotion of early/enhanced flowering in conifers

a. Continued study on 1P. Monitored fourth year of growth, flowering, cone and seed production of surviving outplanted 1984 1P. Completed light, photoperiod and growth regulator treatments on replacement 1988 1P stock, and outplanted in the NoFC nursery. Compiled and analysed data and prepared preliminary figures for journal manuscript on initial results on: EARLY ACCELERATED GROWTH IN LODGEPOLE PINE. (Dendwick/Chapman/Wasarab/Semotiuk)

b. Continued study on wS. Monitored third year of growth, flowering cone and seed production of surviving outplanted 1985 wS. Completed light, photoperiod and growth regulator treatments on replacement 1988 wS stock, and outplanted in the NoFC nursery. (Dendwick/Chapman/Wasarab/Semotiuk)

c. Continued study on jP. Monitored second year of growth, flowering and cone and seed production of surviving outplanted 1986 jP. (Chapman/Wasarb/Semotiuk)

d. Continued study on bS. Monitored first year of growth, flowering and cone and seed production in surviving outplanted 1987 bS. (Chapman/Wasarab/Semotiuk)

e. Deferred initiation of rP study to 1991-92.

f. Prepared and presented an invited, oral technical report on: OPTIMIZING LIGHT SOURCES AND PHOTOPERIODS TO GAIN THE MAXIMUM USE OF YOUR GREENHOUSE SYSTEMS, at the Canada-Manitoba Tree Improvement Workshop on "Rearing Conifer Plants in Containers for Tree Improvement Programs", held January 26-28, 1988 in Winnipeg, Manitoba.

3. Provision of consultative services to NoFC staff and Forestry Canada regional clients

a. Responded to 87 client-initiated contacts, and provided consultative services as requested on matters relating to tree and general plant physiology, nursery management, tree improvement, and cone and seed collection and processing.

b. Attended and presented an invited oral technical report at the Canada-Manitoba Tree Improvement Workshop on "Rearing Conifer Plants in Containers for Tree Improvement Programs", held in Winnipeg, Manitoba, January 26-28, 1988.

c. Attended and presented an oral technical report at the 1988 Combined Meeting of the Western Forest Nursery Council, B.C. Forest Nursery Association, and Intermountain Forest Nursery Association, held in Vernon, B.C., August 8-11, 1988.

e. Collaborated with Drs. R.P. Pharis(Univ. of Calgary), F.C. Yeh, B.P. Dancik and I. B.-J. Jiang (Univ. of Alberta) in their AFDRTF-funded study on "Characterization of the native growth hormones of juvenile lodgepole pine, their relationship to vegetative growth, and inherent superiority in vegetative growth". This was accomplished by:

1) providing Dr. Pharis with unpublished data from NOR-12-01 accelerated growth studies on 1P to support his 1987-88 progress report to the AFDRTF review committee.

2) providing Dr. Pharis with individual freeze-dried shoots and roots of "fast" and "slow" growing phenotypes of surplus NOR-12-01 1P seedlings for continuing analysis of endogenous GA's and auxins.

3) providing Dr. Jiang with details of accelerated growth methods/rearing schedules for his retrospective greenhouse study of inherent superiority in early growth of 1P. The

testing will be conducted in 1989, primarily at the University of Alberta greenhouses, on seed from 120 progeny-tested half-sibling families provided by Dr. N. Dhir(AFS - Tree Improvement Program).

4. Seed analyst duties

No requests for seed analysis were received in 1988.

12. Present Status of Study:

The study was initiated in February 1981, with the hiring of the present study leader(I.J. Dymock). During 1981-82, the final requirements for his Ph.D. degree in Plant Physiology were successfully completed. At the same time, he developed a study proposal to investigate the physiology of overwintering in containerized conifer seedlings. This would involve studying the phenology of overwintering of economically important conifers under outdoor, ambient conditions.

This problem area for physiological research had been identified by nursery clients at the 1980 Prairie Federal-Provincial Nurserymen's Meeting, held November 13, 1980 at the Northern Forest Research Centre. It was felt that there was a decided lack of basic information on the development of dormancy and cold hardiness in overwintered containerized nursery stock, and of the possible effects of overwinter storage conditions on the survival potential of stored seedlings. The study was designed to monitor the phenology of dormancy and cold hardiness development in overwintering containerized seedlings, and its effects on overwintering success. This involved using methods that were currently available for use in nursery production for assessing dormancy and cold hardiness, and the assessment of any newly reported techniques that had potential for use in the Northwest Region.

Preliminary testing began on lP and wP during the latter part of winter in 1981-82, and continued with these species on a regular basis during the 1982-83 overwintering period. After some technical modifications, full scale weekly morphological assessments and dormancy and cold hardiness testing of 1983 lP and bS were conducted throughout the 1983-84 overwintering season. Following this season, a replicated testing program was initiated, whereby each species would be subjected to two subsequent years of biweekly replicate testing for each method used, following the inital year of weekly testing.

Testing of wS and rP were initiated during the 1984-85 overwintering season, as well as replicate work on lP and bS. Additional biweekly freezing tolerance/conductivity tests on shoots and roots of all four species were incorporated into the program. During 1985-86, the testing of jP was initiated, and replicate testing of the other four species continued. Replicate testing of lp, bS, wS and rP was completed during the 1986-87 overwintering season, and replicate work on jP was completed during the 1987-88 overwintering period.

Interim results have been reported to peer groups and clients at seven scientific and four technical meetings to date. Two technical reports on

early aspects of the work have been published and distributed in meeting proceedings. Two additional technical reports were prepared, presented at technical meetings, and are currently in press. To date, one scientific journal article on physiology of overwintering in lP has been completed and is undergoing peer review. A second scientific journal article on the comparative physiology of overwintering in wS and bS is in preparation. A third scientific journal article on the comparative physiology of overwintering in jP and rP will follow.

Cone and seed physiological research was initiated during 1982-83 with a study to investigate the comparative effects of fluorescent vs. high pressure sodium vapour lights on early accelerated growth of twelve conifer species. A technical report on the results was prepared, presented and published.

The interactions of light quality and quantity, photoperiod and the use of applied growth regulators are under study as means of accelerating early growth to promote early, enhanced flowering and cone and seed production. Interim reults have been reported on to peers and clients at five scientific and two technical meetings. One technical report is currently in press, and a scientific journal article on early accelerated growth in lP is in preparation.

Accelerated growth strategies may play a useful role in screening for inherent superiority in vegetative growth at an early age, under controlled environment conditions. Some invited collaboration is in progress with Drs. R.P. Pharis (Univ. of Calgary), F.C. Yeh, B.P. Dancik and I.B.-C. Jiang (Univ. of Alberta) on their AFDRTF funded study on: "Characterization of the native growth hormones of juvenile lodgepole, their relationship to vegetative growth, and inherent superiority in vegetative growth".

A collaborative study on "Altitude and latitude effects on lodgepole pine cone and seed maturation in the Alberta Foothills", was initiated in 1984, with Dr. A.K. Hellum (Forest Science, Univ. of Alberta), and was completed in 1985. A research paper was prepared and presented at a major symposium, and was subsequently published in the meeting's proceedings. This study has been terminated.

13. Goals for 1989-90:

1. Seedling physiological research

   a. Complete peer review/revision of the scientific journal article: PHENOLOGY AND MONITORING MORPHOLOGICAL ATTRIBUTES, DORMANCY AND COLD HARDINESS IN OVERWINTERING CONTAINERIZED LODGEPOLE PINE SEEDLINGS. Submit to Can. J. For. Res.

   b. Complete writing/peer review/revision of a scientific journal article: COMPARATIVE OVERWINTERING PHYSIOLOGY OF CONTAINERIZED WHITE AND BLACK SPRUCE SEEDLINGS. Submit to Can. J. For. Res.

c. Initiate preparation/writing of a scientific journal article: COMPARATIVE OVERWINTERING PHYSIOLOGY OF CONTAINERIZED JACK AND RED PINE SEEDLINGS.

d. Defer initiation of microscopic analyses on stored preserved bud and root tip samples to 1990-91.

e. Defer continuation of methods/bioassays development and initiation of biochemical analyses on stored freeze-dried shoot and root samples to 1990-91. Continue investigating possible collaborators and/or funding sources to conduct analyses.

2. Cone and seed physiological research on accelerated growth and the promotion of early/enhanced flowering in conifers

a. Continue study on lP. Complete writing/peer review/revision of a scientific journal article on: EARLY ACCELERATED GROWTH IN LODGEPOLE PINE. Submit to Can. J. For. Res. Monitor fifth year progress of outplanted 1984 lP and first year progress of outplanted 1988 replacement lP. (Chapman/student).

b. Continue study on wS. Initiate preparation/writing of a scientific journal article on: EARLY ACCELERATED GROWTH IN WHITE SPRUCE. Monitor fourth year progress of outplanted 1985 wS and first year progress of outplanted 1988 replacement wS. (Chapman/student)

c. Continue study on jP. Monitor third year progress of outplanted 1986 jP. (Chapman/student)

d. Continue study on bS. Monitor second year progress of outplanted 1987 bS. (Chapman/student)

3. Provision of consultative services

a. Provide consultative services to NoFC and ForCan staff and regional clients on matters concerning tree physiology and nursery management and tree improvement practices.

b. Continue collaboration with Drs. R.P. Pharis (U. of Calgary), F.C. Yeh, B.P. Dancik and I.B.-J. Jiang (U. of Alberta), on their study: "Characterization of the native growth hormones of juvenile lodgepole pine, their relationship to vegetative growth, and inherent superiority in vegetative growth". Provide Dr. I.B.-J. Jiang with scientific/technical advise for his retrospective lP study on inherent superiority in vegetative growth. Provide use of NoFC tray packing facilities for controlled container filling operations prior to his rearing 120 families of progeny-tested seed plus NoFC control seed, at U. of Alberta. Rear nine control groups of 4 "fast" and 4 "slow" AFS progeny-tested families plus stock NoFC lp seed, under accelerated growth conditions in NoFC greenhouse in support of U. of Alberta. study. (Chapman/student)

4. Perform duties as seed analyst on a request basis.

14. Publications 1988-89:

Dymock, I.J. 1989. Monitoring viability of overwintering container stock in the prairies - an overview of a five year lodgepole pine study. In Proceedings of the Combined Meeting of the Western Forest Nursery Council, Forest Nursery Association of British Columbia, and the Intermountain Forest Nursery Association, held August 8-11, 1988 in Vernon, B.C. T.D. Landis (Ed.). USDA For. Serv., Rocky Mountain For. Range Exp. St., Fort Collins, Colorado. Gen. Tech. Rep.,10 pages. (In press).

Dymock, I.J.; Dendwick, F.M. 1989. Effective use of weather records in conjunction with viability tests for monitoring stock quality. In I.K. Edwards (Compiler), Proc. of the 1987 Prairie Federal-Provincial Nurserymen's Meeting, September 8-10, 1987, Indian Head, Saskatchewan. ForCan, North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X- (In press).

Dendwick, F.M.; Dymock, I.J. 1989. Use of supplemental lights in conifer production - comparing benefits vs. costs. In I.K. Edwards (Compiler), Proc. of the 1987 Prairie Federal-Provincial Nurserymen's Meeting, September 8-10, 1987, Indian Head, Saskatchewan. ForCan, North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X- (In press).

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started:	1981	Completion:	Overwintering studies	=1990
			Revised	=1993
		Cone/seed/accelerated growth/flowering studies		=1993
			Revised	=1995

17. Resources 1989-90:

PYs: Prof.: Dymock 1.0
Tech.:

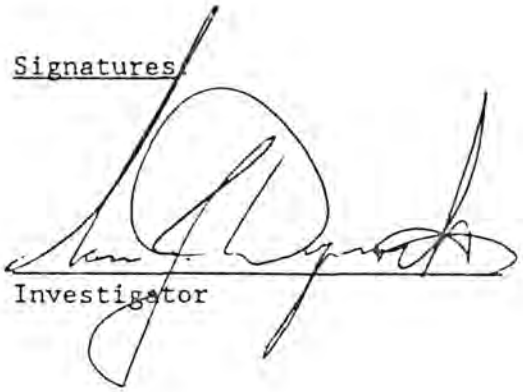
Total: 1.0

Term/Student:

O & M: $1,000

Capital:

18. Signatures:



Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 20, 1989

1. Project: Nursery Management and Tree Improvement

2. Title: Provenance tests for coniferous species

   Experiment a. (Formerly MS187, PNFI 93-I) Provenance experiments with the white spruce of Manitoba and Saskatchewan.

   Experiment b. (Formerly MS089, PNFI 96-J) Red Pine (Pinus resinosa) provenance experiment.

   Experiment c. (Formerly MS088, PNFI 201-F/G/H) Scots pine (Pinus sylvestris) provenance experiment.

   Experiment d. (Formerly MS234, PNFI 200) 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

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, Lonesand and Carberry, Manitoba; Holbein, Indian Head, and P.A. Pulp Camp 6, Saskatchewan; Reno, Alberta

8. Problem:

This study comprises provenance experiments with six conifer species. Five are sub-experiments of co-operative investigations initiated by

Petawawa Forest Experiment Station. The white spruce experiment was initiated by the District Forest Officer in Winnipeg.

Each experiment consists of one or more plantations containing populations of one species but of varying geographic origin, arranged in a replicated design. Populations are compared within experiments on the basis of mean performance at periodic observations usually on survival and growth plus other traits deemed appropriate for a particular experiment. The outcomes of the comparisons are used to draw inferences about (1) the productivity of the tested populations for planting in similar environments, (2) the usefulness of further provenance testing with the same species, (3) patterns of geographic variation, or (4) the value of the tested populations for breeding.

9. 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.

10. Goals for 1988-89:

1. Determine the appropriate disposition of documents pertaining to the terminated experiments, and dispose of these documents accordingly.

Jack Pine:

1. Draft a journal paper on results to 15 years in the plantation at Lonesand, Manitoba.

Black Spruce:

1. Complete tending of the Manitoba plantation and verify location, layout, and stocking in all plantations.

11. Accomplishments in 1988-89:

1. A revised version of the file report on the history and status of the experiments was prepared and distributed. An inventory was compiled of field records, data summaries, correspondence, and reports. The inventory was distributed with a covering letter. Documents for inactive experiments were placed in storage, along with old records from NOR-12-03.

Jack Pine:

1. Data analysis was done on results to 10 years in the plantation at Lonesand, Manitoba. Analysis was not done on data from 200-300 trees surviving at 15 years, and a journal paper was not drafted, owing to lack of sufficient time.

Black Spruce:

1. Tending was not done in the Manitoba plantation, and location, layout, and stocking were not verified in all plantations, owing to lack of funds and support staff for this goal.

12. Present Status of Study:

All objectives have been achieved as far as is feasible for the red pine, Scots pine, and Norway spruce experiments. Completion of objectives will not be feasible for the white spruce experiment. Objectives remain to be completed in future years for the jack pine and black spruce experiments.

13. Goals for 1989-90:

Jack Pine:

1. Draft an Information Report on results to 15 years in the plantation at Lonesand, Manitoba.

Black Spruce:

1. Tend the Manitoba plantation, and the other plantations as required.

2. Verify and document location, layout, and stocking in all plantations.

3. Measure height and diameter and score condition in all plantations after the 15th growing season from planting.

14. Publications 1988-89:

Klein, J.I. 1988. Recommendations for continuance or termination of provenance tests. Agriculture Canada, Canadian Forestry Service, Northern Forestry Centre. File Rep. NOR-12-02, December 1986, Revised April 1988.

15. Environmental Implications:

The NoFC Enviromental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1955 Completion: 2000

17. Resources 1989-90:

PYs: Prof: Klein 0.3
Tech: Chapman 0.1

Total: 0.4

O & M: Nil

Capital: Nil

18. Signatures:

Jerome V. Klein
Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 20, 1989

1. Project: Nursery Management and Tree Improvement

2. Title: Breeding jack pine for the Northern Region.

3. New: Cont.: X 4. No.: NOR-12-03

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: Lonesand, Marchand, Stead, Oakbank, and Boggy Creek, Manitoba; Smeaton, Meadow Lake, and Hudson Bay, Saskatchewan; Wildwood, Alberta

8. Problem:

This study is the first step in an applied breeding program, intended to identify superior genotypes in base breeding populations which are samples of wild populations. These superior genotypes will be propagated for establishment of seed orchards, not necessarily within this study. Future plantations planted with the output from those seed orchards, will have enhanced profitability in consequence of genetic gain achieved under this study.

The sampling and assessment strategy chosen for this study ensures efficient use of whatever genetic variation exists in the sampled populations. No evidence was available as to the magnitude of this variation prior to study initiation.

Breeding districts were delineated in eastern Manitoba, western Manitoba to eastern Saskatchewan, and central Saskatchewan to eastern Alberta. In each breeding district, family tests were established on representative sites, using open-pollinated progenies of parent trees selected primarily within each district. Each family test includes more than 200 progenies in replicated test plantations.

The tests are measured and data analyzed periodically for elucidation of genetic variation patterns within populations, selection of superior genotypes, and estimation of genetic gain from selection. When

appropriate, new trees are produced from selected trees in the test plantations or the clone bank, by grafting or controlled breeding, for establishment of seed orchards. Test results can also be applied by designating superior source locations for seed collections.

9. 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.

10. Goals for 1988-89:

1. Publish the manuscript entitled "Genetic variation of 10-year growth in eastern Manitoba jack pine" in a journal.

2. Provide functional guidance for development of jack pine seed orchards under the Manitoba FRDA, including designing the layout of the pedigreed eastern breeding district seed orchard at Oakbank.

3. Publish a Forest Management Note on selection of western district families at ten years.

4. Determine wood density of 200 disks cut from thinned trees of the district family test, and determine a rule for converting 12-joule pilodyne readings into wood density values for jack pine at 15 years from planting.

5. Analyze 15-year eastern district data to determine whether any seed orchard progenies should be discarded, to assess the amount of additional gain available by selection on 15-year results, and to begin selection of parents for second generation breeding.

6. Complete stock production and assist as required to establish a demonstration plantation with superior and average jack pine families at Pine Ridge Forest Nursery.

7. Continue to serve as chairman of the Canadian Tree Improvement Association.

8. Measure the western district family test at 15 years from planting.

9. Tend family test plantations as required.

10. Produce a video on the jP tree improvement program in the prairies.

11. 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. Act as Scientific Authority for contract involving tree improvement in Alberta under the FRDA.

13. Act as Scientific Authority for a contract to select parents for second generation breeding by analysis of 15-year data from the eastern breeding district family test.

11. Accomplishments in 1988-89:

1. The manuscript entitled "Genetic variation of 10-year growth in eastern Manitoba jack pine" was not published in a journal. A twice-revised version entitled "Heritability of growth in a southeastern Manitoba jack pine family test with cubic lattice design and stand structure" was re-submitted to the Canadian Journal of Forest Research in December 1988.

2. Provided functional guidance for development of jack pine seed orchards under the Manitoba FRDA, including designing the layout of the pedigreed eastern breeding district seed orchard at Oakbank, using a published FORTRAN program, and visiting the seed orchards established under the FRDA.

3. A Forest Management Note on the selection of western district families at 10 years was not published. A draft by P. Chapman is now under review.

4. Wood density of 200 disks cut from thinned trees of the eastern district family test was determined, and a regression formula was developed for converting 12-joule pilodyn readings into wood density values for jack pine at 15 years after planting.

5. Fifteen year eastern district data were analyzed, resulting in discarding of two seed orchard progenies. There would be sufficient additional gain from selection on 15-year results to justify establishment of additional seed orchard, so the area planted with current progenies was accordingly reduced from 10 ha to 6 ha. Family and within family heritability estimates were calculated, and can be used to select parents for second generation breeding.

6. Completed stock production, designed layout, delivered planting stock, and assisted planting for establishment of a demonstration plantation with superior and average jack pine families at Pine Ridge Forest Nursery. An establishment report is on file.

7. Continued to serve as chairman of the Canadian Tree Improvement Association. Planning and preparation for the 22nd meeting of the Association, scheduled for August 14-18, 1989, are proceeding satisfactorily.

8. Height and diameter were measured in all plantations of the western breeding district family test at 15 years from planting. Stem quality and top damage were scored in one plantation. Assistance was provided within NoFC, and by Saskatchewan District Office, Saskatchewan

Silviculture, Saskatchewan Regional Forestry Operations, Weyerhauser and the University of Alberta.

9. Family test plantations were not tended, owing to the lack of support staff during the field season and of funds.

10. A video was produced on the jack pine breeding program and pedigreed seed orchard in southeastern Manitoba.

11. Promoted and enhanced tree improvement technology by reviewing the Manitoba Draft Tree Improvement strategy, by discussing possible NoFC forest genetics research of interest to the Alberta Forest Service tree improvement program with the leader of that program, and by attending and reporting on two meetings concerned with biotechnology and micropropagation. There were no requests to act as regional contact for the national tree improvement program or to coordinate tree improvement in the region.

12. Acted as Scientific Authority for the contract involving tree improvement in Alberta under the FRDA by reviewing a draft report.

13. A contract was drafted for selection of parents for second generation breeding by analysis of 15-year data from the eastern breeding district family test. The contractor reports that a letter of agreement has been sent to Supply and services, who report no contact from the contractor. The graduate student designated to perform the analysis has not reported progress as of 6 January 1989.

12. Present Status of Study:

There has been preliminary identification of superior genotypes based on 10-year performance in family tests, for all three breeding districts. Scions or control-pollinated seeds have been produced for seed orchards in every district. Superior source areas have been identified in eastern Manitoba.

It is likely that selection decisions based on 15-year performance will call for only minor modification in light of subsequent performance. Maintenance and measurement of existing family tests to 25 years is proposed in order to determine inter-age correlations. Superior source areas can be identified for Saskatchewan and western Manitoba using data on hand.

Publication of the scientific findings obtained in the course of the breeding work is considered to be an implicit objective which has not yet been achieved.

13. Goals for 1989-90:

1. Continue to serve as Chairman of the Canadian Tree Improvement Association, including hosting the 22nd meeting.

2. Implement correction of deficiencies of the video on the jack pine breeding program and the pedigreed seed orchard in southeastern Manitoba.

3. Plan, organize, and implement a meeting to discuss the outcome of the first generation of jack pine breeding in Manitoba and Saskatchewan, and related topics, involving staff of Forestry Canada and of client agencies.

4. Publish the MS entitled "Heritability of growth in a southeastern Manitoba jack pine family test with cubic lattice design and stand structure" in the Canadian Journal of Forest Research.

5. Publish the MS entitled "Jack pine family selection in Saskatchewan based on ten year measurement" by P. Chapman as a Forest Management Note.

6. Produce a file report on the relationship between 12-joule pilodyn readings and wood density in jack pine at 15 years from planting.

7. Act as Scientific Authority for a contract to select parents for second generation breeding by analysis of 15-year data from the eastern breeding district family test.

8. Produce a mating plan, and plan and organize controlled breeding among selected parents of the eastern breeding district first generation breeding population.

9. Implement controlled breeding among selected parents of the eastern breeding district first generation breeding population to produce progenies for second generation breeding and a second stage pedigreed seed orchard.

10. Determine the scope and authorship of the next journal publication from the 10-year family test data and begin drafting a manuscript.

11. Advise a graduate student in the University of Alberta Department of Forest Science on preparation of a Ph.D. thesis and a journal paper on 15-year results of the eastern breeding district family test, plus new data on additional traits in the same test.

12. Complete collection of 15-year data in the western breeding district family test, including stem quality, top damage, western gall rust infection (with Y. Hiratsuka) wood density, and possibly other traits.

13. Promote, coordinate, and enhance greater use of tree improvement technology in this region and act as regional contact for the national tree improvement program.

14. Provide functional guidance for development of jack pine seed orchards under the Manitoba FRDA.

15. Tend family test plantations as required.

16. Act as Scientific Authority for the tree improvement program under the Canada-Alberta FRDA. Distribute progress report on tree improvement program.

14. Publications 1988-89:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1967 Completion: 2001

17. Resources 1989-90:

PYs:	Prof.:	Klein	0.7
	Tech.:	Chapman	0.9
	Total:		1.6
	Term/Student:		0.0

O & M: $2,000
Capital:

18. Signatures:

Jerome P Klein
Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 20, 1989

1. Project: Nursery Management and Tree Improvement

2. Title: Forest nursery research and technology transfer

3. New: Cont.: X 4. No.: NOR-12-04

5. Study Leader: vacant

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 Forestry Centre, Edmonton; Provincial Tree Nursery, Oliver; Alberta Forest Service Nursery, Smoky Lake, Champion Forest Products (Alberta) Ltd., Hinton; Blue Ridge Lumber (1981) Ltd., Whitecourt; Prairie Sun Greenhouses, Joffre, Alberta; Saskatchewan Department of Parks, Recreation and Culture Nurseries, Big River, Prince Albert, PFRA Tree Nursery, Indian Head, Saskatchewan; Pineland Nursery, Hadashville; Dakota Ventures, Portage La Prairie; Clearwater Provincial Forest Nursery, The Pas, Manitoba.

8. Problem:

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 bareroot 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. Relevant data on crop tolerance and efficacy are needed for these minor use registrations. In July 1984, a Tree Nursery Weed Control Committee (R.Hallet, ForCan, Fredericton; E. Harvey, ForCan, Edmonton; J. Maxwell, B.C.F.S., Surrey; B. Neill, C.D.A., Indian Head; and C. 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 NoFC and regional nursery facilities.

5. To conduct OECD seed inspections as required.

10. Goals for 1988-89:

1. Continue advisory service and investigate nursery problems.

2. Undertake OECD seed inspection work as required. Liaise with National Seed Centre, PNFI.

3. Cooperate with organizers of the 1988 Prairie Nurserymen's meeting to be held at Smoky Lake.

4. Participate in the Canadian Tree Nursery Weed Control Association and contribute to the workshop to be held at Pineland nursery, Hadashville, Manitoba.

5. Publish proceedings of the 1987 Prairie Nurserymen's Meeting held at Indian Head, Saskatchewan.

6. Complete data entry and analysis, and contract with E. Harvey to write a report on monitoring stock quality of wS and jP in Saskatchewan.

7. Continue to act as Co-Scientific Authority with A. Gardner for a contract to review forest nursery management under the Canada-Saskatchewan FRDA.

8. Initiate an experiment on seedbed density and incorporate root pruning and root wrenching as operational factors.

9. Develop calibration curves for nursery soil at Smoky Lake, Prince Albert, and Big River.

10. Monitor soil fertility and seedling nutrition in bareroot nurseries in Alberta and Saskatchewan. Develop a video on analysis of soil and plant tissue.

11. Accomplishments in 1988-89:

1. Continued advisory service and investigated nursery problems.

2. No OECD seed inspection work was undertaken.

3. The 1988 Prairie Nurserymen's meeting planned for Smoky Lake was postponed. It will be held in 1989.

4. There was no participation in the Canadian Tree Nursery Weed Control Association workshop held at Pineland Nursery Hadashville, Manitoba.

5. Edited and compiled proceedings of the 1987 Prairie Nurserymen's meeting held at Indian Head, Saskatchewan.

6. Completed data entry and contracted with E. Harvey to apply data and write reports on monitoring stock quality of wS and jP in Saskatchewan.

7. Reviewed contract proposal by R. Day to hold technology transfer workshops in forest nursery management under the Canada-Saskatchewan FRDA.

8. Experiment on seedbed density, root pruning and root wrenching was not conducted.

9. Held initial and follow up discussions with Genetics section, Pine Ridge nursery regarding nutrient calibration of soils in seed orchards and clone banks.

10. Monitored soil fertility and seedling nutrition in bareroot nurseries in Alberta and Saskatchewan. A proposal was submitted to Canada-Alberta FRDA to develop a video on soil and plant analysis.

12. Present Status of Study:

Jack pine and white spruce seedlings from Saskatchewan nurseries have been sampled during lifting and graded into various size classes. The purpose is to develop size class standards objectively. Morphological and physiological data have been collected for the stock while monitoring quality. The results indicated that a 21-day test for measurement of root growth potential was superior to a 7-day test.

All nurseries in the region were visited and prescriptions for herbicides, pesticides were developed to solve clients' problems.

Liaison was maintained with client nurseries and technology transfer was achieved through reports, meetings and workshops. Annually, there is a meeting of prairie nurserymen and the presentations are compiled into proceedings for their benefit.

Participated as a member of the Canadian Tree Nursery Weed Control Association and developed an experimental plan for a national trial of oxyfluorfen (goal) in forest nurseries.

13. Goals for 1989-90:

1. Investigate greenhouse and nursery problems and provide advisory service and technology transfer to regional nurseries.

2. Publish the proceedings of the 1987 Prairie Nurserymen's meeting held at Indian Head, Saskatchewan.

3. Act as lead NoFC contact in cooperating with organizers of the 1989 meeting to be held at Smoky Lake, Alberta.

4. Prepare drafts of two reports on size class standards and stock quality monitoring of jP and wS in Saskatchewan.

5. Provide appropriate recommendations on soil fertility management to nursery managers in Alberta and Saskatchewan, based on results of soil and plant analysis. Develop plan for video if proposal approved under the Canada-Alberta FRDA.

6. Participate in the Canadian Tree Nursery Weed control Association by attending workshops.

7. Undertake OECD inspection work as required. Liaise with National Seed Centre, PNFI.

8. Prepare soil calibration plan for use by the Genetics section, Pine Ridge Nursery in seed orchards and clone bank.

14. Publications in 1988-89:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1984 Completion: 1994

17. Resources 1989-90:

PYs:	Prof.: vice Harvey	0.9
	Tech.:	0.0
	Total:	0.9
	Term/Student:	0.0

O & M: Nil

Capital:

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 20, 1989

1. Project: Nursery Management and Tree Improvement

2. Title: Greenhouse and nursery operations

3. New: Cont.: X 4. No.: NOR-12-05

5. Study Leader: vacant

6. Key Words: NoFC greenhouse and nursery, facilities maintenance, management and planning

7. Location of Work: NoFC, Edmonton

8. Study Objectives:

   1. To administer NoFC greenhouse and nursery facilities.

   2. To provide advice on rearing bareroot and container stock to NoFC R & D staff.

9. Progress to Date:

   1. Sodium lamps were installed in the greenhouse.

   2. Extensive "clean-up" was conducted in the headerhouse and NoFC nursery complex.

10. Goals for 1988-89:

   1. Administer and maintain the NoFC greenhouse and nursery facility.

   2. Provide technical assistance and advice on rearing bareroot and containerized stock to other greenhouse users.

   3. Cultivate, fertilize, and release the Colorado spruce component of the nursery shelterbelt.

   4. Grow tropicals for NoFC reception area.

   5. Assess technical content of new greenhouses at Pineland nursery, and at the Pacific, Great Lakes, and Maritimes Forest Centres with regard to replacement of the NoFC greenhouses.

6. Provide, periodically status report on greenhouses to Program Directors to indicate greenhouse utilization by NoFC staff.

11. Accomplishments in 1988-89:

1. Administered and maintained the NoFC greenhouse and nursery facility.

2. Provided technical advice in seedling culture and application of herbicides and pesticides to other users of the greenhouse and nursery facility.

3. The Colorado spruce was weeded but was not cultivated and fertilized.

4. Tropicals were grown for the NoFC reception area.

5. New greenhouses in British Columbia, Manitoba, Ontario and New Brunswick were not assessed.

6. Provided, periodically, status reports on the greenhouses to Program Directors to indicate greenhouse utilization by NoFC staff.

12. Present Status of Study:

Three greenhouses, a headerhouse and a nursery have been administered for the benefit of users at NoFC and other agencies.

Assistance is provided to all users of the facility re cultural practices, fumigation and application of herbicides and pesticides.

The greenhouses are kept tidy for the benefit of other users and the nursery facility is weeded and cultivated each growing season.

Advice on safety procedures and on proper clothing has been provided to greenhouse users.

Chemicals, equipment, and supplies for general use have been ordered for users and an inventory of material is maintained.

Bedding plants and tropicals have been grown and maintained for the building and grounds at NoFC.

13. Goals for 1989-90:

1. Administer and maintain the NoFC greenhouse and nursery facility.

2. Develop a maintenance plan for the nursery area.

3. Cultivate and fertilize the Colorado spruce component of the nursery shelterbelt.

4. Assess technical content of new greenhouses at Pineland nursery and at Pacific, Great Lakes, and Maritimes Forestry Centres with regard to replacement of NoFC greenhouses.

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

15. Publications 1988-89:

Nil

16. Duration:

Start: 1984 Completion: 1995
Revised:

17. Resources 1989-90:

PYs:	Prof.:	vice Harvey	0.1
	Tech.:	Van Dyk	0.2
	Total:		0.3
	Student:		0.0
	Term:	Mills	0.5

O & M: Nil

Capital: $

18. Signatures:

Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 20, 1989

1. Project: Nursery Management and Tree Improvement

2. Title: Nursery soil fertility and seedling growth

3. New: Cont.: X 4. No.: NOR-12-06

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, Alberta; Prince Albert and Big River, Saskatchewan; Hadashville and The Pas, Manitoba

8. Problem:

Demand for conifer seedlings in the Prairie Provinces has been increasing steadily to meet reforestation needs. Traditionally, bareroot seedlings (lodgepole pine and white spruce in Alberta, jack pine and white spruce in Saskatchewan, and jack pine, red pine, Scots pine, white spruce, and black spruce in Manitoba) have been used to meet reforestation targets. However, sub-optimal quality of the nursery stock is a recurring problem owing to a) poor choice of location, soil too fine-textured for conifers and b) improper cultural practices and soil management techniques. The ideal soil texture for producing conifer seedlings is a sand or loamy sand, i.e., the total of silt and clay fractions should not exceed 20 percent. At one Alberta site, clay alone varies between 23 and 76 percent. Fine-textured soil reduces root growth because of high bulk density, drains slowly, and damages the root system during lifting.

Bareroot nurseries in Saskatchewan and Manitoba, although located on coarse or moderately coarse textured soil, are derived from calcareous parent material and are highly calcareous within or just below the root zone, depending on the fluctuating level of the groundwater. Because the soils are coarse, minimum levels of organic matter are necessary; because their pH is unsuitably high, acidification of the soil and irrigation water is required.

The intensive nature of seedling production (high seedling density, three-year crop cycle, and the removal of the complete plant from the

soil at harvest) results in a "mining action" where the plant nutrients are concerned. Replacement of soil fertility and plant available nutrients through fertilization and judicious application of irrigation water are necessary to maintain or improve the quality of stock produced. Plot experiments will be required to determine appropriate levels for seedling density and soil amendments.

Greenhouse production of containerized seedlings has been increasing steadily since 1970 to supplement the number of seedlings available for reforestation by client agencies. Operational development progressed so quickly that, in some cases, questions were being asked of the ForCan before we had the answers. Although requirements for light (quality and intensity), photoperiod, temperature, nutrients, growing medium, and container type and configuration are being tested for different species in different regions, minimal research and development was being done on conifer species that are of economic importance to the prairie provinces. Nutrition experiments have centred on proprietary fertilizers to determine the most effective dosage but there have been no factorial experiments to test nutrient combinations for these species.

Nature of Study:

Growing bare root and containerized coniferous stock under different fertilizer regimes and cultural practices in provincial nurseries in order to optimize production.

Benefits to be expected from the solution:

1. Higher quality of seedlings in terms of height, weight, top/root ratio and higher survival in stand establishment.

2. Reduced growing cycle in the nursery thus affording more efficient use of resources.

Probability of Success:

High but progress will be slow. Seedlings are grown in nurseries for three years before being field-planted. Besides, subsidiary work may be necessary to establish firm conclusions about certain treatments either in the nursery or at field sites.

Probability of results being put into practice:

Potentially high but decision rests entirely with provincial nursery management. Demonstration plots may be necessary to accomplish implementation.

Method Used:

Seedlings are grown in the nurseries in the presence of different combinations of N, P, and K fertilizers. The optimum combination will be selected according to seedling quality in the nursery and on field survival. Support studies of cultural practices will provide data on such aspects as best nutrient source, time and method of fertilization.

5. Conducted a growth chamber trial to determine the effect of a phosphorus - solubilizing fungus in nursery soil. The trial was repeated in the greenhouse using a higher fungal concentration prepared by Philom Bios Corporation.

6. Acted as project leader and coordinator of NOR-12.

7. Acted as Scientific Authority for a contract let to NOVA Corp. under the Canada-Alberta FRDA to develop a heat transfer model for overwintered containerized seedlings.

12. Present Status of Study:

Objective 1 is partially completed. In bareroot nurseries, the main thrust, presently, is soil calibration by relating soil nutrient inputs to stock quality produced. Work on hardening-off of containerized seedlings will continue and wrap up with a further revision of the present "guidelines" publication. Milestones are described below.

i) Nutrient status of the seedbed and transplant areas at the Prince Albert and Big River nurseries has been determined through soil sampling and chemical analysis (NOR-X-46, 1973; NOR-X-189, 1977)

ii) Experiments involving fertilizers (amount, type, form, and frequency), peat, sulphur and leaching have been conducted on jP and wS at Prince Albert (Forestry Report No. 24, 1981). These results have formed the basis for fertilizer prescriptions at nurseries not only in Saskatchewan but also in Alberta and Manitoba.

iii) Fertilizer experiments were conducted at the Provincial Tree Nursery, Oliver, Alberta. The soil was unsuitable for a conifer nursery owing to its heavy texture and a laboratory study to ameliorate it chemically, indicated that this was impractical. Use of tolerant hardwood species was recommended (NOR-X-187, 1977).

iv) Annually (since 1981), soil and plant samples have been collected at nurseries in Alberta, Saskatchewan, and Manitoba and submitted to NoFC for chemical analysis. On the basis of the analytical results, fertilizer prescriptions have been prepared for the nurseries prior to the next cropping season. (As of 1988, samples from Manitoba will be analysed, under contract, by the University of Toronto.)

v) Experiments to determine nutrient requirements of containerized seedlings in the rapid growth phase have been completed. On the basis of the results, a manual with guidelines was prepared in 1979 and later revised (NOR-X-214E, 1983). This publication is in use throughout the Prairies and enjoys wide circulation, generally.

vi) Nutrient requirements during hardening-off of lP, jP, wS, and bS have been determined and similar work on rP, and sP is in progress. A Forest Management Note (FMN) is in preparation.

9. 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.

10. Goals for 1988-89:

1. Publish FMN on residual effects of fertilization on bareroot seedlings at Prince Albert nursery.

2. Publish FMN on hardening-off of wS, 1P, bS, and jP. Analyze data for rP and sP and draft a FMN.

3. Prepare a paper "Effects of fertilization on hardening-off of red pine and Scots pine" for presentation at the 1988 Prairie Nurserymen's Meeting to be held in Smoky Lake, Alberta.

4. Provide advisory services in nursery soil fertility and tree nutrition.

5. Conduct a growth chamber trial to determine the effect of a phosphorus- solubilizing fungus in nursery soil. The trial will be done in collaboration with D. Maynard and the fungal preparation is being supplied by Philom Bios., Saskatoon, a company that is engaged in biotechnology research and development.

6. Act as project leader and coordinator of NOR-12.

7. Act as Scientific authority for a contract let to Nova Corp. under the Canada-Alberta FRDA to develop a heat transfer model for overwintered containerized seedlings.

11. Accomplishments in 1988-89:

1. Prepared draft FMN on the residual effects of fertilization on bareroot seedlings of Prince Albert Nursery.

2. Prepared a draft FMN on hardening off wS, 1P, bS, and jP. Analyzed data for rP and sP for inclusion in main report.

3. The paper "Effects of fertilization on hardening-off of red pine and Scots pine" was not prepared. The 1988 Prairie Nurserymen's Meeting was cancelled.

4. Provided advisory services in nursery soil fertility and tree nutrition.

vii) Technology transfer has been achieved throughout the duration of the study. Research presentations are made at nurserymen's meetings, annually, in the region and beyond and there is interaction with client agencies and organizations in investigating seedling growth problems and providing technical advice. Workshops on nursery soil fertility, water use, and stock quality monitoring were given in 1980 (Edmonton and Prince Albert) and 1987 (Winnipeg).

Objective 2:

An experiment to determine the effect of fertilizer inputs on residual soil fertility and growth of jP and wS at Prince Albert was completed in 1987. A FMN is in preparation. The results indicate nutrient loss from the soil, probably through leaching.

Objective 3:

This objective was postponed because of a Canada-Saskatchewan FRDA contract that was let in 1987 to review and assess cultural practices at Prince Albert and Big River nurseries. Recommendations included monitoring of soil moisture and increased water use efficiency.

13. Goals for 1989-90:

1. Provide advisory service, investigate seedling growth problems, and offer recommendations in soil fertility and seedling nutrition as requested by industry and government agencies.

2. Participate in a joint study involving CANFOR, Peat "T" Inc. and Forestry Canada.

3. Complete biotechnology tests analyze data and prepare a report for Philom Bios Corporation.

4. Complete preparation of reports on stock quality monitoring of wS and jP, using data analyzed by E. Harvey and present a paper at the 1989 meeting of the Prairie Nurserymen's Association.

5. Publish a FMN on the effects of residual fertility on bareroot wS and jP at Prince Albert nursery.

6. Develop methodology to calibrate soil fertility levels in seed orchards and clone banks at Pine Ridge nursery.

7. Publish a FMN on the effects of fertilization on hardening off wS, 1P, bS, rP, and sP.

14. Publications 1988-89:

Edwards, I.K. 1988. Frequency of fertilization and growth of containerized seedlings. In Proceedings of the Prairie Nurserymen's Meeting held at Indian Head, Saskatchewan, September 9-10, 1987. (In preparation).

Edwards, I.K. 1988. Calibration of nutrient prescriptions for bareroot nurseries. In Proceedings of the Prairie Nurserymen's Meeting held at Indian Head, Saskatchewan, September 9-10, 1987. (In preparation)

Edwards, I.K. 1988. Seedling growth in membrane and Spencer-Lemaire containers. For. Can., North. For. Cent., Edmonton, Alberta File Rep. NOR-12-06.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1972 Completion: 1993

17. Resources 1989-90:

PYs:	Prof.:	Edwards	0.8
	Tech.:	Van Dyk	0.8
	Total:		1.6
	Term/Student:		0.3

O & M: $7,000
Capital: Nil

18. Signatures:

I.K. Edwards
Investigator

Program Director, Resources

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 10, 1989

1. Project: Forest Hydrology and Microclimate Research

2. Title: Transfer of technology derived from the Alberta Watershed Research Program, 1963-1986.

3. New: Cont: X 4. No.: NOR-13-01

5. Study Leader: R. H. Swanson

6. Key Words: Hydrologic model, forest climate, gauged basin, soil water.

7. Location of work: Northwest Region

8. Study Objectives:

   1. To design and propose specific land management practices to increase annual water yield, retard flood peaks or improve on-site watershed condition.

   2. To assist in the evaluation of land management practices with respect to their influence on the hydrologic regime of specified test areas.

   3. 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 1988-89:

   1. Publications:

      a. Prepare critique and review of Marmot and Streeter Basin projects for presentation at Canadian Hydrology Symposium-88, 9-11 May 1988. (Swanson with contributions from Alberta Environment, IWD, AES) (87-02)

      b. Prepare and present paper on "Patterns of nutrient depletion in spruce-fir and aspen-grassland research basins in Alberta", at Canadian Hydrology Symposium-88, 9-11 May 1988, Banff. (Singh, Kalra) (88-01)

Added Goal

c. Publish notes from ACH/CWRA sponsored lecture tour.

2. Interaction with provincial clients:

a. Terminate all NoFC involvement in Marmot Creek Basin. Assist Alberta Environment in final removal of instrumentation and clean-up of basin during the summer. Continue to assist in the use of Mount Allan (Marmot) data. Continue to compile and archive data from microloggers serviced by Alberta Environment. Supply data in machine readable or printed form upon request. (Fisera, Hurdle, Swanson) (86-01)

b. Assist Saskatchewan Water Corporation and Parks officials in the application of the WRENSS procedure to the design of a harvesting pattern for the watershed that will increase the water level in Kenosee Lake in Moose Mountain Provincial Park, Saskatchewan. (Swanson) (88-02)

c. Assist in use of WRENSS and other hydrologic tech transfer procedures on ad hoc basis. (Swanson) (88-03)

3. Interaction with outside agencies and NoFC staff:

a. Attend annual and executive committee meetings of the NRC Associate Committee on Hydrology as For Can member. Continue to provide input into the research priorities sub committee of the ACH. (Swanson) (76-01)

b. Continue as organizer and general chairman of Canadian Hydrology Symposium-88 on results from small basin research. Complete selection of papers, finalize technical program and field trips. Prepare final program, assist in registration and conduct of symposium. Assist in preparation of camera ready copy of papers for publication. (Swanson, help from Fisera and Hurdle at symposium) (85-03)

c. Serve as acting editor, Canadian Journal of Forest Research, from January 17 through 25 April 1988 while the editor is away from Edmonton on sabbatical. (Swanson) (87-04)

d. Prepare indexed database for Marmot and Streeter transparencies and photographs in Swanson's collection. (Fisera) (87-05)

e. Continue as general chairman for 1988 Western Snow Conference meeting in Kalispell in April. Complete selection of papers, notify authors and have WSC general secretary forward typing and format instructions to accepted authors. Assemble program materials for transmittal to WSC secretary for printing of program. Assemble camera ready copy supplied by authors for transmittal to publications committee. (Swanson) (87-08)

f. Initiate Canada-wide hydrologic modeling program to provide a common research framework and technology transfer tool. (Swanson) (88-04)

10. Accomplishments in 1988-89:

1. Publications:

a. The critique Entitled "The Marmot and Streeter experimental basin programs" by Swanson (CFS), Hume (AES) and Morton (WSC) was prepared and it will be published as part of the proceedings of this symposium. (87-02)

b. The paper on "Patterns of nutrient depletion in spruce-fir and aspen-grassland research basins in Alberta", for poster presentation the Canadian Hydrology Symposium-88, 9-11 May 1988, Banff, was prepared and presented. It will be published in the proceedings of this symposium. (Singh, Kalra) (88-01)

c. A series of lecture notes for the ACH/CWRA sponsored lecture tour was published in Hydrologic Events 13(2):6-10.

2. Interaction with provincial clients:

a. The clean-up of research debris from Marmot basin was completed as scheduled. Requests for data have been, and will continue to be handled on an ad hoc basis. (86-01)

b. The WRENSS procedure was used to conduct an analysis of the water yield situation at Kenosee lake in Saskatchewan. This analysis indicated that forest cutting could be used to increase water yield to the lake's aquifer by from 2000 to 5100 dam^3 each year. These results were reported to Saskatchewan provincial parks officials for their action. (88-02)

c. Ten requests for the WRENSS snow dominated procedure were filled. A first version of the WRENSS rain-dominated procedure has been sent to selected individuals for evaluation and testing. A term position was filed for 6 months to complete this and other tasks. (88-03)

3. Interaction with outside agencies and NoFC staff:

a. Attended the annual and executive committee meetings of the NRC Associate Committee on Hydrology as For Can member. Also participated in the research priorities sub-committee of the ACH. The ACH has decided to rotate its membership on a scheduled basis from 1988 onward. My term elapses on 31 March 1989. Eugene Hetherington, PFC, Victoria, has been attending as my alternate for the past two years, and will be appointed as ForCan member effective 1 April 1989. (76-01)

b. The symposium was held May 9-11,1988 at Banff. Thirty oral and 22 poster papers were presented. Most of the authors prepared

critical assessments of one or more research basin programs in their geographical area. These assessments have been reviewed and a paper summarizing experience with the Canadian research basin program and recommendations for those contemplating future basin programs has been prepared. The camera-ready copy is in final preparation, and the Symposium proceedings should be available for distribution in April or May 1989. (85-03)

c. Served as acting editor Canadian Journal Forest Research from January 17 to April 25,1988 and from Dec 12,1988 to January 12,1989.

d. The photograph indices were not prepared: Fisera was assigned work transfering Marmot data to computer format as a higher priority.

e. Organised and chaired the Western Snow Conference annual meeting in Kalispell in April 1988. Reviewed and selected papers for presentation, collected camera ready copy from authors and forwarded papers to general secretary for publishing. The proceedings were published and distributed by September 1988.

f. Have started work toward the Canada-wide hydrology modeling program by arranging for two months of intensive training on the HSPF model and by arranging for Hetherington, PFC, to work with me to put Carnation Creek on the model. Should have both Marmot and Carnation Creek operational by early summer 1989.

11. Present Status of Study:

1. The experimental phase of this study has been completed. The Marmot and Streeter experimental basin programs have been terminated and the results published. Data from these and other research facilities have been incorporated into a procedure (WRENSS) for evaluating the effect of existing or proposed forest practices on annual water yield.

2. The current role of this study is primarily one of technology transfer. The WRENSS procedure needs to be brought to the attention of forest managers throughout the region, and to some extent, throughout Canada. At present this is being accomplished through the organization of symposia and through lectures. However, the most effective technology transfer method appears to be through hands-on demonstration of the procedure's use on the users data and problems.

3. The future role beyond gaining acceptance and application of WRENSS has not been decided. We will be demonstrating the use of the rain-dominated WRENSS procedure for use in the more humid forested areas on Canada's east and west coasts.

4. We have initiated work on a more comprehensive hydrologic procedure (HSPF model training at Mountain View) to assist in the solution of

soil moisture and shallow groundwater management problems as affected by forest density and arrangement. This same technique can be used to provide reasonable estimates of the water levels in streams at critical periods, e.g. flood peaks from storms or snowmelt, low flows to maintain fish populations in late summer. The implementation of this model on For Can-VAX computer installations across Canada should provide further communication between researchers in hydrology and local application as a technology transfer tool.

12. Goals for 1989-1990:

1. Publications:

a. Complete editing and composition of CHS88 proceedings. Send to printers and distribute to symposium participants. (Swanson)

b. Publish critique of Marmot and Streeter basin projects in proceedings CHS88. (Swanson, Hume [AES] and Morton [IWD])

c. Publish review of Canada's National Research Basin Program in proceedings CHS88 and in UNESCO's "Nature and Resources": Journal. (Swanson, Dickinson [Trent University], Young [Wilfrid Laurier University])

d. Submit for review a paper on the WRENSS procedure for estimating annual water yield change from forested watersheds in both rain and snow dominated hydrologic regions of Canada. (Swanson)

2. Interaction with provincial clients:

a. Continue work with Saskatchewan Water Corporation and Saskatchewan Parks officials to find a watershed management solution to the levels of water in Kenosee Lake, Moose Mountian Provincial Park. (Swanson)

b. Continue to assist in the use of WRENSS and HSPF on ad hoc basis. (Swanson)

3. Interaction with outside agencies and NoFC staff:

a. Attend annual and executive committee meetings of the NRC Associate Committee on Hydrology in Nova Scotia in June. My membership on this committee will terminate after the June meeting; I have requested Ottawa HQ that Eugene Hetherington, PFC Victoria, be appointed as Forestry Canada member to succeed me. (Swanson)

b. Carry out duties as General Chairman, Western Snow Conference through two-year term expiring at the conclusion of the 1990 annual meeting in Sacramento, California. Attend 1989 annual meeting 17-21 April, Fort Collins, Colorado. (Swanson)

c. Work with various Forestry Canada research centres in Victoria, Quebec City and Fredericton to implement the HSPF model on their VAX computer on ad hoc basis. (Swanson)

d. Continue to work up Marmot data into machine compatible formats for use in HSPF model and to supply to users upon request. (Fisera, Hurdle)

13. Publications 1988-89:

Swanson, R.H. 1988. The Alberta watershed research program -- a model to emulate or to avoid. Hydrologic Events 13(2):6-8.

Swanson, R.H. 1988. WRENSS -- a model-based procedure for estimating the annual evapotranspiration from forested and partially forested catchments. Hydrologic Events 13(2):8-9.

Swanson, R.H. 1988. Measurement of transpiration -- a hydrological and physiological process. Hydrologic Events 13(2):9-10.

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

15. Resources 1989-90:

P/Ys:	Prof:	Swanson	0.5
	Tech:	Fisera	0.5
		Hurdle	0.1
	Total		1.1
	Student:		0.3

O&M: $6,000
Capital: Nil

16. Duration:

Started: 1963 Estimated Completion: 1993

17. Signatures:

Investigator

Program Director, Environment

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 10, 1989

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

5. Study Leader: R. H. Swanson, vice Bernier

6. Key Words: Hydrologic modelling, snowmelt, evapotranspiration, soil water movement, transpiration.

7. Location of work:

Phase I - James River microclimate site near Sundre, Alberta and Northern Forestry Centre, Edmonton, Alberta.

Phase II- Southern portion of Bow and/or Oldman River Basin
Bark beetle outbreak areas in Alberta and/or British Columbia
Other areas in Northwest Region as needed.

8. Study Objectives:

1. To develop vegetation manipulation-hydrologic models applicable to the prescription and evaluation of forest management activities in the Northwest Region.

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 basin. 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 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. In areas where water supply is not plentiful, the reduction of the snowpack through evaporation can also result in reduced growth of trees, or, in the extreme case, mortality of regeneration.

The evaporation process is affected by wind speed, temperature and air dryness. Evaporation occurs from snow on the ground even at temperatures below 0 °C. Snow evaporation is thought to be especially important in Chinook areas such as southern Alberta where wind speeds are high and the air is often dry and warm for extended periods during the winter. There, 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. We know from recent measurements taken at the James River experimental site that evaporation from snow in a large clear-cut is at least 5 times greater than that in the forest, and 3 to 4 times greater than that in a 1 ha cut. With measured rates of nearly up to 2 mm per day, and potential calculated rates of near 1 cm per day in extreme meteorological conditions, evaporation from exposed snowpacks can have a substantial impact on seedling survival or water yield.

The essence of the problem is that the mathematical tools for estimating snow evaporation have been developed for smooth fields, and cannot be directly applied to "rough" surfaces like clear-cut edges, clear-cuts with debris, or regenerating clear-cuts. 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, vapour concentration and site-specific roughness parameters. 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 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 has been carried out in the James River microclimate study site near Sundre. In a continuation of Phase 1, the investigation on snow evaporation is being carried out for a young stand of lodgepole pine. The work is performed on a small artificial stand of 2-3 m pines near the Northern Forestry Centre. From this particular experiment, we expect to get some idea of the length of the "recovery" period, or how quickly does regeneration shelter the snow from the wind. We also want to relate the effect on wind profile to the geometry of the canopies and to the structure of the stand. In that way, results obtained here will be transferable to natural juvenile stands. Once we feel

that we can predict snow evaporative loss under a variety of conditions, Phase II will be implemented to give us a wider variety of field conditions to validate our techniques.

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.

Dr. Hiratsuka has been studying the mechanism of death of trees invaded by bark beetles. Two hypotheses have been advanced. 1) The beetles either release a toxin, or cause one to be released, that interferes with the stomatal mechanism of the leaves and the tree dehydrates out of control, with water loss much greater than can be supplied from the soil. 2) The blue stain fungi that accompany the bark beetles invades the sapwood, plugs the xylem, and cuts off the upper parts of the tree from water from the soil.

The heat pulse velocity instrumentation developed during earlier years in this project can be used to determine transpiration from beetle infested trees. It can also be used to test for sapwood blockage in xylem where only a portion of the xylem in a cross section is affected by blue stain fungi. Dr. Hiratsuka has developed techniques for inoculating xylem with various fungi. A test of the inoculating technique in conjunction with measurements of heat pulse velocities will give us a chance to determine if stomatal failure or xylem blockage is the primary cause of death from bark beetle attacks. This same study will also give us insight to the value of the HPV technique as a diagnostic tool in pathological and physiological investigations.

3. Water stress of seedlings on mechanically-prepared micro-sites.

Currently, about 41% of cut over lands in Alberta are considered not sufficiently regenerated with softwoods. The seedling production and planting costs for such a large area will be very large. It is therefore important to achieve a high survival rate of planted stock. The Alberta Forest Service's Research Division is currently investigating the effect of mechanically produced micro-sites on the seedlings' chance of survival. Their work has so far concentrated in characterizing seedling root generation capacity before planting, and on a few field trials involving the planting of seedlings on different portions of mounds created by a Bracke Mounder. However, they lack the expertise and equipment to investigate extreme water stress, one of the key parameters in seedling survival or mortality.

The purpose of our research effort is to quantify the degree of water stress that occurs on various sites and exposure as a

function of the silvicultural activities that have taken place. We hope to link the work on snow evaporation with the water stress aspect and study how, in some of the more critical locations, water stress can be reduced through appropriate management practices.

4. Effect of groundwater management practices (primarily drainage) on plant water stress and photosynthesis.

Researchers at the University of Alberta have observed that spruce growing on saturated sites have reduced growth rates after drainage. They installed dendrometer bands and observed an increase in circumference for a very short period during the spring, and occasionally in response of rain of sufficient duration and intensity to saturate the porous soil surface. These observations are symptoms of water stress.

The purpose of our proposed investigation is to ascertain the physiological state of these trees versus those on undrained poor-growth sites and well-drained good-growth sites. These data, coupled with those from other NoFC studies should help in the specification of proper drainage programs to maintain the proper soil water conditions for improved tree growth.

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, vapour 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 from the snowpack by evaporation in 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 to snow loss coefficients in WRENSS).

3. Transpiration of beetle-infested pine.

a. Assist Dr. Hiratsuka and others in using the Heat Pulse Velocity technique in determining the transpiration regime of

healthy lodgepole pine trees, and those infected by blue stain fungi.

b. Install heat pulse velocity sensors in xylem above locations inoculated with various fungi and placebo material to ascertain if the fungi plug the sapwood.

4. Water stress of seedlings.

a. Evaluate instrumentation and techniques needed to characterize water stress of seedlings on micro-sites.

b. Determine relationships between site physical characteristics and soil water availability.

c. Test and prescribe forest management techniques to alleviate water-stress related mortality in reforested cut blocks.

5. Effect of groundwater management practices (primarily drainage) on plant water stress and photosynthesis.

a. Determine the differences in water use and/or stress of spruce growing on overly-drained, undrained and good sites.

b. Determine optimum soil moisture and water table levels to maintain maximum growth rates.

c. Test and prescribe drainage programs to alleviate water-stress related poor growth on formerly saturated sites that have been drained.

8c. Current resources:

1. Snow disposition phase I and II

Starting date: 1984-1985
Estimated date of completion: 1993
Estimated Prof. PY: 0.5 per year
Estimated Tech. PY: 1.0 per year

2. Transpiration of beetle-infested pine and water relations of trees on drained sites

Starting date: 1985
Estimated date of completion: 1993
Estimated Prof. PY: 0.1 per year
Estimated Tech. PY: 0.1 per year

3. Water stress of seedlings

Starting date: ? (No personnel to carry out work)
Estimated date of completion: ?
Estimated prof. PY: 0.5 per year
Estimated tech. PY: 0.5 per year

9. Goals for 1988-89:

1. Publications:

a. Submit for review:

1. A paper on using the heat pulse velocity technique in pathological investigations. (Swanson, Hiratsuka) (87-01)

2. A paper on invasion of xylem sapwood by fungi entitled "Inoculation of lodgepole pine with four blue-stain fungi associated with mountain pine beetle, monitored by a heat-pulse velocity (HPV) instrument." (Yamaoka, Swanson, Hiratsuka) (87-02)

b. Prepare and publish "The effect of evaporation on snow distribution in partially clear-cut forests", at the 1988 Western Snow Conference. Swanson) (88-02)

Added Goal

c. Prepare paper on "Wind speed and snow evaporation in a stand of juvenile lodgepole pine in Alberta" (Bernier).

2. Research activities:

a. Continue using Hydrocomp's HSPF model on the VAX computer. Become familiar with its operation by trying to use it with data from one of the province's experimental basin. Assess its potential usefulness in evaluating downstream flooding effects and sediment changes resulting from clear-cutting activities. Couple with transpiration/photosynthesis model for use determining effects of groundwater levels on soil moisture and subsequently on growth processes. (Swanson, Vice Bernier) (86-02)

b. Coordinate and participate in study of snow loss in large clear-cuts with Alberta Forest Service, Bow-Crow Forest. Assist by helping design sampling program, provision of wind instrumentation to monitor speeds associated with snow accumulation patterns, and conduct trial runs of site-specific evaluations of snow loss under various wind, air temperature and atmospheric moisture conditions, using eddy-correlation techniques (Need at least part of the eddy flux equipment (ideally need 3 sets to have a measure of variability) for this; see capital equipment request below). (Swanson, Vice Bernier) (87-03)

c. Pursue the evaluation of S. Running's evapotranspiration model by applying it to local data. Seek out possible sites for testing some of the physiological predictions made by the model. Explore possible ways to integrate this model into HSPF to replace the non-physiologically based ET routine. (Swanson, cooperative with Bernier, LFC) (87-04)

d. Evaluate results of regeneration survey conducted by the Alberta Forest Service to determine the necessity for plant water relations research. (Swanson, Vice Bernier) (87-07)

e. Prepare microcomputer program for the rain-dominated regions of the WRENSS procedure. (Swanson) (88-02)

10. Accomplishments 1988-89:

1. Publications:

a. The paper on the use of heat pulse velocity technique in pathological investigations is being written. The data from the 1985 study of the effect of bark beetle attacks on transpiration of lodgepole pine in Southern Alberta has proven to be more complicated to analyze than expected, and Swanson has not been able to assign this work as high a priority as he would have desired. Work on the paper will continue and the paper will hopefully be reviewed and published in 1989-90. (Swanson, Hiratsuka)

The paper by Yamaoka, Swanson and Hiratsuka has been re-written and is currently being reviewed.

b. A paper entitled "The effect of evaporation on snow distribution in partially clear-cut forests" was presented at the 1988 annual meeting of the Western Snow Conference and published in its proceedings. (Swanson)

c. The paper by Bernier on "Wind speed and snow evaporation in a stand of lodgepole pine in Alberta" has been submitted to Can. J. For. Res.

2. Research activities:

a. The HSPF model was implemented on the NoFC VAX and run successfully on test data furnished by Hydrocomp. We ran into problems in inputting our own data and in calibrating the model to our data sets. It was decided that the most efficient way to achieve implementation of this model was for Swanson to gain hands-on experience with it at Hydrocomp in Mountain View, California. This training period has been arranged and will run from 16 January to mid-March 1989.

b,d. One meeting and numerous telephone conversations have been held with AFS personnel in an effort to gain access to the Bow-Crow regeneration data base. So far our efforts have not been successful in spite of assurances that we could have the data. We have postponed any field work on the effect of snow loss from large clear-cuts on streamflow or on regeneration and survival of seedlings until the data base was available and we could determine if the regeneration problem really existed and the extent of it. Two sets of the three sets of instrumentation necessary to start this work were obtained in November.

c. Several models of root growth have been procured to assist in the implementation of Running's photosynthesis model. Bernier has continued this work with seedlings at the LFC; we have not conducted any field work due to lack of personnel.

e. A temporary programmer/modeller was hired in October to prepare a microcomputer program for the rain-dominated WRENSS procedure. This program has been written and is currently being tested by selected individuals for function and ease of use. We will modify it in accordance with their findings and distribute it, probably by June 1989.

11. Present Status of Study:

1. This study has been used as the scientific source for the coordination and technology transfer work being conducted under study NOR1301. The results from numerous experiments and studies have been published and incorporated into the WRENSS procedure that is currently our primary technology transfer vehicle.

2. This study is also being used as a vehicle for intra project cooperative research within the NoFC. A current example is the heat pulse velocity work in cooperation with Hiratsuka.

3. The future of this study depends very much on whether or not the NoFC intends to maintain in-house hydrologic expertise. The incorporation of the rain-dominated routines into WRENSS was necessary to extend this procedure to the East and West Coast forests. The implementation of the HSPF hydrologic and chemical transport model on computer facilities at all For. Can. Centres is part and parcel of the cross-Canada hydrologic modelling project. There is a need to refine the user interface with the HSPF model and to simplify it in order to operate it on a microcomputer. The snow transport and evaporation studies planned are needed to complete implementation of the WRENSS procedure or HSPF in this region, and to assist in the resolution of regeneration problems that may be caused by snow-loss. It is not possible to efficiently conduct research to strengthen the scientific content of either WRENSS, HSPF or the photosynthesis/transpiration models and engage in technology transfer of our findings at the present scientific staffing level. We must replace Bernier (preferably with a scientist with a background in physical microclimatology) or seriously consider terminating our technology transfer activities of forest hydrology work in Canada.

12. Goals for 1989-90:

1. Publications:

a. Complete paper on use of heat pulse technique in investigations of transpiration in beetle-attacked trees. (Hiratsuka, Swanson)

b. Complete paper on monitoring transpiration in trees inoculated with blue-stain fungi. (Yamaoka, Swanson and Hiratsuka)

c. Prepare paper on using the heat pulse velocity method for measuring transpiration and as an indicator of physiological activity. (Swanson)

d. Publish paper on "Wind speed and snow evaporation in a stand of juvenile lodgepole pine in Alberta" (Bernier).

2. Research activities:

a. Complete installation of Marmot Twin Creek data on the HSPF model on the NoFC VAX, calibrate, and evaluate the effect of this test cutting on streamflow if possible. (Swanson)

b. Assess potential of "regionalizing" the HSPF model parameters for uncalibrated use similar to that of WRENSS. Use the regionalized model for estimating water levels in drained areas and stream flow levels in flood/drought prone area affected by forest cutting. (Swanson)

c. Start programming HSPF in the microcomputer environment to assist in technology transfer of this model. (Vice Bernier, Swanson)

d. Continue efforts to evaluate the possible regeneration problem caused by snow-loss. Assist the AFS in setting up and evaluating their data, selecting sites for further study and analysis of wind and other climatic variables affecting snow retention and distribution on exposed sites. (Swanson, Vice Bernier)

e. Continue to use Running's photosynthesis/transpiration model as a framework for water relations work in mature forests and seedlings. Integrate this model with HSPF to make HSPF more physiologically relevant. (Swanson cooperative with Rothwell/Liefers, University of Alberta; Bernier, LFC, Quebec)

f. Assist in the formation of an integrated study of the effects of soil compaction on soil properties, seedling water stress, physiological performance over an extended time period, and root distribution/growth. (Swanson in cooperation with other disciplines at NoFC, Weldwood Canada)

g. Test and distribute rain-dominated WRENSS procedure on IBM-PC program. (Swanson, Vice Bernier)

h. Remote measurement of wood moisture content at or above fibre saturation. (Swanson: Possible cooperative work in wood moisture content that has been discussed with Paul Woodard if he takes sabbatical leave from the University of Alberta).

i. Construct 8 HPV measurement modules and one manual HPV meter for PFRA nursery, Indian Head, Saskatchewan. Provide traning in installing HPV sensors and work up of data from 21X micrologger. (Hurdle, Swanson)

13. Publications 1988-89:

Bernier, P.Y. 1988. Low-cost wind speed measurements using Naphthalene evaporation. J. Atmospheric Oceanic Techn. 5(5):662-665.

Swanson, R. H. 1988. The effect of in situ evaporation on perceived snow distribution in partially clear-cut forests. Proceedings 55th Annual Meeting, Western Snow Conference, 19-21 April 1988, Kalispell, Montana.

14. Environmental implications:

The NoFC Environmental screening committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

15. Duration:

Started: 1968 Estimated Completion: 1993

16. Resources 1989-90:

P/Ys:	Prof:	Vice Bernier	1.0
		Swanson	0.5
	Tech:	Hurdle	0.9
		Fisera	0.5
	Total		2.9

O&M	$6,000
Capital	$7,000

17. Signatures:

Robert H. Swanson
Investigator

J M. Powell
Program Director, Environment

Investigator

C. D. Hill
Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 13, 1989

1. Project: Wetlands and Forest Productivity Modelling

2. Title: Peatland development and ecology

3. New: Cont.: X 4. No.: NOR-28-02

5. Study Leader: S.C. Zoltai and J.D. Johnson

6. Key Words: Peatland, soils, chemistry, peat, vegetation, succession, climate change

7. Location of Work: Northwest Region

8. Problem:

Peat is constituted by the largely undecomposed remains of vegetation growing in wet places. It usually occurs in depressions and other poorly drained areas, and supports a variety of vegetation from stunted trees to shrubs and sedges. In its natural state the high water table prohibits fast tree growth, but when sufficiently drained it can produce as well or better than the best upland sites. As a raw material, it has many uses depending on its quality, from peat moss as a soil conditioner to liquification as gas fuel.

The Prairie Provinces have enormous areas of peat, all north of the prairie zone. The most recent estimates show that about 28% of Alberta, 12% of Saskatchewan and 42% of Manitoba is covered with peat. This translates into approximately 180,000 km^2 in Alberta, 68,000 km^2 in Saskatchewan and 230,000 km^2 in Manitoba.

The amount of peat involved is equally impressive. Conservatively calculating on a basis of 1.5 m average thickness in Alberta and Saskatchewan, and 2 m in Manitoba, the peat resources are 270 x 10^9 m^3 in Alberta, 102 x 10^9 m^3 in Saskatchewan, and 460 x 10^9 m^3 in Manitoba. Estimating the total dry peat content on the basis of 100 kg/m^3, this would amount to 27.0 x 10^9 tonnes in Alberta, 10.2 x 10^9 tonnes in Saskatchewan, and 46.0 x 10^9 tonnes in Manitoba; a total of 83,200,000,000 tonnes of dry peat.

Peat is a significant reservoir of carbon. Peat formation ties up atmospheric carbon by fossilizing it. On the other hand, oxidation of

peat, whether by burning as fuel or by decomposition, liberates carbon, adding it to the atmosphere as CO_2. Increased atmospheric carbon dioxide levels are believed to trigger global or regional climatic changes. The amount of carbon stored in peatlands is considerable. Using the above data of 83.2×10^9 tonnes of peat, some 75×10^9 tonnes of carbon are immobilized in the peat deposits of the three provinces. A more precise knowledge of the role of peat in the carbon balance is necessary to assess long term climatic changes.

The resources involved are considerable, whether viewed as a growth medium for forestry, range, agricultural or horticultural resources, or as raw material. Any development plans for the use of these resources must be based on the understanding of peatland ecology to determine the suitability of various kinds of peatlands for different uses and the possibilities of rehabilitation of exploited areas. The present state of knowledge of peatland development in the western region is very incomplete, and all available information is confined to a few local areas.

Peatlands are unique as the ecosystem (plants, water, soil, climate) creates its own environment. Accumulation of peat, upon reaching a critical thickness, can bring about a drastic change in the chemistry and nutrient levels of the peat. This in turn allows the invasion of different peat-forming vegetation, changing the complexion of the peatland. Conversely, interference with the natural ecosystem by partial drainage or excavation will interrupt this cycle in the short term and initiates the regeneration of peatland in the long term. The understanding of peatland dynamics is essential in predicting the response of a peatland to manipulation (as for example the drainage studies undertaken in NOR-28-03), in order to avoid disappointment, failure, or the creation of wastelands.

A study of peatland dynamics is in progress within the Boreal Wetland Regions of Alberta, Saskatchewan and Manitoba. This study characterizes the various peatland types in terms of vegetation, past and present, chemistry of surface and peat deposits, quantifying and characterizing the peat occurring in various peatland forms. The rate of peat deposition is measured by studying the layering and secondary root development of trees, and by obtaining radiocarbon dates of suitable peat sequences. The information gathered will be used to characterize the dynamics of various peatland forms in the Boreal Wetland Regions.

Based on this background knowledge, guidelines can be established to recognize the value of wetlands for various uses. The suitability of wetlands for forestry can be predicted with reasonable certainty, and management techniques can be recommended for the improvement of drainage and tending of the forest.

9. Study Objectives:

1. Determine the ecology of peatland development within the region and develop guidelines for peatland management and rehabilitation.

10. Goals for 1988-89:

1. Continue work on manuscript on management of peatlands and peat resources (Zoltai).

2. Prepare first draft of manuscript on wetland classification from remotely sensed imagery (Zoltai).

3. Present paper on wetland conservation in Canada at the field conference of International Mire Conservation Group in Sweden (Zoltai) if attendance approved.

4. Publish paper "Late-Quaternary volcanic ash in the peatlands of central Alberta" (Zoltai)

5. Initiate compilation of vegetation and peatland dynamics in Alberta as an information report (Zoltai, Johnson).

6. Aid publisher in finalizing "Ecoregions of Canada" (Zoltai).

7. Continue contributing to the National Wetlands Working Group in providing classification standards, and providing technical advice on conservation strategy.

Added Goals:

8. Prepare paper on the evaluation of Ecoclimatic Provinces of Canada for climate change.

9. Provide advice on the implications of climate change for forestry.

11. Accomplishments in 1988-89:

1. Preliminary framework for wetland classification with evaluation for management purpose was established.

2. This goal was combined with Goal 1 above.

3. Presented paper "Conservation and preservation of mires in Canada" at field conference of International Mire Conservation Group, Stockholm, July 15, 1988.

4. Paper on volcanic ash in peatlands in Alberta has been accepted by Can. J. Earth Sci.

5. Manuscript on development of bogs in a continental climate has been drafted.

6. "Ecoclimatic Regions of Canada" is now being printed.

7. Participated in a field meeting of the National Wetland Working Group.

8. Prepared paper "Ecoclimatic provinces of Canada and man-induced climatic change", for Newsletter of Can. Comm. on Ecological Land Classification.

9. Participated in ForCan strategy meeting on the impacts of climate change on forestry.

12. Present Status:

The wetland ecology portion of the study is in a 'reporting' stage. In this phase the data collected during the field program are examined and various aspects are presented in journal papers. Increasing emphasis is placed on providing tools for management to decide the use of various types of wetlands. A collaborative program is being developed with Alberta Research Council to provide a classification and guidebook for the selection of the most promising peatlands for drainage to improve forest growth.

The impact of an anticipated climate change, due to the greenhouse effect, on the natural and managed forests is recognized as a serious challenge. Opportunities are explored to clarify the expected adjustments of the forests to the changing climatic conditions.

13. Goals for 1989-90:

1. Develop a proposal for the classification and rating of peatlands for drainage, and their evaluation for forestry in co-operation with Alberta Research Council. Secure funding for the drainage classification and guidelines.

2. Initiate contract on vegetation adjustments to past climatic changes, in cooperation the University of Alberta.

3. Contribute to the development of a Forestry Canada strategy on the forestry aspects of climate change.

4. Cooperate with NOR-28-07 in exploring the possible effects of climate change on forest productivity in the region.

5. Prepare manuscript on the development of patterned fens in the Prairie Provinces.

6. Continue to serve on the National Wetlands Working Group by providing classification standards and technical advice on wetland conservation strategy.

7. Represent Forestry Canada on various national and international committees relating to wetlands and climate change.

14. Publications 1988-89:

Johnson, J.D. 1989. Additions to the vascular flora of Manitoba. Can. Field. Nat. 103(1):in press.

Johnson, J.D. 1989. Additions to the lichen flora of Alberta, Saskatchewan, and Manitoba. Can. Field. Nat. 103(1):in press.

Tarnocai, C.; Zoltai, S.C. 1988. Wetlands of Arctic Canada. Pages 29-53 in: Wetlands of Canada. Ecological Land Classification Series No. 24. Environment Canada and Polyscience Publications Inc.; Montreal.

Zoltai, C.S. 19 . In Press. Late-Quaternary volcanic ash in the peatlands of central Alberta. Can. J. Earth Sci.

Zoltai, S.C. 1988. Ecoclimatic provinces of Canada and man-induced climatic change. Canada Committee on Ecological Land Classification, Newsletter No. 17, p. 12-15.

Zoltai, S.C. 1988. Climate change and forest management. Symposium on Climate Change Impact on the Great Lakes. Chicago, Sept. 27-28, 1988.

Zoltai, S.C. 1988. Wetland environments and classification. Pages 3-26 in: Wetlands of Canada. Ecological Land Classification Series No. 24. Environment Canada and Polyscience Publications Inc., Montreal.

Zoltai, S.C. (Ecoregions Working Group). 1988. Ecoclimatic regions of Canada. First Approximation. Ecological Land Classification Series No. 23, Environment Canada.

Zoltai, S.C.; Tarnocai, C.; Mills, G.F.; Veldhuis, H. 1988. Wetlands of Subartic Canada. Pages 57-96 in: Wetlands of Canada. Ecological Land Classification Series No. 24. Environment Canada and Polyscience Publications Inc., Montreal.

Zoltai, S.C.; Taylor, S.; Jeglum, J.K.; Mills, G.F.; Johnson, J.D. 1988. Wetlands of Boreal Canada. Pages 99-154 in: Wetlands of Canada. Ecological Land Classification Series No. 24, Environment Canada and Polyscience Publications Inc., Montreal.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1981 Estimated Completion: 1994

17. Resources for 1989-90:

PYs:	Prof.:	Zoltai	0.9
		Johnson	0.5
	Tech.:	Ali	0.5
	Total:		1.9
	Term/Student:		0.0

O & M: $5,000

Capital: $1,600 (Portable conductivity meter; dissolved oxygen meter).

18. Signatures:

S.C. Zoltai
Investigator

Program Director, Protection

G.D. Johnson
Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 13, 1989

1. Project: Wetlands, and Forest Productivity Modelling

2. Title: Increasing wood production through forest land drainage (Wetland drainage and improvement program)

3. New: Cont.: X 4. No.: NOR-28-03 (Canada-Alberta NOR-36-02-3)

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, Northwest Region

8. Problem:

In Alberta, concern about the decreasing productive forest land base as more forest land was withdrawn for other uses led foresters to consider increasing the wood-growing capability of forested wetlands. About 4 million ha in Alberta are considered suitable for drainage and conversion to productive forest. There is, however, very little information available on the long-term effects of forest drainage on tree growth and the environment.

The wetland drainage and improvement program, funded by the Canada-Alberta Forest Resource Development Agreement, arose in response to the concerns and shortcomings outlined above. In 1985, three forested wetland areas were selected as experimental drainage sites: a treed bog (McLennan, 259 ha), a treed fen (Wolf Creek, 132 ha), and a treed swamp (Goose River, 320 ha). Portions of each area were designated for ditching, and the remainder preserved as control. The experimental design required that data be collected before and after drainage.

Each area was surveyed and sampled in a similar manner. Weather stations were installed, survey lines cut, topographic surveys conducted and topographic maps produced with contour interval of 0.5 m and scales 1:2000 or 1:5000.

Preliminary peat, water and vegetation surveys and sampling programs were completed to determine wetland, vegetation and peat types, peat depths, nutrient status and other site characteristics.

Drainage ditch network designs were prepared using Toth's synthetic hydraulic curve method to find the optimum ditch spacings. Each network design allowed for evaluation of different ditch spacings on the same site. Ditching was completed on the Goose River area (135 ha ditched) in September, 1986; on McLennan (90 ha) in July, 1987; and on Wolf Creek (60 ha) in October, 1987.

In 1986, transects were established and instrumentation installed on a control site and on three different ditch spacings for each experimental drainage area. Peat, water, and foliage samples were collected on each transect to determine its nutrient status. Ground temperatures and groundwater table levels were monitored during 1986 through 1988. To evaluate the effects of drainage on ground vegetation composition and tree growth, permanent sample plots were established and measured. Stream water samples were collected periodically to determine the effects of ditching on stream water chemistry and suspended sediment loads.

Forestry Canada and Alberta Forest Service (AFS) cooperate closely on all aspects of the study. The AFS is responsible for most of the operational activities, and ForCan carries out the scientific research. Responsibility for installing tree growth PSPs is shared. On the Goose River site, the AFS established fertilizer-thinning studies and also implemented ditch mounding trials.

9. Study Objectives:

1. Evaluate the growth potential of commercial tree species on treed wetland sites where water tables have been lowered.

2. Measure the effects of drainage on hydrological parameters such as water table depths, and on critical soil characteristics such as moisture content, temperature, fertility, hydraulic conductivity and subsidence.

3. Monitor the effects of drainage on the composition of competing vegetation.

10. Goals for 1988-89:

1. To present a paper entitled "Preliminary effects of forest drainage in Alberta, Canada on ground water table levels and stream water quality" at the International Symposium on the Hydrology of Wetlands in Temperate and Cold Regions, Joensuu, Finland, 6-8 June, 1988. (Hillman).

2. Continue to monitor groundwater table levels, ground temperature, and stream water quality on each experimental area. (Hillman, Robson)

3. Observe ground vegetation permanent sample plots at Wolf Creek and remeasure if necessary. (Johnson)

4. Measure peat subsidence on the three experimental drainage areas. (Robson)

5. Complete installation and measurement of tree growth permanent sample plots on the three experimental areas. Some plots to be established perpendicular to ditches. (Johnson, Robson)

6. Establish criteria for sampling trees for stem analyses, and collect tree disks from the Fort McMurray (Athabasca Forest), Goose River, McLennan, and Wolf Creek experimental drainage areas, and carry out tree ring and stem analyses on them to obtain pre- and post-drainage growth rates. (Hillman, Johnson, Robson)

7. Prepare annual report on progress to date, as required by the Wetlands Drainage and Improvement Program, Canada-Alberta Forest Resource Development Agreement. (Hillman)

8. Provide scientific and technical advice on forest drainage projects and problems. (Hillman)

Added Goal:

9. Prepare journal publication entitled "The effects on tree growth of draining forested peatland near Fort McMurray, Alberta".

11. Accomplishments in 1988-89:

1. The paper was presented at the symposium and appeared in Volume 1 of the proceedings, published by The Academy of Finland.

2. Groundwater, ground temperature and stream water quality data were collected from each experimental area between May and October 1988, and then processed.

3. Observation of ground vegetation PSPs at Wolf Creek showed that remeasurement in 1988 was not necessary.

4. Peat subsidence was measured on the three experimental areas in September 1988.

5. A total of 53 tree growth PSPs were installed and measured on the experimental areas in 1988. Thirteen of these were oriented perpendicular to the ditches. The total number of plots established is 125.

6. Forty-two trees were destructively sampled and measured on the Athabasca Forest trial drainage area in August 1988. Disks from each tree were measured on a newly installed tree ring increment measuring system at the laboratory. The data analysis was completed. Sampling on the 3 FRDA experimental areas was postponed until after the Athabasca data had been analyzed.

7. An annual progress report on the Wetlands Drainage and Improvement Program will be prepared by March 31, 1989.

8. a) As scientific advisor, worked closely with AFS to maintain progress of wetlands drainage and improvement program.

   b) Served on Masters thesis committee, University of Manitoba (Thesis entitled "The feasibility of drainage stands of black spruce to increase growth rates in southeastern Manitoba was accepted).

   c) Advised on treatment of wet sites on Canadian Forest Products Ltd. FMA, near Grande Prairie, Alberta.

9. the first draft of the paper "The effects on tree growth of draining forested peatland near Fort McMurray, Alberta" is 90% complete.

12. Present Status of Study:

As of November 1987, all three sites had been ditched, bringing to an end the pre-treatment data collecting period. A minimum of one summer's data and a maximum of two summers' data were collected from the sites. Preliminary analyses on the effects of drainage on groundwater table levels and on stream water quality were completed (Objective 2).

125 tree growth and 150 ground vegetation permanent sample plots were established on the three drainage sites. A few years of post-treatment data are required to meet objectives 1 and 3.

Such information will not be available from the FRDA experimental areas for several years a study near Fort McMurray was undertaken. Its purpose was to obtain estimates of the change in tree growth rates that can be expected as a result of lowering water tables (Objective 1). The Ft. McMurray study area was drained in 1975-80.

13. Goals for 1989-90:

1. In cooperation withe AFS prepare final report as required by the Wetlands Drainage Improvement Program, Canada-Alberta Forest Resource Development Agreement (Hillman).

2. To publish in the Can. J. of For. Res. a paper entitled "Tree growth on drained forested peatland near Fort McMurray, Alberta" (Hillman).

3. Write journal article on McLennan drainage study.

4. To present a paper on the effects of drainage on groundwater table levels and stream water quality to the forestry peatland session at the Peat and Peatlands Symposium, Quebec City, 6-10 August 1989 (Hillman).

5. Continue to monitor groundwater table levels, ground temperature, and stream water quality on each experimental area (Hillman, Robson).

6. To remeasure 150 ground vegetation permanent sample plots on the three experimental drainage areas (Johnson).

7. To install additional tree growth permanent sample plots on the three experimental areas (Johnson, Robson).

8. Provide scientific and technical advice on forest drainage projects and problems (Hillman).

9. Commence economic feasibility analysis of forest drainage in Alberta (Ondro, Hillman). [see study statement NOR-04-08-06].

10. Serve as scientific advisor for forest drainage wildlife study (Hillman).

14. Publications 1988-89:

Ascher, A. 1988. Exploring the potential of peatlands. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Timberlines 5:4-5.

Hillman, G.R. 1988. Improving wetlands for forestry in Alberta. Pages 241-247. in: Rubec, C.D.A. and R.P. Overend, compilers, Wetlands - Peatlands Symposium '87 Proceedings, Edmonton, Alberta. August 23-27, 1987.

Hillman, G.R. 1988. Improving wetlands for forestry in Alberta. Canada-Alberta Forest Resource Development Agreement Report. Can. For. Serv., North. For. Cent., Edmonton, Alberta. 22 pp.

Hillman, G.R. 1988. Preliminary effects of forest drainage in Alberta, Canada on groundwater table levels and stream water quality Pages 190-196. In: Proc. Symp. on the Hydrology of Wetlands in Temperate and Cold Regions. Vol. 1, Joensuu, Finland. June 6-8, 1988. Publications Academy of Finland.

Johnson, J.D. 1988. Additional interesting plant records from a peatland in north-central Alberta. Alberta Naturalist 18(2):63.

15. Environmental Implications:

The NoFC Environmental Screening committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1985 Completion: 1993

17. Resources 1989-90:

PYs:	Prof.:	Hillman	1.0
		Johnson	0.5
	Tech.:	Robson	1.0
		Ali	0.5
	Total:		3.0
	Term/Student:		0.45

O & M: $3,000 (+$39,000 + $7,000 Contract Canada-Alberta Agreement)

Capital: $5,200 (Automatic water samples; float/pot. water level monitor).

18. Signatures:

C.R. Hillman
Investigator

Program Director, Protection

J. Derek Johnson
Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 2, 1989

1. Project: Wetlands and Forest Productivity Modelling

2. Title: An assessment of the energy potential of forest biomass in the Northwest Region

3. New: Cont.: X 4. No.: NOR-28-06

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: Northwest Region

8. Problem:

Fossil fuels such as crude oil, natural gas, tar sands and coals are relatively abundant in Canada, but nevertheless of finite extent. Because such reserves are dwindling, there has been a fresh look at forest fuels as renewable resource. Forest biomass, the total quantity of organic matter in the forest, is an energy source that is currently largely untapped and in many cases going to waste. At the initiation of this program Canada derived about 4% of its total energy supply from forest biomass. The federal program established in 1978 aimed at generating sufficient knowledge and technology to realize a marked increase in the contribution of forest biomass to Canada's energy supply.

Current biomass productivity in the forested areas of the Prairie Provinces and the Northwest Territories ranges from less than 1 t/ha/yr in the north to over 3 t/ha/yr in some southern parts of the provinces. The initial estimate of the above-ground tree biomass reserve in Alberta alone is more than 1 billion tons of oven-dry material. Annual biomass production amounts to 25 million oven-dry tons.

Forestry Canada is the lead agency in administering the federal ENergy from the FORest (ENFOR) program, part of the Federal Panel on Energy R&D (PERD). The NoFC studies are an integral part of the national For Can ENFOR program to assess the potential of biomass as an alternate energy source. The main areas of the For Can ENFOR program have looked at resource assessment, environmental effects, mechanization, silviculture and socio-economic technical studies.

9. 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.

10. Goals for 1988-89:

1. Publish Information Report entitled "Utilization and market potential of poplars in Alberta". (P-207 and extension) (Scientific Authority: W. Ondro). (see also NOR-4-08)

2. Publish Information Report entitled "Economics of alternatives for industrial utilization of aspen". (P-207) (Scientific Authority: W. Ondro.

3. Review the final report "Data analysis of biomass and nutrient content in Alberta aspen ecosystems" and prepare Information Report for publication. (P-205) (Scientific Authority: I. Edwards)

4. Review the final report "Adaptation of nutrient cycling data to the FORCYTE growth simulation model for aspen stands in Alberta". Liaise with Apps and prepare information report for publication. (#P-314 and extension) (Scientific Authority: I. Edwards)

5. Complete review and publish paper on "Variation and prediction of conifer crown fuels in the Northwest Territories". (P-169) (Scientific Authority: T. Singh).

6. Complete review and publish journal note on "Predicting fuel wieghts for small trees and components". (#P-314 extension) (T. Singh).

7. Continue to oversee the three-year contract on "Wood density of Canadian tree species" being undertaken by FORINTEK. (P-335) (Scientific Authority: J.M. Powell)

8. Cooperate in overseeing completion of a contract on "Non-core area wood supply in central Saskatchewan" with Weyerhaeuser Canada and Saskatchewan Research Council. (P-334) (Scientific Authority: Saskatchewan District Office).

9. Carry on such maintenance activities as are required to reactivate the application of FORCYTE-11 to the management of aspen and aspen/mixed stands. (P-353 phase 2 deferred to 1990) (Scientific Authority: M.J. Apps).

10. Establish, monitor and guide a contract with UBC (J.P. Kimmins) for the completion of a benchmark FORCYTE-11 model, and provision of modeling support to CFS FORCYTE users. (P-369) (Scientific Authority: M.J. Apps).

11. Establish and oversee a contract(s) to upgrade the existing FORCYTE-10 Douglas Fir/red alder data set for use as calibration, demonstration and developmental data set for the FORCYTE-11 benchmark model. (P-368) (Scientific Authority: M.J. Apps).

12. Establish, monitor and oversee a contract with J.P. Kimmins UBC to produce documentation of ecosystem components, processes, assumptions, and conceptual representations of the algorithms used in the benchmark FORCYTE-11 model. (P-370) (Scientific Authority: M.J. Apps).

13. Assist in the organization of, and participate in, a user's workshop on the benchmark FORCYTE-11 model, tentatively to be held at PNFI Sept./Oct., 1988. (M.J. Apps, and others).

14. Continue coordination of NoFC ENFOR projects ensuring their completion and publication. Act as establishment representative on national committee and submit reports on the program as required. (J.M. Powell).

11. Accomplishments in 1988-89:

1. The Information Report entitled "Utilization and market potential of poplar in Alberta" is a "Must Publication" but has been with the editors all year. An opportunity was taken to update data to 1988. An additional journal note has been prepared "Present trends and future prospects for poplar utilization in Alberta" and is under review. (P-207 and extension) (Scientific Authority: W. Ondro) (see also NOR-4-08)

2. The Information Report entitled "Economics for industrial utilization of aspen" is a "Must Publication" but has been with the editors all year. (P-207) (Scientific Authority: W. Ondro)

3. The final report "Data analysis and nutrient content in Alberta aspen ecosystems" was not completed. The contractor, Western Ecological Services Ltd. (WES), has revised the regression equations as required but was unable to complete the report, now scheduled for May 1989. (P-205) (Scientific Authority: I. Edwards).

4. The final report "Adaptation of nutrient cycling data to the FORCYTE growth simulation model for aspen stands in Alberta" was not completed. The contractor (WES) was unable to finalize a detailed description of the data set required for FORCYTE because of repeated changes by the subcontractor, Dr. J.P. Kimmins (UBC). Completion of

the report is scheduled for mid-February. (P-314) (Scientific Authority: I. Edwards)

5. A journal paper entitled "Estimating live crown components of conifer tree species of the Northwest Territories, Canada" has been submitted to Forest Science. (P-169) (T. Singh)

6. A journal note entitled "Biomass prediction for small trees in the boreal forest of west-central Canada" is under review. (P-314) (T. Singh)

7. A report "Wood density of Canadian tree species" covering the first two years of the study was received from FORINTEK. Progress is being made in gathering data sources on Canadian species grown outside the country but this has turned out to be a bigger task then originally anticipated and will require additional time and $ resources to complete in 1989-90. An abstract has been submitted for the 7th Bioenergy R&D Seminar. (P-335) (Scientific Authority: J. Powell)

8. The study by Saskatchewan Research Council for Weyerhaeuser Canada Ltd. has been completed and the report "A preliminary determination of Saskatchewan non-core wood supply" received. (P-334) (Scientific Authority: Saskatchewan District Office)

9. Two draft reports "Boreal Mixedwood Forest Management Challenges: A Synopsis of Opinions from 1988 Interviews" and "Boreal Mixedwood Forest Management Challenges: Do Ecosystem Models Such as FORCYTE-11 have a Role" are being prepared for publication (as an ENFOR report and for the 7th Canadian Bioenergy R&D Seminar, respectively). In addition the use of a traditional growth and yield model (STEMS) to provide driving data for FORCYTE-11 has been investigated for aspen (see Grewal, Apps, and MacIsaac, 1988) and is being further developed for spruce and aspen/mixedwood systems. Abstracts have been submitted for 7th Bioenergy R&D Seminar. (P-353 phase 2 deferred to 1990) (Scientific Authority: M.J. Apps)

10. A contract was established with UBC to complete a benchmark FORCYTE-11 model and provide modelling support. A prototype version of the benchmark FORCYTE-11.4 model was evaluated and tested at the FORCYTE Users Workshop at PNFI in September 1988. The final benchmark model is to be completed by 15 March 1989 and will be evaluated at the Users meeting in April 1989. (P-369) (Scientific Authority: M.J. Apps)

11. Two small successive contracts were established with UBC to update the Douglas fir/red alder FORCYTE-10 data set to FORCYTE-11 requirements. A literature search progress report has been received and the FORCYTE-11 data set continuously upgraded. A final report is expected prior to 15 March 1980. (P-368) (Scientific Authority: M. Apps)

12. A contract for "Preparation of Technical and Scientific Documentation for the FORCYTE-11 Model and Completion of the Benchmark FORCYTE-11 Users Manual" was established with Dr. J.P. Kimmins. A draft "FORCYTE-11.4 Users Guide" has been received, one paper submitted for journal publication, and several other papers are in preparation. The journal paper entitled "Evaluation of Aspen Management Alternatives

Using FORCYTE-11.4: Part I. Model structure and an evaluation of its ability to simulate unmanaged stand growth when used as a traditional historical biassay model" by J.P. Kimmins, W.A. Kurz, K.A. Scoullar, M.J. Apps, and E.B. Peterson was submitted to C.J.F.R. in November and involved work carried out under P-353 and P-369. Final drafts of both the Users guide and a Technical Documentation Manual are expected by March 15, 1989. (P-370) (Scientific Authority: M.J. Apps)

13. A second, very successful, CFS FORCYTE Users workshop was held at PNFI Sept. 28-Oct. 1, 1988. Eleven summary papers were delivered by the participants, two days of active gaming to evaluate the prototype benchmark model were conducted, and the strategy plan developed at 1987 workshop was re-evaluated. The results of the workshop were summarized in a report to the ENFOR Technical Committee to support the 1989-90 FORCYTE proposals. The proceedings of the workshop are being compiled for possible release as an ENFOR report prior to 31 March 1989. (M.J. Apps)

14. The ENFOR Technical Committee meeting in late November was attended by Apps and Powell, the former to report on the FORCYTE Users Workshop and their recommendations. Coordination was continued and eight proposals were submitted for consideration for new 1989-90 funding. (J. Powell et al).

12. Present Status of Study:

Since the inception of the program NoFC has undertaken 28 ENFOR contracts of which 19 have been completed except for some final publications. Of the remainder, three final reports are awaited, while six others are on-going through 1988-89.

Contracts to establish biomass prediction equations for regional tree species have been completed, and publications published, although two additional publications refining prediction equations for small diameter components are currently under review.

A major contract to investigate the impact of aspen biomass removal on site quality and nutrient status has been completed although we await the final report. Much of this data and data collected under another study has been used as input to an adaptation of the FORCYTE model for Alberta aspen stands. Major effort is now being expended to document the FORCYTE-11.4 model and sensitivity test the model.

Two contracts provided production and delivery costs of poplar biomass under two operational regimes. Industrial options for use of poplar for products were also assessed including as an energy source; reports on one of these studies are in final editing stages.

Studies were completed and published on the effects of climate and tree growth/biomass including a literature survey and through tree ring analysis. A study to compile a comprehensive source book of wood density data for Canadian tree species is nearing completion. Major input was also provided for the Canadian Biomass inventory including studies of non-inventoried forested areas in the region, and development of a pilot computer mapping system.

13. Goals for 1989-90:

1. Publish Information Report entitled "Utilization and market potential of poplar in Alberta". (P-207 and extension) (Scientific Authority: W. Ondro)

2. Publish Information Report entitled "Economics for industrial utilization of aspen". (P-207) (Scientific Authority: W. Ondro)

3. Publish journal paper "Estimating live crown components of conifer tree species of the Northwest Territories, Canada. (P-169) (Scientific Authority: T. Singh)

4. Complete review and publish journal note entitled "Biomass prediction for small trees in the boreal forest of west-central Canada". (P-314 extension) (T. Singh)

5. Review the final report "Data analysis of biomass and nutrient content in Alberta aspen ecosystems" and prepare Information Report. (P-205) (Scientific Authority: I. Edwards)

6. Review the final report "Adaptation of nutrient cycling data to the FORCYTE growth simulation model for aspen stands in Alberta. Liaise with Apps and prepare Information Report. (P-314) (Scientific Authority: I. Edwards)

7. Oversee the completion of contract on "Wood density of Canadian tree species" being undertaken by FORINTEK, and review final report for publication. (P-335) (Scientific Authority: J.M. Powell)

8. Establish and oversee a contract(s) for the "Application of FORCYTE-11 to aspen and aspen/mixedwood stands in Alberta". (P-353 phase 2 deferred from 1987-88). (Scientific Authority: M.J. Apps)

9. Establish and oversee contract(s) to provide "User support for the FORCYTE-11 benchmark model, publication of the FORCYTE manuals, collection and collation of FORCYTE publications and documents, and coordination of the technical evaluation of the FORCYTE-11 benchmark model". (P-377) (Scientific Authority: M.J. Apps.)

10. Establish and oversee contract(s) and in-house activities to perform a "Systems and sensitivity analysis of the FORCYTE-11 benchmark model". (P-378) (Scientific Authority: M.J. Apps)

11. Assist J.A. Trofymow (PFC) in establishing, overseeing and evaluating contract(s) on test and evaluation of FORCYTE-11 using data from the CFS Shawnigan Lake project. (P-374) (M.J. Apps.)

12. Establish and oversee a two-year contract on "Economic feasibility of utilizing logging slash and fire-killed timber for energy". (P-379) (Scientific Authority: J. DeFranceschi) (see also NOR-3-04)

13. Attend 7th Bioenergy R&D Seminar April 26-28, 1989 in Ottawa as Scientific Authorities for contract work being reported, including acting as co-authors of several poster presentations and reports for the proceedings. (M.J. Apps, I. Edwards, J.M. Powell)

14. Assist in the organization of, and participate in, a user's workshop on the benchmark FORCYTE-11 model to be held at PNFI in April 1989. (M.J. Apps, H. Grewal)

15. Continue coordination of NoFC ENFOR projects ensuring their completion and publication. Act as establishment representative on the national committee and submit reports on the program as required. (J.M. Powell)

14. Publications 1988-89:

Apps, M.J.; Kimmins, J.P.; Kurz W.A.; Scoullar, K.A. 1988. Simulating the consequences of today's management decisions for tomorrow's forest ecosystems on a microcomputer. In Proc. Int'l. Symposium Resource Technology 88, 20-23 June 1988, Ft. Collins, Colorado.

Apps, M.J.; Kurz, W.A.; Kimmins, J.P.; Scoullar, K.A. 1988. User friendly applications of the FORCYTE ecosystem model on a microcomputer. Pages 263-269 in Forest Growth Modelling and Prediction, Ed. A.R. Ek, S.R. Shifley, T.E. Burk. USDA For. Serv., North Cent. For. Exp. Stn., Gen. Tech. Rep. NC-120.

Gonzalez, J.S. 1988. Wood density of Canadian tree species. FORINTEK Canada Corp., Western Region, Vancouver, B.C. Contract report. April 1988. 49 pp.

Grewal, H.; Apps, M.J.; MacIsaac, D.A. 1988. Using a traditional growth and yield model (STEMS) to drive a management simulator (FORCYTE-11). In Abstracts of papers for IUFRO International Conference on Forest Simulation Systems, Berkeley, CA., November 2-5, 1988.

Kimmins, J.P. 1988. Predicting the long-term consequences of alternative stand-level forest management strategies for forest productivity and yield: FORCYTE in soil fertility research. Pacific Regional Soc. Soil Sci., Newsletter No. 15.

Kimmins, J.P.; Comeau, P.; Kurz, W.A. 1988. Modelling the interactions between moisture and nutrients in the control of forest growth. For. Ecol. Management. (in press)

Kimmins, J.P.; Scoullar, K.A.; Apps, M.J.; Kurz, W.A.; Comeau, P.G.; Isze, K.M.; Haley, D. 1988. Predicting the yield and economic returns of forest management in a changing and uncertain future: The FORCYTE approach. In Abstracts of papers for IUFRO International Conference on Forest Simulation Systems, Berkeley, CA., November 2-5, 1988.

Kimmins, J.P.; Scoullar, K.A.; Comeau, P.G.; Kurz, W.A.; Apps, M.J.; Chatarpaul, L. 1988. FORCYTE-11: An example of the hybrid simulation approach to predicting the consequences for production, yield, economics, soil fertility, nutrient and organic matter reserves, and energy efficiency of alternative crop production systems. Pages 2305-2314 in Forest Growth Modelling and Prediction, Ed. A.R. Ek, S.R. Shifley, T.E. Burk. USDA For. Serv., North Cent. For. Exp. Stn., Gen. Tech. Rep. NC-120.

Kimmins, J.P.; Sollins, P. 1988. Modelling long-term forest productivity. In Proc. Symp. Maintaining the Long-Term Productivity of Pacific Northwest Forest Ecosystems. Oregon State Univ., College Forestry, Corvallis. (In press).

Kurz, W.A.; Apps, M.J. 1988. PROBE Users Manual (draft version 2.00C), 32 pages (includes software).

Moore, W.D.; Chow, W. 1988. A mapping and analysis of resources system application. Abs. in Forest Energy Newsletter No. 9 SLU, Garpenberg, Sweden, Oct. p. 5.

Polson, J.; Whiting, J. 1988. A preliminary determination of Saskatchewan non-core area wood supply. Sask. Res. Council Rept. for Weyerhaeuser Canada. Ltd., Prince Albert, Sask. April. 24 p.

Western Ecological Services Ltd. 1988. Boreal mixedwood forest management challenges: Do ecosystem models such as FORCYTE-11 have a role? Contractor's report.

Western Ecological Services Ltd. 1988. Boreal mixedwood forest management challenges: A synopsis of opinions from 1988 interviews, Contractor's report.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1978 Completion: 1993

17. Resources 1989-90:

PYs: Prof.: Edwards 0.2
Apps 0.2

Tech.: 0.0

Total: 0.4

Term/Student: [0.3 ENFOR funding]

O&M: Nil

Contracts & In-house R&D: $126,500 ENFOR funding
Management: $10,000 ENFOR funding
Capital: $3,000 ENFOR funding

Total: $139,500 (From For Can ENFOR allocation from PERD funding)

18. Signatures:

Investigator

Program Director, Protection

Investigator

Regional Director General

Program Director, Environment
ENFOR Representative

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 13, 1989

1. Project: Wetlands and Forest Productivity Modelling

2. Title: Boreal forest risk factor modelling

3. New: Cont.: X 4. No.: NOR-28-07

5. Study leader: T. Singh

6. Key words: Fire hazard, insect and disease infestations, forest growth, pulpwood and timber supply, annual allowable cut, Boreal Forest Region.

7. Location of work: Northwest Region

8. Problem:

Boreal forest is a major forest region of Canada and comprises approximately 82% of the forest land in the country. In Alberta, the boreal tree species are of vital importance in the production of sawlogs and pulpwood. Improved techniques to enable realistic projections of future timber supplies are needed in Alberta and other prairie provinces and Northwest Territories.

Prevailing climatic conditions of long, cold winters and short growing season are responsible for slow growth rates typical of the boreal tree species. Fires which frequently result in destruction of large areas comprising the future growing stock are a common occurrence. During the past two decades the forest area lost in Alberta due to fires averaged 0.5 % annually, which is considerable because of the long rotations under which the boreal forests are managed. During a rotation of 100 years, for example, about a half of Alberta's forest area can be expected to suffer fire losses if all stands were equally prone to fire hazards. In addition, there is mortality due to insect and disease infestations. All these risk factors can cause considerable errors in prediction and realization of annual allowable cut (AAC). These problems have not so far been objectively handled in resource allocation and management in the boreal forest, mainly because of a general lack of available tools for such predictions.

Long-term planning of forest management should be mainly based on expectation of return on investment and management efforts. The fire, insect, and disease risk losses must be included in projected

expectations as these are predictable for large areas within a given time frame. The objective assessment of these risk factors and uncertainties is a necessity for rational formulation of management and timber harvesting strategies in the boreal forest of western Canada.

Development of risk factor model for forest yield prediction will be based initially on Alberta data. The existing data on risk factors and growth and yield will be located and examined through necessary data screening, computer programming, and preliminary modelling procedures under the guidance of the Study Leader. Permanent sample plot data and the data collected by researchers at NoFC for their specific and related purposes will be accessed. Similarly, the historic data will be retrieved from provincial records on fire and insect and disease occurrences, and from the Canadian Climate Centre for climatic data. The data so examined will be used in expressing the various causative factors determined in the study. Field collection of current data will be useful to fill in existing data gaps and to validate the model and its components. The model will have potential for application in the boreal ecoregions in the remaining prairie provinces after necessary modifications.

The study will need cooperation from interested project and study leaders at NoFC because of its multi-disciplinary nature. Inputs from growth and yield, fire, insect and disease, and forest resource groups will form an essential part of the study strategy. As the mathematical techniques for probability and risk analysis are basically similar in these disciplines, the study will provide a unifying link among them. There will also be an opportunity to cooperate with provincial agencies and forest industry to meet their requirements for realistic determination of future yields when subjected to the above-mentioned risk factors and uncertainties.

A total of five years is estimated to cover all stages of the study. These stages are:

1. Initial stage: a review of risk and uncertainty factors in growth and yield due to fire and insect and disease occurrences; collation and evaluation of data relating to such factors.

2. Preliminary development stage: preliminary attempts at development of a conceptual model dealing with risk factors relating to growth and yield.

3. Intermediary stage: implementation of model concepts and strategies to achieve parameter estimation, calibration, and AAC prediction.

4. Refinement stage: improvement and refinement of risk factor model and parameter estimates to enhance model capabilities, and a validation test on independently collected and most recent data in a different geographical location.

5. Final stage: finalizing risk factor model and its components for the boreal forest, and recommendations for its extension to disjunct outliers or ecoregions, including preparation of a manual for

operational use and guidelines to prescribe needed management plans and timber harvesting strategies.

The three modelling methodologies to be used are: a) stochastic, b) deterministic, and c) dynamic modelling. This will enable a comparative assessment of the merits of the three approaches adopted in the study.

Because of the availability of most data bases for modelling, McLeod working circle in the leasehold of Champion Forest Products Ltd. was selected initially as a logical unit for the formulation and development of the model. Preliminary version of FOrestry RIsk Model (FORIM) based on fire risk and growth and yield data from this working circle is ready. For other risk factors, FORMAN model is being tested for impacts on AAC in the Footner Lake and Peace River forests of northern Alberta. Adjoining boreal ecoregions will be accessed to extend the general scope and validity of the models.

9. Study Objectives:

1. To model the risk of fire at the stand and forest level to aid management decisions on the effect of such occurrences on allowable cut and future timber supplies.

2. To determine the frequency of large-scale insect and disease occurrences and derive a model to assess their effect on the present and future forest yields.

3. To test, review, and modify the fire, insect and disease, and climate change risk factor models to extend application over other boreal forest regions in western Canada.

10. Goals for 1988-89:

1. Obtain data from MPC (Microcomputer PSP Catalogue) and Canadian Climate Centre data bases, and from NoFC scientists and technicians, for implementing stages 2 and 3 in the development of risk factor model.

2. Initiate work for incorporating the insect and disease risk module in the model to obtain updated version.

3. Write/modify computer programs for determining annual allowable cut under different risk and growth scenarios simulated on IBM-PC and NoFC VAX system.

4. Prepare risk factor maps for boreal forest ecoregions in the Hinton leasehold.

5. Update training on simulation modelling, differential equations, computer graphics, time series, and linear programming optimization methodologies; attend IUFRO Seminar on Forest Growth Process Modelling of Responses to Environmental Stress, April 19-22, 1988.

6. Prepare journal paper on "Fire risk modelling in the boreal forest of Alberta".

7. Initiate work on a manuscript "Forest insect and disease risk factors in the boreal forest of Alberta" (Singh, Cerezke).

8. Contribute expertise and provide input on the forestry impacts of climatic change to Phase II of SRC contract, and to CCELC.

9. Prepare annual progress report for the Canada-Alberta Forest Resource Development Agreement.

10. Prepare and review paper on soil temperature variations in clearcuts.

11. Provide statistical and other advice to colleagues and clients in the ongoing programs of NoFC, represent CFS and NoFC on advisory committees and other groups, and participate in the planning and development of their activities.

Added Goal:

12. Present a paper on patterns of nutrient yield in spruce-fir and aspen-grassland research basins in Alberta at the Canadian Hydrology Symposium in Banff, Alberta.

11. Accomplishments in 1988-89:

1. Data were obtained from Alberta Forest Service and NoFC Forest Insect and Disease Surveys for developing application of FORMAN model in the Peace and Footner Lake districts in the boreal forest of northern Alberta.

2. A study was initiated for simulating risk impacts from insect defoliations in northern Alberta by applying FORMAN model at the forest level.

3. Work is in progress for assessing the impacts of insect infestations on AAC in P-6 forest management unit of Peace River District. Computer programs initially developed for IBM PC need to be adopted for NoFC VAX system.

4. The simulated data at three risk levels (low, medium, severe) obtained under item 3 above will be stored and used in preparing risk maps as soon as GIS base information becomes available from Alberta Forest Service.

5. Attended IUFRO Seminar; the papers presented dealt with computer methodologies relating to forest productivity under environmental stress factors.

6. A manuscript entitled "Defoliation risk impacts on long-term timber supply from boreal forest of western Canada" was prepared and is being submitted for review as a journal publication.

7. A manuscript "Insect and disease infestations on forest land" prepared by J. Petty from historical data in Alberta is being revised and updated by H. Cerezke and T. Singh for publication as an information report.

8. The climate change expertise and input was provided by contributing "Potential impacts of climatic change on forestry" to CCELC newsletter, and through a presentation entitled "Effects of climate change on managed forest ecosystems" made at the NoFC information seminar.

9. Annual Progress Report was prepared for the risk factor modelling work done under the Canada-Alberta Forest Resource Development Agreement.

10. A manuscript entitled "Soil temperature impacts of clear-cutting in the boreal forest of Alberta" has received the first review and is to be submitted for journal publication.

11. Statistical advice was provided to clients and colleagues on an as needed basis. Also participated in and contributed to various committees and groups in an advisory capacity.

12. A paper entitled "Patterns of nutrient yield in spruce-fir and aspen-grassland research basins in Alberta" was prepared and presented at the Canadian Hydrology Symposium in Banff, Alberta.

12. Present Status:

The study has completed the Initial and Preliminary stages (stages 1 and 2). Fire as a risk factor was studied through the preliminary version of FORIM, a stochastic model. A deterministic approach has since been applied to the insect defoliation data using FORMAN model (stages 2 and 3). A search to identify and adopt a dynamic modelling methodology for including risk and uncertainty in forest management decisions is currently in progress.

13. Goals for 1989-90

1. Undertake testing of risk factors and levels under different scenarios of the intermediary stages to obtain risk-related reductions on volume and areal (GIS) basis.

2. Prepare final report on the risk factor modelling work done in Alberta under the Canada-Alberta FRDA.

3. Review and submit manuscript entiled "Defoliation risk impacts on long-term timber supply from boreal forest of western Canada" for journal publication.

4. Finalize the manuscript "Forest insect and disease risk factors in the boreal forest of Alberta" for publication as an information report (Singh, Cerezke).

5. Complete review and submit "Soil temperature impacts of clear-cutting in the boreal forest of Alberta" for journal publication.

6. Provide statistical advice to clients and colleagues in the ongoing programs of NoFC, represent Forestry Canada and NoFC on advisory committees and other groups, and participate in the planning and development of their activities

14. Publications 1988-89:

Singh, T. 1988. Risk factor modelling for forest yield predictions in Alberta, Canada. Pages 514-520 in A.R. Ek et al., ed. Forest growth modelling and prediction. Vol. I. U.S. For. Serv., North Cent. For. Exp. Sta., Gen. Tech. Rep. NC-120.

Singh, T. 1988. Modelling forest yield risk factors in Canada. National Woodlands 11:21-22.

Singh, T. 1988. Potential impacts of climatic change on forestry. Pages 4-5 in Canada Committee on Ecological Land Classification, Newsletter 17.

Singh, T. 1988. The changing atmosphere and climate: A call for action. Pages 7-8 in Alberta Climatological Association, The General Circulation, Fall '88.

Singh, T. 1988. Measuring potential impacts of climatic change on forestry. Pages 37-56 in Current Applied Climatology in Alberta. Proc. Twelfth Annual General Meeting of the Alberta Climatological Association, 10 March. Envir. Can., Edmonton, Alberta.

Singh, T., compiler. 1988. Proceedings of the workshop and the Eleventh Annual Meeting of the Alberta Climatological Association. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Info. Rep. NOR-X-294.

Singh, T. 1988. Climate research and related activities at Northern Forestry Centre. Pages 57-58 in T. Singh, compiler. Current Climatological Research, Proceedings of the Workshop and the Eleventh Annual Meeting of Alberta Climatological Association, Edmonton, Alberta, Inf. Rep. NOR-X-294.

Singh, T. 1988. Patterns of nutrient yield in spruce-fir and aspen-grassland research basins in Alberta. In Canadian research basins: successes, failures and future. Canadian Hydrology Symposium, Banff, Alberta. (In Press)

Singh, T. 1988. Canadian Hydrology Symposium 1988. Alberta Climatological Association, General Circulation. Summer 1988: 10-11.

Singh, T.; Higginbotham, K.O. 1988. An overview of the effects of climate change and climate variability on forest vegetation in western Canada. Pages 255-273 in B.L. Magil and F. Geddes, eds. The

impact of climate variability and change on the Canadian Prairies: Symposium/Workshop Proceedings, Alberta Dept. Environment

Wheaton, E.E.; Singh, T. 1988. Exploring the implications of climatic change for the boreal forest and forestry economics of western Canada. Climate Change Digest (In press)

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1987 Completion: 1992

17. Resources 1989-90:

PYs:	Prof.: Singh	1.0	
	Tech.: vice Schultz	1.0	(vacant)
	Total	2.0	
	Student:	0.15	

O & M: $2,000

Capital: Nil

18. Signatures:

T Singh

Investigator

Program Director, Protection

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 31, 1989

1. Project: Information

2. Title: Scientific and technical editing and publishing

3. New: Cont.: X 4. No.: NOR-33-01

5. Study Leader: J.K. Samoil and B.J. Boughton (cooperator)

6. Key Words: Editing, publishing, printing, information reports, journal articles, scientists, resource managers, industrial managers

7. Location of Work: Northwest Region

8. Problem:

There is a need for the Northern Forestry Centre to ensure that regional clients (forest resource and industrial managers, scientific community, and educational community) are adequately informed of the results of research and development programs in a relevant and timely manner and at a reasonable cost.

9. Study Objectives:

1. Edit, publish, and distribute scientific, technical, and other publications of the Northern Forestry Centre and its two district offices.

10. Goals for 1988-89:

1. Assist the research staff, through the provision of editing and publishing services, in the preparation and publication of approximately:

   a) 15 Information Reports
   b) 7-10 Forest Management Notes
   c) 8 Pest Leaflets (revisions and reprinting)
   d) 40 journal articles and miscellaneous publications. (J.S., B.B.)

2. Assist in the preparation of a special technical report on diagnosis and recognition of winter frost damage, by H. Zalasky and Y. Hiratsuka (J.S., B.B.)

3. Prepare and publish the Program Review 1987-88 of the Northern Forestry Centre. (J.S., B.B.)

4. Oversee production and printing or reprinting of locally published scientific and technical information. (J.S., B.B.)

5. Continue responsibility for the distribution of scientific and technical publications, maintaining a mailing list, responding to requests for scientific and technical information, and carrying out the necessary correspondence. Conduct a major update of the mailing list to delete inactive subscribers and obtain information on subject interests. (J.S., B.B.)

6. Provide editorial, typographical, and printing assistance for public information activities. (J.S., B.B., E.S.)

7. Print as an Information Report a bibliography of 1980-86 publications of the Northern Forestry Centre. (J.S.)

8. Investigate upgrading and replacement of typesetting equipment, making recommendations regarding timing and type of equipment required. (J.S., B.B.)

9. Serve on in-house, regional, and national working/advisory committees, as required. (J.S.)

10. Present seminars to staff on the revised Forestry Canada style manual and new Forestry Canada publications policy when these are available. (J.S., B.B.)

11. Investigate staff demand for a seminar on techniques of scientific and technical writing and present it if there is sufficient interest. (J.S., B.B.)

12. Establish guidelines for authors on the preparation of computer graphics for use in publications. (J.S., B.B.)

13. In cooperation with development agreement personnel, assess personnel and financial requirements and prepare guidelines for publishing reports arising from agreement activities following expiration of the agreements. (J.S., R.N.)

14. Participate in a training program for communications personnel, as required by Treasury Board. (J.S., B.B.)

Added Goals:

15. Coordinate arrangements for the annual meeting of Forestry Canada scientific editors. (J.S.)

16. Attend a two-week supervisory orientation program. (J.S.)

11. Accomplishments in 1988-89:

1. Assisted the research staff, through the provision of editing and publishing services, in the preparation and publication of the following (February 13, 1988, to January 31, 1989):

   a) 11 Information Reports
   b) 1 Forest Management Note
   c) 61 journal articles and miscellaneous publications.

2. Provided advice regarding the preparation of a special technical report on diagnosis and recognition of winter frost damage, by H. Zalasky and Y. Hiratsuka.

3. Prepared and published the Program Review 1987-88 of the Northern Forestry Centre.

4. Oversaw production and printing or reprinting of locally published scientific and technical information.

5. Continued to distribute scientific and technical publications, maintain a mailing list, respond to requests for scientific and technical information, and carry out the necessary correspondence. A major update of the mailing list was carried out; about 150 names overall were deleted. At the same time, the subscribers were surveyed regarding their background, subject interests, language preference, and desire to continue to receive Timberlines. Out of the 1600 subscribers, there were 23 subscribers who wanted information in both English and French (including 1 from Alberta) and another 23 who would prefer it in French only (none from our region).

6. Provided editorial, typographical, and printing assistance for public information activities.

7. Printed as an Information Report a bibliography of 1980-86 publications of the Northern Forestry Centre. In addition, a supplement was produced that lists NoFC publications for 1987-88 (to November 30, 1988).

8. Typesetter upgrading possibilities were investigated, and a recommendation was made to acquire a p.c.-based system with integrated software for typesetting, graphics, and design and a laser typesetter for high-quality output.

9. Advice on editing, production, and distribution of publications was provided to Forestry Canada personnel at NoFC, the district offices, and other establishments.

10. Copies of the revised Forestry Canada style manual were distributed to all authors. A decision was made to not offer seminars on the style manual or the new ForCan publications policy.

11. Time has not permitted investigation of staff demand for seminars on techniques of scientific and technical writing. This is now scheduled for 1989-90.

12. Until acquisition of the new typesetter system is finalized, guidelines cannot be established for preparation of computer graphics for use in publications.

13. Time constraints have not allowed assessment of personnel and financial requirements for publishing reports arising from agreement activities following expiration of the agreements. This is now scheduled for 1989-90.

14. B. Boughton and J. Samoil participated in the mandatory two-day training program for government communications personnel.

15. Accommodation, travel from and to Calgary, a meeting room, and field trips were arranged for a successful September 1988 meeting in Banff of the Forestry Canada scientific editors.

16. J. Samoil attended the two-week supervisory orientation program in Kananaskis, September 26 to October 7, 1988.

12. Present Status of Study:

Since 1970, 305 Information Reports, 45 Forest Management Notes, 33 Forestry Reports, and nearly 860 journal and symposium articles and miscellaneous publications have been edited and produced.

13. Goals for 1989-90:

1. Assist the research staff, through the provision of editing and publishing services, in the preparation and publication of approximately:

   a) 15 Information Reports
   b) 5 Forest Management Notes
   c) 15 Pest Leaflets (revisions and reprinting)
   d) 40 journal articles and miscellaneous publications. (J.S., B.B.)

2. Prepare and publish the Program Review 1988-89 of the Northern Forestry Centre. (J.S., B.B.)

3. Oversee production and printing or reprinting of locally published scientific and technical information. (J.S., B.B.)

4. Continue responsibility for the distribution of scientific and technical publications, maintaining a mailing list, responding to requests for scientific and technical information, and carrying out the necessary correspondence. (J.S., B.B.)

5. Conduct a survey of mailing list subscribers to determine by which media they prefer to receive scientific and technical information (publications, audiovisuals, conferences, computer disks, etc.). (J.S., B.B., R.N., A.A.)

6. Provide editorial, typographical, and printing assistance for public information activities. (J.S., B.B., E.S.)

7. Prepare two supplements to the NoFC bibliography Information Report (one in April, a second in October). (J.S.)

8. Continue to monitor technology improvements in typesetting equipment. (J.S.)

9. Serve on in-house, regional, and national working/advisory committees, as required. (J.S.)

10. As part of the training priorities for Forestry Canada's Northwest Region, plan and present to designated and interested employees a series of short seminars on techniques of scientific and technical writing. (J.S., B.B.)

11. Establish guidelines for authors on the preparation of computer graphics for use in publications. (J.S., B.B., D.L.)

12. In cooperation with development agreement personnel, assess personnel and financial requirements and prepare guidelines for publishing reports arising from agreement activities following expiration of the agreements. (J.S., R.N.)

14. Publications 1988-89:

Alexander, M.E. 1988. Help with making crown fire hazard assessments. Pages 147-156 in W.C. Fischer and S.F. Arno, compilers. Protecting people and homes from wildfire in the Interior West: proceedings of the symposium and workshop. U.S. Dep. Agric., For. Serv., Intermt. Res. Stn., Ogden, Utah. Gen. Tech. Rep. INT-251.

Ali, M.W.; Zoltai, S.C.; Radford, F.G. 1988. A comparison of dry and wet ashing methods for the elemental analysis of peat. Can. J. Soil Sci. 68:443-447.

Allen, E.A.; Blenis, P.V.; Hiratsuka, Y. 1988. Histological evidence of resistance to Endocronartium harknessii in Pinus contorta. (Abstract) Phytopathology 78(12):1554.

Apps, M.J.; Duke, M.J.M.; Stephens-Newsham, L.G. 1988. A study of radionuclides in vegetation on abandoned uranium tailings. J. Radioanal. Nucl. Chem. 123(1):133-147.

Ascher, A., editor. 1988. Timberlines. No. 5, Winter 1987-88. No. 6, Spring 1988. No. 7, Summer 1988. No. 8, Autumn 1988. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Bella, I.E.; Navratil, S. 1988. Western gall rust dynamics and impact in young lodgepole pine stands in west-central Alberta. Can. J. For. Res. 18:1437-1442.

Bernier, P.Y. 1988. Low-cost wind speed measurements using naphthalene evaporation. J. Atmos. Oceanic Technol. 5(5):663-665.

Brace, L.G.; Bella, I.E. 1988. Understanding the understory: dilemma and opportunity. Pages 69-86 in J.K. Samoil, editor. Management and utilization of northern mixedwoods. Proc. Symp., April 11-14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

Cerezke, H.F.; Emond, F.J. 1989. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba, and the Northwest Territories in 1987. For. Can., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-300.

Chang, K.-F; Blenis, P.V.; Hiratsuka, Y. 1989. Mechanism and pattern of spore release by Endocronartium harknessii. Can. J. Bot. 67:104-111.

Chrosciewicz, Z. 1988. Forest regeneration on burned, planted, and seeded clear-cuts in central Saskatchewan. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-293.

Chrosciewicz, Z. 1988. Jack pine regeneration following postcut burning under seed trees in central Saskatchewan. For. Chron. 64(4):315-319.

Corns, I.G.W. 1988. Compaction by forestry equipment and effects on coniferous seedling growth on four soils in the Alberta foothills. Can. J. For. Res. 18(1):75-84.

Corns, I.G.W. 1988. Site classification and productivity in the boreal mixedwood. Pages 61-69 in J.K. Samoil, editor. Management and utilization of northern mixedwoods. Proc. Symp., April 11-14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

De Groot, W.J. 1987. Examples of Canadian Forest Fire Behavior Prediction System fuel types in Saskatchewan. Can. For. Serv., Saskatchewan Dist. Off., Prince Albert, Saskatchewan. Poster with text.

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15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Start: 1970 Completion: Continuing

17. Resources 1989-90:

PYs:	Prof.:	Samoil	1.0
		Boughton	1.0
	Tech.:	Schiewe	1.0
	Total:		3.0
	Term/Student:	Graphic Artist:	1.0
		Distribution Clerk:	1.0

O&M: $70,000

Capital: Nil

18: Signatures:

Investigator

Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 31, 1989

1. Project: Technology Transfer and Communications

2. Title: Technology transfer and extension services

3. New: Cont.: X 4. No.: NOR-33-02

5. Study Leader: R.G. Newstead

6. Key Words: Technology transfer, forestry extension, innovations, research application

7. Location of Work: Northwest Region

8. Problem:

At NoFC, technology transfer has been conducted largely on an "ad hoc" basis and has generally been effective in encouraging the implementation of research results. Scientific information dissemination has been achieved primarily by traditional publication of research findings, but the more significant achievements have been the result of personal involvement and commitment to implementation on the part of research and technical personnel.

The technology transfer process must encourage the use of planned adoption and innovation procedures. This approach will result in improved estimates of costs involved and benefits accrued and will enable senior management to better estimate time, money, and human resource requirements. This process will also encourage full "user" or "client" participation in any given undertaking. Communication means, methods, and media can be identified and planned and budgeted beforehand. In addition, forthright evaluation can be undertaken in comparison with anticipated goals.

9. Study Objectives:

1. Co-ordinate and promote the planning and delivery of an effective regional technology transfer and extension forestry program.

2. Co-ordinate the development and integration of all information and communications activities of Forestry Canada in the prairie provinces and the Northwest Territories.

10. Goals for 1988-89:

1. Provide project leadership and coordination of technology transfer and information services and activities within NoFC including public information, public relations, scientific and technical editing and publishing, extension services, library and photographic services. (R.N.) (33-2)

2. Serve on in-house, regional, national and NGO working/advisory committees as required. (R.N.) (33-4)

3. Participate in the continued implementation of public information plans under the Manitoba, Saskatchewan, and Alberta FRDAs (see NOR-36). (R.N.) (33-1)

4. Complete retrospective evaluation of NoFC research accomplishments and report on same (R.N.) (33-6)

5. Develop NoFC technology transfer planning process and implementation procedures including TT proposals under FRDAs. (see NOR-36) (R.N.)

6. Attend semi-annual meeting of Federal Laboratory Consortium for Technology Transfer. (R.N.) (33-40)

7. Pursue an opportunity to conclude a twinning arrangement between NoFC and the Chinese Academy of Forestry in Harbin, Heilongjiang Province, People's Republic of China.

8. Continue development of a photographic records system and library including acquisition and duplication of general purpose forestry information slides and photos. (H.S.) (33-5)

9. Develop and implement NoFC public exhibition schedule to include major regional exhibitions, National Forest Week events, Federal Information fairs, and other invitational events. (H.S.) (33-7)

10. Co-ordinate and provide tours and other extension services to schools, youth groups and other publics visiting NoFC. (H.S.) (33-8)

11. Maintain inventory control, stock supplies, re-order schedules etc. for all NoFC Public Information materials, exhibition materials and supplies as required to present and distribute same to public audiences. (H.S.) (33-42)

12. Participate in the development of a major technology transfer project proposal and assist in implementation of same. (R.N.) (33-43)

11. Accomplishments in 1988-89:

1. Coordinated activities of technology transfer and information project staff within NoFC, including public information, public relations, scientific and technical editing and publishing, extension services, library, and photographic services.

Additional activities during the study year included:

- participated in NoFC management committee forest industry visitations
- coordination of ForCan input into operation and funding of "Alberta's Managed Forests" exhibit trailer schedule
- visitation and interpretive contributions to Huestis demonstration forest sponsored by the Canada-Alberta FRDA
- provided technology transfer presentations to Senior Regional Advisory Council and Alberta Forest Service Research Branch Personnel.
- assisted authors in the development and editing of 9 issues of Technology Transfer Notes
- completed Govt. of Canada communications course
- attended CCFM R&D Forum in Edmonton, Feb. 1988
- participated in peer review of NeFC communications project (R.N.)

2. Served on in-house, regional, and NGO Committees as follows: (R.N.) (33-2) (33-4)

   - Canada-Alberta FRDA Public Information Subcommittee
   - NoFC Library committee
   - NoFC Computer users committee
   - NoFC Management Committee
   - National Forest Week organizing committee
   - CIF Rocky Mountain Section Council member and HAMPCO 89 subcommittee member

3. Continued to participate in implementation of communication plans under the Manitoba, Saskatchewan, and Alberta FRDA including the preparations of brochures, mobile and static displays/exhibits, contracting out services, committee co-chairmanship etc. (R.N.) (33-1)

4. Completed 10-year retrospective evaluation of NoFC R&D accomplishments with assistance of W. Moore. Summary report of findings is in preparation and results will be presented to Forestry Canada Senior Management Committee and NoFC research personnel upon completion. (R.N.) (33-6)

5. Technology transfer planning guidelines have been developed for NoFC and these will be implemented following management committee ratification and introduction to NoFC research and development staff. (R.N.) (33-6)

6. Attended the fall meeting of the Federal Laboratory Consortium for Technology Transfer in Mystic Connecticut. (33-40)

7. During the course of a visitation of Alberta (Sept. 1988) by a delegation from the Forest Industry Bureau and the Academy of Forestry of Harbin, P.R.C. a memorandum of discussion was signed between the two establishment heads.

8. There was limited opportunity to further develop the NoFC photographic records and library. Slide duplication equipment has been acquired and will facilitate this endeavor. (33-5)

9. Developed and implemented and assisted District Office personnel with an annual public information exhibits at major regional exhibitions including Red River Exhibition, Saskatoon Pioneer Days, Regina Buffalo Days, Klondike Days, and other invitational events including the Edmonton Sportsman's Show, the Leduc Trade Fair, Lethbridge Ag. Expo, Alberta Science Teachers Federation exhibition at Banff, and National Forest Week, Forestry Centre of Alberta exhibit at Cochrane, AFPA annual meeting at Jasper Park Lodge. Region-wide, NoFC and District Office personnel contacted 120,000 members of the general and other targeted publics and distributed more than 113,000 pieces of literature in the process. In addition, 53,300 visitors toured the "Alberta's Managed Forests" exhibit trailer sponsored by the Canada- Alberta FRDA. (33-7)

10. Coordinated or provided responses to public inquiries, requests for lab tours, presentations and the like. Acted as regional distribution centre for AFA "Forever a Tree" tree planting program. Distributed 6000 tree seedlings to Edmonton school groups, Girl Guides and Boy Scout troops for outplanting. Contracted for the private production of 25,000 Colorado blue spruce and produced 5000 in-house for public distribution at fairs and exhibits. Several NoFC and District staff participated as judges at local and regional Science Fairs in 1988. (33-8)

11. Maintained stocking and control of NoFC inventory of public information and extension literature, exhibition materials and supplies and ordered replenishment or new supplies as required. Packaged and shipped or mailed information/education materials as required in response to public, institutional, or ForCan District Office requests. (33-42)

12. Participation in proposal and planning stages of a major technology transfer symposium on forest modeling. This symposium will take place in Saskatoon March 13-15, 1989. (R.N.)

12. Present Status:

Initiated in 1984 as an aggregate study (technology transfer, extension services, public information, library services and photographic services) at the time of Project establishment. In 1987-88 disaggregation of study activities ensued such that technology transfer and extension services became a distinct study. Increasing emphasis is being given to communications planning and management. Project leader is a member of NoFC Management Committee.

13. Goals for 1989-90:

1. Provide project leadership and coordination of technology transfer, communications, and other information services and activities within Northwest Region including public information, public relations,

scientific and technical editing and publishing, extension services, library and photographic services. (R.N.)

2. Serve on in-house, regional, national and NGO working/advisory committees as required. (R.N.)

3. Participate in the continued implementation of public information plans under the Manitoba, Saskatchewan, and Alberta FRDAs (see NOR-36) (R.N.).

4. Present findings of retrospective analysis of NoFC research and development accomplishments (1977-86) to selected audiences and assist in preparation of final report for publication. (R.N.)

5. Implement or participate in the planning and implementation of up to three specific NoFC technology transfer endeavors in accordance with technology transfer guidelines established in 1988/89. (R.N.)

6. Attend semi-annual meeting of Federal Laboratory Consortium for Technology Transfer. (R.N.)

7. Continue to monitor and assess opportunities to engage in a twinning arrangement between NoFC and the Chinese Academy of Forestry in Harbin, Heilongjiang Province, People's Republic of China. (R.N.)

8. Continue development of a photographic records system and library including acquisition and duplication of general purpose forestry information slides and photos. (H.S.)

9. Develop and implement NoFC public exhibition schedule to include major regional exhibitions, National Forest Week events, Federal Information fairs, and other invitational events. (H.S.)

10. Co-ordinate and provide tours and other extension services to schools, youth groups and other publics visiting NoFC. (H.S.)

11. Maintain inventory control, stock supplies, re-order schedules etc. for all NoFC Pubic Information materials, exhibition materials and supplies as required to present and distribute same to public audiences. (H.S.)

12. Chair NoFC 1990 Open House committee and organize this event to take place during National Forest Week, May 1990. (R.N.)

14. Publications 1988-89:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study

leader, the committee concludes that these study activities are not potentially detrimental to the environment.

16. Duration:

Started: 1984 Completion: continuing

17. Resources 1989-90:

PYs:	Prof.: Newstead	1.0
	Tech.: Stewart, H.	1.0
	Total:	2.0
	Student:	0.3

O & M: 13,000 A-base
10,000 Open House

Capital: $3.0 K

18. Signatures:

Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 31, 1989

1. Project: Technology Transfer and Communications

2. Title: Library Services

3. New: Cont.: X 4. No.: NOR-33-03

5. Study Leader: D.J. Robinson

6. Key Words: Library, acquisitions, cataloguing, interlibrary loans, circulation, reference, SDI profiles, on-line literature searching, automated library systems, information science, data bases.

7. Location of Work: NoFC

8. Problem:

The Library is responsible for providing the staff at the centre and the District Offices with access to publications and the printed materials to meet the needs of NoFC's mandate within the Forestry Canada. The library also serves university and college personnel, staff from other federal, provincial and municipal government departments and members of the public.

The problem of access to research information is affected by the rapid growth in the volume of scientific and technical literature, increasing costs of publications and demands for service as well as resource constraints.

9. Study Objectives:

1. To budget, plan and develop library services to support existing research projects.

2. To develop and maintain a collection which contains copies of all Forestry Canada publications and significant internal reports and other publications required to meet the ongoing and planned research needs of NoFC and its district offices.

3. To provide reference and current awareness services.

4. To coordinate requests for translation of relevant scientific and technical literature.

5. To select and obtain library materials by means of purchase, gift or exchange.

6. To provide a means of access to the collection by cataloguing and classifying library materials according to a recognized standard or system.

7. To provide information or publications through interlibrary loan services where items are not available in the local collection and cooperate with other libraries by supplying reciprocal interlibrary loan services.

10. Goals for 1988-89:

1. To continue to provide library services as required to support the research conducted at NoFC and its district offices.

2. To complete and implement library policy.

3. To continue to provide on-line data base literature searches on site.

4. To develop with advice and input from the Library Committee or a Library Subcommittee and in cooperation with the other ForCan Libraries an acquisition and implementation plan to acquire, install, inaugurate and monitor the Sydney automated Library System including O&M, delivery, capital, training and human resource requirement.

5. To continue to cooperate with ForCan and other associated libraries.

6. To provide assistance and guidance with the organization and setting up of the Manitoba District Office library.

7. To work towards completion of updating of the Periodicals Holdings List.

8. To work towards disposal of duplicate and gift materials.

9. To investigate the use of Serial Management's System's Site program for on-line book ordering with a view to implementation to reduce staff time involved and to fill book order requests more promptly.

11. Accomplishments in 1988-89:

1. Library Services:

The library staff continued to provide services as required in order to support the research conducted at NoFC and its District Offices. Library staff are not longer going to the University of Alberta Library on a regular basis to obtain interlibrary loam requests. Electronic mail is being used where possible to fulfill interlibrary loam requests. Agriculture Canada has provided a software package for this purpose for use within its libraries.

In December 1988 there have been approximately double the number of requests from staff for interlibrary loans.

Denise Leroy, who is a qualified librarian, has been assisting the Library staff on a part-time basis with interlibrary loans and re-labelling pamphlet boxes of government documents.

A survey on usage of current periodical titles was conducted in the fall and the results indicate that one title could be discontinued and a number of other titles of equivalent value ordered to replace it.

The library has acquired a new display stand for newsletters and periodicals. During the past summer, the collection in the main library area was shifted to allow room for new periodicals, abstracts and indexes.

The library staff both took the introductory course on Wordperfect. The most recent Accessions List was compiled using Wordperfect.

2. Library Policy Statement

The Library Policy Statement has been implemented and is subject to annual revision.

3. On-Line Literature Searching

The Library had ten requests for on-line literature searches. In the next fiscal year, 1989-90 an increased demand for on-line literature searching is anticipated.

4. Sydney Library Automated System

The Library staff took training on the Cataloguing/Enquiry and MARC record interface modules during October 1988. Having sufficient time to spend on Sydney has been a major problem for the Library. At present the Library staff are working on customizing the software, setting up codes and authorities which is being done with the help of the computer services staff.

A person is being hired on contract to catalogue the back-log of government publications and other documents so that a designated library staff member can dedicate all of February and March 1989, to customize the cataloguing base system, develop a test database, demonstrate this to staff and modify the system as required.

5. Forestry Canada Libraries

Three or four conference calls have taken place between the Forestry Canada libraries to deal with issues arising with Sydney and to provide senior management at headquarters with input for staffing and budget for the headquarters Forestry Canada Library.

The retrospective conversion of the card catalogues of the Forestry Canada libraries will be a major topic for discussion at the Forestry Canada Libraries Annual Meeting to be held in June 1989 in Edmonton.

Forestry Canada libraries have continued to route journal titles on an informal basis and share their duplicate or superseded editions.

6. The Manitoba District Office Library

A visit was made during the last fiscal year (1987-88) to assess the needs of this library. Proposals and requisitions submitted were placed on hold for a while, pending availability of funds. Equipment and supplies and catalogue cards have since been ordered. It is anticipated that all the books (approx. 300 different titles) will be catalogued by the end of this fiscal year. The librarian is planning another visit (before March 31, 1989) to help set up the card catalogue, train staff to look after the library and to assess the cataloguing needs for the remaining publications.

7. The Periodicals Holdings List has been up-dated and sent to CISTI for inclusion in "The Union List of Scientific Serials in Canadian Libraries." About 720 entries have been changed. A print-out of NoFC serials holdings from the CAN/OLE data base is expected, as soon as the holdings have been updated.

8. Disposal of Duplicate and Gift materials

A number of journal titles donated to the Library have been integrated into the collection. Surplus duplicated, superseded editions and gift materials are being disposed of as time permits on an ongoing basis. A great amount of time has been spent in clearing out unwanted publications, promotional materials and files during the past year.

9. It is recommended that the Library use John Coutts Library Services for book ordering.

12. Present Status of Study:

Management and development of NoFC Library and auxiliary Services has progressed satisfactorily towards servicing research and regional development needs of NoFC and District Offices since its inception in 1970.

13. Goals for 1989-90:

1. To continue to provide library services to support the research conducted at NoFC and its District Offices. This includes provision of on-line literature searches, interlibrary loans and continued cooperation with Forestry Canada and other associated libraries.

2. To undertake training on the Serials module of the Sydney Library Automated System. To revise the plan for Sydney. To implement the plan in its various phases.

3. To host the Forestry Canada's Librarians' Meeting in June 1989 at NoFC and attend the Canadian Library Association's Annual Meeting in Edmonton, June 22-25, 1989.

4. To inform CISTI on a regular basis of any changes to the Library's serials holdings.

5. To develop a policy statement and procedures for the storage of archival material in collaboration with NoFC Library Committee or Task Force.

6. To implement with Purchasing, the recommendation that NoFC use John Coutts Library Services for ordering books.

14. Publications 1988-89:

Nil

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these study activities are not potentially detrimental to the environment.

16. Duration:

Start: 1970 Completion: Ongoing

17. Resources 1989-90:

PYs:	Prof.:	Robinson	1.0
	Tech.:	Hopp	1.0
	Total:		2.0
	Student:		0.3

O & M: $30,000

Capital:

18. Signatures:

L. Robinson
Investigator

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 31, 1989

1. Project: Technology Transfer and Communications

2. Title: Communications

3. New: Cont.: X 4. No.: NOR-33-04 (inlcudes NOR-33-05, Photography)

5. Study Leader: A. Ascher (Cooperator: P.S. Debnam)

6. Key Words: Communications, public relations, media relations, public information, photography

7. Location of Work: Northwest Region

8. Problem:

Forestry Canada activities continue to suffer from lack of recognition in non-forested and urban areas throughout the northwest region. This is due to several attitudinal and situational factors, both internal and external to the Northern Forestry Centre. The challenge is to examine each of these factors to see what can be changed or turned to the Northern Forestry Centre's advantage, and to develop strategies to bring about such changes.

9. Study Objectives:

1. Create increased public awareness and understanding of Forestry Canada and NoFC initiatives in the forestry sector, and inform target audiences of the benefits of the forest resource both to people in our region, and to Canadians as a whole.

2. Enhanced internal Forestry Canada and NoFC communications opportunities to exchange information, solicit feedback, and to identify and act upon concerns or issues warranting attention.

3. Provide a range of public and media relations services.

4. Provide a full range of photographic support services to NoFC personnel.

10. Goals for 1988-89:

1. Coordinate information services and activities within NoFC, including translation, public information, public relations, media relations and internal communications. (A.A.)

2. Obtain management approval of an annual communications plan, based on the External Communications framework already drafted. Such a plan could include promotion and distribution of the Big Fish Lake Experimental Burning Project video; distribution of the Canada-Manitoba FRA tabloid; writing, printing and distribution of a Canada-Alberta FRDA tabloid, promotion of seed shipment to China, and startup of planning for a 20th Anniversary Open House in 1990. (A.A.)

3. Develop public information and media materials, including media releases, feature articles, back grounders, exhibits, brochures, videos and others as required. (A.A.)

4. Investigate means of improving internal communication in the region, including the feasibility of initiating a monthly newsletter. (A.A.)

5. Participate in the continued implementation of public information plans under the Manitoba FRA, and Saskatchewan and Alberta FRDA's (see NOR-36). (A.A.)

6. To publish or otherwise make available to staff members the results of the inventory of in-house video, graphics, etc. capabilities, including instructions to access these facilities. (A.A.)

7. Assist in the development of a sequence of steps to be followed when assembling audio-visual presentations. (A.A.)

8. To continue to publish TIMBERLINES four times a year, taking into account management objectives and public interest, and work to time its distribution with publications offerings. (A.A.)

9. To coordinate the publication of proceedings from the Mixedwood Symposium. (A.A.)

10. To coordinate the publication of a "Who's Who" of NoFC, in cooperation with the Scientific and Technical Publishing Unit. (A.A.)

11. To continue serving on NoFC Awards Committee, and any other in-house, regional, national, and NGO working/advisory committees as required. (A.A.)

12. To participate as required in Government of Canada communications training workshop. (A.A.)

13. Provide photographic and advisory services to NoFC 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. Investigate the acquisition of slide duplication equipment. (P.D.)

14. Undertake field trips to gather photographic resource material as time allows. (P.D.)

15. Complete transfer of photography inventory, developing a system workable for both photo section and stores. (P.D.)

Added Goals:

16. Production of a video describing ecological site classification and its value to improved forest management.

17. Production of a video describing jack pine tree improvement program and its value to improved forest management.

18. Coordination of media relations on behalf of Alberta Forest Products Association for a media tour during National Forest Week.

19. Attend and complete Government of Canada Supervisory Orientation Program.

11. Accomplishments in 1988-89:

1. Coordinated information services and activities within NoFC, including translation, public information, public relations, media relations and internal communications.

2. Management approval given to annual communications plan, and plan distributed to all project leaders and district office managers with letter from Regional Director General.

3. Developed public information and media materials including media releases, feature articles, back grounders, tabloids and videos as required.

4. Re-introduced production and distribution of monthly internal newsletter.

5. Attended public information subcommittee meetings under Canada-Manitoba FRA; assisted in determining and carrying out public information priorities to the conclusion of the agreement. Limited involvement in Saskatchewan and Alberta FRDA communications activities.

6. Inventory of in-house video, graphics, etc. capabilities not completed. Initial responses from a survey of project leaders necessitated follow-up which was hampered by more pressing projects. continual acquisitions or upgrades to existing equipment also made it difficult to keep such an inventory current.

7. Comparison of different slide production methods is underway, with guidelines outlining required times for all steps of audio-visual presentation production to be prepared and posted upon receipt of this information.

8. Timberlines published regularly; distribution coordinated with one publications offering. In addition, a readership survey card was distributed with the summer issue. Poor response quantitatively; however, response to shortened format favorable.

9 Acted as coordinator for receipt of materials related to proceedings of Mixedwood Symposium; forwarded such materials as required.

10. Decision made to defer publication of a "Who's Who" for an indefinite period, opting for a simpler contact sheet. Contact sheet has been designed, typeset and pasted up in preparation for final approval and printing.

11. Served on NoFC Awards Committee (now defunct). No other committee participation required during the year (other than Canada-Manitoba FRA committee mentioned in goal 5).

12. Participated in mandatory PCO-initiated communications training workshop.

13. Provided photographic and advisory services to NoFC research and regional development projects including processing, printing, photo enlargement/reduction, specialized photography and layouts, and/or monitored the performance of contract services for same. Slide duplications equipment purchased.

14. There were neither requests nor opportunities to undertake field trips to gather photographic resource material.

15. Transfer of photography inventory to Stores completed.

16. Site classification video was produced and distributed within evaluation form.

17. Jack pine tree improvement video was produced. Video is currently undergoing revisions.

18. Media relations services were provided on behalf of Alberta Forest Products Association for NFW media tour, and a summary evaluation written.

19. Attended and completed Government of Canada Supervisory Orientation Program.

12. Present Status of Study:

Development of an external communications plan in 1988-89, together with reintroduction of an internal newsletter have provided a positive starting point toward a more focussed and integrated communications approach at the Northern Forestry Centre. The potential of new mediums such as video to reach external audiences is being explored and refined. Public and media relations services are provided when required. Provision of a full range of photographic services is ongoing.

13. Goals for 1989-90:

1. Examine the problems hindering effective communication of Forestry Canada and Northern Forestry Centre programs outlined in the Problem statement, and develop a communications strategy to counter and overcome these problems.

2. Draft and carry out a comprehensive 1989-90 Communications Plan in consultation with NoFC Management Committee. This plan to integrate the communications strategy to be developed as per goal 1 above.

3. Continued coordination and communication of general information services and activities on a regional basis, including translation, public information, public relations, media relations and internal communications (including issues management involving headquarters).

4. To undertake special leave.

Photographic Services

5. Provide photographic and advisory services to NoFC research and regional development projects including processing, printing, slide duplication, photo enlargement/reduction, specialized photography and layouts, and/or monitor the performance of contract services for same.

14. Publications 1988-89:

Ascher, A. 1988. Timberlines, Nos. 5, 6, 7, and 8. Author and editor

Ascher, A. 1988. Inside Information, July 1988, August 1988, September 1988, October 1988, and November 1988.

Ascher, A. 1988. "Canada-Alberta Forest Resource Development Agreement Update", Alberta Forestry Association Newsletter, Issue No. 1.

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these study activities are not potentially detrimental to the environment.

16. Duration:

Start: 1987 Completion: Ongoing

17. Resources 1989-90:

PYs:	Prof:	Ascher	1.0
	Tech.:	Debnam	1.0
	Total:		2.0

O&M: $15,000 (Photography 5.0 K)

Capital:

18: Signatures:

A Ascher

Investigator

Regional Director General

NOR-36-01

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 31,1989

1. Project: Development Agreements

2. Title: Canada-Manitoba Forest Renewal Agreement and District Office

3. New: Cont: X 4. No.: NOR-36-01

5. Study Leader: J. McQueen

N.B. See details in separate study statements for:

Name	Number
a) Forest pest mgmt surveys & damage appraisal	36-01-01
b) Standtending/regeneration demonstrations	(36-01-02) see NOR-36-01-12
c) Fire management	36-01-03
d) Silvicultural guidelines for Spruce	(36-01-04) see NOR-36-01-11
e) Jack pine seed orchards	36-01-05
f) Site classification	(36-01-06) see NOR-2-01
g) Nursery development	(36-01-07) see NOR-12-01
h) Forest economics	(36-01-08) see NOR-3-01
i) Forest inventory	(36-01-09) see NOR-4-01
j) Tree improvement	(36-01-10) see NOR-12-03
k) Silvicultural research & Tech Transfer	36-01-11
l) Forest renewal & intensive forest mgmt.	36-01-12

6. Key Words: Forest renewal,intensive management, resource data base, fire management, fire protection, nursery management, public information, agreement, administration, evaluation, job creation, economic development

7. Location of work: Winnipeg District Office 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 fo 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.

d) assessing Forestry Canada and Manitoba Natural Resources forestry related needs.

2. To provide regional liaison for all ForCan 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 Forestry Canada in matters related to federal and provincial governments, industry and the general public.

9. Goals for 1988-89:

1. Forest Renewal and Intensive Management - Review, approve and monitor reforestation and stand-tending projects developed by industry (Manfor and Abitibi); fund and monitor seeding growing contracts to meet industry requirements in relation to Agreement reforestation activity.

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. Monitor development and implementation of Province's short and medium-term action plans for completing provincial forest inventory data.

4. Public Information - Ensure continued implementation and revision, as required, of the Public Information Strategy approved in 85/86 by the Agreement Directorate, including liaison with DSS, appropriate NoFC/FEDC Office staff, contractors, and provincial representatives.

5. Evaluation - Ensure development funding and implementation of projects pursuant to Directorate approval of an evaluation

framework. Also, implement such procedures as are necessary at the District Office to ensure collection of required data at the appropriate source.

6. To become involved with the Western Diversification Office on forestry related matters

7. Fire Protection - to provide technical expertise in the implementation of Manitoba oriented computer fire management programs.

8. Economics - to continue work defining the size scale and scope of Manitoba forestry work opportunities. Efforts will be made in the technology transfer area to provide information on increasing mill efficiency. A study on the Manitoba Christmas tree markets will be done. An opportunity ID conference will be planned with the idea of holding the conference in early winter 1988 being given strong consideration.

9. Forest mensuration - to collect insect and disease information with the end goal of being able to predict areas where an outbreak is likely to occur.

10. Administration - Direct District staff and coordinate functional direction from NoFC (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 form compliance with Agreement reporting requirements and provision of accommodation, equipment (including micro computer) and other District and NoFC needs.

12. Publications, Reports 1987-88:
See individual study statements especially those relating to Economics, fire management and forest research

13. Environmental Implications:
The agreement manager has been directed by management committee to include all pertain environmental related information on the PAF associated with these projects. The PAF will serve as the official document which the environmental screening committee will review.

10. Accomplishments in 1988-89:

1. The two major forest industry companies in the Province completed a variety of reforestation projects during the year.

Regeneration Surveys
Site preparation
Planting
Thinning
Herbiciding

2. Quarterly directorate meetings were held with provincial staff and meetings were held with industry representatives to ensure an orderly implementation of the forest renewal sections of the agreement.

3. Cost-shared funding was provided to the Manitoba forest Inventory group for the purpose of loading the G.I.S. Approximately 200 townships in the South-eastern corner of the Province have been completed and another 84 are in progress. The next area to be addressed will be the North west corner of the Province including Manfor's FML.

4. ForCan was involved in thirteen community fairs during the year and made an estimated 50,000 visitor contacts.

5. Project submissions were reviewed and funding was made available for all projects approved by the directorate. The Green Ribbon Committee report was addressed and all recommendations were responded to in the appropriate fashion.

6. No CEIC forestry programs were implemented during the current fiscal year.

7. A variety of fire management training courses were presented to provincial staff. Analysis of fire weather and behavior associated with the Wallace Lake wildfire was started and is expected to be completed next year. Through agreement funding we are compiling a fire incidence data base for the years 1968 to 1986. K. Hirsch has been seconded to the Province until at least the end of March, 1989.

8. Economics - One report was completed - Forest Industry in Manitoba 1985. A series of time and motion studies were also completed.

9. Forest Mensuration: 355 damage plots were measured in May and 110 were remeasured in the fall. A series of population study plots were remeasured four times during the summer season.

10. Administration Projects were implemented upon directorate approval with funding obtained from the appropriate allocation. Agreement activities involved expenditures of $2,300,000.

11. Developed and established the Oakbank seed orchard with 22,000 Jack Pine seedlings. Maintained existing northern breeding district orchards. Prepared pedigreed seed and sowed seed at Hadashville. Carried out a major thinning and selection program in the Eastern District.

12. Assessed container seedling performance in various regions of the Province. An experimental design and layout on the Abitibi FML was done. Stock site trials will continue next spring. Report preparation on a variety of silvicultural reports continued during the winter months.

11. Goals for 1989-90:

1. Forest Renewal and Intensive Management - Review and monitor reforestation and stand-tending projects conducted by industry (Manfor and Abitibi) during the agreement period.

2. Agreement Management - Current: 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.

   - Anticipated: It is anticipated that a new agreement will be put into place during the fiscal year 1989/90. Should this happen significant time and effort will be required of all staff to ensure that the agreemenmt is implemented in a timely fashion.

3. Monitor development and implementation of Province's short and medium-term action plans for completing provincial forest inventory data.

4. Public Information - Ensure continued implementation and revision, as required, of the Public Information Strategy approved in 85/86 by the Agreement Directorate, including liaison with DSS, appropriate NoFC/FEDC Office staff, contractors, and provincial representatives.

5. To become involved with the Western Diversification Office on forestry related matters

6. Fire Protection - to provide technical expertise in the implementation of Manitoba oriented computer fire management programs.

7. Forest mensuration - to collect insect and disease information with the end goal of being able to predict areas where an outbreak is likely to occur.

8. Administration - Direct District staff and coordinate functional direction from NoFC (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 form compliance with Agreement reporting requirements and provision of accommodation, equipment (including micro computer) and other District and NoFC needs.

12. Publications 1988-89:

See individual study statements especially those relating to Economics, fire management and forest research

13. Environmental Implications:

The agreement manager has been directed by management committee to include all pertain environmental related information on the PAF associated with these projects. The PAF will serve as the official document which the environmental screening committee will review.

14. Resources 1989-90:

PYs: Agreement: 9.0
A-base: 4.0

Total: 13.0

O & M: 146.0 K

Capital: 0.0

Salaries: 178.0 K

Grants & Contributions: 159.0 K

15. Signatures:

District Manager

Program Director Development

Regional Director General

NOR-36-01-1

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 19, 1989

1. Project: Development Agreements

2. Title: Forest pest management, surveys, and damage appraisal (Manitoba)

3. New: Cont.: X 4. No.: NOR-36-01-1

5. Study Leader: Marilyn Daoust-Savoie

6. Key Words: Damage appraisal, impact, hosts, forest pests, sampling methods, management, mortality, growth loss, forest renewal, jack pine budworm, detection, distribution, parks, recreation, easement atmosphere, effluents

7. Location of Work: Manitoba District Office, Manitoba wide

8. Study Objectives:

   1. To develop methods for predicting short and long term impact of pest(s) including damage appraisal on forest resources, 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 forests and pest populations, to limit forest damage to tolerable levels by use of silvicultural, chemical and biological techniques.

   5. To provide management agencies, and the public with diagnostic impact and appraisal services relating to insects, diseases, climatic influences, and pollutants on trees, shrubs and other types of vegetation.

   6. To contribute to FIDS national overview of important pest conditions.

9. Goals for 1988-89:

1. Continue assessment of possible relationship between microsporangiate bud counts and defoliation intensity in the prediction of future defoliation of the jack pine budworm. (Daoust-Savoie)

2. Assess cumulative and current defoliation from the jack pine budworm in the "Damage Appraisal Permanent Plots". (Daoust-Savoie)

3. Continue jack pine phenology study in Belair and Sandilands. (Daoust-Savoie)

4. Continue the Jack Pine Population Study, in the Sandilands, Kettle Hills, and Manigotogan plots. (Daoust-Savoie)

5. Place jack pine pheromone traps at Belair, Sandilands, Kettle Hills, Sandilands (Hadashville) and Manigotogan plots. (Daoust-Savoie)

6. Complete analysis of the data from the Jack Pine Budworm Phenology Study. (Daoust-Savoie)

7. Complete analysis of the data of the Jack Pine Budworm Population Study. (Daoust-Savoie)

8. Survey, map and report on major forest pest of Manitoba (jack pine budworm, spruce budworm, forest tent caterpillar, etc.) (Grandmaison)

9. Conduct special surveys for particular pests or of designated areas. (Grandmaison)

10. Conduct pest surveys of young plantations and high value stands. (Grandmaison)

11. Compile and report on the forest pest situation in Manitoba for 1988 and pest predictions for 1989. (Grandmaison)

12. Perform annual assessments on the four ARNEWS plots. (Grandmaison)

13. Participate in the completion of a slide/tape presentation of major pest problems in Manitoba. (Grandmaison, Daoust-Savoie)

14. Participate in the annual Regional Insect and Disease Technical Advisory Committee meeting. (Grandmaison, Daoust-Savoie)

15. Provide pest extension service and technology transfer to various client agencies and the general public. (Grandmaison, Daoust-Savoie)

16. Represent NoFC and ForCan on various provincial forest insect and disease committee and advisory groups. (Grandmaison, Daoust-Savoie)

10. Accomplishments in 1988-89:

1. Field work for assessing the relationship between microsporangiate bud counts and defoliation intensity was completed.

2. Defoliation in the "Damage Appraisal Plots" were assessed.

3. Field work on jack pine budworm phenology study completed.

4. Field work on jack pine budworm population study was completed.

5. Jack pine budworm pheromone traps were placed in plots at Sandilands, Manigotogan and Kettle Hills.

6. Data on jack pine budworm phenology were made machine readable.

7. Data on the jack pine budworm population estimates were made machine readable.

8. Surveys of the spruce and jack pine budworms, the forest tent caterpillar, and other important pests were conducted.

9. Surveys for introduced insects and scleroderris canker were conducted. No evidence of these pests were detected.

10. A pest detection survey was conducted in twenty one plantations in Manitoba.

11. A file report describing pest conditions in Manitoba in 1988 with prediction for 1989 was prepared.

12. All four ARNEWS plots were visited and the annual assessments and collections made.

13. All required photographs and text for the slide/tape presentation were prepared and delivered to Manitoba Natural Resources. The final product is now available.

14. The annual Regional Insect and Disease Technical Advisory Committee meeting was held in Winnipeg and presentations were made on pest conditions in Manitoba.

15. Pest extension information was provided to various clients.

16. Forestry Canada was represented on the Regional Insect and Disease Technical Advisory Committee.

11. Goals for 1989-90:

1. Complete a final report on the jack pine budworm population, phenology, and defoliation studies.

2. Survey, map, and report on the major forest pests in Manitoba.

3. Conduct and prepare data on an intensive impact survey of the 5 ha plantations in Manitoba.

4. Conduct and prepare data files on tree assessments in 50 permanent forest inventory sample plots in Manitoba.

5. Conduct the annual assessments of the four permanent ARNEWS plots.

6. Compile a report on the forest pest situation in Manitoba for 1989 and pest prediction in 1990.

7. Provide a pest extension service and technology transfer to various client agencies.

8. Prepare material for presentation at the annual Regional Insect and Disease Technical Advisory Committee.

9. Represent ForCan on various forest pest committees and advisory groups.

12. Publications 1988-89:

Grandmaison, M. Pest Conditions in Manitoba for 1988. File Report.

13. Environmental Implications:

The agreement manager has been directed by management committee to include all pertinent environmental related information on the PAF associated with this Project. The PAF will serve as the official document which the environmental screening committee will review.

14. Duration:

Start: 1984 Completion: 1990

15. Resources 1989-90:

PYs:	Prof.:	Daoust-Savoie	1.0 (Agreement)
	Tech.:	Grandmaison	1.0 (A-base)
	Total:		2.0
	Term/Student:		0.0

O&M: $4,000 (Daoust-Savoie)
$8,000 (A-base 11-01) (Grandmaison)

Capital:

16. Signatures:

Investigator

Supervisor

Technical Advisor

District Manager

Program Director, Protection

Program Director, Development

Regional Director General

NOR-36-01-3

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 7, 1989

1. Project: Development Agreements

2. Title: Fire Management (Manitoba)

3. New: Cont.: X 4. No.: NOR-36-01-3

5. Study Leader: K.G. Hirsch

6. Key Words: Fire management, information exchange, training, development, fire weather, cost effectiveness, fire behavior, fuels, fire environment

7. Location of Work: Manitoba

8. Study Objectives:

   1. To participate in the development of and facilitate the application of fire research technology that is relevant to Manitoba and will help to improve and advance fire management in the province.

   2. To promote and encourage the identification and expression of fire research requirements by the fire management agencies in Manitoba so as to assist the effective communication and presentation of these ideas to the NoFC fire research project and other appropriate research groups.

   3. To collect pertinent information on a variety of fire management subject areas, permitting the development and application of models to assist fire managers in their decision-making process.

9. Goals for 1988-89:

   1. Maintain liaison between fire research and operations in Manitoba by:

      a) participating in provincial and regional meetings which deal with the various aspects of Manitoba's fire management program,

      b) interacting with fire management personnel at all levels of the organization,

c) continue to participate as a member of the Manitoba Fire Research Committee,

d) continue to provide advisory services on fire weather and serve as a member of the Central Region Fire Weather Committee.

2. Continue to monitor and provide input and direction to research projects and other fire management activites conducted under the Agreement.

3. Complete a file report on the accuracy of the thermohygrometer.

4. Finish the analysis of the fire occurrence database (1968-86) and complete a file report showing any significant trends in Manitoba. A formal presentation of this report will be made to the province.

5. Publish an article and an Information Report on the fire weather and fire behavior associated with the 1987 Wallace Lake Fire.

6. Collect fuel loading, fire weather and fire behavior data on a prescribed fire conducted by the province at Lake St. George.

7. Assist in the field work associated with the Lowland Black Spruce Experimental Burning Project at Big Fish Lake (NOR-05-05).

8. Continue to provide technology transfer services by:

a) participating in and conducting workshops on various topics (e.g., fire weather, fire behavior) upon request from the province,

b) producing and distributing two Technology Transfer Notes on topics related to fire management in Manitoba.

c) continuing to provide advice and serivces on fire management topics, especially to the provincial fire management organization.

10. Accomplishments in 1988-89:

1. Various activities have taken place which maintained the liaison between fire research and operations. This included:

- One and/or two day meetings with Fire Control Officers in the Northwestern, Western and Eastern Regions.

- Attended a provincial field demonstation of new suppression equipment.

- Seconded to provincial Fire Programs Office from December 1, 1988 to March 31, 1989. Designated projects included:

(a) revising the current fire report form and creating a new fire report database with special statistical analysis and plotting capabilities,

(b) evaluating fire weather/behavior software and proposing the most effective uses for it,

(c) assisting in the creation of a fire managment planning team and any ensuing planning activities.

- Continued to serve as a federal member of the Central Region Fire Weather Committee and also represented the province at the annual meeting December 7, 1988 in Saskatoon.

2. Worked cooperatively with Regional Services staff to coordinate the fire management projects under the agreement including a preliminary study on a detection video camera, out-of-country fire suppression and fire management training, team evaluation of various aspects of the provincial fire managment program.

3. The data from the thermo-hygrometer study was forwarded to the Petawawa National Forestry Institute for analysis. It will be used as part of a larger study on the accuracy of various humidity sensors.

4. The fire occurrence database has been turned over to the province for use in a fire occurrence display system built for IMB/PCs. Because of the desire to create a new database no analytical studies were desired at this time.

5. A comprehensive slide presentation on the Wallace Lake Fire was completed. Presentations were given at:

- Region Fire Weather Committee Scientific and Technical Seminar,
- Annual Manitoba-Ontario border cooperation meeting,
- Abitibi-Price annual spring fire meeting,
- Cranberry-Portage District fire operations meeting.

Due to the secondment to the province an Information Report was not completed however an overview of the fire weather and fire behavior was published in Fire Management Notes (see publications).

6. Fuel loading data was collected on the Lake St. George prescribed burn site but the burn itself did not occur due poor weather conditions.

Fire weather and fire behavior information was collected during four prescribed burns in the Duck Mountains in October. A brief report was provided to the province.

7. Assisted in the field work associated with the Lowland Black Spruce Experimental Burning Project at Big Fish Lake (NOR-05-05). Due to poor burning conditions only 1 experimental fire was conducted.

8. - Conducted 5 introductory workshops on fire weather and fire behavior at: (a) CL-215 pilot training course, and (b) Western, Interlake, Northeastern and Southeastern region's Level III fire suppression training courses.

   - Produced and distributed two technology transfer notes (see publications). One of these notes was also published in Fire Management Notes.

   - Provided consultation to Riding Mountain National Park regarding their wildland/urban interface problem.

   - Provided assistance to the fire suppression team at the Brereton Lake Fire and also collected fire behavior information. This information was analyzed along with data collected by field staff on the Gull Lake and Kenora #14 Fires and a case study will be produced in 1989.

   - Fire weather data from 1980 to 1987 was compiled and forwarded to R/EMS Ltd. for use in a fire weather software package purchased by the province.

   - Reviewed three unsolicited manuscripts.

   - Participated in the public information programs during forest week and at the Flin Flon Trout Festival (June 29 - July 2).

11. Present Status:

1. Various technology transfer activities have been undertaken to improve and advance fire management in Manitoba. This includes:

   - planning and conducting workshops and training courses on recent developments in fire weather, fire behavior, and fire management planning,

   - demonstrations of new fire fighting equipment and computer programs,

   - publication of newsletters (2/year) and posters on topics of current interest to fire management staff, and

   - distribution of publications on various fire management topics plus personal consultation.

2. To assist the identification of research needs, meetings are held annually with regional and provincial fire management staff. A formal committee composed of field and management staff has also been established to deal with fire research matters in the province.

3. A number of applied research projects have been conducted in order to assist fire managers in their decision-making process. This includes:

   - an analysis of the provincial fire weather stations and instrumentation used,
   - the development of a fire occurrence database for the period of 1968-86,
   - the compilation of all available fire weather data,
   - an analysis of the efficiency of the present fire weather station network,
   - a report on the use of Bird-dog aircraft in Manitoba,
   - an analysis of some examples of extreme fire behavior in Manitoba, and
   - the creation of a provincial fire managment planning team.

   The objectives of this study are on-going and will be continued if the present Canada-Manitoba Forest Renewal Agreement is renewed.

12. Goals for 1989-90:

1. Continue to provide technology transfer services to the province by:

   a) participating in provincial and regional meetings which deal with the various aspects of Manitoba's fire management program,

   b) interacting with fire management personnel at all levels of the organization,

   c) participating in and conducting workshops on various topics (e.g., fire weather, fire behavior) upon request from the province,

   d) providing advice and services on fire managment topics including fire management planning, prescribed fire and fire behavior prediction.

2. Continue working on the secondment projects designated by the province. This includes:

   a) developing of a fire report database and statistical analysis system,

   b) evaluating and developing a plan for implementing the R/EMS fire weather and fire behavior software,

   c) assisting in the development of a provincial fire management planning team and possibly in a pilot planning project.

d) coordinate a project designed to evaluate the use of a high quality video camera for fire detection.

3. Present and publish a poster paper entitled an Analysis of the Fire Weather and Fire Behavior Associated with Three 1988 Spring Wildfires in Central Canada. This will be presented at the 10th conference on Forest and Fire Meteorlogy in Ottawa to be held April 17-21, 1989.

4. Co-author a poster paper to be presented at an international wildfire conference to be held in Boston, Ma. July 23-26, 1989. This paper, titled the Use of Posters for Interpreting Fire Behavior/Danger Research will also be published in Fire Management Notes.

5. Continue to serve as a member of the Central Region Fire Weather Committee and coordinate the 6th Scientific and Technical Seminar to be held April 4, 1989. Proceedings form this seminar will be published as a file report.

13. Publications 1988-89:

Hirsch, K.G. 1988a. An overview of the 1987 Wallace Lake Fire, Manitoba. Fire Management Notes 49(2).

Hirsch, K.G. 1988b. Documenting wildfire behavior: an example from the 1988 Brereton Lake Fire, Manitoba. Govt. Can., For. Can., Man. Dist. Office, Winnipeg, Man., Tech. Trans. Note M-003. 4 p.

Hirsch, K.G. 1988c. Ignition patterns used in prescribed burning. Gov't Can., For. Can., Man. Dist.Office, Winnipeg, Man., Tech. Trans. Note M-004. 4 p.

Hirsch, K.G. 1988d. Documenting wildfire behavior: an example from the 1988 Brereton Lake Fire, Manitoba. Fire Management Notes 50(?) [in press].

14. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these study activities are not potentially detrimental to the environment.

15. Duration:

Started: 1984 Estimated Completion: 1990

16. Resources 1989-90:

PY's:	Prof.: Hirsch	1.0
	Tech:	0.0
	Total:	1.0

O & M: $4000

16. Signatures:

Investigator

District Manager

for J. M. Powell
Technical Advisor

Program Director, Development

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 7, 1989

1. Project: Development Agreement

2. Title: Establishment of jack pine seed orchards in Manitoba

3. New: Cont.: X 4. No.: NOR-36-01-5 (NOR-36-08)

5. Study Leader: A. Nanka

6. Key Words: controlled breeding, mass selection family test, plantation tending, pedigreed seed orchard, crown management

7. Location of Work: Winnipeg, Oakbank, The Pas, Lonesand, Interlake Hadashville, Marchand, Stead

8. Study Objectives:

   1. To establish jack pine seed orchards for eastern and western Manitoba by controlled breeding of trees selected under study NOR-12-03.

   2. To establish jack pine seed orchards for the Interlake and Northern Regions of Manitoba using mass selection in plantations of source-identified populations.

   3. To prepare a comprehensive establishment report for each seed orchard established under this study to facilitate their development and utilization by the Manitoba Forestry Branch (MFB) beyond the 1989 termination of the Canada-Manitoba Forest Renewal Agreement.

   4. To provide required support to study NOR-12-03 in Manitoba, including but not limited to determining and carrying out required plantation tending.

9. Goals for 1988-89:

   1. In cooperation with MFB continue to operate and share the use of the Tree Improvement Facility at Pineland Forest Nursery until May 30, 1989. No commitments beyond this date.

2. Prepare a comprehensive establishment report for the IMSSO and work towards developing a joint maintenance schedule with MFB Regional staff.

3. Complete Oakbank orchard site development (land levelling and irrigation installation). Complete crop rearing of pedigreed stock. Complete orchard establishment (plot layout and planting) including fencing and fireguarding.

4. Follow through with second phase of the Eastern Breeding District (EBD) thinning process (uproot and remove 6,000 stumps and relocate all plot pins).

5. Select the base option for the Western Region orchard or procure clonal stock only.

6. Develop a joint maintenance program for the NMSSO with FB staff in the Northern Region.

Added Goals:

7. Organized a Tree Improvement Workshop with specialists from all areas of tree improvement. Present a topic paper on Rearing Jack Pine Seedlings in Containers. Prepare a file report on presntations of this workshop.

8. Presented crown management technology on increased jack pine cone crop production for grafted and outplanted seed orchards as requested by Canadian International Pulp & Paper of Hawksberry, Que.

9. Present technology transfer on utilization of "cone rake" technology for spruce cone collection from the B.C. Forest Service to MFB.

10. Demonstrate to MFB staff how to improve operational practices to achieve the best results from tree improvement tests.

10. Accomplishments in 1988-89:

1. Reared 10,000 pedigreed jack pine orchard stock; reared 20,000 colorado spruce and currently growing second crop of 20,000 seedlings; reared 2,000 jack pine root stock; grafted 800 jack pine for Western Region Clone Bank (CBD); reared 6000 douglas fir seedlings; and jointly operated the Tree Improvement Facility to full capacity with the Manitoba Forestry Branch.

2. Prepared first draft of NMSSO establishment report and a schedule for monitoring orchards jointly with MFB staff (see Project Work Plan, Sec. 8, Obj. 2).

3. Completed establishment of Pedigreed Seed Orchard including fencing and fireguarding.

4. Provided support to study NOR 12-03 in Manitoba; thinned 6,000 stems in EBD; printed and tagged 6,000 trees; and provided guidance to video contractor.

5. Selected option for Western Region Clone Bank which is under development at Pineland (scheduled completion date June 1988.

6. Continue to provide technology transfer through a joint maintenance program with MFB regional staff for NMSSO and IMSSO according to project work plans (see Sec. 8, Obj. 2, 3 and 4).

7. Organized and coordinated a Workshop on Rearing Conifers in Containers For Tree Improvement. Prepared a File Report (#1) of workshop presentations.

8. Provided crown management technology on increasing jack pine cone crop production for grafted and out planted seed orchards to Canadian International Pulp & Paper of Hawksberry Que.

9. Provided technology transfer on utilization of "cone rake" technology for spruce cone collection from the B.C. Forest Service to MFB.

10. Provided to MFB staff demonstrations how to improve operational practices and achieve best results/benefits from tree improvement tests via Mass Selection Orchard site development.

11. Goals for 1989-90:

1 (a) Provide demonstration on propagation and rearing of clonal stock and prepare layout design for the Western Region Clone Bank at Pineland Prov. For. Nursery.
(b) Examine new project proposals and manage when the need arises

2 (a) Complete final draft of NMSSO establishment report, include thinning plans and maintenance schedule till 1994 and mount signs on both sites.
(b) Prepare Forest Management Note on NMSSO.

3 (a) Complete final draft of IMSSO establishment report, include thinning plans and maintenance schedule till 1995 and mount signs on site.
(b) Prepare Forest Management Note on IMSSO.

4 (a) Complete final Draft of Oakbank Pedigreed Orchard establishment report, mount signs on site and complete irragation details.
(b) Prepare Orchard Management Plan.
(c) Prepare Forest Management Note on Pedigreed Orchard.

5 (a) Present crown management technology on increasing cone production for jack pine grafts and seedling orchard stock as requested by B.C. Seed Orchard Managers Group in Prince George B.C.
(b) Examine new project proposals as the need arises.

(c) Examine the feasibility in amalgamating projects with similar objectives as a joint venture with forest industry, federal and provincial funds. ie. rooting of jack pine cuttings.

12. Publications 1988-89:

Nanka, A.M. Guide to Jack Pine Family Test Plantations In Manitoba And Saskatchewan Study NOR 1203 File Report No. 1.

13. Environmental Implications:

The Agreement Manager has been directed by Management Committee to include all pertinent environment-related information on the PAF associated with the project. The PAF will serve as the official document which the environmental screening committee will review.

14. Resources 1989-90:

P/Ys:	Prof:	0.0
	Tech: Nanka	1.0
	Total:	1.0
	Term/Student:	0.0

O & M: $7,000
Capital:
Grants & Contributions:
O & M for (TIF/PFN) -

15. Signatures:

Investigator

Supervisor

Technical Advisor

District Manager

Program Director, Development

Regional Director General

NOR-36-01-11

FORESTRY CANADA

STUDY WORK PLAN

1988-89

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: March 6, 1989

1. Project: Development Agreements

2. Title: Silvicultural research and technology transfer, Manitoba.

3. New: Cont.: X 4. No.: NOR-36-01-11 (NOR-10-05)

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

8. Study Objectives:

   1. To establish strong lines of communication with various forest management agencies in Manitoba.

   2. To assess, maintain and conduct silvicultural research, field trials, and demonstrations in Manitoba.

   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 1988-89:

   1 a. To establish a spruce stock-site trial in cooperation with Abitibi-Price Inc. near Pine Falls by supervising planting and taking outplanting measurements. Soil moisture data will be collected bi-weekly from all areas during the growing season.

   b. To prepare an establishment report for (a).

   c. To select areas and carry out block layout for a second planting replication in spring 1989 in anticipation of a new 1989 Agreement.

2. To assess Soviet Scots Pine provenance trials in the Sandilands Forest Reserve and at Cowan and conduct a short tour for major Christmas tree growers in Manitoba.

3. To supervise study NOR-36-01-3.

4. To perform liaison and technology transfer with Manitoba and CFS personnel.

5. To participate in a number of public awareness activities.

6. To complete all publications on MS-226, MS-238 and MS-229.

7. To complete field measurements on MS-228 shelterwood cutting (4 areas in the Porcupine Mountain). (Kolabinski)

8. To complete revisions required for MS-182 manuscript. (Kolabinski)

9. To compile and analyse MS-228 shelterwood data and prepare a report. (Kolabinski)

10. To compile and analyse MS-211-216 and prepare a report.

11. To organize a number of CFS public information displays in Winnipeg and rural Manitoba. (Dyck)

12. Added Goal. To remeasure DMS 032, Jack pine barrel and anchor chain scarification at Candle Lake, Turtle Lake, White Gull Lake and Lily Plain SK (Kolabinski).

10. Accomplishments in 1988-1989:

1. (a) A spruce stock-site trial was established in cooperation with Abitibi-Price Inc. near Pine Falls. Two split block experiments on trenched and untrenched corridors were planted in May and June with two stock types: 1) current crop of black and white spruce Can Am 2 containers and 2) container transplants in May and June. A total of 3200 seedlings were planted on the strips.

   Four randomized block experiments, on two trenched and two untrenched open areas were planted with the same stock types at the same time. A total of 3200 seedlings were planted on the open areas.

   (b) caliper and height measurements were recorded on 6400 seedlings immediately after planting.

   (c) Soil moisture samples were taken biweekly during the period May 16-Sept 22 from eight stations at two depths. Moisture percentages were then determined using gravimetric methods.

   Seedling condition was assessed in late October 1988, results compiled and a file establishment report prepared.

2. Soviet Scots Pine provenance trials in the Sandilands and at Cowan were measured in August; a tour of the Sandilands site was given in March. Results are being compiled.

3. Supervised study NOR-36-01-3.

4. Numerous contacts were made with Manitoba government nurserymen and field and industrial foresters with the Abitibi work. Organized a field trip and made a presentation to the annual Regional Reforestation Technical Committee meeting at Riding Mountain. Toured on-going regional site classification in the Sandilands and attended site classification review in Winnipeg. Gave a talk at the Abitibi seminar at Pine Falls. Attended Vegetation Management meeting in Sault Ste. Marie and provided Ed Oswald with abstracts of CFS vegetation management research in Manitoba and Saskatchewan.

5. Organized 12 public information shows in Winnipeg and rural Manitoba by obtaining concession contracts, preparing displays, ordering literature, scheduling staff and allocating accomodations and vehicles. Many requests for literature and general forestry information were provided. (Dyck) Participated in a number of public awareness activities including Forestry Week, Ukrainian Festival and the Morris Stampede (Ball).

6. Provided literature to students and responded to requests from the general public and provided inventory to FORCAN COMMUNICATIONS. (Dyck)

7. FMN manuscripts have been prepared for MS 229 and MS 238. (Ball). MS 226 work has been compiled and a 125-page file report "Converting Aspen Stands to White Spruce by Planting and Seeding on Scalped Strips, Manitoba." has been prepared. (Dyck)

8. Field measurements on MS-228 shelterwood cutting have been completed. (Kolabinski)

9. Secondary revisions have been made to the MS-182 manuscript which is still with the reviewers. (Kolabinski)

10. MS-228 shelterwood data is being compiled. MS-211-216 data is being compiled together. (Kolabinski)

11. Regeneration surveys of DMS 032 at Candle Lake, Turtle Lake and White Gull Lake have been completed (Kolabinski).

11. <u>Goals for 1989-90</u>:

1. a. To continue the spruce stock-site trial near Pine Falls by planting two stock types of black and white spruce on trenched and untrenched strip and open areas off the Trans Licence Road.

   b. To record individual outplanting height and root collar diameter of 1989-planted seedlings.

c. To collect bi-weekly soil moisture data on the 1989-planted areas during the May-Sept. growing season.

d. To record condition, height and caliper of the 1988 stock in October 1989 after the second growing season.

e. To record condition of 1989 stock in October, 1989.

f. To test a Troxler model 3401B density-moisture gauge and examine differences in soil moisture and soil bulk density between trenched and untrenched areas.

g. To prepare a file report on items listed above.

2. To supervise study NOR-36-01-3.

3. To perform liaison and technology transfer with Manitoba and FORCAN personnel and participate in a number of public awareness activities.

4. To co-author and present a poster paper on soil compaction and seedling growth at the Joint USA-CANADA REGIONAL ISTVS MEETING at Victoria.

5. To complete editorial work on MS 229 and MS 238 FMN's.

6. To prepare an Information Report based on the 125-page MS 226 file report (Dyck).

7. To organize all FORCAN public information displays in Winnipeg and rural Manitoba (Dyck).

8. To provide literature to students and respond to requests from the general public; to provide inventory to FORCAN COMMUNICATIONS.

9. To complete editorial work on the MS 182 Information Report (Kolabinski).

10. To complete compilation and analysis of MS 228 and prepare a report (Kolabinski).

11. To complete compilation and analysis of MS 211-216 and prepare a report (Kolabinski).

12. To complete a regeneration survey of DMS 032 at Lily Plain and White Gull Creek, SK and compile the data (Kolabinski).

13. To remeasure NOR 17 container and bare-root plantations at Candle Lake SK (Kolabinski).

12. Publications 1988-89:

File Reports:

Ball, W.J.; Dyck, J.R. 1989. Pine Falls Stock Site Trials Establishment Report.

Dyck, J.R.,1989. "Converting Aspen Stands to White Spruce by Planting and Seeding on Scalped Strips, Manitoba."

13. Duration:

Started: 1984 Estimated Completion Date: 1990

14. Environmental Implications:

The agreement manager has been directed by management committee to include all pertinent environmental information on the PAF associated with this project. The PAF will serve as the official document which the environmental screening committee will review.

15. Resources 1989-90:

PY's:	Prof.:	Ball	1.0
	Tech.:	Dyck	1.0
		Kolabinski	1.0
	Total:		3.0

O & M: $4,000
Capital:
Grants & Contributions:

16. Signatures:

Investigator

District Manager

Program Director, Development

Regional Director General

3/2

NOR-36-01-12

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 7, 1989

1. Project: Development Agreements

2. Title: Forest Renewal and Intensive Forest Management (Manitoba)

3. New: Cont.: X 4. No.: NOR-36-01-12

5. Study Leader: N. M. Cataldo

6. Key Words: Forest renewal, intensive forest management, industrial forest management license area (Abitibi & Manfor), federal lands, agreement, planting, seeding, thinning, release cutting

7. Location of Work: Manitoba District Office, Manitoba wide

8. Study Objectives:

   1. To monitor, under the Canada-Manitoba Forest Renewal Agreement, the use of federal funds relating to:

      a) Program A: Forest Renewal, Subprogram 2: Forest Renewal on Industrial Forest Management License Areas, Private Woodlots and Federal Lands; and b) Program B: Intensive Forest Management, Subprogram 4: Forest Stand Tending on Industrial Forest Management License Areas, Private Woodlots and Federal Lands.

   2. To assist Abitibi-Price Inc. and Manfor Ltd. with their:

      a) Project proposals under Programs A-2 and B-4; and
      b) Implementation of approved projects under Programs A-2 and B-4.

   3. To monitor, assess and evaluate all projects performed by Abitibi-Price Inc. and Manfor Ltd. under Programs A-2 and B-4.

   4. To provide advice and technical assistance, as required, in relation to Programs A-2 and B-4.

5. To promote and monitor forest renewal and stand tending projects on federal lands and, to assist Native Bands with the implementation of such projects.

6. To establish Demonstration Areas in order to demonstrate forest management techniques and practices for the establishment and tending of pine and spruce stands.

7. To remeasure and maintain Demonstration Areas and prepare appropriate reports on treatments and obtained results for use by practising foresters and whenever for the general public.

9. Goals for 1988-89:

1. Review, approve and monitor reforestation and stand tending projects developed by industry (Manfor and Abitibi-Price).

2. Fund and monitor seedling growing contracts to meet Industry and, where applicable, Band requirements in relation to Agreement reforestation activities.

3. Monitor industry quarterly advance payment requests, progress claims, and program budgets.

4. Identify Native Bands for silvicultural project involvement and where applicable administer and implement suitable renewal and/or stand tending operations.

5. In close co-operation with the Manitoba Forestry Branch, NoFC research staff and Program Directors, and based on recommendations contained in Johnson Forestry Services review of Manitoba-Saskatchewan R & D plots established between 1904-1970, plus any other suitable study plots, select additional field plots for use as Demonstration Areas in Manitoba.

6. Remeasure, as appropriate, selected Demonstration Areas and prepare appropriate short reports outlining treatments and updated results.

7. Prepare appropriate maps at suitable scales indicating demonstration plot locations and ensure that the selected Demonstration Areas are duly recorded by the Manitoba Land Titles Branch.

8. In co-operation with the Manitoba Forestry Branch and the Forestry Relations Officer (NoFC) prepare and erect appropriate demonstration plot signage.

9. Assist in distributing the Forest Management Demonstration Manual and Notes to provincial foresters and update as required.

Added Goals:

10. Prepare and conduct a Juvenile Spacing Training Program for Manfor Ltd. in The Pas.

11. Prepare and present a paper on Intensive Forest Management at Abitibi-Price Inc. Silviculture Seminar in Pine Falls.

10. Accomplishments in 1988-89:

1. A variety of forest renewal and intensive forest management projects and activities were implemented during the year. The work was conducted on the license areas of the two major forest companies in Manitoba, Abitibi-Price Inc. in Pine Falls and Manfor Ltd. in The Pas. This consisted of surveying 9 328 ha, purchasing 821 000 seedlings, site preparing 357 ha, seeding 35 ha, planting 2 035 214 trees, herbicide spraying 136 ha, and juvenile spacing 474 ha. Through these activities 3 706 person weeks of employment were created.

2. The 1988 planting stock agreement between Abitibi-Price Inc. and Dakota Ventures Ltd., which represents Dakota Tipi and Dakota Plains Indian Bands from Portage la Prairie, was cancelled. This agreement which supplies seedlings for Abitibi's federal planting program and funded under the Agreement, was cancelled due to problems at Dakota Tipi and Dakota Plains greenhouses. The 1988 stock was purchased from the provincial nursery in Hadishville.

3. Abitibi-Price and Manfor quarterly advance payment requests, progress claims, and budgets were monitored. Total expenditures under Programs A-2 and B-4 amounted to $ 1 144 561.00.

4. Assistance was provided to the Split Lake Indian Band to concerns regarding a 200 ha fire in 1987 on the reserve. A project proposal from the Hollow Water Indian Band was assessed and preliminary work in carrying out a project with the Band commenced.

5. Forest renewal work conducted by the Dominion Forest Service and the Manitoba Department of Natural Resources in the Turtle Mountain and Spruce Woods Provincial Forests was examined for possible use as demonstration areas. Field measurements were taken from plantations in the Spruce Woods Provincial Forest.

6. Five final reports for demonstration purposes were prepared in 1988-89.

7. Location maps have been prepared for all published reports and all demonstration areas located on Crown Land have been registered with the Manitoba Crown Land Registry.

8. Demonstration plot signs (24) have been erected.

9. Five new Forest Management Demonstration Notes were printed and distributed by the Province.

10. Prepared and conducted a three day training program in juvenile spacing for Manfor's two contracting crews in October 1988.

11. Participated and made a presentation on Intensive Forest Management

at a Silviculture Seminar sponsored by Abitibi-Price of April 7, 1988 in Pine Falls.

11. Goals for 1989-90:

1. To review, approve and monitor reforestation and stand tending projects developed by industry (Manfor and Abitibi-Price) and to assist as required.

2. To fund and monitor where applicable seedling growing contracts to meet Industry and Band requirements in relation to Agreement reforestation activities.

3. To monitor industry quarterly advance payment requests, progress claims, and program budgets, and to prepare quarterly statements and an annual report.

4. To respond to Native Band forest renewal and stand tending project proposals and where applicable administer and implement suitable programs.

5. To continue selecting and remeasuring study field plots for use as Demonstration Areas in Manitoba and to continue preparing appropriate short reports outlining treatments and updated results.

6. To prepare and erect in cooperation with the Manitoba Forestry Branch appropriate demonstration plot signage.

7. To continue assisting and participating in public awareness activities.

12. Publications 1988-89:

Bella, I.E. 1988. Spacing Effects 20 Years After Planting Three Conifer Species In Manitoba. Can.-Man. Econ. Reg. Dev. Agreement. For. Mgmt. Dem. Note No. 12:63-65.

Cataldo, N.M. 1988. Post Stand Tending Inspection and Assessment: An Evaluation of Work Quality Performance. File Report. 28p.

Chrosciewicz, Z. 1988. Burning for Black Spruce Regeneration on a Lowland Cut-Over Site in Southeastern Manitoba. Can.- Man. Econ. Reg. Dev. Agreement. For. Mgmt. Dem. Note No. 9:47-49.

Walker, N.R. 1988. Experimental Seeding in 1920 Produces Overstocked Stands of White Spruce; Jack Pine Destroyed by Hares. Can.-Man. Econ. Reg. Dev. Agreement. For. Mgmt. Dem. Note No. 8:39-45.

Walker, N.R. 1988. Scarification in 1966 Produces Densely Stocked Areas of Natural White Spruce. Can.-Man. Econ. Reg. Dev. Agreement. For. Mgmt. Dem. Note No. 10:51-56.

Walker, N.R. 1988. Effects of Hare Browsing, Competition, and Drought on Some 1920 and 1922 Planting Trials of Pine and Spruce. Can.-Man. Econ. Reg. Dev. Agreement. For. Mgmt. Dem. Note No. 11:57-61.

13. Environmental Implications:

The agreement manager has been directed by management committee to include all pertinent environmental information on the PAF associated with this project. The PAF will serve as the official document which the environmental screening committee will review.

14. Resources 1989-90:

PYs:	Prof.: Cataldo	1.0
	Tech.: Walker	1.0
	Total:	2.0
	Term/Student:	0.0

O & M: $18,000.00
Capital: 0.0

Grants & Contributions: $150,000.00

15. Signatures:

Investigator

District Manager

Program Director, Development

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: January 20, 1989

1. Project: Development Agreements

2. Title: Canada-Alberta Forest Resource Development Agreement and Development Program Coordination

3. New: Cont.: X 4. No.: NOR-36-02

5. Study Leader: S. Price

N.B. See also separate study statements for:

i)	Forest Vegetation Management (Alberta)	See NOR-10-03 See NOR-10-03 See NOR-7-04 See NOR-3-01
ii)	Tree Improvement (Alberta)	See NOR-12-03
iii)	Wetland Drainage (Alberta)	See NOR-28-03
iv)	Forest Pest Management & Damage Appraisal (Alberta)	
v)	Managed Stand Yield Tables (Alberta)	See NOR-4-10
vi)	Demonstration Project (Alberta)	See NOR-10-04
vii)	Forest Economics & Statistics (Alberta)	See NOR-3-01
viii)	Public Information (Alberta)	See NOR-33-04
ix)	Boreal risk factor modelling	See NOR-28-07

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: Alberta wide and NoFC, Edmonton.

8. Problem:

N/A

9. 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 ForCan 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.

10. Goals for 1988-89:

1. Manage Alberta Agreement as required by NoFC management committee & program director.

2. Assist with Manitoba and Saskatchewan agreements if required.

11. Accomplishments in 1988-89:

A. Alberta Agreement:

1. Reforestation:

- implemented 17 projects ranging in value from $1,000 to $67,000 and involving activities including release cutting tree planting management plan development and assistance with post-burn salvage.

- projects handled by two forestry officers.

- reviewed 25 provincial direct delivery proposals.

2. Forestry Research Development Demonstrations

- served as secretary to B.3 committee.

- maintained records & monitored 26 B.3 projects ranging in value from $2,000 to $188,000 - for details see NOR-3, 4, 7, 10, 12, 28, 33.

- implemented (34 projects in B.4 subprogram (9 cost shared and 15 federal direct delivery projects) ranging in value from $1,900 to $100,000.

3. Public Information, Evaluation & Administration

   - implemented 13 project ranging in value from $1,500 to $133,000.

   - for details re: Public Information see NOR-33.

B. Development General:

1. Assisted district Managers as required and where possible.

2. Reviewed Manitoba and Saskatchewan project authorization forms and coordinated approval process.

3. Implemented DEVMIS with the assistance of personnel under NOR-51.

12. Goals for 1989-90:

1. Manage Alberta Agreement in its final "clean up" year as required by NoFC management committee and program director.

2. Assist with Manitoba and Saskatchewan Atgreements in their "clean up" years as required.

13. Publications 1988-89:

See attached list.

14. Environmental Implications:

The agreement manager has been directed by management committee to include all pertinent environment related information on the PAF associated with this Project. The PAF will serve as the official document which the environmental screening committee will review.

15. Resources 1989-90:

See attached.

16. Signatures:

Alberta Agreement Manager

Program, Director, Development

Regional Director General

REPORTS PRINTED UNDER CANADA-ALBERTA F.R.D.A. 1988-89

Name	Author(s)
Kink flaked maxichips the manufacture, testing & evaluation of composite board	Morrison Knodsen Forest Products Co Ltd.
Workshop on wood plastic composites	B.W. Karaim, T. Szabo
Biogeoclimatic cosystem classification of the forestry portion of southwestern Alberta	AFS Forest Research Branch
Comparison of balsam & aspen poplar trees	Alberta Research Council
A study of Alberta's secondary forest products manufacturing industry	Hallmark Eng. Ltd. Woodbridge, Reed & Assoc. Ltd.
Market study for cement/gypsum bonded particleboard	D.G. Bell & Assoc. Ltd.
Pacific Rim markets for forest products in the 1990's: Economic Assessment of demand & supply	Brett Gellner U of Alberta
Preliminary assessment of impulse radar to detect decay in hardwood	Canpolar Inc.
Interim progress report tree improvement applied research and technology transfer	Alberta Forest Service
Utilization and marketing opportunities for Alberta aspen solid wood products	Eugene M. Wengert
On-line system for board product quality control	Glen Byers
Improving wetlands for forestry in Alberta	G.R. Hillman
Birch supply lumber potential and cost in Alberta	Jasper Millwork Ltd. Woodland Resource Services
A tutorial for grading aspen, birch and other Canadian hardwoods	Eugene M. Wengert
Status of balsam (black) poplar utilization in watterboard OSB production	F. Pfaff Forintek Canada Corp.
Development opportunities for an Alberta plywood plant	Woodbridge Reed and Associates

Westlam: glue laminated wooden beams product acceptance and market development	Western Archrib
Shingles and shakes from Alberta jack pine and aspen	Silvcom
Alberta economic timber supply analysis	James A. Beck Jr. Richard G. Anderson Glen W. Armstrong Glenn H. Farrow
Directory of primary wood-using industries in Alberta - 1988	C.R. Bamsey
Management and utilization of northern mixed woods	Proceedings
Forestry G.I.S.: next step	Proceedings.

Canada-Alberta Forest Resource
Development Agreement

1989-90

		PYs	O&M	Contracts/ Supplies	G & C	Capital
-02						
.2	Reforestation	1.0	50,000	-	56,990	-
.3	Forestry R&D	2.0	531,650	-	-	-
.4	Hardwood R&D	-	285,400	-	146,860	39,000
.5	Public Information	-	4,850	-	5,150	-
.6	Evaluation	-	-	-	-	-
.7	Administration	2.0	30,000	-	-	-
:		5.0	901,900	-	209,000	39,000

NOR-36-02-4

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 1, 1989

1. Project: Canada-Alberta Forest Resource Development Agreement

2. Title: Forest pest management and damage appraisal (Alberta)

3. New: Cont: X 4. No: NOR-36-02-4

5. Study Leader: P. Amirault

6. Key Words: Damage appraisal, diagnostic and advisory services, forest management, forest pests, forest pest surveys, hazard rating, pest impact, technology transfer.

7. Location of Work: Northern Forestry Centre; Alberta-wide

8. Background:

The Province of Alberta, like other jurisdictions in Canada, is adopting "intensive" forest management techniques. This has implications for all fields of forest research and planning, and implies that damage caused by forest insects and diseases will be minimized. This was recognized in the Canada-Alberta Forest Development Agreement as funds were allotted for forest insect and disease studies. The proposal which governs the agreement is a comprehensive document which outlines a wide variety of potential areas of study. While varied, these areas of study are designed to compliment existing Forest Insect and Disease Survey (FIDS) programs. The studies initiated as a result of the Canada-Alberta Forest Resource Development Agreement are intended to provide information that will enhance and improve the survey and management of forest pests in Alberta.

9. Study Objectives:

1. To identify when and where damage by forest pests may occur, and to rank stands according to potential losses.

2. To determine how and to what extent pest damage affects forest resource users and management plans.

3. To provide technology transfer, training, and diagnostic and advisory services to AFS staff and other forestry personnel in the province.

4. To develop or improve existing methods to assess population and infestation levels of forest pests.

10. Goals for 1988-89:

1. Report on the use of forest inventory permanent sample plots for insect and disease surveys.

2. Expand and improve surveys for insect and disease incidence in young stands in Alberta (cross reference this goal with NOR-11-01). Report on results to date.

3. Continue with spruce and jack pine budworm surveys in Alberta. Continue to work with the AFS in closely monitoring spruce budworm conditions in northern Alberta (cross reference NOR-11-01).

4. Continue with field testing and financial support for developing a pheromone lure for the spruce beetle (cross reference NOR-11-03).

5. To continue to investigate the distribution of pine budworm species in Alberta.

6. To continue to offer diagnosis and advice on insect and disease problems to provincial personnel and to promote their involvement in forest insect and disease surveys.

7. To report on the distribution and impact of dwarf mistletoe on jack pine in Alberta.

8. To continue to incorporate historical FIDS data into a Geographic Information System (cross reference NOR-11-01).

Added Goals:

9. To co-ordinate the development of pest depletion estimates in the Northwest Region for inclusion in the national pest depletion estimate, 1982-1987 period (cross reference NOR -11 -01).

10. To assist Dr. B. Moody in preparing his information report on the impact of forest pests in the Northwest Region.

11. To attend the IUFRO Cone and Seed Insects Working Party Conference (Victoria, June 26-30) and present paper on the "Cone and seed insects of tamarack in eastern North America".

12. To have data collected to date during pest surveys in young stands (goal 2) analyzed via contract, with the goal of improving methodology (cross reference NOR -11 -01).

11. Accomplishments 1988-89:

1. A file report on the use of forest inventory permanent sample plots for insect and disease surveys is being prepared.

2. Surveys of insect and diseases in young stands have been expanded. A Canada-Alberta FRDA report on the two year results of said surveys is in final stages of preparation.

3. Spruce and jack pine budworm surveys have been continued. Spruce budworm conditions in northern Alberta have been continuously monitored. Status report on the situation was prepared for client distribution.

4. Field testing of a pheromone lure for the spruce beetle was expanded. A contribution agreement with the University of Calgary funded some aspects of the research. There were indications that the lure being developed is superior to that currently available.

5. Pine budworms were trapped during ongoing pheromone trapping studies. Low population densities made collections elsewhere impossible.

6. Diagnosis and advice was offered to provincial personnel as requested. Some survey activity was cooperatively conducted.

7. A file report on the distribution and impact of dwarf mistletoe on jack pine is being prepared.

8. Some progress in incorporating historical FIDS data into a Geographic Information System has been acheived. Further training in the Arc\ Info system was received.

9. The process of developing pest depletion estimates for the Northwest Region has been started.

10. The information report on pest impact in the Northwest Region is being prepared for review.

11. Attended the IUFRO Cone and Seed Insects Working Party Conference and presnted a paper on the "Cone and seed insects of tamarack in eastern North America".

12. Contract to review pest surveys in young stands being developed and implemented.

12 Present Status of Study:

1. Various documents pertaining to plot information and the results of trial surveys have been assembled and recommendations as to the use forest inventory permanent sample plots (PSPs) for pest surveys have been proposed. There have been some discussions (between FORCAN and AFS staff) on the feasibility of implementing the use of PSPs for this purpose. If this scheme is developed I hope to be able to provide assistance based on previous experience.

2. A FRDA report entitled "Pest distribution and impact in young lodgepole pine stands in west-central Alberta" is being finalized.

3. Spruce and jack pine budworm surveys will continue at levels determined by the status of the budworms. FIDS personnel are reviewing results of pheromone trapping to date to determine benefits.

4. A FRDA agreement project report is in preparation by the researchers developing the improved pheromone lure for the spruce beetle. Continuation of the project is dependent on further agreement funding.

5. Continued low population levels of jack pine budworm make collections for taxonomic studies impractical at this time.

6. Diagnostic and advisory services will continue as requested.

7. A file report on the results of a study on the impact of dwarf mistletoe on jack pine is close to completion. It contains recommendations on future study.

8. The incorporation of historical FIDS data into a Geographical Information System will be an ongoing process.

9. The goal is to have depletion estimates prepared for the national report in the spring of 1989. This may involve some time at PNFI where training in methodology is being offered.

10. The information report on pest impact in the Northwest Region is with the authors for editing.

11. Paper on the "Cone and seed insects of tamarack in eastern North America" to be published along with proceedings of IUFRO working party conference.

12. Contract to review data from pest surveys in young stands has been discussed with potential clients and contract details have been outlined.

13. Goals for 1989-90:

1. Contribute to the initiative to use forest inventory permanent sample plots for insect and disease studies, as requested.

2. Act as scientific advisor (with J. Volney) for the contract to analyse data from pests surveys in young stands. Field test various methods of conducting pest surveys, as proposed by contractors (cross reference NOR-11-01).

3. Complete file report on the distribution and impact of dwarf mistletoe in jack pine in Alberta.

4. Continue incorporating historical FIDS data into the geographic information system (cross reference NOR-11-01).

5. Complete depletion estimates for the Northwest Region (cross reference NOR-11-01).

6. **Assist in the completion of the information report on pest impact in the Northwest Region (cross reference NOR-11-05).**

7. **Continue to provide diagnostic and advisory services on pest problems as requested.**

8. **Complete reports/documentation requested as part of the FRDA final report process.**

14. Publications 1989-90:

No publications finalized in 1988-89. Two are currently in production, see PRESENT STATUS 2) and 11), and one funded report to be produced by outside agency (PRESENT STATUS 4)).

15. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the proposed study activities. On the basis of information provided by the study leader, the committee concludes that these activities are not potentially detrimental to the environment.

16. Duration:

Started: 1985 Estimated Completion: 1990

17. FRDA Resources 1989-90:

PYs:	Prof.:	Amirault	1.0
	Tech.:		0.0
	Total:		1.0
	Term/Student		0.0

Salaries: $ 38,000
O & M: $ 67,600
Capital:
Grants & Contributions:

18. Signatures:

Investigator

Program Director, Protection

Program Director, Development

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreements

2. Title: Canada-Saskatchewan Forest Resource Development Agreement

3. New: Cont.: X 4. No.: NOR-36-03

5. Study Leader: R. Fautley

Note: Refer to following study statements for additional information:

i)	Forest Mensuration Research (Sask.)	NOR-36-03-01
ii)	Silviculture Investigations (Sask.)	NOR-36-03-02
iii)	Forest Nursery Investigations (Sask.)	NOR-36-03-03
iv)	Fire Management (Sask.)	NOR-36-03-04
v)	Stem Injection of Residual Aspen (Sask.)	NOR-36-03-05
vi)	Vegetation Management (Sask.)	NOR-36-03-06
vii)	Forestry Public Information (Sask.)	NOR-36-03-07
viii)	Insect and Disease Investigations (Sask.)	NOR-36-03-08 (See NOR-11-05)
ix)	Forest Economics (Sask.)	NOR-36-03-09 (See NOR-3-01)

6. Key Words: Canada-Saskatchewan Forest Resource Development Agreement, renewal, growth enhancement, technology transfer, public information, evaluation, job development, forest relations, management, economic development, liaison, woodlots.

7. Location of Work: Saskatchewan District Office, Prince Albert and Saskatchewan wide

8. Study Objectives:

1. To manage and co-ordinate 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 Forestry Canada activities related to the Canada-Saskatchewan Forest Resource Development Agreement.

3. To provide technical input into the implementation of forestry employment programs in Saskatchewan.

4. Represent Forestry Canada in Saskatchewan within the federal and the provincial governments, industry, and the general public.

5. To facilitate the maximization of funding available to the forestry sector in Saskatchewan from other funding agencies.

9. Goals for 1988-89:

1. Forest Renewal/Growth Enhancement and Stand Tending:

- develop, discuss and solicit forestry project proposals from forest industry, Indian Bands and private woodlot owners;

- discuss, develop and process for approval, revised and updated multi-year forestry project plans for forest industry, Indian Bands and private woodlot owners;

- review, amend and process for approval, Project Authorization Forms (PAF's), for forestry projects under the FRDA in conformance with the work plan;

- plan, implement (directly or indirectly), monitor and audit federally delivered forestry projects;

- review and monitor provincially implemented cost-shared projects in Programs 1 and 2;

- plan, co-ordinate and implement a silvicultural equipment trial for mechanical thinning in the fall of 1988;

- plan, co-ordinate and implement the mechanical mixing silvicultural trial;

- arrange the planting of the second phase/treatment of areas of shearblade completed this fall, as well as the monitoring of areas planted in 1987;

- produce report on the silvicultural equipment field trial of secondary treatments conducted in 1987, ensure publication of "Field Trials of Donaren 180, TTS Delta Powered Disc Trenchers

in the Boreal Mixedwood of Saskatchewan". Produce a technical note on the mechanical thinning trial completed in the summer of 1988;

- liaise and co-ordinate other administrative and research activities with the District and Regional Office Supervisor: FO2, Renewal and Intensive Management Co-ordinator (RIM), 1 EG ESS 6, RIM Specialists.

2. Agreement Co-ordination and Management:

- represent Forestry Canada on the Program Management Committee (PMC) to consult, plan, review, administer and monitor programs and activities under the FRDA;

- consult, liaise, and co-ordinate with other federal agencies having impacts in regional development including DRIE (NEDSA), INAC (Indian forestry, job creation), CEIC (Job Strategy, training), FEDC (ERDA co-ordination, PFRA/PWC (construction services);

- direct, co-ordinate and consult with sub-committee of the PMC including Nursery Development, Public Information, GIS and Evaluation;

- provide overall day-to-day direction to programs under the FRDA with industry, Indian bands, the Province, with Forestry Canada and other federal departments;

- co-ordinate and facilitate the strong technology transfer aspect of the programs funded from FRDA through liaison, work planning, program review, research work planning and training.

3. Woodlot Program:

- complete the formation of the Saskatchewan Christmas Tree Growers' Association;

- establish and implement an operational woodlot program;

- to organize and deliver a woodlot seminar to demonstrate proper forest management and silvicultural techniques.

4. Nursery Development:

- ensure that the modifications to the acid injection system result in an operational system;

- the recommendations of Dr. R.J. Day (Lakehead University), reports on the Cultural Practices for the Prince Albert and Big River Nurseries, are supported and implemented.

5. Geographic Information System:

   - assemble hardware and software and commence to make the system operational.

6. Evaluation:

   - provide data for national and other evaluations and facilitate Green Ribbon evaluation.

7. Administration:

   - provide appropriate direction and support.

8. Job Creation:

   - access program to supplement program requirements.

10. Accomplishments for 1988-89:

1. Forest Renewal/Growth Enhancement and Stand Tending:

   - solicited, developed and discussed over 26 forestry projects and proposals from forest industry and Indian bands--total private woodlots under management is 52. Over 25,000 trees planted and over 300 hectares of various silvicultural treatments completed. Twenty-three management plans prepared by consultants;

   - developed and processed for approval multi-year operational plans for NorSask Forest Products Inc., Saskatchewan Forest Products Corporation and Weyerhaeuser Canada Ltd., as well as Indian bands and private woodlot owners;

   - reviewed, amended and processed for approval, 26 Project Authorization Forms (PAF's) for forestry projects under the FRDA in conformance with the work plan;

   - planned, implemented, monitored and audited 26 federally delivered forestry projects;

   - reviewed and monitored provincially implemented cost-shared projects in Programs 1 and 2, the only one being the Productive Forest Depletion Survey;

   - planned, co-ordinated and implemented silvicultural field trial of the Eden Bedding Plow, Madge Rotoclear, A2 Forester, involving the client agencies of the Province of Saskatchewan, Weyerhaeuser Canada and Saskatchewan Forest Products Corporation;

   - planned, co-ordinated and implemented mechanical strip thinning with the Seppi M Brush Mower;

- completed the planting and marking of the Shear Blade Trial, monitored and evaluated planting on the Power Disc Trencher trial established in 1986 in co-operation with GFLC;

- started the reforestation trials in Cypress Hills;

- produced a file report on the field trials of the Donaren 180, TTS Delta Powered Disc Trenchers in the Boreal Mixedwoods of Saskatchewan. The Eden Bedding Plow, A2 Forester, Seppi mechanical thinning, silviculture in Cypress Hills, Bracke Mounder file report;

- co-ordinated with administrative and R&D activities in District and Regional office through jointly developing projects to address the problems associated with site preparation of "wet" sites, sites with high vegetative competition, and analyzing equipment trial results.

2. Agreement Co-ordination and Management:

- represented Forestry Canada at Program Management Committee meetings to plan, review and administer and monitor programs and activities under the FRDA;

- ensure consultation and liaison with other federal agencies involved in regional development through meetings with representatives for PWC, INAC, PFRA, CEIC, Soil Conservation Board, Agriculture Canada, FEDC, Western Diversification, SIAP, Manitoba Remote Sensing as well as other groups seeking involvement in agreement activities including AMNSIS, National Indian Forestry Institute, Northern Institute of Applied Science and Technology, SRC, NRC, and municipal governments and other non-governmental agencies;

- developed and distributed periodic reports and work plans to the agreement directorate;

- arranged meetings, site visits and presentation under agreement program with representatives from industry, Indian bands, the Province and other government and non-governmental agencies;

- prepared information requested for the Green Ribbon Evaluation Committee, documentation as well as field tour and interviews with clients;

- meet with representatives from government, industry and Indian bands to determine what direction and programs should be included in the next agreement;

- produced a first draft of a framework of items proposed for the next Canada-Saskatchewan Forest Resource Development Agreement by the federal government;

- co-ordinated the Evaluation Committee tour.

3. Woodlot Program:

   - the Saskatchewan Christmas Tree Growers' Association (SCTGA) fully organized and extremely well established;

   - operational woodlot program underway;

   - over 20 public presentations delivered, in excess of 50 media reports (TV, radio, and print) on program;

   - attendance at eight out-of-province meetings by 17 people, both staff and clients;

   - ground work laid for formation of Saskatchewan Woodlot Owners' and Operators Association.

4. Nursery Development:

   - completed the re-design and installation of the Acid Injection System for the Prince Albert Pumphouse;

   - held a 1988 Soil Management Course for the staff of the Prince Albert and Big River Forest Nurseries by Professor R.J. Day and H.F. Kogel of Lakehead University.

5. Geographic Information System:

   - system fully operational with data assembled on several GIS projects.

6. Evaluation:

   - data produced as requested and Green Ribbon Report completed.

7. Administration:

   - function maintained.

8. Job Creation:

   - utilized Student Employment Program and ACE (A change for Employment) through Canada Manpower (5 students and 2 ACE)

11. Goals for 1989-90:

1. Forest Renewal/Growth Enhancement and Stand Tending:

   - participate in the development a framework for the next Canada-Saskatchewan agreement in conjunction with industry, Indian bands, public at large, provincial government and forest technical committee;

   - complete projects outlined in the multi-year plans for forest industry, Indian bands and private woodlot owners;

- review, amend and process for approval PAF's for forestry projects under the FRDA in conformance with the work plan;

- plan, implement (directly or indirectly), monitor and arrange for audit of federally delivered forestry projects;

- review and monitor provincially implemented, cost-shared projects in Program 1 and 2;

- produce technical notes on equipment trials completed in 1988 and 1989, including the Seppi, A2 Forester, Madge Rotoclear, Eden Bedding Plow;

- liaise and co-ordinate with other administrative and research activities in the District and Regional office (Supervisor: FO2, Renewal and Intensive Management Co-ordinator (RIM), 2 EG-ESS-06, RIM Specialists).

2. Agreement Co-ordination and Management:

- represent Forestry Canada on the Program Management Committee (PMC), to consult, plan, review, administer and monitor programs and activities under the FRDA;

- consult, liaise and co-ordinate with other federal agencies having impact in regional development including DRIE (NEDSA), INAC (Indian forestry, job creation), CEIC (Jobs Strategy, training), FEDC (ERDA Co-ordination), PFRA/PWC (construction services), WDO.

- direct, co-ordinate and consult with sub-committee of the PMC including Nursery Development, Public Information, GIS and Evaluation;

- co-ordinate with and advise the FRDA Directorate and the MOU Sub-committee;

- provide overall day-to-day direction to programs under the FRDA with industry, Indian bands, the Province, within Forestry Canada and other federal departments;

- co-ordinate and facilitate the strong technology transfer aspect of the programs funded from the FRDA through liaison, work planning, program review, research work planning and training.

3. Woodlot Program:

- deliver spring treeplanting program to current woodlot clients;

- prepare management plans for potential new woodlot clients as requested and time permitting;

- complete evaluation of present program for future developments under next forestry agreement;

- assist in completion of formation of woodlot owner association;
- continue to deliver seminars and public presentations;
- continue to provide extension services to SCTGA.

4. Nursery Development:

- continue to monitor adaptation of Lakehead's nursery reports.

5. Geographic Information System:

- continue to be on leading edge and facilitate new technology in micro applications.

6. Evaluation:

- distribute evaluation reports, Green Ribbon as well as national to interested parties.

7. Administration:

- facilitate move to new Federal building (Fall '89);
- provide appropriate direction and support;
- strengthen contractual arrangements.

8. Job Creation:

- continue to access person-months through various manpower programs.

12. Publications 1988-89:

Sidders, D.; Adamson, M.. 1987. Draft Report on the TTS Delta Disc Trencher and Donaren Disc Trencher Trial, Saskatchewan 1987.

Amisk Lake Reserve 184. Inventory and Five-year Forest Management Plan. Silviba Services Ltd.

Greenwater Lake Vegetation Management Plan. Johnston and Weichel Resource Management Consultants.

Thunderchild Reserve 115D. Inventory and Five-year Forest Management Plan. National Indian Forestry Institute.

Sturgeon Weir Reserve 184. Inventory and Five-year Forest Management Plan. Silviba Services Ltd.

GIS Data Bank for Indian Lands. International Forestsearch Ltd.

Forest Technical Feasibility Study for Indian Bands. International Forestsearch Ltd.

Steele, T.W.; Boylen, D.M.; Baumgartner, A. 1988. Saskatchewan's Forest Industry 1985. Can. For. Serv., North. For. Cent., Edmonton, Alberta Inf. Rep. NOR-X-295.

A Directory of Secondary Wood-using Industries in Saskatchewan 1988.

Forestry '88 - A Vital Saskatchewan Resource. Insert in Sask Report. May 1988.

14. Environmental Implications:

The agreement manager has been directed by Management Committee to include all pertinent related information on the PAF associated with this project. The PAF will serve as the official document which the Environmental Screening Committee will review.

15. Duration:

Start: June 21, 1984 Completion: December 31, 1989

16. Resources 1989-90:

		Agreement		A-base	
PY's:	Prof.:	De Groot	1.0	Gardner	1.0
		Newman	1.0	Fautley	1.0
				Loseth	1.0
	Tech.:	Barth	1.0		
		Sidders	1.0		
		Halland	1.0		
		Johnston	1.0		
		Casual	0.3		
	Support:	Urquhart	1.0	Bacon	1.0
	Total:		7.3		4.0

Contracts/O&M: $329.9 K and $8.0 K (A-base)

Capital:	7.0 K
G&C:	385.7 K
Salaries:	248.0 K
Total:	969.6 K

17. Signatures:

District Manager

Program Director, Development

Senior Implementation Officer

Regional Director General

Canada-Saskatchewan Forest Resource
Development Agreement
1989-90

	PY's	Contract/O&M	G&C	Capital
NOR-36-03 (includes $8,000. A-base)	7.0	Development Agreement 285,955	323,838	
NOR-36-03-1	1.1	Forest Mensuration $6,000	-	$7,000
NOR-36-03-2	1.6	Silviculture Investigations $9,186	44,112	
NOR-36-03-3	0.0	Nursery Investigations 0	-	-
NOR-36-03-4	1.0	Fire Management $10,114	-	-
NOR-36-03-5	0.0	Stem Injection 0	-	-
NOR-36-03-6	0.0	Vegetation Management 0	-	-
NOR-36-03-7	0.6	Public Information $17,645	17,750	-
NOR-11-05	0.0	Insects and Disease 0	-	-
Total	11.3	#138,000	$385,700	$7,000

NOR-36-03

	Development Agreement General 36-03	Mensuration 36-03-1	Silviculture 36-03-2	Nursery 36-03-3	Fire 36-03-4	Stem Injection 36-03-5	Vegetation Management 36-03-6	Public Information 36-03-7	Insect & Disease 11-05	Total
Fautley	1.0									1.0
Becon	1.0									1.0
Gardner			1.0							1.0
Newman	1.0									1.0
Loseth		1.0								1.0
De Groot					1.0					1.0
Sidders	1.0									1.0
Barth		0.1	0.3					0.6		1.0
Johnston	1.0									1.0
Halland	1.0									1.0
Urguhart	1.0									1.0
Students			0.3							0.3
Total	7.0	1.1	1.6	0	1.0	0	0	0.6	0.0	11.3

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreements

2. Title: Forest Mensuration Research (Saskatchewan)

3. New: Cont.: X 4. No.: NOR-36-03-01

5. Study Leader: P. Loseth

6. Key Words: Growth and yield, analytical procedures, computer modelling, data manipulation, geographic information systems, technology transfer

7. Location of Work: Saskatchewan

8. Study Objectives:

   1. To interface closely with DPRC personnel in Timber Management, Inventory and Silviculture Branches, and with industry representatives, with the objective of undertaking specific projects relating to growth and yield data manipulation and analysis.

   2. To contribute through technology transfer to the development and advancement of growth and yield data analysis procedures and growth projection systems.

   3. To provide an advisory role on growth and yield-related projects under FRDA and provide liaison with other regions and agencies participating in growth and yield research projects.

   4. To interface closely with DPRC personnel and industry representatives with the objective of undertaking specific projects relating to geographic information systems, and the advancement of GIS technology in Saskatchewan.

9. Goals for 1988-89:

   1. Maintain liaison with and contribute to Regional Growth and Yield Co-operative and Saskatchewan Growth and Yield Co-operative by

attending meetings and ensuring communications are maintained among co-operators.

2. In co-operation with Weyerhaeuser Canada, ensure completion of contract with Applied Biometrics Ltd., Nanaimo, B.C., related to development of site index curves for major commercial species in Saskatchewan.

3. Attend GIS meeting in Edmonton, March 1988.

4. Continue provision of advice and services and technology transfer in the area of growth and yield research and development to client base in Saskatchewan.

5. Complete the installation of GIS hardware and software, initiate data loading and undertake GIS training.

10. Accomplishments in 1988-89:

1. Liaison was maintained with the Western Boreal Growth and Yield Co-operative (WESBOGY) through attending the annual meeting in February 1988, where the incumbent was chosen as Saskatchewan provincial representative. Subsequently have maintained dialogue with Saskatchewan members and with WESBOGY Chairman completed a provincial user needs study, and helped plan the upcoming annual meeting. The Saskatchewan members of WESBOGY intend to pursue further co-operative projects building on and improving on the results of the contract mentioned in 2 below.

2. The FRDA-funded site productivity system contract between Weyerhaeuser and Applied Biometrics was not completed to the original schedule of specifications due to conflicting legal problems encountered by the contractor, therefore the final payment was not made to the contractor. However, Weyerhaeuser is using the derived site index estimates operationally in planning long-term forest management schedules.

3. The GIS meeting in Edmonton was attended, resulting in good contacts being made and worthwhile information gathered.

4. Maintained close contact with the Saskatchewan client base. Have initiated and participated in meetings to discuss long-term goals for growth and yield research in Saskatchewan. Also provided information on peripheral topics such as the high altitude photography work conducted in Alberta.

5. Received delivery of all the hardware and software for the office micro GIS system. Installed, set up and debugged hardware. Installed software, received training in use of Terrasoft GIS. Maintained dialogue with other GIS users. Obtained existing cartographic data, modified to suit needs of private woodlot program. Supervised the work of a COSEP student at digitizing changes to maps. Determined structure of attribute database and linkages to map required.

11. Present Status of Study:

Study leader has become familiar with the status of growth and yield and of GIS in Saskatchewan, and has established a sound working relationship with the client base. Emphasis has shifted from strictly growth and yield to include geographic information systems and related forest inventory issues. Objectives are all being met and activity will continue in all areas.

12. Goals for 1989-90:

1. Maintain liaison with and contribute to Western Boreal Growth and Yield Co-operative by attending meetings and functioning as Saskatchewan representative through dialogue with and between the Saskatchewan members and the Chairman.

2. Create a GIS implementation plan for the Saskatchewan district office, to include staffing and funding requirements and objectives, immediate and long term (1990-95).

3. Maintain communication with the forestry GIS user community in Saskatchewan, encourage sharing of data and ideas, agreement on exchange standards and common map bases and other GIS issues.

4. In co-operation with SPRC Forestry Branch and Weyerhaeuser Canada, and within the confines of available funding and manpower, prepare available growth and yield data for analysis and develop strategies for improving the growth and yield data base, with emphasis on managed stand yields.

5. In co-operation with other WESBOGY members, proceed to choose an appropriate growth model and calibrate to Saskatchewan conditions using the natural stand data available, and with a view to later incorporating managed stand data as it becomes available.

6. Together with I. Bella, Project Leader, Stand Productivity, write a practical guide to initial spacing and subsequent thinning of Jack pine in Saskatchewan.

7. Provide technical assistance to NorSask Forest Products of Meadow Lake in establishing a growth and yield field trial of Siberian Scots pine to test for growth variation by stocking density and site condition.

8. Continue provision of advice and services and technology transfer in the areas of GIS and growth and yield research and development to the client base in Saskatchewan.

13. Publications 1988-89:

Nil.

14. Environmental Implications:

The agreement manager has been directed by Management Committee to include all pertinent environmental information on the PAF associated with this project. The PAF will serve as the official document which the Environmental Screening Committee will review.

15. Duration:

Started: 1986 Completion: 1990

16. Resources 1989-90:

PY's:	Prof.:	Loseth	1.0
	Tech.:	Barth	0.1
	Total:		1.1
	Term/student:		0.0

O & M: $6,000

Contract: nil

Capital: $7,000

17. Signatures:

Investigator

District Manager

Supervisor

Program Director, Development

Regional Director General

NOR-36-03-2

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreements

2. Title: Silviculture Investigations (Saskatchewan)

3. New: Cont.: X 4. No.: NOR-36-03-02

5. Study Leaders: A. Gardner, G. Barth

6. Key Words: Technology transfer, forest renewal surveys, LSP, site preparation, tree improvement, seeding, fertilization, demonstration, seed collection

7. Location of Work: Saskatchewan

8. Study Objectives:

   1. To contribute to the development and advancement of forest renewal operations in Saskatchewan through provision of advice and services and technology transfer relevant to several aspects of regeneration, silviculture, including surveys, site preparation, planting stock handling and assessments of seeding, as well as in the broader areas of tree improvement and forest fertilization.

   2. To initiate, conduct and report on field trials relevant to planting stock types, site preparation equipment and seeding of coniferous species.

   3. To promote technology transfer by organizing and conducting technical workshops and seminars from time to time on topics of importance and relevance to silvicultural advancement in Saskatchewan.

9. Goals for 1988-89:

   1. Complete installation of stand establishment trial at Red Earth site.

2. Initiate stocking surveys on provincial plantations established 10 or more years ago to determine levels of stocking to intended species and present stocking to all commercial species.

3. Continue to promote and participate in discussions with Saskatchewan Parks, Recreation and Culture on third level plantation surveys. Data from Goal 2 will contribute to discussions.

4. Initiate technology transfer activity in Cypress Hills Provincial Park related to regeneration of native lodgepole pine stands. Activities to include monitoring of spring planting program in 1988, establishment of survival and growth plots on a variety of sites and development of extended program of technology transfer.

5. Continue to participate with Weyerhaeuser Canada on a contract to evaluate busulphan as a chemo-sterilant for use in hare population control.

6. Continue participation on Regional Reforestation Technical Advisory Committee.

10. Accomplishments for 1988-89:

1. Completed the installation, initial and first growing season assessments of the stand establishment trial at Red Earth.

2. Initiated and supervised a contract to study stocking levels of commercial species and vegetation profiles on provincial plantations established from 1963-1982.

3. Continued discussion with Provincial silviculture personnel through their involvement in activities under (2) above have successfully promoted the necessity of implementing a third level of plantation survey. The concept is under active consideration at present.

4. Four test sites were planted with bareroot and container lodgepole pine and have been assessed for first growing season survival and growth.

5. Effectiveness of busulfan as a chemo-sterilant has been successfully evaluated on captive hare populations. Dosage rates and bait delivery system have been formulated in preparation for field testing.

6. Attended the Regional Reforestation Technical Committee in Riding Mountain, Manitoba and reported on Canada-Saskatchewan FRDA silviculture activities.

11. Present Status of Study:

Study is meeting objectives in technology transfer. The study will operate in a maintenance made in 1989-90 due to funding restrictions relating to current FRDA termination.

12. Goals for 1989-90:

1. Complete maintenance and second-year assessment activities on Red Earth stand establishment trials.

2. Complete maintenance and second-year assessment activities on Cypress Hills stock monitoring trial.

3. Continue and complete contract to monitor the effectiveness of busulfan as a control agent for hare populations around high value forest plantations.

4. Complete final assessment and file report relating to chemical injection of aspen to control post-harvest suckering.

5. Continue duties as Recording Secretary of the Expert Committee on Weeds (Western) Silviculture Group. This involves preparing minutes of the annual business meeting of the group and distributing same to over 75 clients in western Canada.

6. Continue participation on the Regional Reforestation Technical Committee and contribute to the organization and hosting of the 1989 annual meeting in Cypress Hills.

7. Provide advice, extension and general services to client base in Saskatchewan, in-house and others as required on vegetation management, designs for layout and sampling of operational trials, manuscript reviews and general silviculture.

13. Publications 1987-89:

Barth, G.R. 1986. Direct seeding of white spruce Picea glauca (Moench) Voss: A critical review of the inherent requirements and limitations of this reforestation option. Can. For. Serv., Sask. District Office. File Report. 52 p.

Moss, I.S. 1986. Review of planting, stock handling procedures, standards, quality and quality assessment methods employed by the Province of Saskatchewan. Industrial Forestry Service Inc., Prince George, B.C. Contract Report.

Dendron Resource Surveys Inc. 1987. Weyerhaeuser-Saskatchewan Parks, Recreation and Culture cutover survey. Dendron Resource Surveys Inc., Ottawa, Ont. Contract Report--Large Scale Aerial Photography.

Barth, G.R. 1987. White spruce stock performance trial in the Mixedwood Section of Saskatchewan. File Report. 14 p.

TAEM Ltd. 1989. Saskatchewan Forest Plantation Stocking Survey. Terrestrial and Aquatic Environmental Managers Ltd. Melville, Saskatchewan. Contract Report.

14. Environmental Implications:

The agreement manager has been directed by Management Committee to include all pertinent environmental information on the PAF associated with this project. The PAF will serve as the official document which the Environmental Screening Committee will review.

15. Duration:

Started: 1985 Completion: 1993

16. Resources:

PY's:	Prof.: Gardner (Brace A-base)	1.0
	Tech.: Barth	0.3
	Total:	1.3
	Term/student:	0.3

O & M: $9,186

Contract: 0.0

Capital: 0.0

G & C: $44,112

17. Signatures:

Investigator

Investigator

District Manager

Program Director, Development

Regional Director General

NOR-36-03-3

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreements

2. Title: Forestry Nursery Investigations (Saskatchewan)

3. New: Cont.: X 4. No.: NOR-36-03-03

5. Study Leader: A. Gardner

6. Key Words: Forest nurseries, technology transfer, seedlot quality, lifting dates, storage temperatures

7. Location of Work: Saskatchewan

8. Study Objectives:

   1. To improve quality and utilization of seedlots used for nursery sowing operations.

   2. To determine optimum lifting dates and storage temperatures for spring lifted nursery stock.

   3. To contribute, through technology transfer and research projects, to the continued development of nursery stock production operations and procedures with special reference to cultural regimes, stock physiology and nursery pest management.

9. Goals for 1988-89:

   1. To continue technology transfer in the area of forest tree seedling cultural regimes in Saskatchewan nurseries by initiating contracts to:

      i) provide in-field workshops for Prince Albert and Big River nursery staff on the subjects of irrigation technology (water management) and fertilization technology.

      ii) develop soil moisture retention curves and soil pH buffer curves for both nurseries and an operational manual for the rhizometer at Prince Albert nursery.

iii) review, evaluate and make recommendations for improvement of the irrigation system at both nurseries.

10. Accomplishments 1988-89:

1. R.J. Day of Lakehead University was contracted to provide training courses to Provincial forest tree nursery staff at Big River and Prince Albert. Training courses on water management and fertilization were provided and manuals were produced and distributed to nursery staff.

2. R.J. Day and H. Kogal have prepared a report on the development of soil moisture retention curves and pH buffer curves for both Provincial nurseries and the implementation of the technology.

3. The Design Division of the Prairie Farm Rehabilitation Administration in Regina has completed an evaluation of the irrigation systems for both nurseries. Copies of the report have been distributed.

11. Status of Study:

The original objectives of the study have now been addressed with respect to bareroot production. As this study was funded under the Canada-Saskatchewan FRDA it will have to be terminated due to the expiration of funds in the nursery program under the current agreement. Further development of container production regimes is required.

12. Goals for 1989-90:

Nil. Study terminated.

13. Publications:

Woodland Resource Services Inc. 1987. Review of white spruce and jack pine seed collection, processing and utilization procedures used in Saskatchewan. (Contract Report)

Day, R.J.; Fraser, N.J. 1988. Recommendations and guidelines for cultural practices at the Prince Albert Nursery. Nursery Report 87-1; Lakehead University, School of Forestry, Thunder Bay, Ont.

Day, R.J.; Fraser, N.J. 1988. Recommendations and guidelines for cultural practices at the Big River Nursery. Nursery Report 87-2; Lakehead University, School of Forestry, Thunder Bay, Ont.

Day, R.J.; Kogal, H. 1989. Soil moisture retention curves and soil buffer curves for the Big River Nursery. Nursery Report 88-1; Lakehead University. Thunder Bay, Ont.

Day, R.J.; Kogel, H. 1989. Soil moisture retention curves and soil buffer curves with notes on container stock rearing and rhizometer

use for Prince Albert Forest Nursery. Nursery Report 88-2; Lakehead University, Thunder Bay, Ont.

Anon. 1989. Irrigation system evaluation for Prince Albert and Big River forest nurseries. Nursery Report 88-3. Agriculture Canada, Prairie Farm Rehabilitation Administration, Engineering Service, Design Division.

14. Environmental Implications:

Nil. Study terminated.

15. Duration:

Started: 1986 Completion: 1989

16. Resources 1989-90:

PY's	Prof.:	0.0
	Tech.:	0.0
	Total:	0.0
	Term/student:	0.0

17. Signatures:

Investigator

Program Director, Development

District Manager

Regional Director General

NOR-36-03-4

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreements

2. Title: Fire Management (Saskatchewan)

3. New: Cont.: X 4. No.: NOR-36-03-4

5. Study Leader: W.J. De Groot

6. Key Words: Fire management, technology transfer, development, training, intelligence systems, information data base

7. Location of Work: Saskatchewan

8. Study Objectives:

   1. To provide fire management information to Saskatchewan through research and technology transfer that will assist in the development and advancement of fire management in the province.

   2. To promote the continued fire research effort in Saskatchewan by participating in problem/need identification and analysis with provincial personnel and NoFC fire research staff to aid in the development of a comprehensive fire management program for the province.

9. Goals for 1989-90:

   1. While working under secondment for the Saskatchewan Department of Parks, Recreation and Culture:

      i) Provide technology transfer information by working closer with Regional Fire Operations and on-site fire activities.
      ii) Develop an initial Baseline Presuppression Planning System for Saskatchewan through a review of literature and other similar operational systems, and through participation and consultation with Saskatchewan fire operations.
      iii) Develop personal fire management expertise through exposure and participation in provincial fire management operations.

2. Provide information transfer through communication with Fire Research staff, the 'Saskatchewan Forest Fire Notes' technical newsletter, participation on committees, training workshops, seminars, field work and personal contact.

3. Develop fire management expertise through courses and field experience.

4. Continue to supervise a contract to evaluate the efficiency of the Saskatchewan Detection System.

5. Continue to provide support for provincial personnel to attend training courses and seminars on various aspects of fire management.

6. Continue to act as project officer on cost-shared projects and capital purchases.

7. Complete a paper dealing with fire behavior on the Elan Fire.

10. Accomplishments 1988-89:

1. Secondment to the Forest Fire Management Branch of Saskatchewan Department of Parks, Recreation and Culture was extended an extra six months to cover the period April 1, 1988 - March 31, 1989. The following areas were the focus of the secondment:

   i) Technology Transfer
   - attended regional spring fire meetings in Prince Albert, Meadow Lake, La Ronge, and Hudson Bay in April;
   - attended the Saskatchewan-Manitoba Border Fire Meeting in April;
   - prepared and presented an Introductory Fire Behavior Officer's Course to provincial fire response teams in Melville;
   - instructed the Fire Weather Index System at the Tower Observer's Course in May;
   - participated on the Cypress Hills Management Planning Committee. The core area of the park and fire fighting facilities were toured and reviewed in May; recommendations were submitted in a subsequent report; fire guards were determined in June;
   - served as Fire Behavior Officer on the Weasel Fire (4,800 ha.);
   - assisted with a Crew Boss Training Course in Buffalo Narrows in May;
   - prepared and presented a preliminary fire investigation report on the Cowboy Fire (1,200 ha.) in Saskatoon Region;
   - provided a post-fire analysis of burning conditions and fire behavior of the Burns Fire (16 ha.) which occurred just north of Prince Albert;
   - served as Fire Behavior Officer on the Coffee Fire (33,000 ha.); providing hourly predictions and acting as liaison with the weather section at the Provincial Fire Centre;

- assisted in the preparation of a public information slide program for Cypress Hills Provincial Park on the role of fire in the park;
- assisted with a preliminary investigation of the Elk Fire (10 ha.) in Yorkton/Melville region;
- attended the Prince Albert Regional Fall Fire Meeting in October;
- prepared and presented a fire behavior analysis at the Coffee Fire debriefing in Prince Albert;
- instructed on the Canadian Forest Fire Danger Rating System at two sector boss courses in January;
- completed a training package on the FWI System for the Province.

ii) Initial Attack Preparedness System
- prepared and presented initial attack preparedness system proposals to regional directors and fire management staff in December and January;
- provided an information session and discussion on the proposed preparedness system at each of the regional offices in January;
- following discussions with field staff and testing with historical data, a final proposal for an Initial Attack Preparedness System was completed and presented to the Province.

iii) Field and Operations Experience
- participated in fire operations at the Weasel Fire, and in the Buffalo Narrows Fire Cache in May;
- participated on the Coffee Fire in June, assisting with fire behavior and burn-out operations;
- returned to the Coffee Fire in July to act as sector boss, and to assist with infra-red scanning activities;
- spent considerable time working with provincial fire operations staff, particularly the duty officer.

2. Provided Information Transfer by:
- consultation with NoFC Fire Research staff on all fire management activities in Saskatchewan;
- serving as co-ordinator for the 5th Central Region Fire Weather Committee (CRFWC) Scientific and Technical Seminar in April;
- presenting a paper entitled: "Fire Behavior on the 1987 Elan Fire, Saskatchewan" at the CRFWC Seminar;
- presenting an analysis of fire behavior on the Elan Fire at the Advanced Fire Behavior Course in Hinton, Alberta;
- participating as interim NoFC member on the National Prescribed Fire Working Group which met in April;
- participating in a field tour and meeting with Prince Albert National Park staff to discuss fire management concerns in the Park;
- continuing discussions with and providing consultation to the Canadian Wildlife Service in regards to prescribed burning and fire behavior;

- attending and assisting with the First Interior West Fire Council's Annual Meeting and Workshop in Kananaskis, Alberta;
- attending the Northwest Fire Council's Annual Meeting and Seminar in November;
- participating in the Regional Fire Research Technical Committee's Meeting on foam suppressants in Edmonton;
- presenting an agency report at the 14th Annual Meeting of the Central Region Fire Weather Committee in Saskatoon;
- assisting the Saskatchewan Institute of Applied Science and Technology with requests for information on fire behavior and the Canadian Forest Fire Danger Rating System;
- continuing distribution of the 'Forest Fire Notes' series to Saskatchewan field offices.

3. Completed the Following Courses:
   - Aerial Detection Course, April;
   - Tower Observers Course, April;
   - Aerial Incendiary Device Course, January;
   - Fire Weather Course, March.

4. Continued supervising a contract to evaluate the efficiency of the Saskatchewan Detection System.

5. Provided travel funds for one provincial employee to attend the Advanced Fire Behavior Course in Hinton, Alberta; for one provincial employee to attend an Instructor Training Course; for two NoFC staff to travel to Saskatchewan on two trips to present information sessions on IFMIS (Intelligent Fire Management Information System) being developed for Saskatchewan.

6. Served as Project Officer on the following:
   - Meteorologist contract;
   - Detection Study contract;
   - Damage Appraisal Study (through NoFC Economics Project);
   - contract with Saskatchewan Research Council (for Detection Study data).

7. A paper on "Fire Behavior on the 1987 Elan Fire, Sask." was presented at the 5th Central Region Fire Weather Committee Scientific and Technical Seminar, and will be printed in the Seminar Proceedings.

11. Present Status of Study:

1. Information transfer has reached the level of activity designated in the original agreement Operational Plan. The technology transfer process and activities under the FRDA are firmly established and are ongoing at a rate commensurate with all predetermined goals.

2. The continued long-term fire research effort in Saskatchewan by NoFC is being encouraged and promoted through various studies being done in the province with support from the agreement.

12. Goals for 1989-90:

1. Provide a technology and information transfer function through communication with Fire Research staff, the 'Saskatchewan Forest Fire Notes' technical newsletter, participation on committees, training workshops, seminars, field work, and personal contact.

2. Continue to develop fire management expertise through courses and field experience.

3. Supervise the completion of the contract to evaluate the efficiency of the Saskatchewan Detection System.

4. Continue to act as Project Officer on cost-shared projects and capital purchases.

13. Publications 1988-89:

De Groot, W.J.; Schisler, J. 1988. Fire behavior on the 1987 Elan Fire, Saskatchewan. IN Proceedings of the Fifth Central Region Fire Weather Committee Scientific and Technical Seminar (April 6, Winnipeg, Man.), W.J. De Groot (compiler and editor). Forestry Canada, Saskatchewan District Office, Prince Albert, Sask. (in press).

De Groot, W.J. (compiler and editor) 1989. Proceedings of the Fifth Central Region Fire Weather Committee Scientific and Technical Seminar (Apr. 6, 1988, Winnipeg, Man.). Forestry Canada, Saskatchewan District Office, Prince Albert, Sask. Study NOR-36-03-4. File Report (in press).

De Groot, W.J. 1989. An Initial Attack Preparedness System proposal for Saskatchewan. Forestry Canada, Saskatchewan District Office, Prince Albert, Sask. Study NOR-36-03-4. File Report (in press).

14. Environmental Implications:

The agreement manager has been directed by Management Committee to include all pertinent environmental information on the PAF associated with this Project. The PAF will serve as the official document which the environmental screening committee will review.

15. Duration:

Started: 1985 Completion: 1990

16. Resources 1989-90:

PYs:	Prof.:	De Groot	1.0
	Total:		1.0

O & M: $6,114

Contract: $4,000

Capital: Nil

17. Signatures:

Investigator

for Technical Advisor

Supervisor

Program Director, Environment

District Manager

Program Director, Development

Regional Director General

NOR-36-03-5

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreement

2. Title: Stem Injection of Residual Aspen

3. New: Cont: X 4. No.: NOR-36-03-5

5. Study Leader: A. Gardner

6. Key Words: Technology transfer, aspen control, herbicide stem injection, girdling

7. Location of Work: Saskatchewan (Weyerhaeuser Limit Area)

8. Study Objectives:

   1. To determine the effects of control of residual mature aspen stems immediately following softwood removal on post harvest density of aspen suckers.

   2. To demonstrate and compare stem injection of herbicides and stem girdling for control of mature aspen stems and for efficacy with respect to control of post harvest suckering.

   3. To contribute findings to Regional Vegetation Control Project (NOR-10-09) and to ECW Silvicultural Abstracts.

9. Goals for 1988-89:

   1. Conduct second annual assessment of the aspen-injection trial.

   2. Prepare file report on status of treatment efficacy related to aspen sucker control and composition of vegetation community.

   3. Transfer goals to NOR-36-03-02. Terminate Study.

10. Accomplishments for 1988-89:

   1. Second annual assessment of the trial was completed.

2. Second year results were reported at the business meeting of the Expert Committee on Weeds. A file report is under preparation and will be completed following the third-year assessment in June 1989.

3. The study has been terminated. Third-year assessments will be supported by NOR-36-03-02.

11. Present Status of Study:

Study is terminated. Further efforts will be supported under NOR-36-03-02.

12. Goals for 1989-90:

Nil. Study terminated.

13. Publications 1988-89:

Nil.

14. Environmental Impacts:

Nil. Study terminated.

15. Duration:

Started: 1986 Completion: 1989

16. Resources 1989-90:

PY's:	Prof.:	0.0
	Tech.:	0.0
	Total:	0.0
	Term/student:	0.0

O & M: Nil
Contract: Nil
Capital: Nil

17. Signatures:

Investigator

Program Director, Development

District Manager

Regional Director General

NOR-36-03-6

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreement

2. Title: Crop tree and vegetation response to various vegetation control treatments in boreal/mixedwood sites in Saskatchewan.

3. New: Cont.: X 4. No.: NOR-36-03-06

5. Study Leader: A. Gardner

6. Key Words: Weyerhaeuser Canada, SPRC, vegetation response, crop tree response, efficacy, crop tolerance, chemical and non-chemical vegetation, application guideline development, project evaluation.

7. Location of Work: Saskatchewan

8. Study Objectives:

   1. To provide liaison and technology transfer advice and services to government and industrial clients in Saskatchewan on forest vegetation management options as required.

   2. To assist government and industrial agencies in the development of project guidelines for forest chemical applications.

   3. To maintain liaison with Regional Vegetation Control Project (NOR-10-09) and to the Expert Committee on Weeds (Western), Siviculture Group.

9. Goals for 1988-89:

   1. Continue to provide advice and services and information exchange on forest vegetation management technology to client base in Saskatchewan.

   2. To assist in the development of project guidelines for forest chemical applications in Saskatchewan by contributing to the drafting of preliminary guidelines and project evaluation forms for

review by Saskatchewan Parks, Recreation and Culture and Saskatchewan Environment.

3. Maintain liaison with Regional Vegetation Management Project at NoFC on forest vegetation management activities in Saskatchewan.

4. Serve as recording secretary to the Expert Committee on Weeds (Western) Silviculture Group at the annual meeting Nov. 28-Dec. 1, 1988, Winnipeg, Manitoba.

10. Accomplishments for 1988-89:

1. General information on chemical compounds, label registration processes, application methodology and target species were distributed to various governmental, industrial and private clients in Saskatchewan.

2. Information packages on forest herbicide project regulation and evaluation were assembled for British Columbia, Alberta, Manitoba and Ontario and submitted to the Executive Director, Saskatchewan Parks, Recreation and Culture, for comparative purposes in designing Saskatchewan provincial regulations and guidelines relating to forest herbicide projects. The provincial government has not pursued this initiative beyond preliminary contact with Saskatchewan Environment to date.

3. Updated information on vegetation management in Saskatchewan was reported to the Project Leader, Regional Vegetation Management Project and other regional representatives at the Regional Reforestation Technical Committee meeting in Manitoba, October, 1988.

4. Served as recording secretary to the Expert Committee on Weeds (Western) Silviculture Group in Winnipeg, Manitoba, Nov., 1988. Minutes of the business meeting were prepared and distributed to over 75 members.

11. Present Status of Study:

Inactivity with respect to forest herbicide usage/vegetation management in Saskatchewan at present coupled with the impending termination of the Canada/Saskatchewan Forest Resource Development Agreement suggest limited justification for maintaining the activities described here as a separate study. Activities associated with the Expert Committee on Weeds and herbicide/vegetation management information dissemination will be transferred to Silviculture Investigations and Services.

12. Goals for 1989-90:

Terminate study and transfer major activities to NOR-36-03-02.

13. Publications 1988-89:

Nil.

14. Environmental Implications:

Nil. Study terminated.

15. Duration:

Started: 1986 Completion: 1989

16. Resources 1989-90:

PY's:	Prof.:	0.0
	Tech.:	0.0
	Total:	0.0
	Term/student:	0.0

O & M: Nil

Contract: Nil

Capital: Nil

17. Signatures:

Investigator

Program Director, Development

District Manager

Regional Director General

NOR-36-03-7

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 9, 1989

1. Project: Development Agreement

2. Title: Forestry Public Information

3. New: Cont.: X 4. No.: NOR-36-03-7

5. Study Leaders: G. Barth, R.G. Newstead

6. Key Words: Communications, public information, public relations, press releases, media, ceremonies, liaison.

7. Location of Work: Saskatchewan

8. Study Objectives:

   1. Co-ordinate and administer the planning and delivery of an effective forestry public information program in Saskatchewan.

   2. Promote increased public awareness and understanding of Forestry Canada and FRDA initiatives in the forestry sector, inform targeted publics in Saskatchewan of the benefits of the forest resource.

   3. Develop and co-ordinate the agreement-related media activities for Forestry Canada in Saskatchewan.

9. Goals for 1988-89:

   1. Co-ordinate Forestry Canada and FRDA public information programming and activities within Saskatchewan.

   2. Co-chairman of the Canada-Saskatchewan Forest Resource Development Agreement public information subcommittee.

   3. Develop with provincial consultation, program of public information for the FRDA for 1988-89.

   4. Serve as Scientific Authority on the standing offer (with Sask. public relations firm) for production of FRDA-related public information publications.

5. Develop and co-ordinate approval of press releases related to FRDA activities.

6. Arrange for a maximum of media focus on FRDA-related activities including press tours, interviews, feature articles and presentations.

7. Provide ongoing support of Forestry Canada National Awareness Campaign in co-operation with NoFC (Information) and CFS HQ as requested.

8. Promote Private Woodlot Extension Program through literature/publications and the use of appropriate displays.

9. Co-ordinate (with NoFC, NOR-33-02/04) and conduct the 1988-89 public information exhibit schedule for Saskatchewan including National Forest Week, Saskatoon Exhibition, Prince Albert Exhibition, Regina Exhibition, North Battleford Exhibition.

10. Maintain liaison between Forestry Canada Saskatchewan and other forestry organizations and associations including the SFA, CFA, CIF.

11. Organize and co-ordinate opening ceremonies for the Prince Albert Pumphouse and the Big River Pumphouse and Cold Storage and Packing Facility.

12. Produce a publication jointly with the Province describing agreement accomplishments to date.

13. Continue promoting use of in-house slide/tape and video presentations regarding agreement-related initiatives, among school groups and others.

14. Initiate and complete evaluation and accompanying report on the Can.-Sask. FRDA 1984-1989.

15. Provide input for national and regional newsletters.

16. Assist local CIF contingency in completing preparations for the hosting of the 1988 CIF annual meeting.

10. Accomplishments 1988-89:

1. Co-ordinated Forestry Canada and FRDA public information programming activities within Saskatchewan.

2. Acted as co-chairman of Canada-Saskatchewan FRDA public information subcommittee.

3. Developed with provincial consultation, a program of public information for the FRDA 1987-88.

4. Served as Scientific Authority on the production of FRDA update publication handled by Sask Report Newsmagazine. In all, 50,000

copies of the tabloid were produced and have since been distributed both provincially and nationally. Note: previous standing offer with Saskatchewan public relations firm - Roberts and Poole was not renewed for 1988-89 as anticipated projects did not warrant it.

5. Arranged for media focus on FRDA-related activities via interviews and feature articles. Initially planned for the week of the 1988 CIF meeting, official opening ceremonies recognizing upgrading initiatives of both the Prince Albert and Big River nurseries under FRDA failed to come together due to constraints precluding participation of federal-provincial forestry ministers on the same day.

6. Co-ordinated (with NoFC NOR-33-02/03/04) and conducted the 1988-89 public information exhibit schedule for Saskatchewan including National Forest Week proceedings and summer fair venues in Hudson Bay, Saskatoon, North Battleford, Prince Albert and Regina.

7. Distributed and encouraged the use of in-house publications and other materials promoting Forestry Canada and FRDA-related initiatives, forest values and general forestry principles among school groups, the public and the private sector, etc.

8. Maintained liaison between Forestry Canada Sask. and other forestry organizations and associations including the SFA, CFA and CIF.

9. Assisted local CIF contingency with the delivery of the 1988 Annual Meeting which was well received, attracting some 277 attendees.

10. Assisted Green Ribbon Committee members in their analyses and evaluation of the Canada-Saskatchewan FRDA 1984-89 and received the final report of their findings and recommendations December 1988.

11. Present Status of Study:

The office continues to provide public and private sector information services in support of Forestry Canada mandates, FRDA initiatives, tech. transfer goals and promotion of forestry values.

In addition to written, radio and television advertisements, interviews, personal contacts, and the traditional distribution of informative in-house materials, the office most recently produced a FRDA tabloid highlighting Agreement initiatives and accomplishments to date. Distribution of 50,000 copies through various channels both provincially and nationally, proved to be a very efficient means to reach a broad public and private sector audience.

Displays and exhibits during National Forest Week and summer fair venues continue to be well received and are once again planned for the spring and summer of 1989.

12. Goals for 1989-90:

1. Co-ordinate Forestry Canada and FRDA public information programming and activities within Saskatchewan.

2. Arrange for media focus on FRDA related activities including feature articles, interviews, etc.

3. Co-ordinate (with NoFC, NOR-33-02/03/04) and conduct the 1989-90 public information exhibit schedule in support of Forestry Canada, FRDA and Woodlot Extension initiatives during National Forest Week and summer fair venues in Saskatoon, North Battleford, Prince Albert and Regina.

4. Maintain liaison between Forestry Canada Sask. and other forestry organizations and associations including SFA, CFA and CIF.

5. Provide input for national and regional newsletters as requested.

13. Publications 1988-89:

1. Canada-Saskatchewan FRDA update tabloid: "Forestry - A Vital Saskatchewan Resource", May 1988 (via Sask Report Newsmagazine).

2. Canada-Saskatchewan FRDA Final Evaluation - Evaluation Review Team, December 1988.

14. Environmental Implications:

The agreement manager has been directed by Management Committee to include all pertinent environmental information on the PAF associated with this Project. The PAF will serve as the official document which the Environmental Screening Committee will review.

15. Duration:

Started: 1984 Completion: 1989

16. Resources 1989-90:

PY's: Tech.: Barth 0.6
Total: 0.6

O & M: $17,645 (from federal portion of G&C below, leaving $11,000 in federal G&C)
G & C: $ 6,750 provincial, $28,645 federal

Contracts: Nil

17. **Signatures**:

Investigator

Investigator

District Manager

Program Director, Development

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Financial Services

3. New: Cont.: X 4. No.: NOR-51-01

5. Study Leader: D. Benke

6. Key Words: Finance

7. Location of Work: NoFC, Edmonton

8. Problem:

N/A

9. Study Objectives:

To supply financial services and advice to NoFC, Saskatchewan District Office and Manitoba District Office.

10. Goals for 1988-89:

1. Process all invoices within 10 days of receipt in finance unless written evidence of problems is on the file, with the exception of major utilities which will be processed within two days of receipt in finance so no late payment charges incurred.

2. Process all travel claims within 10 days of receipt in finance.

3. When it is not possible to travel with the use of individual travel cards, process all travel advances so all requestors receive their advances at the latest on the day they require them.

4. Maintain a monthly record of:

   a) turnaround time
   b) No. of invoices
   c) No. of travel claims
   d) No. of travel advances.

   Provide this information to the Manager, Management Services by the fifth working day of the following month.

5. Process JV's for gas, stores, and other chargebacks within 5 working days of having received them in Finance.

6. Maintain a commitment system. Commitments will be input to FINCON within 2 days of receipt. A system which enables quick access to the actual document setting up the commitment will be maintained. Commitments will be analyzed monthly in finance to ensure only "good" commitments are in the system.

7. Continue to maintain integrity and usefulness of commitments.

8. DSS statements, FINCON statements, Batch ledger and monthly financial statements will be reconciled monthly.

9. Requests for adjustments to the system will be performed within 2 working days of the request.

10. Requests for information such as from Manager, Management Services, HQ, Program Directors, Project Leaders, study leaders will be processed within 24 hours of the request or the deadline requested if later.

11. Accurate financial statements will be provided to Program Directors within 5 working days of monthly close off.

12. Use E-mail to communicate financial report info. to District Managers and receive feed back via E-mail or equivalent. System will be in place by August 1, 1988.

13. Monitor use of Individual Travel Cards.

14. Reconcile agreement reporting and systems to ensure proper control and integrity in numbers used and communicated.

15. Know at all times, the total agreement funds by province and be able to reconcile all information (received from headquarters) on funding within this total.

16. Develop and implement a new financial reporting system using the VAX, which is well documented and provides better description of studies/projects. To be completed by July 1, 1987.

17. Develop standards for the processing of travel claims and invoices.

11. Accomplishments in 1988-89:

1. Achieved. Late payment charges with major utilities have been eliminated. Average turn around time was 7.5 days compared to 10.0 days for the same period last year. Total invoices processed was 2891. Stats - Edmonton only (Dec. 87 - Nov. 88).

2. Achieved. No. of travel claims processed was 918. Average turn around was 3.5 days compared to 5.4 days for the same period last year. Stats - Edmonton only.

3. Achieved. Compliments have been received from various employees regarding the achievement of this goal. No. of advances issued was 235. Stats - Edmonton only.

4. Achieved in a timely and accurate manner for NoFC and the two districts.

5. Achieved. No. of J.V.'s processed was 237. Stats - Edmonton only.

6. Achieved. Open and closed commitments are provided to program directors monthly for their review. No. of commitments input were 2745. Stats - Edmonton only. Commencing in December 88 Finance reviewed open commitments as well as program directors to enable total resource utilization.

7. Commitment descriptions have been incorporated into inquiries. Commitments are reviewed monthly to ensure their integrity.

8. Monthly reconciliations of DSS, FINCON and the batch log, are being conducted regularly, with the working papers being retained on file. Adjustments are up to date.

9. Achieved normally on a same day basis.

10. Achieved normally on a same day basis or within requested deadline.

11. Achieved. Monthly financial report includes detail on budgets, agreement detail and person year information.

12. Application of this goal as it relates to the monthly financial report has been deferred due to the variety of systems from which information is gathered to complete the report. E-mail is, however, used to get feedback on the monthly Agreement Cash Flow Monitoring Report. New products (e.g., Teradata) will enhance the full implementation of this goal.

13. Achieved.

14. Achieved. DEVMIS and FINCON are reconciled monthly. Financial reports are generated following this reconciliation.

15. Achieved. Monthly updates of these figures are conducted.

16. Achieved. Positive feedback has been received from Program Directors regarding the format timeliness and content of the monthly financial report.

17. Using past three years statistics this goal will be achieved prior to fiscal year end. Statistics will be gathered from other regions to form a better base for the standard.

Added accomplishments:

18. Participated in the development a PY system, and served as test site for the new PY system.

19. Reviewed financial procedures at the Prince Albert District Office.

20. Attended Admin. and Finance meeting in Montreal.

12. Goals for 1989-90:

1. Process all invoices within 10 days of receipt in finance unless written evidence of problems is on the file, with the exception of major utilities which will be processed within two days of receipt in finance. No late payment charges will be incurred.

2. Process all travel claims within 10 days of receipt in finance.

3. When it is not possible to travel with the use of individual travel cards, process all travel advances so all requestors receive their advances at the latest on the day they require them. Implement the use of Travellers cheques at NoFC.

4. Maintain a monthly record of:

   a) turnaround time
   b) No. of invoices
   c) No. of travel claims
   d) No. of travel advances.

   Provide this information to the Manager, Management Services by the fifth working day of the following month.

5. Process JV's for gas, stores, and other chargebacks within 5 working days of having received them in Finance.

6. Maintain a commitment system. Commitments will be input to FINCON within 2 days of receipt. Commitments will be analyzed monthly in finance to ensure only "good" commitments are in the system. All commitments must be based on written documentation.

7. DSS statements, FINCON statements, Batch ledger (excluding salaries) and monthly financial statements will be reconciled monthly for all TBAs including salaries.

8. Requests for adjustments to the system will be performed within 2 working days of the request.

9. Requests for information such as from Manager, Management Services, HQ, Program Directors, Project Leaders, study leaders will be processed within 24 hours of the request or the deadline requested if later.

10. Accurate financial statements will be provided to Program Directors within 5 working days of monthly close off. Change financial reports to include a separate page on salaries and modify present PY page. Learn to do Agreement reports from DEVMII so L. Ross in development does not need to do this.

11. Increase use of E-mail to communicate financial report info. to Headquarters and Districts and receive feed back via E-mail or equivalent.

12. Reconcile agreement reporting and systems to ensure proper control and integrity in numbers used and communicated.

13. Know at all times, the total agreement funds by province and be able to reconcile all information (received from headquarters) on funding within this total.

14. Implement and accurately maintain the enhanced PY Management System. This applies to both PY and salary $ resources.

15. Assess Teradata and its usefulness to NoFC. If positive apply teradata to our financial reporting system.

16. Attend one Finance meeting and one Admin. and Finance meeting as required by HQ.

17. Perform agreement audits as requested by Regional Development personnel or as required.

18. Implement automatic JV system similar to one at LFS so JV is automatically produced and input to FINCON done automatically by June 30, 1989.

13. Publications 1988-89:

Nil

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs:	Benke	1.0
	Iskra	1.0
	Owens	1.0
	Cooper	1.0
	Total:	4.0

O & M: $16,000

Capital:

16. Signatures:

Investigator

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Management Services

3. New: Cont.: X 4. No.: NOR-51-02

5. Study Leader: P.G. Stewart

6. Key Words: Management services

7. Location of Work: NoFC, Winnipeg, Prince Albert

8. Problem:

N/A

9. Study Objectives:

To provide financial, administrative and facilities support services to NoFC Director General, Program Directors, Project Leaders, Study Leaders, District Offices, and employees.

10. Goals for 1988-89:

1. Oversee financial, administrative, materiel management, vehicles and building operations (see other study statements).

2. Collect monthly data on functions under Management Services

3. Update users handbook for use by employees in NoFC by March 31, 1989 if sufficient changes to warrant reprinting.

4. Participate in Management of NoFC; take minutes at Management Committee and circulate the typed minutes within three (3) working days of the meeting.

5. Monitor NoFC resources on a monthly basis and draw attention to problem areas. Provide monthly financial statements.

6. Visit each District Office at least once during the year.

7. Attend two (2) meetings of Managers, Management Services.

8. Monitor capital budgets.

9. Liaise with tenants in the building.

10. Conduct study on the size of the vehicle fleet.

11. Act as Secretary to the Project Leaders Meeting. Issue notice one week before meeting, issue agenda one day prior to meeting and circulate minutes within one week of the meeting.

12. Attend Manager, Management Services meeting to discuss capital construction budget for 1989-90.

11. Accomplishments in 1988-89:

1. Oversaw financial, Administration, Material Management, vehicles and building operations (see other relevant studies).

2. Collected monthly data on Management Services function; extended the system to include Building Maintenance and operations.

3. A file was being kept on items to update on the NoFC Admin. Manual. Not enough changes were identified to warrant re-issuing the manual.

4. Participated in Management of NoFC; took minutes of meetings and produced them within 3 working days of the meeting. In December 1988, D. Lyzun became secretary to the Committee and she began producing the minutes.

5. NoFC resources were monitored on a monthly basis; monthly financial reports were produced.

6. The Manitoba District Office was visited in May 1988 in conjunction with the Annual Managers retreat. D. Benke visited the Saskatchewan District Office in November 1988.

7. Attended a meeting of Managers, Management Services meeting in May 1988 at CFS-M; a second meeting was attended in Montreal in October 1988 which included Finance Officers as well.

8. The capital budgets were monitored on an on-going basis. NoFC will spend all of its Minor Equipment budget. Under its minor construction budget, NoFC received an additional $120.0 K and completed 10 projects in addition to the 8 originally approved in January 1988.

9. Discussions were on-going with the tenants in the building. A meeting was also held with AFS to discuss their possible move in the building. Invoices were sent out in October 1988 to recover the costs of space occupied.

10. G. Fawcett and P. Stewart reviewed the fleet size and possible methods to analyze it. No suitable methods were found other than to review usage overall and the condition of the vehicles. As a result two (2) vehicles (79-46 and 82-146) were disposed of with no replacement purchased; consequently the fleet was decreased by 2. In future the number of half-ton trucks will be gradually reduced since these are not poplar for field operations.

11. Acted as Secretary of the Project Leaders Committee. Sent out notices, prepared agendas and prepared minutes of meetings. Meetings were held on June 24, 1988 and March 24, 1988. The fall meeting was postponed.

12. Attended meeting in Calgary, January 17-18, 1989 to determine list of ForCan Minor Construction Projects to be recommended to SMC for approval.

Added Accomplishments:

13. Implemented WHMIS at NoFC by providing information and setting up information seminars (2) through Labour Canada. A system to control the distribution of MSDS's was also established.

14. Arranged for the disposal of PCB's in the building through J. Shuya.

15. Prepared the information and co-ordinated the approval process for the extension of the Candle Lake lease. Treasury Approved it on December 21, 1988 and the Order in Council is presently being prepared.

16. Provided the information for and follow up on the Treasury Board submission for the Desmond Crossley scholarship fund. A cheque was sent of the University of Alberta in October 1988.

17. Negotiated with PSC to obtain person year funding for D. Sawchuk under the Non-Traditional Roles for Women Program. Four (4) Person Months were provided which NoFC will match in 1989/90, resources permitting.

18. Rewrote the Regional Manager, Management Services Position in an attempt to make it an AS-6. Forestry Canada said it was still an AS-5. The position will be rewritten to make it an FI-3.

19. Participated in a task Force to implement the Auditor General's recommendation on full costing of Scientific Projects/Study. In conjunction with this visits were made to Headquarters and to LFC in Quebec. A draft report will be discussed with all the Managers, Management Services in Calgary in January.

20. Refilled Admin. Officer job; awaiting final security clearance to Secret in order to finalize competition.

21. Provided a seminar session on Finance and Administration for the SOP courses in Banff in October 1988.

22. Sat on Competition Board with G. Segiun and D. Gair to fill GLFC/FPMI Senior Financial Officer position. Assisted with questions for AS-4 Board for AG Canada.

12. Goals for 1989-90:

1. Oversee financial, administrative, materiel management, vehicles and building operations (see other study statements).

2. Collect monthly data on functions under Management Services

3. Update users handbook for use by employees in NoFC by March 31, 1990 if there are sufficient changes to warrant reprinting.

4. Participate in Management of NoFC by attending Management Committee Meetings and advising on Finance and Admin issues.

5. Monitor NoFC resources on a monthly basis and draw attention to problem areas. Provide monthly financial statements by the fifth working day of the next month at the latest.

6. Visit each District Office at least once during the year.

7. Attend two (2) meetings of Managers, Management Services.

8. Monitor capital budgets.

9. Liaise with tenants in the building. Arrange for the inclusion of AFS Research Branch in the building if applicable.

10. Act as Secretary to the Project Leaders Meeting. Issue notice one week before meeting, issue agenda one day prior to meeting and circulate minutes within one week of the meeting.

11. Attend Manager, Management Services meeting to discuss capital construction budget for 1990-91.

12. Participate in rewriting or Managers, Management Service jobs for Forestry Canada.

13. Publications 1988-89:

N/A

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs: P. Stewart 1.0

Total: 1.0

O & M: $4,600
Capital: $5,000

16. Signatures:

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Administration

3. New: Cont.: X 4. No.: NOR-51-03

5. Study Leader: A.R. Fulton

6. Key Words: Word processing, records management, telecommunications, administration

7. Location of Work: NoFC

8. Problem: N/A

9. Study Objectives:

To provide reception, word processing, records management, mail, telecommunications and general administrative service to NoFC.

10. Goals for 1988-89:

Word Processing:

1. Provide the following turn around time to clients:

1 - 5 pages	1 working day
5 - 25 pages	3 working days

2. Ensure an even distribution of workload among all operators.

3. Purchase Magnetic Tape backup for the system to reduce the downtime when performing back-up to between 30 mins. - 1 hr.

4. Conduct a study and recommend how to change the word processing equipment to PC's that operate on the new VAX 8350. Provide a written report by March 31, 1988 (at least interim) and a final report by June 4, 1988.

Records and Photocopying:

1. Open all mail and record all incoming mail, with the exception of advertisements, newspapers, magazines.

2. Distribute all incoming mail within one hour of receipt as per routing.

3. Hand-deliver upon receipt to addressee's office or put in mail box all DEX and telex messages.

4. Prepare and forward 3 times a week mail to the District Offices and Ottawa by Priority Post.

5. Prepare mail for pick-up each day by Canada Post and private courier.

6. Ensure photocopier in mail room is working and properly supplied; call maintenance within one hour of machine being reported as malfunctioning. Recommend the acquisition of a new machine for NoFC. Provide alternatives so budget constraints are considered.

7. Renew contract before March 1/88 on the main copier in the mail room.

8. Maintain and operate a BF system.

9. Continue to maintain scientific records room.

Telecommunications:

1. Review rental charges each month to ensure they are accurate and correct. Maintain monthly detail of rental costs.

2. Place an order for repair or change within two days of receiving the order.

3. On a monthly basis, provide finance with billings on each study for long distance chargeback.

Reception:

1. Greet visitors, refer to the appropriate employee in NoFC.

2. Answer the telephone switchboard, take messages, forward calls and maintain monthly statistics.

3. Prepare correspondence and contracts within 24 hours of receiving them. Maintain a log of all typing.

4. Produce quarterly, a telephone directory for NoFC, using the VAX. Distribute to staff. Provide information to Word Processing Unit for semi-annual directory.

Administration:

1. Prepare the 1989-90 Conference Plan for the deadline set by HQ.

2. Monitor the 1988-89 Conference Plan:

   a. to ensure approved attendee's know they are on the plan and make their arrangements;

   b. to make changes and substitutions as necessary.

   c. to submit quarterly reports to HQ.

   d. Input data to conference file on VAX by February 28, 1988 and update within 2 days of changes occuring throughout 1988/89.

3. Action classification and staffing requests within 2 days of receiving them, as long as there are no extenuating circumstances. Ensure all packages forwarded to Personnel are complete. Keep record of actions completed. The Program Director will sign the classification form prior to D. Kiil approving it.

4. Monitor Training Plan by:

   a. Informing attendees of approvals; arranging for approval documentation.

   b. Monitoring the plan and following-up with approved attendees at least one (1) month prior to course date to ensure all arrangements have been made.

   c. Ensuring all necessary documentation is completed, forwarded and filed within 2 weeks of the course completion.

   d. Prepare 1989/90 training plan by December 1988.

   e. Prepare 1989-90 Training Plan documentation.

5. Prepare, monitor, and do not exceed budget for administration without specific approval from Manager, Management Services.

6. Compile monthly statistics and provide to Manager, Management Services.

7. Prepare, monitor and maintain organization charts for region. Provide updated charts for April 1 and October 30 and above this as requested.

8. Submit to Finance within five working days of June 30, September 30, December 31, March 31 the details of amounts to bill non-NoFC users in the building. Charges are for telex, telephone long distance, postage, copier, etc.

9. Purchase and arrange for installation of new directory board for building showing NoFC down to the project level and tenants.

11. Accomplishments for 1988-89:

Word Processing:

1. Provided the following turn around time to clients:

1 - 5 pages	1 working day
5 - 25 pages	3 working days

No of jobs - January 1/88 to December 31/88 = 2034
No of priority jobs - Jan. 1/88 to Dec. 31/88 = 1192

2. Ensured an even distribution of workload among all operators.

3. The magnetic tap backup for the system was not purchased due to the decision to change from the AES system to PC's that operate on the VAX 8350.

4. The study and recommendations to change the word processing equipment to PC's could not be initiated and completed in the time frame specified as the new VAX 8350 was not delivered until the end of March. However, the study was done and it was decided in October 88 to switch from the AES system to PC's effective April 1989.

Records and Photocopying:

1. Recorded all incoming mail and opened all mail, with the exception of advertisements, newspapers, magazines.

   Number peices incoming mail = 49,732

2. Distributed all incoming mail witnin one hour of receipt as per routing.

3. Hand-delivered upon receipt to addressee's office or put in mail box all facimile and telex messages.

   Number incoming facsimilies/pages = 2,606/9,584
   Number outgoing facsimilies/pages = 2,255/8,546

   Telex machine was removed because of declining use. Arranged for a Telex Service subscription at great savings to NoFC.

4. Prepared and forwarded mail to the District Offices 3 times a week and Ottawa daily by Priority Post.

5. Prepared mail for pick-up each day by Canada Post and private courier.

   Number pieces outgoing mail = 53,089

6. Ensured photocopier in mail room was working and properly supplied; called maintenance within one hour of machine being reported as malfunctioning. Recommended the acquisition of a new machine for NoFC.

Provided alternatives so budget constraints were considered. An upgraded photocopier with features necessary to NoFC users was installed in June 1988.

7. Renewed contract before March 1/88 on the main copier in the mail room.

8. Maintained and operated a BF system.

9. Continued to maintain scientific records room.

Telecommunications:

1. Reviewed rental charges each month to ensure they were accurate and correct. Maintained monthly detail of rental costs.

2. Placed orders for repair or change within two days of receiving the order.

3. On a monthly basis, provided Finance with billings to each study for long distance chargeback.

Reception:

1. Greeted visitors, refered to the appropriate employee in NoFC.

2. Answered the telephone switchboard, took messages, forwarded calls and maintained monthly statistics.

   Number of calls answered Jan. to Dec. 1988 = 52,595

3. Prepared correspondence and contracts within 24 hours of receiving them. Maintained a log of all typing.

   Number of jobs competed Jan. - Dec. 1988 = 1,290

4. Produced quarterly, a telephone directory for NoFC, using the VAX. Distributed to staff. Provided information to Word Processing Unit for semi-annual directory.

Added Accomplishment:

5. Maintained and updated new computerized message centre in front lobby.

Administration:

1. Prepared the 1989-90 Conference Plan for the deadline set by HQ.

2. Monitored the 1988-89 Conference Plan:

   a. to ensure approved attendee's knew they were on the plan; issued letter of notification on April 27, 1988.

   b. made changes and substitutions as necessary (2).

c. submited quarterly reports to HQ.

d. updated conference file on VAX within 2 days of changes occuring throughout 1988/89.

3. Actioned classification and staffing requests within 2 days of receiving them, as long as there were no extenuating circumstances. Ensured all packages forwarded to Personnel were complete. Kept record of actions completed. Ensured Program Director signed the classification form prior to D. Kiil approving it.

4. Monitored Training Plan by:

   a. Informing attendees of approvals; arranging for approval documentation.

   b. Monitoring the plan and following-up with approved attendees at least one (1) month prior to course date to ensure all arrangements had been made.

   c. Ensured all necessary documentation was completed, forwarded and filed within 2 weeks of the course completion.

   d. Prepared 1989/90 training plan by December 1988.

   e. Prepared 1989-90 Training Plan documentation.

5. Prepared, monitored, and did not exceed budget for administration without specific approval from Manager, Management Services.

6. Compiled monthly statistics and provided to Manager, Management Services.

7. Prepared, monitored and maintained organization charts for region. Provided updated charts for April 1 and October 30 and above this as requested.

8. Submitted to Finance within five working days of June 30, September 30, December 31, March 31 the details of amounts to bill non-NoFC users in the building. Charges for telex, telephone long distance, postage, copier, etc.

9. The purchase and installation of new directory board for building showing NoFC down to the project level and tenants was not accomplished.

12. Goals for 1989-90:

Word Processing:

1. Provide the following turn around time to clients:

1 - 5 pages	1 working day
5 - 25 pages	3 working days

2. Transfer from AES system to PC's operating on VAX. Transfer all documentation currently on AES to Wordperfect on VAX.

3. Provide training to operators to ensure they understand and use the Wordperfect system to full capabilities.

4. Ensure an even distribution of workload among all operators.

Records and Photocopying:

1. Open all mail and record all incoming mail, with the exception of advertisements, newspapers, magazines.

2. Distribute all incoming mail within one hour of receipt as per routing.

3. Hand-deliver upon receipt to addressee's office or put in mail box all facsimilie and telex messages.

4. Prepare and forward mail to the District Offices 3 times a week and daily to Ottawa by Priority Post.

5. Prepare mail for pick-up each day by Canada Post and private courier.

6. Ensure photocopier in mail room is working and properly supplied; call maintenance within one hour of machine being reported as malfunctioning.

7. Maintain workload counts as presently being done.

8. Maintain and operate a BF system.

9. Continue to maintain scientific records room.

10. Have files and filing fully set up and backlog filed by May 1, 1989. Backlog has resulted because Head of Records Office was performing Admin. Officer's job as well.

Telecommunications:

1. Review rental charges each month to ensure they are accurate and correct. Maintain monthly detail of rental costs.

2. Place an order for repair or change within two days of receiving the order.

3. On a monthly basis, provide finance with billings on each study for long distance chargeback.

4. Adjust chargeback computer to include federal sales tax by April 1, 1989.

Reception:

1. Greet visitors, refer to the appropriate employee in NoFC.

2. Answer the telephone switchboard, take messages, forward calls and maintain monthly statistics.

3. Prepare correspondence and contracts within 24 hours of receiving them. Maintain a log of all typing.

Administration:

1. Prepare the 1990-91 Conference Plan for the deadline set by HQ.

2. Monitor the 1989-90 Conference Plan:

   a. to ensure approved attendee's know they are on the plan and make their arrangements;

   b. to make changes and substitutions as necessary.

   c. to submit quarterly reports to HQ.

   d. Input data to conference file on VAX by April 1, 1989 and update within 2 days of changes occuring throughout 1989/90.

3. Action classification and staffing requests within 2 days of receiving them, as long as there are no extenuating circumstances. Ensure all packages forwarded to Personnel are complete. Keep record of actions completed.

4. Monitor Training Plan by:

   a. Informing attendees of approvals; arranging for approval documentation.

   b. Monitoring the plan and following-up with approved attendees at least one (1) month prior to course date to ensure all arrangements have been made.

   c. Ensuring all necessary documentation is completed, forwarded and filed within 2 weeks of the course completion.

   d. Prepare training plan by December 1990.

5. Prepare, monitor, and do not exceed budget for administration without specific approval from Manager, Management Services.

6. Compile monthly statistics and provide to Manager, Management Services.

7. Prepare, monitor and maintain organization charts for region. Provide updated charts for April 1 and October 30 and in addition to this as requested.

8. Submit to Finance within five working days of June 30, September 30, December 31, March 31 the details of amounts to bill non-NoFC users in the building. Charges are for telex, telephone long distance, postage, copier, etc.

13. Publications 1988-89:

N/A

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs:	Fulton	1.0
	vice Fulton	1.0
	Simunkovic	1.0
	Ratansi	1.0
	Phillips, T.	1.0
	Total:	5.0

O & M: $ 120,000

Capital: $22.0 K (FAX Machine, Wordprocessing Equipment)

16. Signatures:

Investigator

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Materiel Management

3. New: Cont.: X 4. No.: NOR-51-04

5. Study Leader: G.R. Fawcett

6. Key Words: Material management, purchasing, inventory, supplies, stores, removal

7. Location of Work: NoFC, Edmonton, Alberta

8. Problems

N/A

9. Study Objectives:

To provide purchasing, removal, stores, inventory and Material Management Services to NoFC including functional guidance to the District Offices.

10. Goals for 1988-89:

Purchasing

1. Provide a 24 hour turnaround time on all requisitions so that end document is issued within one (1) day of receipt in purchasing as long as all information is supplied.

2. Ensure proper signing authority is on each requisition before actioning. Code all requisitions except for line objects.

3. Follow up on all documents issued:

   a. within 10 working days of issuing if delivery date is not known (9200's).

   b. within 2 working days if good/services are not received on delivery date. Written documentation will be placed on each file of this follow-up.

4. Records will be maintained of all documents issued and received.

5. Monthly reports will be prepared on the above.

6. Necessary documentation will be kept on file for all exceptional purchasing (e.g., emergencies).

7. Implement MMIS into the present purchasing system if computing capability available. New VAX to be installed February/March and MMIS should be operational for 88/89 Fiscal Year as long as computer acquisition meets the anticipated deadline.

8. Train Purchasing Clerk in use of terminal and in maintaining purchasing end of MMIS.

9. Develop a method to produce purchasing documents directly from MMIS. NoFC's aim would be to have the system in place by July 31, 1988.

Stores

1. An inventory of all stores items will be maintained. An inventory of expendables and stationary will be performed on April 30, July 30, Oct. 30, and Jan. 30. A report will be written. The aim is to achieve 10% or less error rate.

2. Items requested will be available. If not available, it will be acquired or at least ordered within 24 hours of a request if it is a stores issue item. A record of the number of issues will be maintained and reported monthly.

3. A minimum/maximum system will be maintained and stores supply will be within these.

4. Requested office supplies will be available. The budget will not be exceeded without specific permission from the Manager, Management Services.

5. Monthly costs for receivable items will be provided to Finance by the second (2) working day of the following month for JVing back to projects.

6. The individual bar code card system will be maintained. Adapt present bar code system to MMIS system by July 31, 1988.

7. MMIS will be fully implemented.

8. Ensure proper warehousing and storage in the areas where assigned shelving is located.

9. Ensure proper warehousing of all parts of the storage shed so space is used most efficiently.

Inventory

1. All equipment and attractive items will be tagged and furniture, equipment and attractive items entered into the inventory before the item is released from stores. Assigned holders will sign for all equipment issued.

2. Arrange disposal of surplus equipment.

3. Perform inventories in Saskatchewan and Manitoba district office.

11. Accomplishments in 1988-89:

Purchasing

1. Provided a 24 hour turnaround time on all requisitions so that end document is issued within one (1) day of receipt in purchasing as long as all information is supplied. Number of purchase orders including petty cash from January 1 - December 31, 1988 was 2328.

2. Ensured proper signing authority is on each requisition before actioning. Coded all requisitions and began coding line objects.

3. Followed up on all documents issued:

   a. within 10 working days of issuing if delivery date is not known (9200's).

   b. within 2 working days if good/services are not received on delivery date. Written documentation will be placed on each file of this follow-up. Number of followups recorded January 1 - December 31/88 was 202.

4. Records were maintained of all documents issued and received.

5. Monthly reports were prepared on the above.

6. Necessary documentation was kept on file for all exceptional purchasing (e.g., emergencies). A monthly report was prepared on sole source LPOs, and LPOs over $500 and reviewed with the Manager, Management Services.

7. Implemented MMIS into the present purchasing system and was operational for the 88/89 Fiscal Year. Training held for District Offices in January 1989 and they will implement system immediately.

8. Trained M. Keryliuk and J. Newton in use of terminal and in maintaining purchasing end of MMIS.

9. Developed a method to produce purchasing documents directly from MMIS and had it in place by July 31, 1988. All documents are now produced directly from MMIS with no typing required.

Stores

1. An inventory of all stores items was maintained. An inventory of expendables and stationary was performed on April 30, July 30, Oct. 30, and Jan. 30. A report was written. The error rate remains at 30%.

2. Items requested were available. If not available, it was acquired or at least ordered within 24 hours of a request if it was a stores issue item. A record of the number of issues was maintained and reported monthly. Total issued from January 1 to December 31, 1988 was 2020.

3. A minimum/maximum system was maintained and stores supply was within these with the exception of October - December when a shortage of funds required adjusting the levels.

4. Requested office supplies were available. The budget was not exceeded without specific permission from the Manager, Management Services.

5. Monthly costs for receivable items were provided to Finance by the second (2) working day of the following month for JVing back to projects.

6. The individual bar code card system was maintained. Adapting the present bar code system to MMIS system by July 31, 1988 was not possible because MMIS programming did not allow for it.

7. MMIS was fully implemented for asset control.

8. Ensured proper warehousing and storage in the areas where assigned shelving is located. Lists were prepared for assignment of space and are in stores records.

9. Ensured proper warehousing of all parts of the storage shed so space is used most efficiently.

Inventory

1. All equipment and attractive items were tagged and furniture, equipment and attractive items entered into the inventory before the item was released from stores. Assigned holders signed for all equipment issued.

2. Arranged disposal of surplus equipment including 2 storage trailers with a total value of $242,699.00; 166 items were disposed of.

3. Performed inventories in Saskatchewan. Manitoba district office put off for financial reasons.

4. Trained M. Keryliuk as stores clerk to replace A. Yohannes who was assigned to FIDS.

2. Goals for 1989-90:

Purchasing

1. Provide a 24 hour turnaround time on all requisitions so that end document is issued within one (1) day of receipt in purchasing as long as all information is supplied. This turnaround time will be documented and given to the Manager, Management Services each month.

2. Ensure proper signing authority is on each requisition before actioning. Code all requisitions including line objects.

3. Follow up on all documents issued:

   a. within 10 working days of issuing if delivery date is not known (9200's).

   b. within 2 working days if good/services are not received on delivery date. Written documentation will be placed on each file of this follow-up.

4. Records will be maintained of all documents issued and received.

5. Monthly reports will be prepared on the above.

6. Necessary documentation will be kept on file for all exceptional purchasing (e.g., emergencies).

7. Implement PASS System and investigate and if feasible integrate into MMIS.

Stores

1. An inventory of all stores items will be maintained. An inventory of expendables and stationary will be performed on April 30, July 30, Oct. 30, and Jan. 30. A report will be written. The aim is to achieve 10% or less error rate.

2. P. Stewart and G. Fawcett will investigate charging all items back to the end user.

3. Items requested will be available. If not available, it will be acquired or at least ordered within 24 hours of a request if it is a stores issue item. A record of the number of issues will be maintained and reported monthly.

4. A minimum/maximum system will be maintained and stores supply will be within these budgets allowing.

5. Requested office supplies will be available. The budget will not be exceeded without specific permission from the Manager, Management Services.

16. Signatures:

Investigator

Manager, Management Services

Regional Director General

6. Monthly costs for receivable items will be provided to Finance by the second (2) working day of the following month for JVing back to projects.

7. The individual bar code card system will be maintained. It will be integrated into MMIS using student assistance.

8. Ensure proper warehousing of all parts of the storage shed so space is used most efficiently and assigned areas are clearly marked.

9. Co-ordinate and action the transfer of stores from B001 to receiving area.

Inventory

1. All equipment and attractive items will be tagged and furniture, equipment and attractive items entered into the inventory before the item is released from stores. Assigned holders will sign for all equipment issued.

2. Arrange disposal of surplus equipment.

3. Perform inventories in Manitoba district office and NoFC.

13. Publications 1988-89:

Nil

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs:	Fawcett	0.5
	vice Sampson	1.0
	Yohannes	0.5
	Total:	2.0
	Student:	0.3

O & M: $18,000

Capital: Construction: move stores from basement to receiving area: $135,000

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Building Maintenance

3. New: Cont.: X 4. No.: NOR-51-05

5. Study Leader: H. Schoendube

6. Key Words: Maintenance, building upkeep, building repairs, major renovations

7. Location of work: NoFC

8. Problem:

N/A

9. Study Objectives:

To conduct maintenance and repairs to the NoFC facilities to ensure they aee in a superior state of upkeep and repair, supervise the construction and/or renovation of facilities at NoFC.

10. Goals for 1988-89:

1. Overhaul M.F. tractor at a cost of approximately $9 K.
2. Replace/repair several sections of main roof as detailed on consultants report by July 1, 1988. (Approximate cost $200 K)
3. Replace #1 to #4 sumps including sump pumps.
4. Replace Bolen tractor and equipment at a cost of $16,700.
5. Provide glass canopy for both northside entrances.
6. Provide glass enclosure for southside courtyard.
7. Provide general maintenance in the building.
8. Clear snow as required from the parking lots and driveways.

9. Maintain the grounds during the summer months including cutting the grass, planting and maintaining flowers, attending to shrubs and trees regarding the proper pruning and fertilizing of the plants.

10. Replace shrubs on southside of the building.

11. Oversee the installation of a new lawn including sprinkler system.

12. Continue a regular preventative maintenance program.

13. Live within budget provided.

14. Plant popular on the berm and finish planting the evergreen trees.

15. Paint 16 rooms in the building.

16. Upgrade the concrete slab on the southside of the building to prevent flooding in heavy rain.

17. Install drainage system in nursery to solve the drainage problem.

18. Repair 2 ventury fume hoods which use perchloric acid in M041 and M054.

19. Devise a statistical methodology for the Maintenance Operations.

20. Improve the public address system so it may be heard in all parts of the building.

21. Replace approximately 20 venetian blinds which cannot be repaired.

22. Refill Senior Craftsman's position.

23. Test fire alarm system twice during the year.

11. Accomplishments in 1988-89:

1. Not done, highest priority was for purchase of new small lawn tractor. M/F overhaul scheduled for 1989-90.

2. Replaced/repaired roof sections where needed. Total cost approximately $137,000.00

3. Replaced sumps of #1 to #4 unit. Pumps not replaced at this time.

4. Replaced Bolen tractor, complete with lawn cutter, grass pick-up and rotary brush.

5. Provision of glass canopies for north entrances in progress at this time. Completion before end of fiscal year 1988/89.

6. No funds allotted for this project in Fiscal Year 1988/89.

7. Provided general maintenance to/in the building. To December 31/88, issued 343 work orders. This includes preventative maintenance work orders as well. See #12.

8. Cleared snow as required from parking lots and driveways.

9. Maintained the grounds during the summer months which included the cutting of the grass, planting and maintaining flowers, attending to shrubs and trees with respect to proper pruning and fertilizing of the plants.

10. Replaced shrubs on southside of the building.

11. No funds allotted for this project in Fiscal Year 1988/89.

12. Continued a regular preventative maintenance program. See #7 above.

13. Lived within budget.

14. Planted poplars on the berm and completed planting of evergreens on the university grounds.

15. Painted 22 rooms in the building.

16. Upgraded the concrete slab on the southside of the building to prevent flooding in heavy rain.

17. Installed drainage system in nursery to solve the drainage problem.

18. Repaired two (2) ventury fume hoods which use perchloric acid in M041 and M054.

19. Devised a statistical methodology for the Maintenance Operations. Keeping records on an on-going basis.

20. Improvement not feasible with the system we have presently in use.

21. New blinds for whole building ordered. These will be installed by March 31, 1989.

22. Refilled Senior Craftsman's position.

23. Tested fire alarm system twice in Fiscal Year 1988/89. System tested in April and October.

Additional Accomplishments:

24. Replaced frames of cooling coils with stainless steel material. Old frames were completely deteriorated.

25. Installed safety devices for new chemical storage doors.

26. Installed storage cabinets for S.C.B.A. in chemical storage shed.

27. Installed new overhead door in groundskeeper's shed.

28. Installed water supply and drainage lines for deglazing machine in 3036.

29. Oversaw cleaning contract in building. Changed contractor due to unsatisfactory services.

30. Fabricated test tube holders for M054 and M058 for Y. Kalra.

31. Fabricated 20 digesting trays for M089 for S. Lux.

32. Fabricated specimen bottle holders for M058 for Y. Kalra.

33. Connected instruments for various laboratories e.g., EPS; C. Feng; CWS and FIDS.

34. Repaired plotting rod for Mat Fairbarns M113.

35. Fabricated shelving for personnel office.

36. Repaired equipment for fire lab including fire pumps, roof vent.

37. Installed a book rack for M068 for B. Chow.

38. Assembled new shelving for chemical storage rooms and publications-J. Samoil, development-J. Mrklas, and library-D. Robinson.

39. Fabricated six (6) soil sample boxes for D. Maynard.

40. Fabricated and installed a gas supply arrangement for EPS (Room 3012).

41. Painted additional 4 rooms, B009, and several hallway walls where needed.

42. Removed all old PCB-containing ballasts form offices and labs. on main- second-, and third floor.

43. Installed new light fixtures in all offices of administration and accounting.

44. Installed new telephone lines for various offices on the second floor. H. Gates, publications, EPS lines in old Grain Commission Office.

45. Repaired Ford snow blower.

46. Repaired trailer for D. Allan.

47. Relocated full stock inventory from penthouse to B097.

48. Painted hallway ceiling tiles and stairwells.

49. Performed preventative maintenance to mechanical equipment.

48. Installed locks on five (5) doors of rooms occupied by EPS.

49. Built and installed computer shelf for D. Smith.

50. Removed desk cabinets and utility service strip in 3069.

51. Provided ramp for handicapped at rear entry which also provides safe access for employees moving chemicals.

52. Disposed or all PCB containing ballasts which were stored in metal shed.

12. Goals for 1989-90:

1. Overhaul M.F. -- tractor. Estimated cost $13.0 K

2. Provide general maintenance in the building.

3. Clear snow from driveways and parking lots as required by 7:30 am the day after a storm.

4. Maintain the grounds during the summer including cutting the grass, planting flower and maintaining flowers and shrubs.

5. Oversee electrical contract.

6. Live within budget provided unless over expenditure approved by Manager, Management Services. Forecast expenditures monthly.

7. Continue regular preventative maintenance program.

8. Replace one cooling coil for #4 unit.

9. Replace stainless steel ductwork on three (3) perchloric acid fumehoods between main floor and penthouse.

10. Replace lawn including installation of sprinkler system (estimated cost $40.0 K).

11. Reconstruct the front entryway to provide access for handicapped employees or visitors. (estimated cost $35.0 K).

12. Renovate the front lobby if fnds become available. (estimated cost $20.0 K)

13. Replace cartetting in the conference room (Estimated cost 10.0 K)

14. Move stores from basement to loading dock area. (estimated cost $170 K). Co-ordinate this with G. Fawcett.

15. Repair/replace landing of headerhouse loading dock by March 31, 1989. (estimated cost $5 K).

17. Provide a detailed listing of specific projects with estimated time requirements and costs to P. Stewart by May 31, 1989.

18. Fertilize poplars and softwood trees on the berm, keep grass down to eliminate competition and replace any damaged and dead ones by May 30, 1989.

13. Publications 1988-89:

N/A

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs:	Schoendube	- 0.5
	Thibodeau	- 0.9
	Schmidt	- 1.0
	Burton	- 1.0
	Total	- 3.4

O & M: $25,800

Capital: Equipment: Massey Ferguson Tractor overhaul - $13.0 K
Contruction: Lawn Replacement - $40.0 K

16. Signatures:

H. Golenchuk
Investigator

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Building Operations

3. New: Cont.: X 4. No.: NOR-51-06

5. Study Leader: H. Schoendube

6. Key Words: Building operations

7. Location of Work: NoFC

8. Problem:

N/A

9. Study Objectives:

To maintain the heating, ventilation, and air conditioning systems at NoFC.

10. Goals for 1988-89:

1. Monitor energy usage and effect cost savings in relation to laboratory operations with respect to air quality and heat distribution.

2. Daily monitor the operation of the boilers and equipment to ensure safe and efficient operation.

3. Carry out preventative maintenance on boilers and associated equipment as required.

4. Daily check the greenhouses and adjust temperatures, air, etc. to meet specifications set out by the greenhouse users.

5. Carry out complete building checks daily and make adjustments as required to heating, ventilation, air conditioning, safety systems, to ensure safe and efficient operation.

6. Control work and materials by issuing workorders for all projects undertaken.

7. Supervise cleaning, waste management, elevator maintenance, and commissionaire's contracts and ensure a high quality of service.

8. Provide heat, light, natural gas, water, and air conditioning services to the building.

9. Overhaul/replace #1 feedpump and control valve by July 31, 1988.

10. Overhaul/replace #31 & #32 laboratory air compressors by July 31, 1988.

11. Overhaul/replace #1 condensate pump and receiver tank by September 1, 1988.

12. Supply and install additional air supply and exhaust systems for room M109 by May 31, 1988.

13. Forecast expenditures for the safe and efficient operation of the facilities which will be for gas, power, water, Corps. of Commissionaires, janitorial services, waste management, electrical contractor, elevator contractor, maintenance plus service costs including emergency expenses. The budget will not be exceeded without the prior approval of the Manager, Management Services.

14. Replace present lights in boiler room with fluorescent lights by June 30, 1988.

15. Move steam generator from basement to penthouse by May 31, 1988.

16. Complete the stock taking by making up cards for all items and move all items to Room M097, B093, B091. Clean up M129 area and work area B091 and B089 by October 31, 1988.

11. Accomplishments in 1988-89:

1. Monitored energy usage and effected cost savings in relation to laboratory operations with respect to air quality and heat distribution.

2. Daily monitored the operation of the boilers and equipment to ensure safe and efficient operation.

3. Carried out preventative maintenance on boilers and associated equipment.

4. Daily checked the greenhouses and adjusted temperatures, air, etc. to meet specifications set out by the greenhouse users.

5. Carried out complete building checks daily and made adjustments as required to heating, ventilation, air conditioning, safety systems, to ensure safe and efficient operation. The number of checks made were 17,272.

6. Controlled work and materials by issuing workorders for all projects undertaken. The number of work orders issued were 458.

7. Supervised cleaning, waste management, elevator maintenance, and commissionaire's contracts and ensured a high quality of service.

8. Provided heat, light, natural gas, water, and air conditioning services to the building.

9. Overhauled #31 & #32 air compressor by July 31, 1988

10. Overhauled #1 feedpump and control valve. Work completed on July 31, 1988.

11. Did not overhaul #1 condensate pump since it was established that no repair work had to be done at this time.

12. Supplied and installed additional air supply and exhaust systems to laboratory M109. Installation will be completed by January 15, 1989.

13. Forecasted expenditures for the safe and efficient operation of the facilities which will be for gas, power, water, Corps. of Commissionaires, janitorial services, waste management, electrical contractor, elevator contractor, maintenance plus service costs including emergency expenses. The budget was not exceeded.

14. Replaced present lights in boiler room with fluorescent lights. Work completed on 30 June 1988.

15. Moved steam generator from basement to penthouse. Project completed on May 31, 1988.

16. Completed the stock taking by making up cards for all items and move all items to Room M097, B093, B091. Cleaned up M129, B091 and B089 work area by October 31, 1988.

Additional Accomplishments:

17. Operated the Hot Water Boiler and systems to conserve energy during the months of May through October.

18. Carried out the necessary checks and adjustments to equipment and systems to ensure safety for the chemical storage rooms. Regularly checked for temperature and heat.

19. Installed cathodic protection devices into domestic hot water systems.

20. Removed all "PCB" containing ballasts from the lights.

21. Carried out painting in boiler room; not completed yet.

22. Repaired lagging and insulating of steam lines and water pipes in boiler room.

23. Replaced equipment as suggested by "Labour Canada" during their last inspection.

24. Commenced cleaning of penthouse. Not completed due to work of contractors in that area.

25. Fan in chemical storage room has been tied in with light switch to provide positive ventilation.

12. Goals for 1989-90:

1. Monitor energy savings and effect cost savings in relation to laboratory operations with respect to air quality and heat distribution.

2. Daily monitor the operation of the boilers and equipment to ensure safe and efficient operation.

3. Carry out preventative maintenance on boilers and associated equipment as required.

4. Daily check the greenhouses and adjust temperatures, air, etc. to meet specification set out by the greenhouse users and similarly for the chemical storage room.

5. Carry out daily building checks and make adjustments as required to the heating, ventilation, air conditioning, and safety system to ensure safe and efficient operations.

6. Control work and materials by issuing work orders for all projects undertaken.

7. Provide heat, light, natural gas, water, and air conditioning services to the building.

8. Supervise cleaning, waste management, elevator maintenance and commissionaire's contracts and ensure a high quality of service. Meet monthly with cleaning contractor to discuss performance and problems. Document these meetings.

9. Replace copper lines in swamp coolers in greenhouse by June 30, 1989.

10. Level swamp coolers by June 30, 1989.

11. Reslope gravel bed around the greenhouses to provide better drainage by June 30, 1989.

12. Provide drainage ditch at southend of greenhouses by June 30, 1989.

13. Complete cleaning and painting of boiler room by Sept. 30, 1989.

14. Complete cleaning and painting of penthouse equipment and pipe lagging by Sept. 30, 1989.

15. Change lights in penthouse over to fluorescent by Sept. 30, 1989.

16. Install cooling coil in H&V discharge ductwork by June 30, 1989.

17. Repipe spray water lines and nozzles in units #1 to #4 and replace pumps by June 30, 1989.

18. Change feedwater storage (deaerator) relief valve to low pressure.

19. Replace fibreglass softener tanks as required in boiler room.

20. Provide a detailed listing of specific projects with estimated time requirements and costs to P. Stewart by May 31, 1989.

13. Publications 1988-89:

Nil

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs:	Schoendube	- 0.4
	Fisher	- 0.75
	Lybbert	- 1.0
	De Costa	- 0.9
		3.05

O & M: $244,000

Capital: Construction: Conference room carpeting - 10,000

16. Signatures:

H Schoendube
Investigator

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Camps

3. New: Cont.: X 4. No.: NOR-51-08

5. Study Leader: H. Schoendube

6. Key Words: Camps

7. Location of Work: Hinton, Chip Lake, (Alberta), Candle Lake, Nesbitt Duplex, Prince Albert (Saskatchewan), Oakbank (Manitoba)

8. Problem:

N/A

9. Study Objectives:

To maintain the Physical Facilities of the NoFC camps at Hinton, Candle Lake, Chip Lake, Prince Albert and Oakbank.

10. Goals for 1988-89:

1. Open and close camps in Spring and Fall of 1988.

2. Arrange through C. Rentz for the cutting of grass at Hinton Camp in the summer months of 1988.

3. Arrange for the supply of propane and electricity to Hinton Camp.

4. Arrange for the water supply in Candle Lake.

5. Install signs at Hinton, Candle Lake and Oakbank.

6. Visit and assess conditions of the camps prior to the visit of working crews to determine work to be done.

7. Improve conditions of log buildings in Candle Lake by removing old varnish from the outside walls and applying new coats of varnish.

8. Paint or varnish doors on trailers 446 and 448.

9. Varnish the washrooms cabin at Hinton.

11. Accomplishments 1988-89:

1. Opened and closed camps in Spring and Fall of 1988. Made 4 trips to Hinton to open and close camp.

2. Arranged through C. Rentz for the cutting of grass in Hinton camp in the summer months of 1988.

3. Arranged for the supply of propane and electricity to Hinton camp.

4. Arranged for the water supply in Candle Lake.

5. Installed forestry signs in Hinton and Candle Lake, and sent necessary material to Manitoba District Office to install the sign at Oakbank, Manitoba.

6. Visited and assessed conditions of the camps prior to the visit of working crews to determine work to be done. Visited Hinton, Candle Lake and Chip Lake.

7. Improved condition of log buildings in Candle Lake by removing old varnish from the outside walls and applying new coats of varnish.

8. Painted and/or varnished doors of trailers 446 and 448.

9. Varnished the utility cabin in Hinton.

Added Accomplishments:

10. Replaced/repaired exhaust fans on all trailers; installed guard rails on stairs of trailers per Labour Canada request; and cleaned out some propane lines on some of the trailers at Hinton.

11. Repaired grass cutting equipment and repaired propane pumping system at Hinton.

12. Goals for 1989-90:

1. Open and close camps at Hinton in Spring and Fall of 1989.

2. Complete the following work at the Hinton Camp by May 31, 1989.

- repair trailer roofs and vents where required 1989.
- replace gas line with ½" black iron piping on some trailers
- replace deteriorated staircases.
- repair/replace floor coverings in trailers
- arrange for trailer levelling where required
- arrange for cleaning of trailers and appliances; supervise contract to perform the work.
- continue with painting of building and stairs.
- carry-out safety improvements as per "Labour Canada" recommendations.

3. Arrange for grass cutting at Hinton through C. Rentz.

4. Arrange for supply of electricity, propane and water at Hinton camp. Keep track of expenditures and projected costs on monthly basis.

5. Visit and assess conditions of camps including Hinton, Chip Lake and Candle Lake in Spring of 198^{0}.

6. Complete the following projects at Candle Lake by June 30, 1989.

   - arrange for water supply at Candle Lake camp.
   - replace damaged propane gas line to log building in Candle Lake camp.
   - change heating system log building over to electric
   - change the door locks, old ones are obsolete
   - install new wiring to accommodate the electric heaters
   - repair bathroom plumbing
   - provide ventilation for building
   - replace existing water and electrical fixtures
   - provide new dishes for loghouses
   - repair/replace domestic hot water tank

7. Upgrade standards in Chip Lake to prevent excessive deterioration of equipment.

8. Modify Government of Canada signs at all campsites due to change of title by June 30, 1989.

9. Unhook and bring to NoFC Edmonton the propane tank and generator at Chip Lake by May 31, 1989.

10. Monitor and forecast costs for gas and electricity for buildings at Candle Lake and Nesbitt Duplex monthly.

13. Publications 1988-89:

N/A

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs:	Schoendube	- 0.1
	Thibodeau	- 0.1
	De Costa	- 0.1
	Total:	- 0.3

O & M: $8,000

Capital:

16. Signatures:

Investigator

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services

2. Title: Vehicles

3. New: Cont.: X 4. No.: NOR-51-09

5. Study Leader: G. Fawcett

6. Key Words: Vehicles

7. Location of Work: Northwest Region

8. Problem

N/A

9. Study Objectives:

To maintain an adequate fleet to meet the needs of NoFC and to report the necessary information in order to perform proper fleet management.

10. Goals for 1988-89:

1. Assign vehicles for the 1988 field season by May 1, 1988.

2. Integrate 1988/89 replacement vehicles into the fleet. Dispose of the vehicles the new ones are replacing.

3. Order in 1989/90 replacement vehicles in October 1988.

4. Ensure all vehicles in the fleet have the required maintenance performed on them per a written maintenance schedule. Perform scheduled safety maintenance requirements.

5. Provide monthly the required FMIS information by the 10th of the following month using the computerized system.

6. Develop by June 1, 1988 the kilometer charges for 1988/89. By the tenth (10) working day of the following month provide to Finance the charges by study for the previous month.

7. Within reason satisfy all requests for vehicles during the fiscal year.

8. Do not exceed the budget provided without permission from the Manager, Management Services.

9. Implement and manage the new parking policy if applicable co-ordinate the installation of automatic gates if funds approved.

10. Ensure proper safety and winter emergency kits are available in vehicles stores.

11. Conduct a study in conjunction with Manager, Management Services to assess whether the fleet is too large and investigate whether maintenance schedules and practices as presently exist are the best ones. Complete by September 30, 1988.

11. Accomplishments in 1988-89:

1. Assigned vehicles for the 1988 field season by May 1, 1988.

2. Integrated the one 1988/89 replacement vehicle into the fleet. Disposed of the one vehicle the new one replaced as well as disposed of 2 others.

3. Ordered 5 vehicles for 1989/90 replacement vehicles in October 1988.

4. Ensured all vehicles in the fleet have the required maintenance performed on them per a written maintenance schedule. Performed scheduled safety maintenance requirements.

5. Provided monthly the required FMIS information by the 10th of the following month using the computerized system.

6. Developed by June 1, 1988 the kilometer charges for 1988/89. By the tenth (10) working day of the following month provided to Finance the charges by study for the previous month. The rate was re-adjusted in because chargebacks exceeded actual costs.

7. Within reason satisfied all requests for vehicles during the fiscal year.

8. Did not exceed the budget provided without permission from the Manager, Management Services.

9. New parking policy is still in limbo and no implementation took place.

10. Ensured proper safety and winter emergency kits are available in vehicles stores.

11. Conducted a study in conjunction with Manager, Management Services to assess whether the fleet is too large and investigate whether maintenance schedules and practices as presently exist are the best ones. Completed by September 30, 1988.

    The study did not determine any formulated review process available which could be economically implemented (software worth $2000 would only be partially useful). It was felt current maintenance routines were effective. Fleet strength will be reduced by 2 vehicles by March 31/89.

12. Goals for 1989-90:

    1. Assign vehicles for the 1989 field season by May 1, 1989.

    2. Integrate 1989/90 replacement vehicles into the fleet. Dispose of the vehicles the new ones are replacing.

    3. Order in 1990/91 replacement vehicles in October 1989.

    4. Ensure all vehicles in the fleet have the required maintenance performed on them per a written maintenance schedule. Perform scheduled safety maintenance requirements.

    5. Provide monthly the required FMIS information by the 10th of the following month using the computerized system.

    6. Develop by June 1, 1989 the kilometer charges for 1989/90. By the tenth (10) working day of the following month provide to Finance the charges by study for the previous month. Investigate and implement if applicable a rate which includes both gasoline and repairs.

    7. Within reason satisfy all requests for vehicles during the fiscal year.

    8. Do not exceed the budget provided without permission from the Manager, Management Services.

    9. Ensure proper safety and winter emergency kits are available in vehicles stores.

13. Publications 1987-89:

    Nil

14. Environmental Implications:

    N/A

15. Resources 1989-90:

PYs:	Fawcett	0.5
	Wake	0.5
	Total:	1.0

O & M: $21,800
Capital: vehicles (5) $120,000; Camper $10,000

16. Signatures:

Investigator

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 3, 1989

1. Project: Financial, Administrative and Support Services
2. Title: Safety
3. New: Cont.: X 4. No.: NOR-51-10
5. Study Leader: H. Schoendube
6. Key Words:
7. Location of Work: NoFC
8. Problem:

   N/A

9. Study Objectives:

   To provide safety training to NoFC employees.

10. Goals for 1988-89:

    1. Conduct three (3) first aid courses.
    2. Conduct four (4) C.P.R. courses.
    3. Provide training and upgrading in use of the SCBAs. There should be at least 6 on each floor.
    4. Put on safety films with respect to safety in the workplace on a monthly basis as a minimum.
    5. Put on a defensive driving course.

11. Accomplishments 1988-89:

    1. Conducted two (2) First Aid Courses -- 16 people.
    2. Conducted two (2) CPR courses -- 8 people.
    3. Provided training of the maintenance department with respect to use of S.C.B.A. equipment.

4. Conducted "Student Orientation Program" with respect to safety at the workplace and also safe use of hand and power tools. Showing safety films on a once a month basis did not work out at this time.

5. Did not conduct/arrange defensive driving course. Lack of participants.

Additional Accomplishments:

6. Purchased three (3) SCBAs.

7. Installed two (2) SCBAs in the metal shed (chemical storage rooms).

8. Several staff members attended to safety courses regarding "Lab. Safety", implementation of the "WHMIS" program, "Personal Protective Gear".

9. Requalified two (2) people for First Aid and CPR instructor certificate.

12. Goals for 1989-90:

1. Conduct three (3) First Aid Courses.

2. Conduct three (3) CPR-courses.

3. Provide training with SCBA equipment.

4. Provide fire extinguisher demonstration.

5. Purchase additional training films.

6. Provide training for the implementations for WHMIS.

7. Arrange "Defensive Driving" course if interest is sufficient.

13. Publications 1988-89:

N/A

14. Environmental Implications:

N/A

15. Resources 1989-90:

PYs: Fisher 0.25
Total: 0.25

O & M: $2,000

Capital: Nil

16. **Signatures:**

H. Schenck
Investigator

Manager, Management Services

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 13, 1989

1. Project: Computing and Data Processing Services.

2. Title: Computing and data processing services.

3. New: Cont.: X 4. No.: NOR-53-01

5. Study Leader: W. Chow

6. Key Words: Computing, electronic data procesiing, systems analysis, telecommunications, office automation.

7. Location of work: Edmonton and District Offices

8. Study Objectives:

   1) To provide computer and data processing services to solve scientific problems and to provide other consulting services regarding various types of analyses using the in-house computer (VAX 8350) and personal computer systems for mathematical and scientific analyses, financial and material management systems; to provide data output using laser printers, plotters and various terminals; to develop and maintain programs and systems on the mini and micro computers.

   2) To provide training on various software packages used on the VAX and the personal computers, consulting and programming assistance on the usage of the in-house computer, personal computers, plotters, printers and graphics terminals. To trouble-shoot problems with the VAX, PC's, software, terminals, laser printers and plotters.

   3) To provide data entry and operational assistance, tape backup and restore, address label printing and workplan updates.

   4) To advise on statistical procedures and packages available, computer related problems, system analysis and design, and to provide any other computer related services and advice which may be required by NoFC staff, other agencies or outside users who are working on joint projects with NoFC.

9. Goals for 1988-89:

   1. Prepare yearly report on computer usage by projects (Chow). Prepare the annual EDP report for headquarters and various other

reports (Chow). Assist users buying EDP products with justification statements; maintain communications with the ForCan EDP coordinator in Ottawa; coordinate the requests for new EDP purchases (Chow). Participate in a word processing study at NoFC and offer suggestions as to hardware and software selection (Chow, Paradis).

2. Write or adapt programs and systems as required and provide documentation; develop, expand and maintain programs and systems (Irwin). Assist with the installation of the various information systems (Paradis). Continue with the Ottawa work plan rollup and enter year end corrections (Chow, Hai).

3. Provide training and assistance as required with in-house courses. (Chow, Carrigan) Assist users with INGRES, DATATRIEVE, MINITAB and SAS as required (Chow, Irwin). Help users with C and FORTRAN (Irwin, Paradis, Carrigan, Chow). Assist users with the Polaroid Palette and plotter (Paradis). Assist with the software packages for the various personal computers (Carrigan, Paradis). Assist with installation of the finance section's updates to the FINCON and pay systems here and in the district offices (Paradis, Chow). Prepare a management presentation on graphics from a PC and Harvard Graphics (Paradis).

4. Provide data entry, backup-restore services and other operations services required by various projects (Hai).

5. Continue with assistance to the district offices regarding personal computers, data processing, word processing and telecommunications; assist with the assessment of the NWT - Development proposals for acquiring various computer hardware components; attend meetings to help set up communications to Alberta Research Council (ARC) so the GIS system installed by LFW on ARC's VAX can be used from NoFC and to assist with any technical problems (Paradis, Chow). Do trouble-shooting when users have problems with their terminals, PC's, programmes, other software, laser printers, graphics and plotters (Paradis, Carrigan, Chow).

6. 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) - (All).

7. Installation of VAX system software and layered products (Paradis, Chow). Tune the laser printers, network, VAX, PACS and Wordperfect; expand and maintain the local area and printer networks and set up new fonts for the HP laser printers (Paradis). Installation of LaTex wordprocessing system to use with ARC report prepared for Development (Irwin, Chow) .

8. Three summer students to assist with SAS, INGRES, MMIS, SYDNEY, LABEL system, fire section programming, FIDS section, relieve the operator when she's on holidays, help with systems, other programming and trouble-shooting.

10. Accomplishments for 1988-89:

1. Prepared yearly report on computer usage; prepared the annual HQ report; assisted with PC justifications and purchases and kept in contact with ForCan EDP coordinator in Ottawa (Chow). Completed the old year and new year Ottawa work plan entries and revisions (Hai, Chow). Participated in a word processing study at NoFC and made suggestions as to hardware and software (Chow, Paradis).

2. Wrote or adapted programs and systems (Irwin, Chow, Carrigan, Paradis). Installed the new MMIS system and updates (Chow). Installed SYDNEY and updates (Chow). Assisted with the start of the library use of SYDNEY (Carrigan).

3. Gave in-house courses to potential users of the VAX system (Chow). Prepared and presented beginners personal computing course on a one to one basis; prepared and gave Wordperfect courses to staff at NoFC and the district offices; prepared D-base, Lotus 1-2-3 and SAS courses. (Carrigan). Prepared several pamphlets on how-to-use the printers, plotter, wordperfect, etc. (Carrigan, Paradis). Assisted users with DATATRIEVE, MINITAB and SAS, systems used for data bases and statistics (Irwin, Carrigan). Assistance was given to people who wished to use the Polaroid palette slide display system and prepared a management presentation on the Harvard Graphics display system, which is used with the Palette (Paradis).

4. Provided data entry services, backup and restore, label processing and other operations services (Hai).

5. Continued with assistance to the district offices and set up regular visits as proposed by the CUC - Computer Users' Committee (Chow, Paradis). Evaluated GIS proposals and sat in on meetings concerning the use of ARC's systems with LFW GIS software (Paradis, Chow). Did trouble-shooting when users had problems with their terminals, PC's, programmes, other software, laser printers, graphics and plotters (Paradis, Carrigan, Chow).

6. Attempted to keep current with all aspects of computing, word processing, personal computers and telecommunications by attending workshops, trade shows and reading trade magazines and literature (All).

7. Installed VAX system software and layered products (Paradis, Chow). Tuned the laser printers, network, VAX, PACS and Wordperfect; expanded and maintained the local area and printer networks and set up new fonts for the HP laser printers (Paradis). Installed LaTex wordprocessing system to use with ARC report prepared for Development (Irwin, Chow) .

8. Summer students assisted with SAS, INGRES, MMIS, SYDNEY, LABEL system, fire section programming, FIDS section, relieved the operator when she was on holidays, helped with systems, other programming and trouble-shooting.

11. Present Status:

1. The Computing Centre is providing the best service to NoFC users possible with the present computer configuration and personnel. We cover data processing, programming, system analysis, computer modelling, graphics, information retrieval, evaluations of personal computer requests, word processing and telecommunications and we provide assistance with office automation. Since this is a service study, our goals tend to be continued from year to year.

12. Goals for 1989-90:

1. Prepare yearly report on computer usage by individual reseacher. Prepare the annual EDP report for headquarters; assist users buying EDP products with the necessary justifications; act as the NoFC representative at the ITAC and other EDP meetings; prepare a shadow billing project report monthly or yearly in consultation with the Manager of management services (Chow).

2. Write or adapt programs and systems and provide documentation (Irwin, Carrigan, Chow). Develop, expand and maintain programs and systems, such as the MAIL-LABEL system and DEVMIS programs (Irwin). Install and/or update the information systems - MMIS, SYDNEY, HRIS, personnel leave system, etc. (Chow, Paradis). Assist with the software packages for the various personal computers (Paradis, Carrigan). Assist users with DATATRIEVE, INGRES, MINITAB, SAS, and WORDPERFECT - systems for data bases, statistics and document editing (Irwin, Carrigan, Paradis, Chow). Help users with C and FORTRAN (Carrigan, Irwin, Paradis). Assist with the plotting system, Polaroid Palette, slide and overhead presentations (Paradis).

3. Continue with the Ottawa work plan and enter year-end corrections, prepare year-end roll-up and enter new year figures (Hai, Chow).

4. Attend training courses for the VAX and language utilization and on the operation and management of the VAX (All). Give in-house courses to new users of the VAX system (Carrigan, Chow). Continue with assistance regarding personal computers, data processing, word processing and telecommunications (Paradis, Carrigan, Chow). Set up a regular twice-a-year, or more, site visits to the district offices which follows the recommendations of the CUC (Chow, Paradis, Carrigan).

5. Provide data entry services and backup and restore services as required by various projects; provide various other operator services (Hai). Continue to expand ethernet LAN and terminal server network as new users are hooked up to the system (Paradis). Continue to work on full integration of the PC's, VAX, word processing and document preparation systems (Paradis, Carrigan, Chow). Continue development of network between ForCan HQ, NoFC, and others, eg. LFW and ARC (Paradis, Chow). Continue to trouble-shoot problems with terminals, PC's, VAX software, etc. (All).

6. 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) and by attending courses as appropriate on the VAX (All). Attend the U.S. DECUS meeting to obtain the very latest news in DEC and DEC compatible hardware and software and attend meetings dealing with VAX problems (Chow).

7. Provide assistance to various projects and to help when computer staff is on holidays and to help with trouble-shooting (Students).

13. Publications 1988-89:

Nil.

14. Environmental Impact:

N/A.

15. Duration:

Start: 1969 Estimated Completion: Ongoing.

16. Resources 1989-90:

PYs: Prof.: Chow 1.0
Irwin 1.0
Paradis 1.0

Tech.: Hai 1.0

Total: 4.0

Term/Students 1.9 (Carrigan, D. - term 1.0)

O & M: $51,800
Capital: $62,500.

17. Signatures:

Investigator

Program Director, Enviornment

Regional Director General

FORESTRY CANADA

STUDY WORK PLAN

1989-90

Responsibility Centre: NORTHERN FORESTRY CENTRE

Date: February 8, 1989

1. Project: Management of Regional Development Program

2. Title: Management of Regional Development Program

3. New: Cont.: X 4. No.: NOR-54-01

5. Study Leader: S. Price

6. Key Words: Management, common support, economic development, agreements, job creation, prairie region, FORSTATS, Industrial Development

7. Location of Work: Northwest Region

8. Study Objectives:

   1. To manage the delivery of NWT, Manitoba, Saskatchewan, and Alberta federal-provincial forestry Agreements and other programs related to forest sector development including programs of job creation, forest inventory, and industrial liaison.

   2. To promote and facilitate economics and statistical research.

   3. To participate in corporate management decisions for NoFC as part of NoFC Management Team.

   4. To provide leadership to development & economics personnel & opportunities for career development and employment satisfaction.

9. Goals for 1988-89:

   1. To deliver the large array of programs associated with NOR-36.

   2. To manage, through the District Managers the Winnipeg and Prince Albert offices.

   3. To develop long term strategies for the future of district offices along the scenarios a) Agreements renewed b) Agreements not renewed.

   4. To advocate forestry's interest to CEIC, DRIE and other related Government departments and agencies.

5. To manage the NOR-3 economics program, through the project leader.

6. To cooperate with the various Ottawa DG's directed programs which have a regional expression.

7. To cooperate with various corporate government exercises such as ERDA's and Western Initiatives.

10. Accomplishments for 1988-89:

1. Programs and projects delivered through Manitoba, Saskatchewan, and Alberta FRDA's in compliance with federal-provincial agreement policies and procedures and to the satisfaction of Forestry Canada clients projects ranged from tree planting through to forest products development. In excess of 300 projects were delivered with 3 provincial administrations and 9 major forestry corporations. Total costs of program delivery in 1988-89 exceeded $7,800.00.

2. District offices were managed so as to ensure adequate delivery of Forestry Canada programs in Manitoba and Saskatchewan as well as ensuring continued job satisfaction to personnel in these offices. The review of technical positions in the District Offices was completed as was a review of all Forestry Officer positions. A generous training program was approved and implemented as was a conference plan providing opportunities for district staff to participate in major national and international conferences. Two secondments of Forestry Canada personnel to work with provincial agencies were approved. Regular contact with District Managers was maintained through telephone, electronic mail, correspondence and personal visits.

3. Long term strategies for district offices were developed in conjunction with NoFC management committee.

4. Forestry's interests were advocated with other agencies including CEIC, EDO, Ag Canada, Statistics Canada, INAC and DSS. Opportunities in job development programing, economic diversification through forestry, federal land programing, unsolicited proposals, and national soil conservation programs were explored and implemented where possible. In addition, investigations into the licencing and patenting of NoFC research innovations were conducted in cooperation with CPDL.

   Meetings were held with representatives of these organizations and where required proposals were developed.

5. The NOR-3 forest economics and statistics program was managed through the project leader. Research programs which had been initiated by 2 Agreement economists were continued or completed by NOR-3 personnel. A forest industry and product market intelligence program was initiated. Research studies towards the development of a private woodlot program were initiated. The initial phase of the FORDAT project (forestry research data bank) was completed. Personnel continued on-going research and provided responses to

numerous requests for reviews, comments, information from industry, university, government personnel and the general public.

6. Regular attendance at meetings of Regional Development Directors ensured continued contact with Headquarters personnel as well as Forestry Canada personnel form across Canada. Involvement in the development of guidelines for new federal-provincial forestry agreements; guidelines for private land forestry programs; a memorandum of understanding between Forestry Canada and Indian Affairs concerning Indian lands and; a MOU between NWT and Forestry Canada concerning forest inventory ensured continuing expression of NoFC concerns and points of view.

7. Meetings were held with WDO personnel concerning WDO initiatives and new ERDA initiatives. Background information concerning the forest sector was provided as requested. Forestry Canada HQ personnel and the Deputy Minister have been apprised of all regional dealings with WDO.

11. Goals for 1989-90:

1. To deliver the large array of programs associated with NOR-36.

2. To manage, through the District Managers the Winnipeg and Prince Albert offices.

3. To develop long term strategies for the future of district offices along the scenarios a) Agreements renewed b) Agreements not renewed.

4. To advocate forestry's interest to CEIC, DRIE and other related Government departments and agencies.

5. To manage the NOR-3 economics program, through the project leader.

6. To cooperate with the various Ottawa DG's directed programs which have a regional expression.

7. To cooperate with various corporate government exercises such as ERDA's and Western Initiatives.

8. To participate in the Executive Leadership Development Program.

12. Publications 1988-89:

See NOR-3 and NOR-36

13. Environmental Implications:

The NoFC Environmental Screening Committee has evaluated the study activities with regards to their environmental implications. Based on information provided by the study leader, the committee concluded that the study activities present no potential to cause detrimental effects on the environment.

14. Duration:

Started: 1984 Completion: 1990 or continuing

15. Resources 1989-90:

PYs:	Prof.: Price	1.0
	Tech.:	0.0
	Total:	1.0

Term/Student:

O & M: $15 K
Capital: $5 K

16. Signatures:

Steve Price
Program Director, Development

Regional Director General