

NOR-026

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date:

1. Project:
2. Title: Forest tree rusts of western North America
3. New: Cont.: X 4. No.: NOR-026
5. Study Leader: Y. Hiratsuka
6. Key Words: Cronartium, Pucciniastrum,
Peridermium, Melampsora,
Chrysomyxa, cytology,
morphology, taxonomy,
Uredinales, inoculation
experiment, pathogenicity.
7. Location of Work: Edmonton (laboratory, greenhouse and mycological
herbarium) Kananaskis Forest Experiment Station,
Western North America with particular emphasis on
Northern Region (field).
8. Problem:

Rust fungi are known to attack vigorously growing plants rather than weakened ones because of their obligate parasitism. Damage caused by this group of fungi tend to be increased by intensive cultural practices as evidenced by such cases as, white pine blister rust in North America, poplar rusts in Europe, comandra blister rust of hard pines in southeastern North America, and wheat stem rusts and coffee rust in many parts of the world.

An estimate of the losses attributable to forest tree rusts in the region has not been obtained but significant growth loss and mortality of several major forest tree species, including lodgepole pine, jack pine, white spruce, black spruce, balsam fir and sub-alpine fir, have been suggested. In addition, several rust species endemic to the region have been recognized as serious pathogens in other areas where forestry practices are more intensive.

Our knowledge of western forest tree rusts has been inadequate to solve present and future problems which are and will be caused by

this group of fungi and studies of this group of fungi on identity, life history, host range, cytology, morphology, distribution and pathogenicity are necessary.

9. Study Objectives:

General:

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

10. Resources:

- a) Starting date: 1968: Projects A-232 (1961) and A-254 (1965) were combined and redesigned in 1968.
- b) Estimated year of completion: Continuous.
- c) Estimated total Prof. man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man years Prof. Y. Hiratsuka .5
 Supp. P.J. Maruyama .5
 Total 1.0

O & M funds req'd: \$1,540.00

11. Progress to date:

1. Comparative studies of the nuclear phenomena of the aeciospores and germinating aeciospores of P. harknessii and P. stalactiforme have been completed and the results have been published. Further nuclear studies have been carried out with the aeciospores of P. harknessii material from other regions. Similar studies with C. comptoniae and C. comandrae were completed and results have been published.
2. Studies on temperature and pH requirements for an orange and white spored aeciospore germination of P. harknessii and P. stalactiforme have been completed and published.
3. White spored P. stalactiforme (Cronartium coleosporioides f. album) was discovered in 1960 in a small area in Banff National Park and annual observations were commenced in 1963. Occurrence of this form and the results of the annual observations of canker growth and tree mortality up to 1965 were published in 1966. Annual surveys of the white spored form and the typical yellow spored form in the area were continued.
4. A study trip to northern Europe (Norway, Sweden, Netherlands, Scotland) was conducted during May and June of 1967 to study germ tube cytology of host alternating and pine-to-pine races

of Cronartium=flaccidum (Peridermium pini). About 300 fixed slides of germinating spores have been prepared and brought back for cytological studies. Significant differences between the two races were found and the results have been published.

5. Study of aeciospore germ tubes of pine gall rust from Quebec and New Brunswick showed clearly that they are Peridermium harknessii rather than Cronartium quercuum as previously reported. A note has been published.
 6. Study of aeciospore germ tubes of Peridermium ephedrae from New Mexico indicated an unusual nuclear cycle and a note has been published.
 7. Pucciniastrum vaccinii complex: Inoculation experiments and preliminary morphological comparisons have been completed.
 8. Yellow-spored Peridermia on Abies: Morphological comparisons and literature survey have been completed and compilation of results for publication has been started.
 9. Spruce needle rusts: Several inoculation experiments have been done. Inoculation of Pucciniastrum sparsum from Artostaphylos rubra to Picea glauca was successful. This presents the first record of this rust on Picea in North America and the results have been published.
 10. Taxonomic revision of pine stem rusts, including the establishment of a new genus for autoecious species, is completed and results have been published.
 11. Morphological study of forest tree rusts by scanning electron microscope is in progress and significant results have been obtained. Two papers on the subject have been published.
 12. Surveys of the occurrence of Tuberculina maxima on pine stem rusts have been undertaken. Two papers on the occurrence have been published.
 13. Field and herbarium surveys of the occurrence of the pine stem rusts in Canada have been carried out and distribution maps were prepared.
 14. The first draft of the proposed publication "Pine stem rusts of Canada" was nearly completed.
12. Goals for 1972-73:
- a. Complete the proposed departmental publication entitled "Pine stem rusts of Canada" with J.M. Powell.
 - b. Continue detailed morphological comparison of spruce needle rusts with scanning electron microscope and other forest tree rusts.

- c. Continue greenhouse inoculation experiments of pine stem rusts to study host penetration, disease establishment and symptom development.
- d. Continue life history and taxonomic studies of several spruce and fir needle rusts.
- e. Continue survey of Cronartium coleosporioides f. album in Banff National Park.
- f. Complete two manuscripts on the taxonomy and nomenclature of endocyclic rust fungi.
- g. Survey and study Cronartium ribicola in Jasper National Park and Banff National Park.
- h. Plan and start the impact study of Cronartium ribicola in southern Rocky Mountain region.

Proposed publication:

Hiratsuka, Y. and J.M. Powell. Pine stem rusts of Canada (Departmental publication).

Hiratsuka, Y. Taxonomy and nomenclature of endocyclic Uredinales.

Hiratsuka, Y. Nomenclature of the genus Endocronartium.

13. Accomplishments in 1972-73:

- a. Draft manuscript of the publication entitled "Pine stem rusts of Canada" with J.M. Powell has been sent to Ottawa for review.
- b. A new method to study fragile fungus material was developed and incorporated into a manuscript for publication.
- c. Inoculation experiments of western gall rust (Endocronartium harknessii) on several native and exotic species were completed.
- d. Several new records of fir needle rusts have been obtained.
- e. Survey of Cronartium coleosporioides f. album in Banff National Park was continued.
- f. The manuscript of a paper proposing the conservation of the generic name Peridermium has been prepared.
- g. Alternate host stage of Cronartium ribicola was found for the first time in Jasper National Park, and also at a point 12 miles NNE of Hinton, Alberta.

- h. Impact study of Cronartium ribicola in southern Rocky Mountain region was cancelled because of the lack of funds.
- i. Stem rust problems on a tree farm and in thinned stands in central Alberta were assessed and draft reports were prepared, with J.M. Powell and R. Blauel.
14. Goals for 1973-1974:
1. Continue inoculation experiments with western gall rust on native and exotic pine species. Study made of penetration of the pathogen on pine tissue.
 2. Complete and publish morphological study of the genus Chrysomyxa in North America.
 3. Complete a manuscript proposing the conservation of a generic name Peridermium.
 4. Critical comparative study of pine stem rusts and other forest tree rusts will be carried out in conjunction with the study trip to Asia from March to August, 1973.
15. Publications:
- Up to 1972-73
- Powell, J.M. and W. Morf. 1965. The occurrence of Tuberculina maxima Rost. on Cronartium rust infected trees in Alberta. Can. Dept. For., For. Ent. & Path. Br., Bi-mon. Prog. Rept. 21(1):3.
- Powell, J.M. 1966. A white spored Peridermium stalactiforme in Alberta. Plant Disease Reporter, 50:144.
- Powell, J.M. and W. Morf. 1966. Temperature and pH requirements for aeciospore germination of Peridermium stalactiforme and P. harknessii of the Cronartium coleosporioides complex. Can. J. Bot. 44:1597-1606. + 1 plate.
- Hiratsuka, Y., W. Morf and J.M. Powell. 1966. Cytology of the aeciospores and aeciospore germ-tubes of Peridermium harknessii and P. stalactiforme of the Cronartium coleosporioides complex. Can. J. Bot. 44, 1639-1643. III Plats.
- Hiratsuka, Y. and E.J. Gautreau. 1966. Occurrence of Cronartium comptoniae in Alberta and the Northwest Territories. Pl. Dis. Repr. 50, 419.
- Hiratsuka, Y., L.E. McArthur and F.J. Emond. 1967. Clarification of the identity of two needle rusts of alpine fir, Pucciniastrum geoppertianum and P. epilobii in Alberta. Can. J. Bot 45, 1913-1915.

- Hiratsuka, Y. and P.J. Maruyama. 1968. Nuclear condition of the germ tubes of Peridermium ephedrae. Mycologia 60, 437-438.
- Hiratsuka, Y. and P.J. Maruyama. 1968. Identification of Peridermium harknessii in eastern Canada on the basis of nuclear condition of aeciospore germ tubes. Pl. Dis. Repr. 52, 650-651.
- Hiratsuka, Y. 1968. Morphology and cytology of aeciospores and aeciospore germ tubes of host-alternating and pine-to-pine races of Cronartium flaccidum in northern Europe. Can. J. Bot. 46, 1119-1122. IV plates.
- Hiratsuka, Y. and J.M. Powell. 1969. Cytology and taxonomy of autoecious pine stem rusts. (Ab.). XI International Botanical Congress. Seattle, Washington, Abstracts:91.
- Hiratsuka, Y. 1969. Endocronartium, a new genus for autoecious pine stem rusts. Can. J. Bot. 47, 1493-1495.
- Powell, J.M. and Y. Hiratsuka. 1969. Nuclear condition and germination characteristics of the aeciospores of Cronartium comandrae and C. comptoniae. Can. J. Bot. 47, 1961-1963. 2 plates.
- Hiratsuka, Y. 1970. Identification and morphology of the aecial state of Pucciniastrum sparsum in northwestern Canada. Can. J. Bot. 48, 433-435.
- Hiratsuka, Y. 1970. Emergence of the aeciospore germ tube of Cronartium coleosporioides (= Peridermium stalactiforme) as observed by scanning electron microscope. Can. J. Bot. 48, 1692.
- Krebill, R.G. and Y. Hiratsuka. 1971. Possible life cycle and nuclear condition of Peridermium ephedrae. Southwestern Naturalist 16: 431-459.
- Powell, J.M. 1971. Occurrence of Tuberculina maxima on pine stem rusts in western Canada. Can. Plant Dis. Surv. 51(2): 83-85.
- Powell, J.M. 1971. Additional records of Mycodiplosis larvae (Diptera:Cecidomyiidae) feeding on rust fungi. Can. Plant Dis. Sum. 51(2): 86-87.
- Hiratsuka, Y. 1971. Spore surface morphology of pine stem rusts of Canada as observed under a scanning electron microscope. Can. J. Bot. 49. 371-372. 6 plates.

1972-73

Hiratsuka, Y. 1973. Sorus development, spore morphology, and nuclear condition of Gymnosporangium gaeumannii ssp. albertense. Mycologia (In press).

Hiratsuka, Y. 1973. The nuclear cycle and the terminology of spore states in Uredinales. Mycologia (In press).

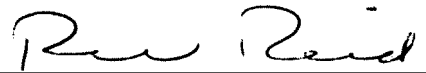
Hiratsuka, Y. Nuclear cycle, taxonomy, and nomenclature of autoecious pine stem rusts in North America and Europe. Reports of the Tottori Mycological Institute (in Japanese) In press.

Hiratsuka, Y. and P.J. Maruyama. A modified critical point drying method to study germ tubes of rust fungi under scanning electron microscope Can. J. Bot. (submitted).

Hiratsuka, Y. and J.M. Powell. Pine stem rusts of Canada. Departmental Publication (submitted for review).

16. Signatures:

Y. Hiratsuka, Investigator



Paul Reid
Program Manager



G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 -74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 29, 1973

1. Project: Detection and appraisal of tree pests and vegetative disturbances.
2. Title: Forest Insect and Disease Survey
3. New: Cont.: X 4. No.: NOR-1-033
5. Study Leaders: W.G.H. Ives, Y. Hiratsuka, H.R. Wong, R.A. Blauel and J.K. Robins.
6. Key Words: Detection, appraisal, distribution, parasites, hosts, damage, predators, biological control, hazard, susceptibility, stability, management, parks, recreation, symptoms, effluents, easement, atmosphere, landspill, pipeline break.
7. Location of Work: Throughout region.
8. Problem:

Forest insects and diseases annually destroy or degrade large quantities of otherwise useable wood fibre. They cause important damage to nursery plantations, shelterbelts and park plantings which have high aesthetic or shelter values. The relations between insects, diseases and their hosts are complex and often obscure. Many of the problems confronting resource managers have their origin in insect or disease activities, but in other instances unsuspected factors may be responsible for the damage, and the insects or diseases are of secondary importance. Correct diagnoses therefore require a highly trained technical and professional staff.

The data collected by the Survey provide essential information on life cycles, natural control agents, distribution and general abundance, which is of value to research entomologists, pathologists and other biologists. Many of the species reported by the Survey have a wide distribution, and the regional data are part of a larger body of data collected by this and other regions. Recent work has shown that the general information collected by the Survey can be used in a meaningful manner to help explain fluctuations in insect abundance.

Requests for surveys and advisory services in environmental and pollution problem areas are being directed with increasing frequency to the Canadian Forestry Service. The Forest Insect and Disease Survey acts on these requests, and provides management agencies and public with impact and appraisal information relative to disturbances in the forest environment.

9. Study Objectives:

1. To gain an improved knowledge of forest insects and diseases in the region for the purpose of minimizing damage to the forest attributable to these organisms and to provide an advisory service to management agencies and the public. 2. To provide detection, appraisal, and impact information on vegetative disturbances relating to environment and pollution.

10. Resources:

- a) Starting date: 1941 at Winnipeg and Indian Head
- b) Estimated year of completion: Continuing. Revised:
- c) Estimated total Prof. man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man years: Prof. 2.3 - Ives, Hristova, Wong, Blawie.
 Supp. 12.0
 Casual 0.3
 Total 14.6 O & M funds req'd.: \$16,360.00

11. Progress to date:

Infestations of all the major forest insects have been assessed since the inception of the Survey and more recently a large amount of information on diseases of the region has also been obtained. Much of this information has been stored on magnetic tape or punch cards for easy analysis and retrieval. Life cycles and other biological data have been obtained for most of the major insects and diseases within the region. Numerous impact and appraisal surveys have been carried out in response to special needs. Reference collections for insects and diseases have been established and maintained.

Ground surveys of insect and disease conditions in Waterton Lakes National Park were conducted, data were extracted from the historic file and a hazard rating was devised. The report "Insect and Disease Hazard in Relation to Stand Stability", by J. Petty and W.G.H. Ives was completed and submitted to the National and Historic Parks Branch where it was favorably received. No field work was done in 1971-72.

Preliminary surveys of 65 campgrounds were conducted during 1971. Data were collected on the intensity of use, method of preparation

(when available), cover description and condition, site, and insect and disease pests. In addition, increment cores were removed from a limited number of trees and preliminary soil samples were taken.

A more detailed examination of one campground (Tunnel Mountain, Banff National Park) was undertaken to determine the credibility of the cursory surveys conducted there and elsewhere. Additional increment cores were taken, lateral growth was measured on the same trees, and a more adequate evaluation of soil conditions was made.

A limited but fairly intensive aerial and ground check of vegetation in the vicinity of Thompson, Manitoba, revealed two areas, in total of approximately 50 square miles, where damage was occurring due to effluents released from the International Nickel Company plant in Thompson. Damage varied from incipient to severe. The surveys were carried out in co-operation and with assistance from the Manitoba Government and the International Nickel Company. Two reports were submitted to the agencies concerned.

An aerial survey with ground checks was carried out over a recently developed natural gas field in western Alberta and within long established oil and natural gas fields in other parts of that Province. No significant damage to vegetation was detected with the exception of a few minor damage areas resulting from well blow-outs. A report was submitted to appropriate Alberta Government agencies.

A ground check was made of vegetation damage resulting from a blow-out from a high pressure condensate line in western Alberta. Resultant gas-liquid mixture caused some discoloration of adjacent foliage, which extended a distance of two miles from the pollutant source. A report was submitted to the appropriate Alberta Government agencies.

12. Goals for 1972-73:

1. The detection and appraisal of insect and disease outbreaks in forested areas will continue, augmented by aerial surveys where warranted. Particular attention will be given to the accessible forested areas presently under utilization, and to high use recreational areas.
2. Spruce budworm and spruce beetle damage appraisal surveys will be carried out.
3. Maintenance and improvements of regional insect and disease identifications, biologies and reference collections will be carried out.
4. Editing of historical data on insects will be completed.

5. The historical file on insects and diseases will be used to provide annotated check lists of insects and diseases found in each of the western national parks, and in the Sandilands Provincial Forest.
 6. Summarize available information on forest insect and diseases in Prince Albert National Park. Conduct the necessary field surveys during the 1972-73 field season to supplement the pest data already available for the Prince Albert National Park. Complete a report similar to that prepared for Waterton Lakes National Park, consisting of color coded maps and written text, outlining potential problem areas. Submit report to National and Historic Parks Branch.
 7. Complete analyses of data on campground conditions collected in 1971. Report to client agencies. Collect additional samples or data if required to clarify conditions in some of the campgrounds examined in 1971. Obtain additional photographic documentation of conditions (both good and bad) in as many of the campgrounds examined in 1971 as is practical.
 8. In co-operation with management agencies within the region to provide a survey and assessment of air pollution effects on vegetation in forested regions. Specific areas for inspection are located near McMurray (Great Canadian Oil Sands) in Northern Alberta, Exshaw (cement plant) in southern Alberta, Flin Flon and Thompson areas in Manitoba and possibly one location in Saskatchewan. Action will be taken on further requests as received and as resources allow.
 9. Obtain infra-red aerial photos of areas in which red belt damage was suspected to occur. Ground truth accessible areas to determine whether apparent damage is real. Some areas were visited in winter, as they are inaccessible during the summer. Prepare a report for CCRS (Project 116) who provided the aerial photography of red belt damage.
 10. To develop and test a technique for conducting low-level aerial surveys for the detection of dwarf mistletoe infections in stands of jack pine in AFS Management Unit A7. To prepare reports describing the equipment and its application in the surveying of dwarf mistletoe infestations.
13. Accomplishments in 1972-73:
1. Pest conditions in the Prairies Region during 1972 were highlighted by the continued increase in forest tent caterpillar populations in Manitoba and Saskatchewan and by the occurrence of a large area of spruce infected with needle rusts in Alberta. Forest tent caterpillar defoliation occurred at scattered locations across central Manitoba and in parts of northern Saskatchewan

and a major outbreak appears to be developing. Spruce budworm populations remained at much the same levels as in 1971, with most of the defoliation confined to the Sprucewoods and Inter-lake areas of Manitoba. Large aspen tortrix populations were on the increase across the Region and, in Manitoba, were often mixed with forest tent caterpillar. Defoliation by the fall cankerworm increased in Manitoba and Saskatchewan, and was especially noticeable in metropolitan Winnipeg. Jack pine budworm infestations also increased in severity in the Sandilands Provincial Forest in Manitoba. The birch skeletonizer caused moderate to severe damage in parts of Saskatchewan and Manitoba and defoliation by the yellow-headed spruce sawfly was widespread and severe in the agricultural areas, especially in Alberta and Saskatchewan.

2. The spruce budworm and spruce beetle infestations in Alberta have both subsided. No special budworm survey in Alberta was required, and the survey for the spruce beetle indicated that the 1972 survey will be the last required for that insect, although checks will have to be made by the ranger in the area in case there is a resurgence in populations. Stand deterioration in the reserve block was evaluated, and an annual examination will be required for a number of years, since many dead trees are still standing. The spruce budworm infestation continued in the Sprucewoods area of Manitoba, and was surveyed by staff from the Winnipeg sub-office.
3. Work continued on the maintenance and improvement of the regional insect and disease reference collections.
4. Editing of historical data on insects is nearing completion.
5. Printouts of insects and diseases collected in each of the western national parks have been obtained. Annotated check lists of forest fungi collected in Yoho and Kootenay national parks have been published. Similar lists for insects collected in Waterton Lakes National Park and in the Kananaskis Forest Experiment Station area are nearing completion. Lists of insects collected in each of the remaining western national parks are being compiled and should be completed before the 1973 field season.
6. Information on forest insects and diseases in Prince Albert National Park has been summarized. Field surveys to supplement the above data were completed. The preparation of a report is currently under way. Color coding of the large number of maps involved will be time-consuming and probably will not be completed until early spring, 1973.
7. Data from all campgrounds that were examined was perused superficially, and those collected in national park campgrounds were examined in greater detail. It is the investigator's opinion that the problems encountered in heavily-used campgrounds stem

largely from overuse, poor design and inadequate maintenance, and that the CFS or FIDS can do very little to correct the situation unless the agencies responsible for the campgrounds improve design or maintenance when these are faulty.

A file report presenting data on tree increment and soil compaction in eight campgrounds in Rocky Mountain National Parks, and a list of suggestions for improving design or maintenance of campgrounds was submitted to the western regional office of the National and Historic Parks Branch.

8. The Thompson Smoke Easement Survey

An aerial reconnaissance, a ground appraisal and a ground truthing were carried out in the suspect fume damaged forest areas around Thompson, Manitoba. The fume damaged areas were delineated and current levels of damage were documented at 14 different sites. Ground truthing was co-ordinated with remote sensing procedures conducted by C.C.R.S.

Smelter Fume Damage near Flin Flon

A preliminary air and ground appraisal was performed to determine the effects of ore smelting air pollutants on the forest in the Flin Flon-Creighton areas of Manitoba and Saskatchewan. Apparent damaged areas were located and some preliminary documentation of the damages was carried out. A brief ground truthing complemented low level multispectral imagery obtained from C.C.R.S.

The Effects of the Cement Production Industry on the Forest Community in the Exshaw Area

A survey was conducted to assess the condition of the forest community subjected to the air pollutants from the cement production industry near Exshaw, Alberta. Sampling of vegetation, stem analysis and other documentation procedures were performed.

The Effects of Potash Industry Pollutants on Trees and Shelterbelts near Guernsey, Saskatchewan

A preliminary survey was conducted in the Guernsey, Saskatchewan area to determine and document the effects of the potash production industry on trees and shelterbelts. Some of the vegetation examined was found to be damaged, symptoms and foliar analysis indicating chemical burning.

The Impact of Air Pollutants from the Alberta Tar Sands Oil Extraction Industry on the Surrounding Forest

A survey was conducted to determine the impact of the pollutants on the forest community near several sulphur dioxide monitoring

stations located in the area. It was also determined that the monitoring stations were located out of the main air pollutant impingement area.

Forest Damage Resulting from a Light Hydrocarbon Spray Released from a Gas Pipeline

An appraisal was performed to determine the extent and progression of damage to the forest subjected to the spray to delineate the area of damage, and to determine plausible restoration procedures.

The Effects of Air Pollutants from the Gas Processing Industry on the Forest Community in the Rocky Mountain Foothills

Survey is contributing to the detection aspects of an in-depth study to determine the effects of sulphur pollutants on the forest community. This year a joint brief by Canadian Forestry Service and Environmental Protection Service was presented at a hearing conducted by the Alberta Government, concerning an application by Gulf Oil of Canada Ltd., for exemption from minimum sulphur recovery guidelines.

Pollutant Damage to the Forest Community in the Swan Hills Area

A preliminary detection and appraisal survey revealed that the forest community is being affected by gas flaring, sulphur gas releases, hydrocarbon coating, condensate spraying, saline pipeline ruptures and oil spills.

The Effects of Air Pollutants from the Prince Albert Pulpmill on the Surrounding Forest Community

A small area of air pollutant damage was noted near the Prince Albert pulpmill. A preliminary appraisal survey was conducted and a report issued.

Other brief assessments of pollutant releases were conducted during the field season at the request of provincial forest management and environmental agencies. These assessments included determination and documentation of pollutant effects. The problems included a volatile hydrocarbon release in the Black Diamond area, a sulphur gas release in the Crossfield area, battery site air pollutants in the Savanna Creek area, spray drifting in the Penhold area, suspect pollutant damaged forest near the Blue Ridge gas processing plant and summer-time discoloration of street trees in Prince Albert.

9. A successful air photo survey technique has been devised and has been used by the Alberta Forest Service (AFS) to map red belt areas. Two sample areas have been examined three times, and some of the areas mapped by AFS have been ground checked

this winter. It appears that it will be possible to relate gross symptoms of original damage to the eventual fate of some trees.

10. The equipment was designed and tested. Ground checks indicated the aerial surveys to be reliable in the detection of mistletoe infections. Management Unit A7 was surveyed and the data obtained supplied to the AFS, who have used it in preparing type maps of the area, in which mistletoe infection is indicated by one of three categories.

14. Goals for 1973-74:

1. The detection and appraisal of insect and disease outbreaks in forested areas will continue, augmented by aerial surveys where warranted. Particular attention will be given to accessible forested areas presently under utilization, and to high use recreational areas.
2. To delineate, in as much detail as is feasible, the extent and severity of outbreaks of defoliating insects. Specifically: forest tent caterpillar in Alberta, and a mixture of this insect and large aspen tortrix in Manitoba and Saskatchewan; spruce and jack pine budworm in Manitoba; and other species that may reach outbreak proportions.
3. To conduct detailed surveys of specified areas to determine whether control procedures are needed to reduce forest tent populations around campgrounds. Early larval and egg-band surveys will be required.
4. Maintenance and improvements of regional insect and disease reference collections will be carried out.
5. Annotated check lists of forest diseases for Prince Albert and Riding Mountain National Parks will be prepared. Any check lists for forest insects that were not completed in 1972-73 will be completed.
6. Complete a report of insect and disease hazard for Prince Albert National Park and submit it to National and Historic Parks Branch.
7. To complete reports for campgrounds under provincial jurisdiction and to submit these to the agencies concerned. No additional field work is planned. Study terminated.
8. In co-operation with management agencies within the region to provide a survey and assessment of pollution effects on vegetation in forested regions. Specifically:

not included

not included

not included

not sufficient data - no report

The Thompson Smoke Easement Survey

not reported

Efforts will be concentrated on the evaluation and interpretation of the low level imagery which was taken, the processing of samples and analysis of the data and documentation obtained. High level imagery cancelled due to inclement weather has been resubmitted for C.C.R.S., and E.R.T.S. imagery from the area has been requested. A complete report of the Thompson Smoke Easement Survey will then be issued.

Report

Smelter Fume Damage near Flin Flon

Reported

High level multispectral imagery of the affected areas has been requested from C.C.R.S.. E.R.T.S. imagery has also been requested. Efforts will be confined to analyzing the data and documentation obtained, interpretation and evaluation of the imagery, and the issuing of a report.

Report

The Effects of the Cement Production Industry Pollutants on the Forest Community in the Exshaw area

Done?

The samples will be processed, the data and documentation analyzed and finalized into a report.

Report

The Effects of Potash Industry Pollutants on Trees and Shelterbelts near Guernsey, Saskatchewan

Reported

Based on information received in the preliminary survey, the Saskatchewan Department of the Environment has requested another, more detailed appraisal and documentation of the problem. The field appraisal will be conducted this summer and the laboratory work carried out in the winter months. A full report will follow.

Report

Report Completed
Another report

The Impact of Air Pollutants from the Alberta Tar Sands Oil Extraction Industry on the Surrounding Forest

Reported

The Alberta Department of the Environment has requested an appraisal survey be conducted in the main air pollutant impingement areas to determine, document and define pollutant caused degradations to the forest community. Further they have requested the implementation of bio-monitoring procedures to complement ongoing ambient air sampling.

The appraisal will be conducted this summer if a suitable means of transportation into the area is arranged by the Alberta Department of the Environment. Bio-monitoring procedures will be implemented near the continuous monitoring stations (two are now in operation) if the stations are moved into the main pollutant impingement area.

Forest Damage Resulting from a Light Hydrocarbon Spray Released from a Gas Pipeline

In co-operation with the Alberta Forest Service, a plan for field reclamation procedures will be designed for the damaged area. The Alberta Forest Service will be in charge of, and carry out, all reclamation trial procedures. Plots to evaluate these will be established. Further, a few plots will be left undisturbed in order to evaluate natural recovery processes.

File report prepared

The Effects of Air Pollutants from the Gas Processing Industry on the Forest Community in the Rocky Mountain Foothills

Survey will continue to contribute to the detection aspects of the problem by advising and conducting field supervision visits.

Advised

Pollutant Damage to the Forest Community in the Swan Hills Area

The Alberta Forest Service has requested detailed appraisals of the pollutant problems in the Swan Hills area. This will include all the primary objectives of the survey pollutant appraisal. The field work will be conducted this summer in co-operation with the Alberta Forest Service who will have personnel involvement and provide transportation assistance where needed. In addition, a request has been placed with C.C.R.S. for high level aerial imagery of the area, and with the Northern Forest Research Centre's remote sensing group, for low level photography of special problem areas.

The Effects of Air Pollutants From the Prince Albert Pulpmill on the Surrounding Forest Community

The Saskatchewan Department of Forestry and the Prince Albert pulp-mill have expressed a wish for a monitoring service to be conducted in the area, one that is relevant to the impact on the biological community. This year a preliminary survey will be conducted to assess the approximate size and location of the main air pollutant impingement area and to gather the background data necessary to determine if bio-monitoring is practical within that region. In addition, an integrated bio-monitoring ambient air monitoring system will need to be worked out with an agency capable of providing the ambient air monitoring services.

Should have been removed

We will continue to respond to new requests from clients concerning tree and forest community pollutant problems. Responses will be conducted in the most practical manner possible that will yield desirable results and fall within the limits of our resources.

9. Continue ground truthing of aerial photos of areas containing red belt. Continue to make observations on the condition of surviving trees. Conduct ground and/or aerial surveys of other areas where

red-belt damage has occurred. Prepare a report on history, extent, and impact of red belt.

This goal was put in a line of study. Should have been included

- 10. Undertake preliminary surveys of selected plantations or natural regeneration throughout the region to determine where possible the effect of diseases and insects on regeneration survival.

15. Publications:

Goals 1-5 (1972-73)

The Forest Insect and Disease Survey started in Winnipeg and Indian Head in 1941, and listing publications and reports back to that date would provide a very impressive list, but would be pointless. Publications have therefore been listed only since the establishing of the Northern Forest Research Centre in Edmonton.

1970 - 71

Ives, W.G.H., R.A. Blauel, and J.K. Robins. 1971 Important Forest Insect and Diseases, Prairies Region. In Annual Report of the Forest Insect and Disease Survey, 1970. Can. For. Serv., Dept. of Fisheries and Forestry, Ottawa.

Reports:

Robins, J.K. et al. 1971. Annual District Reports, Forest Insect and Disease Survey Prairies Region, 1971. Forest Research Laboratory, Edmonton. File Report.

Stevenson, R.E. The spruce budworm in Northern Alberta with emphasis on the Wabasca outbreak. Int. Rept. A 28 March, 1970.

Safranyik, L. and J. Petty, 1971. 1970 Spruce Beetle Survey of the Crowsnest Forest, Alberta. For. Res. Lab., Edmonton. Int. Rept. A-41.

Cerezke, H.F. 1970. Spruce budworm conditions in northern Alberta and Northwest Territories. File Report.

Blauel, R.A. 1970. The survival of container seedlings planted at Mercond, Alberta. File Rept.

Blauel, R.A. and R.C. Tidsbury. 1970. The 1970 Thompson Smoke Easement. File Rept.

1971 - 72

Publications:

Anonymous. 1971. Special Report: Forest Insects and Diseases. edited by W.G.H. Ives, Can. For. Ser., Northern Forest Res. Centre, Forestry Report, Vol. 1, No. 3.

Anonymous. 1971. Forest Insects and Diseases. edited by W.G.H. Ives. Can. For. Ser., Northern Forest Res. Centre, Forestry Report Vol. 1, No. 4.

Ives, W.G.H., R.A. Blauel and J.K. Robins. 1972. Important Forest Insects and Diseases, Prairies Region. In Annual Report of the Forest Insect and Disease Survey, 1971. Can. For. Ser. Dept. of the Environment, Ottawa.

Wong, H.R. 1971. Forest Entomologists in the Prairies Region. Bull. Ent. Soc. Canada. 3(1):15.

Reports:

Blauel, R.A. 1971. A field inspection of a Forest Subjected to an Alberta Gas Trunk Pipeline Condensate Release - Can. For. Service, Northern Research Centre, Edmonton. A File Report.

Blauel, R.A. 1971. Pine Stands Infected with Dwarf Mistletoe in the Athabasca Forest. Canadian Forestry Service, Northern Forest Research Centre, Edmonton. Internal Report NOR-7.

Blauel, R.A. and J.K. Robins, 1971. Preliminary report on impact of insects and diseases in strip cutting areas of the Grande Prairie Forest. Can. For. Ser. Northern Research Centre, Edmonton. File Report.

Ives, W.G.H. 1971. The forest tent caterpillar in Alberta. Northern Forest Res. Centre. Internal Report NOR-4.

Ives, W.G.H. 1972. Forest insects and diseases in eight of the western national parks, 1971. Northern For. Res. Centre. Information Report NOR-X-12.

Lawrence, J.J., and Y. Hiratsuka. 1972. Forest fungi collected in Banff National Park, Alberta. Information Report NOR-X-22.

Lawrence, J.J., and Y. Hiratsuka. 1972. Forest fungi collected in Jasper National Park, Alberta. Information Report NOR-X-21.

Lawrence, J.J., and Y. Hiratsuka. 1972. Forest fungi collected in Waterton Lakes National Park, Alberta. Information Report NOR-X-20.

Patterson, V.B. and G.N. Still. 1972. Forest insect and disease conditions in Manitoba Provincial Parks, 1971. Northern Forest Research Centre, Information Report NOR-X-24.

Mortenson, K.L., R.C. Tidsbury and E.J. Gautreau. 1972. Forest Insect and disease conditions in Saskatchewan provincial parks, 1971. Northern Forest Research Centre, Information Report NOR-X-25.

- Petty, J., G.J. Smith, J. Susut and R. Caltrell. 1972. Forest insect and disease conditions in Alberta provincial parks, 1971. Northern Forest Research Centre, Information Report NOR-X-26.
- Robins, J.K., et al. 1972. Annual district reports: Forest Insect and Disease Survey, Prairies Region, 1971. Northern Forest Research Centre, Internal Report NOR 13.
- Safranyik, L., J. Petty and G.J. Smith. 1972. 1971 spruce beetle survey of the Crowsnest Forest, Alberta. Northern Forest Res. Centre, Internal Report NOR 11.

1972 - 73:

Publications:

- Anonymous. 1972 (Prepared by H.R. Wong). Western Forest Insect Work Conference. Bull. Ent. Soc. Canada 4(2):29.
- Ives, W.G.H., J.J. Lawrence and J.K. Robins. 1973. Important forest insects and diseases, Prairies Region. In Annual Report of the Forest Insect and Disease Survey, 1972. Can. For. Ser. Dept. of the Environment. Ottawa (In Press).
- Whitney, H.I. and R.A. Blauel. 1972. Oospore dispersion in Caratocystis spp. and Europhium clavigerum in conifer resin. Mycologia 44:410-414.
- Wong, H.R. 1972. The spread of the European spruce sawfly, Diprion hercyniae (Hymenoptera:Diprionidae) in Manitoba. Can. Ent. 104:755-756.

Reports:

- Lawrence, J.J. and Y. Hiratsuka. 1972. Forest fungi collected in Yoho National Park, British Columbia. Northern Forest Research Centre, Information Report NOR-X-27.
- Lawrence, J.J. and Y. Hiratsuka. 1972. Forest fungi collected in Kootenay National Park, British Columbia. Northern Forest Research Centre, Information Report NOR-X-28.
- Powell, J.M., H.R. Wong and J.C.E. Melvin. 1972. Arthropods collected from stem rust cankers of hard pines in western Canada. Northern Forest Research Centre, Information Report NOR-X-38.

Goal 6(1972-73)

Reports:

Up to 1972-73

Petty, J. and W.G.H. Ives. 1971. Insect and disease hazard in relation to stand stability: Waterton Lakes National Park. Northern Forest Research Centre, June, 1971. 21 pp.

1972 - 73: Nil.

Goal 7(1972-73)

Reports:

1972-73

Ives, W.G.H., V.B. Patterson and J. Petty. 1972. Stand stability in selected high-use campgrounds in Rocky Mountain National Parks. File Report NOR-Y-41. 11 pp.

Goal 8(1972-73)

Reports:

Up to 1972-73:

The 1970 Thompson Smoke Easement Survey

1972-73: Completed:

Blauel R.A. The 1971 Thompson Smoke Easement Survey. NOR-Y-4. 18 pages. April 1972.

Blauel, R.A. Summertime Street Tree Foliage Discoloration in Prince Albert, Sask. NOR-Y-22. 4 pages. Aug. 1972.

Susut, J.P. & R.A. Blauel. Examination of a Damaged Forest Area near the Blue Ridge Gas Processing Plant, Alberta. NOR-Y-21. 9 pages. July 1972.

Blauel, R.A. Preliminary Report Concerning Escaped Volatile Hydrocarbons and the Effect on Trees & Shrubs South of Black Diamond, Alberta. File Report. 2 pages. July 1972.

In progress:(1973-74)

Blauel, R.A. Impacts of Alberta Battery Site emissions on the surrounding forest vegetation.

Blauel, R.A. A preliminary report on the response of trees to saline solution released from a ruptured buried pipeline.

Blauel, R.A. A reported sulphur gas release in the Crossfield area of Alberta.

Smith, G.J. & R.A. Blauel. Shelterbelt trees damaged by an applied drifting spray near Penhold, Alberta.

Blauel, R.A. & K.L. Mortensen. Preliminary assessment of potash production emission damages to shelterbelts near Guernsey, Saskatchewan.

Blauel, R.A. Evaluation of the forest condition around the cement production industry located in Exshaw, Alberta.

Blauel, R.A. Current forest conditions around the sulphur dioxide monitoring stations located in the vicinity of the Alberta Tar Sands oil extraction industry.

The effects of an accidental natural gas pipeline condensate release on a mixedwood boreal forest.

I-The progression of damage to the forest - Blauel, R.A.

II-Insects in the area - Wong, H.R.

III-The effect on soil and growth properties, with reclamation proposals - Blauel, R.A. & Lesko, G.L.

Blauel, R.A. Escaped volatile hydrocarbons and their effects on trees and shrubs south of Black Diamond, Alberta.

Planned:(1973-74)

Blauel, R.A. The 1972 Thompson Smoke Easement Survey.

Blauel, R.A. The impact of smelter smoke on the forest in the Flin Flon area.

Goal 9 (1972-73)

Reports:

1972-73

Robins, J.K. and J.P. Susut. 1972. Weather damage to lodgepole pine in the Coal Branch area of Alberta in 1972. Northern Forest Research Centre, File Report NOR-Y-18. 6 pp.

Goal 10 (1972-73)

Reports:

1972-73

Robins, J.K. 1972. Dwarf mistletoe surveying method: Results of preliminary trials in the Athabasca Forest, March, 1972. Northern Forest Research Centre. File Report. NOR-Y-10. 6 pp.


Muir, J.A., J.K. Robins and J.P. Susut. 1972. Dwarf mistletoe survey in the Athabasca Forest, Alberta: Ground check of infestation. Northern Forest Research Centre, File Report NOR-Y-43. 19 pp.

Muis, J.A., and J.K. Robins. Detection of dwarf mistletoe infestation centres in jack pine on aerial photographs. (Manuscript has been prepared for inclusion in Plant Disease Reporter). 5 pp.

16. Signatures:



 W.G.H. Ives, Investigator



 Program Manager

 Y. Hiratsuka, Investigator



 G.T. Silver, Director

 H.R. Wong, Investigator

 R. A. Blauel, Investigator

 J.K. Robins, Investigator

NOR-1-057

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 14, 1973

1. Project: Detection and Appraisal of Tree Pests
2. Title: Identification and life history studies of miscellaneous forest insects in the Prairies Region and the Territories.
3. New: Cont. X 4. No.: NOR-1-057
5. Study Leader: H.R. Wong
6. Key Words: Galls, damage, distribution, hosts, parasites, seasonal occurrence.
7. Location of work: Edmonton, Alberta.
8. Problem:

To recognize all stages and damage of the more common forest insects in the Canadian Prairies and the Territories.

Studies on the life history and identification provide information on parasites, hosts, abundance and distribution of these species. It would also aid in determining methods of control either by chemical or biological means.

The success of such studies is good providing populations of these insects and technician support are available.

Results obtained would increase the efficiency of the Forest Insect Survey by providing information on all stages, damage and distribution of these insects, provide material for the reference collection, and indicate the best time to apply chemical or biological controls.

Material is provided by personnel of the Forest Insect and Disease Survey and by the Investigator. The insects are reared in the insectary in Edmonton, and in the field. The adults obtained are submitted to officers of the Insect Taxonomy Section, Canada Department of Agriculture for determination.

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9. Study Objectives:

1. To determine the species, life history, distribution, damage, host and parasites of the more common forest insects in the Prairies Region and the Territories.
2. To build up the mature and immature reference collections of the Edmonton Laboratory.
3. To provide pictures and illustrations at the mature and immature stages of the more common forest insects together with their damage in the Prairies Region and the Territories.

10. Resources:

- a) Starting date: 1948
 - b) Estimated year of completion: 1973 Revised _____
 - c) Estimated total Prof. man-years required: indefinite
 - d) Estimated new major equipment items for 1973/74 with costs: Nil.
 - e) Estimated new major equipment items beyond 1974 with costs: Nil.
 - f) 1973-74 man-years

Prof.	0	H.R. Wong
Supp.	<u>0</u>	J.E. Melvin
Total	<u>0</u>	
- O & M Funds req'd 0

11. Progress to date:

The identification and description of the complex of insects in the tops of black spruce have been made, together with a diagnostic key to separate them and the type of feeding damage caused by each species. The study showed no indication that insects caused the club-top condition on black spruce.

Field keys and description have been published on how to separate the adult June beetles attacking coniferous plantations in Manitoba, and galls of Saperda, Xyela and Eurytoma.

The results of studies on the distribution, parasites and life history of the following insects in the Prairies have been published: Saperda prob. calcarata attacking root collars of poplar, Zeugophora scutellaris, Agrilus criddlei, Herculia thymetusalis, Pseudexentera oregonana, Eucosma gloriola, Rhyacionia frustrana, Eurytoma calycis and Dioryctria banksiella in western gall rust.

The life history and importance of the syrphid predator Phalactodira nioritarsis in controlling Chrysomela crotchii has been published, as well as the distribution of the elm bark beetle, Hylurgopinus rufipes in Manitoba and Saskatchewan.

For the region of Manitoba and Saskatchewan, reports have been prepared on: Additions to the Forest Lepidoptera; the insect collection of the Forest Insect and Disease Survey Part I, Lepidoptera; the insect collection of the Forest Insect and Disease Survey Part II, Coleoptera; Some of the more common galls and abnormal plant growths caused by insects and mites; and insect parasites of some insect galls. The arthropod fauna of Dibotryon morbosum for the same region has been published.

The distribution of Choristoneura pinus pinus, C. fumiferana, C. lambertiana, C. biennis and C. occidentalis have been mapped in Alberta and their hosts and seasonal occurrence recorded. The relationship of the main egg parasites of Malacosoma californicum lutescens to location of the egg bands on the host plant, the presence of spumulin and their seasonal occurrence have been determined.

12. Goals for 1972-73:

1. Collaborate with Dr. J.M. Powell in preparing a paper on Arthropods collected from cankers of stem rusts on hard pines in the Canadian Prairies.
2. Collaborate with W.G.H. Ives on the internal report Insects and Diseases attacking jack pine in the Sandilands Provincial Forest, Manitoba.
3. Determine the seasonal occurrence, parasites and larval habits of a bur oak blotch miner, Cameraria macrocarpae.

13. Accomplishments in 1972-73

1. Information Report - Powell, J.M., H.R. Wong and J.C.E. Melvin. 1972. Arthropods collected from stem rust cankers of hard pines in Western Canada. NOR-X-42.
2. A report has been prepared on the insects, mites and pathogens collected by the forest insect and disease survey in southeastern Manitoba. This is part of a compendium of research on jack pine in this area from 1967-1970.
3. The study on life history and habits of a leaf miner, Cameraria macrocarpae Freeman, on bur oak has been submitted to the Canadian Entomologist for publication.

14. Goals for 1973-74:

1. Complete identification of insects associated with trees injured by the accidental release of gas condensate in the Strachan area, Alberta.
2. Complete identification of insects collected from poplar and willow catkins in the Prairies.
3. Collaborate with J.A. Drouin on the distribution of a root collar Saperda in Alberta, and a study of the early instars.
4. Terminate studies on NOR 057.

15. Publications:Up to 1972-73Research

- Wong, H.R. and W.J. Turnock. 1949. Forest Insect Survey. Canada Dept. Agric., For. Biol. Div., Bi-monthly Prog. Rept. 5(6):2.
- Wong, H.R. 1950. Rearing methods. Proc. Ent. Soc. Manitoba 6:14-15.
- Wong, H.R., J.A. Drouin and B.B. McLeod. 1959. Observations on a complex of insects in tops of black spruce in Manitoba and Saskatchewan. Can. Ent. 91:543-548.
- Wong, H.R. 1960. Preliminary notes on the life history of Herculia thymetusalis Wlk. Canada, Dept. Agr., For. Biol. Div., Bi-monthly Prog. Rept. 16(1):3.
- Wong, H.R. J.A. Drouin and B.B. McLeod. 1961. A round-headed borer in the root collar of poplars. Canada Dept. Forestry, For. Ent. and Path. Br., Bi-monthly Prog. Rept. 17(2):2-3.
- Wong, H.R. and J.A. Drouin. 1962. Eurytoma calycis Bugbee in Saskatchewan, Canada, Dept. Forestry, For. Ent. and Path. Br., Bi-monthly Prog. Rept. 18(4):2.
- Wong, H.R. and L.L. McDowall. 1962. Pine tip moth in southeastern Manitoba. Canada Dept. Forestry, For. Ent. and Path. Br., Bi-monthly Prog. Rept. 18(4):2.
- Wong, H.R. and J.J. Lawrence. 1963. Pine shoot moth in Manitoba. Canada, Dept. Forestry, For. Ent. and Path. Br., Bi-monthly Prog. Rept. 19(2):2.

- Wong, H.R., B.B. McLeod and J.A. Drouin. 1963. Saperda calcarata Say in the root collars of poplars. Canada, Dept. Forestry For. Ent. and Path. Br., Bi-monthly Prog. Rept. 19(5):2.
- Wong, H.R., B.B. McLeod and J.A. Drouin. 1964. A preliminary study of a poplar root saperda in Manitoba and Saskatchewan. Interim Research Report. Forest Entomology Lab., Winnipeg. May: 1-15.
- Wong, H.R. 1965. Wood borers. Proc. Ent. Great Plains Conf. Ent. 37:18-19.
- Wong, H.R. and J.C.E. Melvin. 1965. Insects and mites associated with black knot of cherry, Dibotryon morbosum (Schw.) Theiss, and Syd. Bi-monthly Prog. Rept. 21(4):3.
- Wong, H.R. and B.B. McLeod. 1965. Two species of gall-producing Saperda in Manitoba and Saskatchewan. Bi-monthly Prog. Rept. 21(5):3.
- Wong, H.R. and B.B. McLeod. 1965. The host and distribution of Agrilus criddlei Frost in Canada. Bi-monthly Prog. Rept. 21(4):3.
- Nairn, L.D. and H.R. Wong. 1965. Field Key to adult June beetles (Phyllophaga spp) attacking coniferous plantations in Manitoba. Proc. Ent. Soc. Manitoba 21: 33-35.
- Hildahl, V. and H.R. Wong. 1965. Distribution of the native elm bark beetle Hylurgopinus rufipes (Eichhoff), in Manitoba and Saskatchewan. Proc. Ent. Soc. Manitoba. 21:36-38.
- Wong, H.R., B.B. McLeod and J.C.E. Melvin. 1966. Life histories of Saperda concolor Lee and S. moesta Lec. in Manitoba and Saskatchewan (Coleoptera:Cerambycidae). Forest Research Lab., Winnipeg. Internal Report MS-34. 12 pp.
- Elliott, K.R. and H.R. Wong. 1966. An important predator of the aspen leaf beetle, Chrysomela crotchii Brown in Manitoba and Saskatchewan. Bi-monthly Res. Notes 22(5):3-4.
- Wong, H.R., A.E. Campbell and J.J. Lawrence. 1968. Damage caused by Eucosma gloriola Heinrich in three different forest sites in the Sandilands Forest Reserve, Manitoba. Bi-monthly Res. Notes. 22(6):4.
- Wong, H.R. and J.C.E. Melvin. 1967. The leaf roller Pseudexentera oregonana Wlsh. Bi-monthly Res. Notes 23(1):3-4.

- Melvin, J.C.E., H.R. Wong and B.B. McLeod. 1967. The fauna of black knot of cherry. Dibotryon morbosum (Schw.) Theiss and Syd. (Ascomycetes:Dothideaceae) in Manitoba and Saskatchewan. Forest Research Lab., Winnipeg. Internal Report M5-58: 5 pp.
- Melvin, J.C.E., B.B. McLeod and H.R. Wong. 1967. Ecological observations on the more common insects associated with black knot of cherry Dibotryon morbosum (Schw.) Theiss and Syd. (Ascomycetes:Dothideaceae) in the forested areas of Manitoba and Saskatchewan. Forest Research Lab., Winnipeg. Internal Report MS-59: 12 pp.
- Wong, H.R. and A.E. Campbell. 1967. The biology of the eastern pine shoot moth, Eucosma gloriola Heinrich (Lepidoptera:Tortricidae) on jack pine regeneration in the Sandilands Provincial Forest, Manitoba. Forest Research Lab., Winnipeg. Internal Report MS-62: 13 pp.
- Wong, H.R. and G.N. Still. 1967. Hybrid poplars damaged by the cottonwood leaf-mining beetle, Zeugophora scutellaris Suffr. Bi-monthly Res. Notes 23(5):36.
- McLeod, B.B. and H.R. Wong. 1967. Biological notes on Saperda concolor Lec. in Manitoba and Saskatchewan (Coleoptera: Cerambycidae) Manitoba Ent. 1:27-33.
- Wong, H.R. and A.E. Campbell. 1967. The larval feeding habits of the eastern pine-shoot borer Eucosma gloriola Heinrich (Lepidoptera:Tortricidae) in jack pine regeneration in Manitoba. Manitoba Ent. 1:42-46.
- Wong, H.R. and J.C.E. Melvin. 1969. Additions to the Forest Lepidoptera of Manitoba and Saskatchewan. Forest Research Lab., Winnipeg. Information Report MS-X-26:45 pp.
- Melvin, J.C.E. and H.R. Wong. 1969. The arthropod fauna of Dibotryon morbosum (Schw.) Theiss, and Syd. (Ascomycetes: Dothideaceae) in Manitoba and Saskatchewan. Manitoba Ent. 3:58-64.
- Wong, H.R., B.B. McLeod and J.C.E. Melvin. 1970. Some of the more common galls and abnormal plant growths caused by insects and mites in the forested areas of Manitoba and Saskatchewan. Forest Research Lab., Winnipeg. Information Report MS-X-23:55 pp.

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Melvin, J.C.E. and H.R. Wong. 1970. Insect parasites of some insect galls in the forested areas of Manitoba and Saskatchewan. Forest Research Lab., Winnipeg. Information Report MS-X-25:12 pp.

Deboo, R.F., W.L. Sippell and H.R. Wong. 1971. The eastern pine borer, Eucosma gloriola (Lepidoptera:Tortricidae) in North America. Can. Ent. 103:1473-1486.

MISCELLANEOUS

Wong, H.R. 1958. In B.M. McGugan Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Vol. I. Canada, Dept. Agric., Forest Biology Div. Pub. 1034:1-76.

Wong, H.R. 1962. In R.M. Prentice Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Vol. II. Canada, Dept. Forestry, Bull. 128:77-281.

Wong, H.R. 1963. In R.M. Prentice Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Vol. III. Canada, Dept. Forestry, Bull. 1013:282-543.

Wong, H.R. 1964. In R.M. Prentice Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Vol. IV. Canada Dept. Forestry, Publ. 1142:544-840.

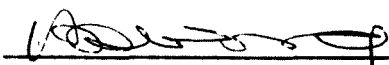
Melvin, J.C.E., D.W. Murray, J. Harding and H.R. Wong. 1969. The insect collection of the forest insect and disease survey in Manitoba and Saskatchewan. Part I. Lepidoptera. Forest Research Lab. Winnipeg. Information Report MS-X-22:29 pp.


Melvin, J.C.E., D.W. Murray, J. Harding and H.R. Wong. 1970. The insect collection of the forest insect and disease survey in Manitoba and Saskatchewan. Part II. Coleoptera. Forest Research Lab. Winnipeg. Information Report MS-X-27: 27 pp.

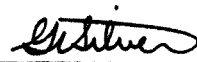
1972-73

Wong, H.R. 1972. Dioryctria banksiella (Lepidoptera:Pyralidae) in the western gall rust, Endoctrionartium harknessii (Basidiomycetes:Uredinales) Can. Ent. 104:251-255.

16. Signatures:


H.R. Wong, Investigator


Program Manager


G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 14, 1973

1. Project: Detection and Appraisal of tree pests.
2. Title: Sawfly systematics.
3. New Cont. X 4. No.: NOR-1-058
5. Study Leader: H. R. Wong
6. Key Words: Tenthredinoidea, Nearctic Region, Distribution, Hosts, Keys, Life History, Morphology, New Genera, New Species, Biogeography, Revision, Symphyta, Evolution, Phylogeny.
7. Location of Work: Edmonton, Alberta
8. Problem:

To study the systematics of the sawflies of Canada. Until sawflies are identified, they cannot be discussed or treated in a scientific way. Accurate identification of pest species can determine their area of spread and assist in confining their damage to a restricted area. Systematic studies can provide the means of making predictions and generalizations about probable habits, distribution, future importance of newly discovered species, and clues on possible methods of control. It is the means by which an orderly system is provided for storing information about sawflies and is an important retrieval device.

Success in this study is excellent provided time, funds and technician assistance are available. Since I am the only one in Canada, at the present time, actively engaged in the systematic study of sawflies, any results obtained would add to the knowledge of this group of insects in Canada, and their role in our environment. Such knowledge would also aid certain biological and ecological studies in North America.

The material is made available by a number of agencies requesting identification services, in particular the Forest Insect and Disease Surveys across Canada. Species identification is generally based on the microscopic examination of the extracted genitalia, which are mounted on slides. After comparison with available

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types, any new species are described and illustrated together with other pertinent information on host, life history, distribution, immature stages, phylogeny etc. Keys are constructed to assist in future identification.

9. Study Objectives:

1. To make systematic studies of the sawflies of Canada, noting their mature and immature forms, distribution, host, seasonal occurrence, importance to forestry, subspecies, strains and phylogenetic relationships.
2. To separate the various sawfly species by means of keys, descriptions and illustrations.
3. To study the evolution and biogeography of the more important sawfly genera.
4. To study the external and internal morphology of the more economic sawfly species.

10. Resources

- a) Starting date: 1950
 - b) Estimated year of completion: a continuing project Revised _____
 - c) Estimated total Prof. man-years required: indefinite
 - d) Essential new major equipment items for 1973/74 with costs:
nil
 - e) Essential new major equipment items beyond 1974 with costs:
nil
 - f) 1973-74 man-years Prof. 0.5
 Supp. 0.0
 Casual .3
 Total 0.8
- O & M funds req'd: \$500

11. Progress to date:

The value of cocoons in determining families and genera of sawflies has been published. Sawfly larvae of the subfamily Nematinae attacking conifers in the Canadian Prairie have been identified.

The Nearctic species of Pristiphora have been studied and several species placed in synonymy or in other sawfly genera, other species were found to be Holarctic in distribution and not restricted to North America or Eurasia. A phylogenetic study has been made of Pristiphora in an effort to obtain an understanding of the relationship of the species and the circumstances under which they evolved.

Descriptions have been published on the external morphology of the male, female and ultimate larval instar of the larch sawfly; and the intersexes and gynandromorphs of this insect.

The sawfly genus Decanematus was discovered to be new to North America and the genus Micronematus in North America was found to be a synonym of the European genus Eitelius.

New species were described in the following genera: Pristiphora (Brazil, Canada and U.S.A.); Allantus (Canada and U.S.A.); Decanematus (Canada); Pristola (Canada), Melastola (Canada and U.S.A.); and Susana (Canada).

Larval descriptions have been published on species in the following sawfly genera: Anoplonyx, Platycampus, Tenthredo, Nematus, Pikonema, Nematinus, Dimorphopteryx, Arge, Croesus, Cimbex, Trichiosoma, Empria, Priophorus and Pristiphora.

Diagnostic keys to species in the following genera have been published: Pristiphora (South American adults), Eitelius (North American and European adults), Allantus (North American adults with black hind tibiae), Decanematus (North American, Japanese and European adults) Pristola (North American adults), Melastola (North American adults) and Sharliphora (Eurasian adults).

Diagnostic keys to genera of the tribe Pristolini have been published, and new genera Sharliphora and Melastola were established.

It has been determined that the use of Mahalanobis D^2 statistic and discriminant function analysis failed to separate populations of the larch sawfly, which were resistant or susceptible to the parasite Mesoleius tenthredinis.

The European spruce sawfly has been discovered for the first time in southeastern Manitoba along with the parasite, Palexorista bohémica, which was released against it in eastern Canada.

12. Goals for 1972-73:

1. Identify adults of Pristiphora and other sawfly genera in which I am the specialist, from across Canada in the Canadian National Collection.
2. Prepare a report on the spread of Diprion hercyniae in Manitoba.
3. Describe new species of Pristiphora from the Canadian Arctic.

13. Accomplishments in 1972-73:

1. A brochure was prepared on the life history, damage and control of the three birch leaf-mining sawflies in the Prairies.
2. The Pristiphora section of the new Hymenoptera of America North of Mexico synoptic catalog was revised for Dr. D.R. Smith, Washington, D.C.
3. Spent 11 days in Ottawa identifying and curating sawfly specimens in the Canadian National Collection. Identified 121 sawfly specimens for U.S.D.A. Systematic Lab., Washington, D.C., and a number of specimens for the larch sawfly life table plot study in Manitoba and for various other laboratories. This involved extracting the genitalia from each specimen and mounting them on slides for microscopic examination.
4. The spread of Diprion hercyniae in Manitoba has been published in the Canadian Entomologist.
5. Genitalic slides and illustrations have been prepared for two new species of Pristiphora from the Canadian Arctic.

14. Goals for 1973-74:

1. Identify adults of Pristiphora and other sawfly genera in which I am the specialist, from across Canada in the Canadian National Collection.
2. Conclude the examination of two strains of larch sawfly for possible morphological differences in the genitalia.
3. Commence work on Pristiphora mimograph.

15. Publications

Up to 1972-73

- Lejeune, R.R. and H.R. Wong. 1949. Distribution of larch sawfly in Manitoba and Saskatchewan. Canada, Dept. Agric. For. Biol. Div., Bi-monthly Prog. Rept. 5(6): 2.
- Wong, H.R. 1950. Sawfly larvae of the subfamily Nematinae attacking conifers in the forests of the Canadian Prairies. Master thesis. Michigan State University: 1-33.

- Wong, H.R. 1951. Cocoons of some sawflies that defoliate forest trees in Manitoba and Saskatchewan. Ann. Rept. Ent. Soc. Ontario. 82:62-67.
- Wong, H.R. 1954. Common sawflies feeding on white birch in the forested areas of Manitoba and Saskatchewan. Can. Ent. 86: 154-158.
- Wong, H.R. 1955. Nearctic larvae of the genus Anoplonyx (Tenthredinidae:Hymenoptera). Can. Ent. 87: 224-227.
- Wong, H.R. 1956. Preliminary notes on intersexes and gynandromorphs of the larch sawfly. Can. Ent. 88: 545.
- Wong, H.R. 1956. Common Tenthredo larvae feeding on deciduous trees in the Canadian Prairies (Tenthredinidae:Hymenoptera). Interim Rept. Forest Biology Lab: 19-25.
- Wong, H.R. 1957. Sawflies of the genus Platycampus Schiodte on trembling aspen in the Canadian Prairies. Canada, Dept. Agric., For. Biol. Div., Bi-monthly Prog. Rept. 13(4):2.
- Wong, H.R. 1958. The morphology of the adult of the larch sawfly, Pristiphora erichsonii (Htg.) (Tenthredinidae: Hymenoptera). Interim Rept. Forest Biology Lab., Winnipeg 1958-1: 1-43.
- Wong, H.R. 1958. The morphology of the ultimate larval instar of the larch sawfly, Pristiphora erichsonii (Htg.) (Tenthredinidae: Hymenoptera). Interim Rept., Forest Biology Lab., Winnipeg 1958-2: 1-16.
- Wong, H.R. 1960. Evolution of the sawfly genus Pristiphora Doctor of Philosophy in Entomology Thesis. University of Illinois: 1-113.
- Wong, H.R. and H.H. Ross. 1960. New Nearctic species of the genus Pristiphora Latreille (Hymenoptera: Tenthredinidae) Can. Ent. 92(3):193-198.
- Wong, H.R. 1960. Evolution of the sawfly genus Pristiphora Diss. Abs. 21(6):1676.
- Wong, H.R. 1963. The external morphology of the adults and ultimate larval instar of the larch sawfly, Pristiphora erichsonii (Htg.) (Hymenoptera:Tenthredinidae). Can. Ent. 95:897-921.
- Wong, H.R. and R.B. Benson. 1965. A new species of Pristiphora from Brazil (Tenthredinidae:Hymenoptera). Can. Ent. 97(7): 779-782.

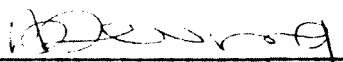
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- Wong, H.R. 1966. A new species of Allantus Panzer on birch (Hymenoptera:Tenthredinidae) Can. Ent. 98(8): 852-854.
- Wong, H.R. 1967. The Namatine genera Eitelius and Micronematus in North America (Hymenoptera:Tenthredinidae). Can. Ent. 99: 1101-1104.
- Wong, H.R. 1968. Decanematus, a sawfly genus new to North America (Hymenoptera: Tenthredinidae). Can. Ent. 100(1): 84-86.
- Wong, H.R. 1968. Pristiphora gelida, a new species from Alaska (Hymenoptera: Tenthredinidae) J. Nat. Hist. 2: 185-186.
- Wong, H.R. 1968. A revision of the tribe Pristolini (Hymenoptera: Tenthredinidae) Can. Ent. 100: 1049-1057.
- Wong, H.R. 1969. Reassignment of the ambigua group of Pristiphora to a new genus Sharliphora (Hymenoptera:Tenthredinidae). Can. Ent. 101: 332-335.
- Wong, H.R. 1969. Pristiphora acidovalva, a new sawfly on willow (Hymenoptera:Tenthredinidae). Can. Ent. 101: 970-972.
- Wong, H.R. and W.G.H. Ives. 1969. The European spruce sawfly in Manitoba. Bi-monthly Res. Notes. 25(6): 47.

1972-73

- Wong, H.R. The spread of the European spruce sawfly Diprion hercyniae (Hymenoptera:Diprionidae) in Manitoba. Can. Ent. 104: 755-756.
- Wong, H.R. and H.E. Milliron. 1972. A Canadian species of Susana on western juniper (Hymenoptera:Tenthredinidae) Can. Ent. 104: 1025-1028.

16. Signature:


 H.R. Wong, Investigator


 Program Manager


 G.T. Silver, Director

NOR-1-089

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 30, 1973

1. Project: Detection and Appraisal of Tree Pests
2. Title: Analysis and synthesis of Forest Insect and Disease Survey historical data and information.
3. New: Cont.: X 4. No.: NOR-1-089
5. Study Leader: W.G.H. Ives
6. Key Words: Population trends, computer mapping, data retrieval, insects and environment.
7. Location of work: Edmonton and Ottawa
8. Problem:

The large body of data collected by the Forest Insect and Disease Survey since its inception has never been thoroughly examined to determine what information it contains regarding population trends and the environment.

Some of the data on general distribution and abundance and on rates of parasitism were in reports or on raw data sheets, but had not been transferred to forms suitable for computer input. Similarly, the format used by the Meteorological Branch of the Department of Transport for summarizing their weather data was not suitable for some of the analyses, and additional summaries had to be prepared.

This study has undertaken to consolidate all of the available information on common insects and weather records for Manitoba and Saskatchewan into a format suitable for computer input, and to subject these data to a thorough examination. Writing of the necessary computer programs will be undertaken by staff in Ottawa.

9. Study Objectives:

To determine if the large amount of data on insect infestations collected by the Forest Insect and Disease Survey during the past years can be utilized to help explain fluctuations in populations of forest insects, and thus lead to a better understanding of the factors contributing to insect outbreaks.

10. Resources:

- a) Starting date: 1969.
- b) Estimated year of completion: Indefinite. Revised: I 1974
II 1976.
- c) Estimated total Prof. man years required: 3.
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man-years
- | | |
|----------------------|-----|
| Prof. W.G.H. Ives | 0.3 |
| Supp. K.L. Mortensen | 0.2 |
| R.C. Tidsbury | 0.3 |
| Casual | - |
| Total | 0.8 |

O & M funds req'd: \$500.00

11. Progress to date:

Annual infestation histories (1945 to 1968) for 11 of the most common forest insects in Manitoba and Saskatchewan have been mapped, the data transferred to special forms and then recorded on punch cards and edited. Parasite rearing or dissecting records for 15 of the more common forest insects have been transferred to specially designed forms suitable for computer input, and the data key punched and edited. Temperature and precipitation data from the "Monthly Record" have been transferred to special forms, keypunched and edited.

Requests for the writing of a number of computer programs to summarize the above data were submitted to Ottawa.

12. Goals for 1972-73:

1. To complete the examination of relationship between heat units and forest tent caterpillar outbreaks and to publish the results.
2. To complete the editing of the historical file.
3. To devise appropriate methods for summarizing data on the historic file in a format compatible with weather and parasite summaries.
4. To begin preliminary analyses of possible relationships between insect abundance and environmental factors.

13. Accomplishments in 1972-73:

1. The numbers of heat units during a fixed overwintering period and a shifting early larval feeding period for the forest tent caterpillar, Malacosoma disstria Hbn., were calculated from official weather data and related to known infestations or outbreaks of this insect in the Prairie Provinces and Ontario. Years with increasing populations had cooler overwintering


periods and warmer early feeding periods than did those with decreasing populations. A single year with a relatively cool winter and an unusually warm spring occurred two to four years before the first reported defoliation for all known infestations at each of 10 weather stations. Most population collapses were accompanied by cool springs and some by warm winters. The same general pattern prevailed for infestations in southern Ontario, when compared with the number of heat units at Toronto for the period 1860 to 1969. Favorable temperatures are therefore believed to be primarily responsible for triggering the onset of outbreaks of the forest tent caterpillar, and unfavorable temperatures are believed to be a major factor in their termination. The results should aid in predicting when and where outbreaks are likely to occur.

The manuscript has been accepted for publication in the Canadian Entomologist.

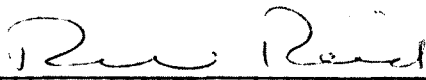
2. Editing of the historic file for Manitoba and Saskatchewan should be completed before the next field season.
 3. The format proposed in 1970 should achieve this objective.
 4. No summaries were received from Ottawa, so attention was switched to a more general examination of relationships between published records of spruce budworm outbreaks and heat units. Analyses are not complete, but current results show heat units during the fall, winter and large larval stage may influence population trends. Just what form this relationship will take has yet to be determined.
14. Goals for 1973-74:
1. To consult with programmers in Ottawa and have them develop the necessary programs for providing the computer summaries first requested in 1970.
 2. If forthcoming, to use these summaries in preliminary investigations of population trends for some of the more common insects.
 3. To investigate the relationships between published records of spruce budworm outbreaks and heat units or other expressions of temperature, and to publish the results if the analyses proceed favorably.
15. Publications:
- Up to 1972-73 Nil.
- 1972-73

Ives, W.G.H. Heat units and outbreaks of the forest tent caterpillar, Malacosoma disstria Hubner (Lepidoptera: Lasiocampidae). Can. Ent. (In press).


16. Signatures:



W.G.H. Ives, Investigator



Program Manager



G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 2, 1973

1. Project: Detection and Appraisal of Tree Pests.
2. Title: Development of survey sampling techniques.
3. New: Cont.: X 4. No.: NOR-1-090 .
5. Study Leader: W.G.H. Ives
6. Key Words: Large aspen tortrix, Choristoneura conflictana, sequential sampling.
7. Location of work: Manitoba
8. Problem:

The Forest Insect and Disease Survey collects samples for a large number of insect species, and consequently must use general sampling methods for most of its work. The two methods most commonly used are beating and hand-collecting. Beating is a very satisfactory method for collecting most defoliating insects, but it is difficult to make the sample quantitative, as the sampling unit is largely undefined. Hand-picking is entirely qualitative. There is therefore a need for more quantitative sampling methods, especially for the most important insects. However, the time required to conduct this sampling must be kept to a minimum, otherwise the technique is impractical for survey use.

Sequential sampling, because it requires a smaller number of sample units for the equivalent degree of accuracy, is much more suitable for survey purposes than is conventional sampling. Sequential sampling techniques have been developed for several forest insects and have proved invaluable. The populations are still rated into broad categories, usually light, medium or heavy, but these terms are defined within meaningful limits, based on experience for each particular insect. The very subjective element involved in rating infestations based on beating or hand-picking is therefore removed and greater uniformity of results is obtained.

The large aspen tortrix is characterized by a rapid build-up and decline of populations, but no sampling techniques for measuring

these have been devised. Preliminary data were therefore collected in 1968 to test the feasibility of developing a sequential sampling technique that might be used in the prediction of outbreaks of this serious aspen defoliator.

9. Study Objectives:

To develop or modify survey sampling techniques for forest insects, as the opportunities arise, in order to improve the quality of the population estimates obtained by the Forest Insect Survey. Specifically, to develop a sequential sampling system for the large aspen tortrix.

10. Resources:

- a) Starting date: 1968.
- b) Estimated year of completion Indefinite Revised 1973.
- c) Estimated total Prof. man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man-years Prof. 0
 Supp. 0
 Casual 0
 Total 0 O & M funds req'd: Nil.

11. Progress to date:

- 1. The collections of egg masses made in 1968 yielded data that were encouraging. There were some sampling problems in heavily defoliated stands, as the oviposition sites were largely destroyed by feeding. The frequency distribution of numbers of egg-masses per leaf cluster appeared to follow the Poisson distribution.
- 2. Larval and egg mass samples were collected in 1969. The data have not been analyzed.

12. Goals for 1972-73:

No field work planned as reductions in staff and funds have made this impractical at the present time. The development or improvement of techniques suitable for survey use is considered to be important, but has been deferred until funding, at least, is more adequate.


13. Accomplishments in 1972-73: Nil - study inactive

14. Goals for 1973-74:

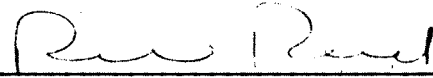
None. Study will be terminated, and the development of sampling techniques, if and when required, will be undertaken in the study in which the need arises.

15. Publications:

No publications of survey sampling techniques were produced after the study was formally initiated, as the work terminated when staff was reduced in 1969.

16. Signatures:

W.G.H. Ives, Investigator



Program Manager



G.T. Silver, Director

NOR-110

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March, 1973

1. Project: 1
2. Title: Dutch Elm Disease Survey and Dutch Elm Disease Aerial Survey and Photo Interpretation.
3. New: Cont.: X 4. No.: NOR-110
5. Study Leader: V. Hildahl
6. Key Words: Entomology, pathology, detection, appraisal, insect control, disease control, tree species.
7. Location of Work: Manitoba
8. Problem:

Nature

Dutch elm disease is a potential and serious hazard to elms in the prairie sections of the region. The pathogen was first discovered in the northeastern United States about 1933, and since then has spread north and eastward into Canada and westward in the United States to Idaho and Colorado. At the present time it covers about 80 percent of the range of natural American elm in Canada and the United States. In areas where the disease has been prevalent for several years, the host tree has been practically eliminated. How severely elms will be affected in southern Manitoba (and the prairie sections) is difficult to predict, but if the impact is as great as it has been in the areas outlined above the economic loss would be incalculable.

Benefits

Major benefits of the study will be to maintain the aesthetic values and pleasant environments associated with American elms in rural, urban and park areas; which would otherwise be completely destroyed. In many urban centres (including Winnipeg) throughout the prairie region American elm represents up to 80 percent of the tree cover.

Probability of success

Early detection of the disease can keep losses of American elms within tolerable limits. This has been demonstrated in areas where adequate sanitation programs were established when the pathogen was first discovered tree losses have been kept to 1 to 2 percent per year.

Methods used

Suspect trees are sampled, and material subsequently cultured under laboratory conditions and techniques for determination of causal organism. In conjunction with ground sampling programs, the use of low level aerial photography (infrared) has been proposed for parts of the Red River Valley in Manitoba in 1973. Results of the aerial photography will be used primarily to: 1) expedite detection of suspect trees leading to early diagnosis of the pathogen in southern Manitoba, 2) provide a continuous permanent record pertaining to the condition of American elm stands along the Red River, and 3) develop an inventory of elms in high hazard areas.

9. Study Objectives:

Study objectives are primarily: 1) to carry out systematic detection and diagnostic services leading to early discovery of the Dutch elm disease in the Region, and 2) provide technical guidance and assistance to provincial, municipal and urban governments with respect to control techniques if and when the disease is detected in the province. An important advisory function pertaining to the Dutch elm disease study is serving as a member on a Provincial Advisory Committee on Tree Protection established by the Minister of Agriculture.

In conducting the detection program, the Manitoba Department of Agriculture provides three student assistants annually for field sampling.

10. Resources:

- a) Starting date: 1970
- b) Estimated year of completion: Continuing
- c) Estimated total Prof. man-years required:
- d) Essential new major equipment items for 1973-74: Nil.
- e) Essential new major equipment items beyond 1974: Nil.
- f) 1973-74 man-years: Prof. 0
 Supp. .4
 Casual 0
 Total .4 O & M funds req'd.: \$1,200.00

11. Progress to date:

From 1970 to 1972 the Dutch elm disease program has involved both

ground and aerial reconnaissance. Detection surveys have been conducted along all river valleys, and in urban centres and rural areas where major concentrations of American elm occur. More than 3000 suspect trees (trees with characteristic external symptoms - flagging, dead branches or die-back in the crown) were sampled, of which 35 percent showed evidence of peripheral stain in the wood. Laboratory diagnosis of material from these trees has indicated widespread infections of Fusarium wilt, Verticillium wilt, and occasional occurrence of Cephalosporium wilt. The fungus, Ceratocystis ulmi which causes Dutch elm has not been isolated from sample material in southern Manitoba to date.

Diagnostic procedures were carried out in conjunction with Dr. James Reid, Botany Department, University of Manitoba, who provided final determination of causal organisms.

12. Goals for 1972-73:

Continuing detection surveys in high hazard areas, and diagnostic services as required.

13. Accomplishments in 1972-73:

1. All suspect elms as detected by CFS personnel or reported by co-operating agencies were sampled;
2. diagnostic services were carried out as required; and
3. reports and technical assistance were provided to co-operating agencies.

14. Goals for 1973-74:

1. Continue detection surveys in the southern part of the province, and provide diagnostic services as required for co-operating agencies.
2. Implement proposed aerial photography program relative to Dutch elm disease detection. This program will involve complete aerial coverage of the Red River Valley in a test area 2 x 10 mi. from St. Norbert to Glenlea at scales of 1:1000 and 1:3300.
3. Publish an information report including all Dutch elm disease investigations to date in Manitoba for distribution to co-operating agencies.

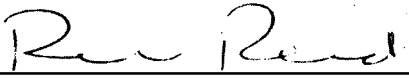
15. Publications:

Up to 1972-73:

Hildahl, V. 1971. Dutch Elm Disease, a Threst to Prairie Elms.
The Prairie Graden (published by Winnipeg Horticultural Society).

16 Signatures:

V. Hildahl, Investigator



Program Manager



G.T. Silver, Director

NOR 1-125

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: January 31, 1973

1. Project: Detection and appraisal of tree pests.
2. Title: Technical impact and appraisal services and surveys in environmental, pest and pollution problems.
3. New: Cont.: X 4. No.: NOR 1-125
5. Study Leader: W.G.H. Ives, R.A. Blauel
6. Key Words: hazard, susceptibility, stability, management, parks, recreation, symptoms, damage, effluents, easement, atmosphere, landspill, pipeline break.
7. Location of work: Throughout region.
8. Problem:

Requests for surveys and advisory services in environmental, pest and pollution problem areas are being directed with increasing frequency to the Canadian Forestry Service. The Forest Insect and Disease Survey (FIDS) can handle many of these requests. Because the services do not fall within traditional FIDS terms of reference the study herein described will serve as a vehicle to provide a continuing record of FIDS response to these problems. The services recorded herein will only be those not sufficiently involved or costly to warrant individual study statements.

Each special service will be described in attached and numerically ordered supplements.

Supplement 1

8. Problem:

Forest insects and diseases influence the stability of certain forest cover types in the National Parks. Planners laying out campgrounds, nature trails, wilderness sectors etc., require information on that subject. Prior knowledge will permit, in some circumstances, more effective planning which will ensure recreational and aesthetic objectives can be maintained on a long term basis.

9. Study Objectives:

To provide National and Historic Parks Branch with an assessment of short and long term effects insects and diseases will have on stability of forest cover in those parks.

10. Resources:

- a) Starting date: 1970.
- b) Estimated year of completion: 1973. Revised: 1974.
- c) Estimated total Prof. man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man years

Prof.	0	
Supp.	0	
Casual	-	
Total	0	0 & M funds req'd.: Nil.

(1972-73 costs financed by National and Historic Parks Branch)

11. Progress to date:

Ground surveys of insect and disease conditions in Waterton Lakes National Park were conducted, data were extracted from the historic file and a hazard rating was devised. The report "Insect and Disease Hazard in Relation to Stand Stability", by J. Petty and W.G.H. Ives was completed and submitted to the National and Historic Parks Branch where it was favorably received. No field work was done in 1971-72.

12. Goals for 1972-73:

- 1. Summarize available information on forest insect and diseases in Prince Albert National Park.
- 2. Conduct the necessary field surveys during the 1972-73 field season to supplement the pest data already available for the Prince Albert National Park.
- 3. Complete a report similar to that prepared for Waterton Lakes National Park, consisting of color coded maps and written text,

Supplement 1

outlining potential problem areas. Submit report to National and Historic Parks Branch.

13. Accomplishments in 1972-73:

1. Information on forest insects and diseases in Prince Albert National Park has been summarized.
2. Field surveys to supplement the above data were completed.
3. The preparation of a report is currently under way. Color coding of the large number of maps involved will be time-consuming and probably will not be completed until early spring, 1973.

14. Goals for 1973-74:

Complete a report of insect and disease hazard for Prince Albert National Park and submit it to National and Historic Parks Branch. Finalize within study 033.

15. Publications:

Up to 1972-73

Petty, J. and W.G.H. Ives. 1971. Insect and disease hazard in relation to stand stability: Waterton Lakes National Park. Northern Forest Research Centre, June, 1971. 21 pp.

1972-73: Nil.

16. Signatures:


W.G.H. Ives, Investigator

Program Manager



G.T. Silver, Director

Supplement 2

8. Problem:

The recreational use of our forests has become increasingly important with the advent of good roads and large numbers of tent-campers and travel trailers. Campgrounds near any of the large population centres or major geographic attractions such as beaches, mountains, or parks are utilized to capacity, especially during July and August. Considerable personnel liaison and correspondence has preceded the initiation of this study. All park management agencies express a need for assistance in this area.

9. Study Objectives:

1. To provide park agencies with assessments and recommendations relating to maintenance and stability of forest cover in campsites.
2. To identify forest stability problems (in campsites) requiring a research input.

10. Resources:

- a) Starting date: 1971
- b) Estimated year of completion: Indefinite. Revised: 1974
- c) Estimated total Prof. man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil
- e) Essential new major equipment items beyond 1974 with costs: Nil
- f) 1973-74 man years Prof. 0
Supp. 0

Total 0 0 & M funds req'd: Nil

11. Progress to date:

Preliminary surveys of 65 campgrounds were conducted during 1971. Data were collected on the intensity of use, method of preparation (when available), cover description and condition, site, and insect and disease pests. In addition, increment cores were removed from a limited number of trees and preliminary soil samples were taken.

A more detailed examination of one campground (Tunnel Mountain, Banff National Park) was undertaken to determine the credibility of the cursory surveys conducted there and elsewhere. Additional increment cores were taken, lateral growth was measured on the same trees, and a more adequate evaluation of soil conditions was made.

Supplement 2

12. Goals for 1972-73:

1. Complete analyses of data collected in 1971. Report to client agencies.
2. Collect additional samples or data if required to clarify conditions in some of the campgrounds examined in 1971.
3. Obtain additional photographic documentation of conditions (both good and bad) in as many of the campgrounds examined in 1971 as is practical.

13. Accomplishments in 1972-73:

Data from all campgrounds that were examined was pursued superficially, and those collected in national park campgrounds were examined in greater detail. It is the investigator's opinion that the problems encountered in heavily-used campgrounds stem largely from over-use, poor design and inadequate maintenance, and that the CFS or FIDS can do very little to correct the situation unless the agencies responsible for the campgrounds improve design or maintenance when these are faulty.

A file report presenting data on tree increment and soil compaction in eight campgrounds in Rocky Mountain National Parks, and a list of suggestions for improving design or maintenance of campgrounds was submitted to the western regional office of the National and Historic Parks Branch.

14. Goals for 1973-74:

1. To complete reports for campgrounds under provincial jurisdiction and to submit these to the agencies concerned. Finalize in study 033 and terminate.

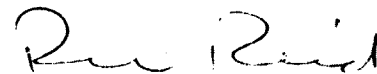
15. Publications:

Up to 1972-73

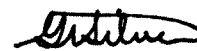
Ives, W.G.H., V.B. Patterson and J. Petty. 1972. Stand stability in selected high-use campgrounds in Rocky Mountain National Parks. File Report NOR-Y-41. 11 pp.

16. Signatures:


W.G.H. Ives, Investigator



Program Manager



G.T. Silver, Director

8. Problem:

Need for service:

Within the Region covered by the Northern Forest Research Centre large industrial complexes are involved with extraction and refinement of basic resources. Most of these are located within forested areas. Provincial resource managers and industry are concerned that significant damage may occur to forests from process effluents emitted into the atmosphere. The Forest Insect and Disease Survey historically has provided an insect and disease surveillance throughout the region where the complexes are located. The Provincial and industrial managers have requested pollution damage surveillance be provided in several specific areas. The Forest Insect and Disease Survey has been charged with providing that service.

9. Study Objectives:

Delineate and assess effects of pollutants upon vegetation.

10. Resources:

- a) Starting date: 1971.
- b) Estimated year of completion: 1974.
- c) Estimated total Prof. man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man years: Prof. 0
 Supp. 0
 Casual -
 Total 0 O & M funds req'd: Nil.

11. Progress to date:

A limited but fairly intensive aerial and ground check of vegetation in the vicinity of Thompson, Manitoba, revealed two areas, in total of approximately 50 square miles, where damage was occurring due to effluents released from the International Nickel Company plant in Thompson. Damage varied from incipient to severe. The surveys were carried out in co-operation and with assistance from the Manitoba Government and the International Nickel Company. Two reports were submitted to the agencies concerned.

An aerial survey with ground checks was carried out over a recently developed natural gas field in western Alberta and within long established oil and natural gas fields in other parts of that Province. No significant damage to vegetation was detected with the exception of a few minor damage areas resulting from well blow-outs. A report was submitted to appropriate Alberta Government agencies.

Supplement 3

A ground check was made of vegetation damage resulting from a glow-out from a high pressure condensate line in western Alberta. Resultant gas-liquid mixture caused some discoloration of adjacent foliage, which extended a distance of two miles from the pollutant source. A report was submitted to the appropriate Alberta Government agencies.

12. Goals for 1972-73:

In co-operation with management agencies within the region to provide a survey and assessment of air pollution effects on vegetation in forested regions. Specific areas for inspection are located near McMurray (Great Canadian Oil Sands) in Northern Alberta, Exshaw (cement plant) in southern Alberta, Flin Flon and Thompson areas in Manitoba and possibly one location in Saskatchewan. Action will be taken on further requests as received and as resources allow.

13. Accomplishments in 1972-73:The Thompson Smoke Easement Survey

Starting date: 1970 Est. comp. date: 1975.

An aerial reconnaissance, a ground appraisal and a ground truthing were carried out in the suspect fume damaged forest areas around Thompson, Manitoba. The fume damaged areas were delineated and current levels of damage were documented at 14 different sites. Ground truthing was co-ordinated with remote sensing procedures conducted by C.C.R.S.

Smelter Fume Damage near Flin Flon

Starting date: 1972 Est. comp. date: 1975

A preliminary air and ground appraisal was performed to determine the effects of ore smelting air pollutants on the forest in the Flin Flon-Creighton areas of Manitoba and Saskatchewan. Apparent damaged areas were located and some preliminary documentation of the damages was carried out. A brief ground truthing complemented low level multispectral imagery obtained from C.C.R.S.

The Effects of the Cement Production Industry on the Forest Community in the Exshaw Area

Starting date: 1972 Est. comp. date: 1973

A survey was conducted to assess the condition of the forest community subjected to the air pollutants from the cement production industry near Exshaw, Alberta. Sampling of vegetation, stem analysis and other documentation procedures were performed.

Supplement 3

The Effects of Potash Industry Pollutants on Trees and Shelterbelts near Guernsey, Saskatchewan

Starting date: 1972 Est. comp. date: 1974

A preliminary survey was conducted in the Guernsey, Saskatchewan area to determine and document the effects of the potash production industry on trees and shelterbelts. Some of the vegetation examined was found to be damaged, symptoms and foliar analysis indicating chemical burning.

The Impact of Air Pollutants from the Alberta Tar Sands Oil Extraction Industry on the Surrounding Forest

Starting date: 1972 Est. comp. date: 1975

A survey was conducted to determine the impact of the pollutants on the forest community near several sulphur dioxide monitoring stations located in the area. It was also determined that the monitoring stations were located out of the main air pollutant impingement area.

Forest Damage Resulting from a Light Hydrocarbon Spray Released from a Gas Pipeline

Starting date: 1971 Est. comp. date: 1973-74

An appraisal was performed to determine the extent and progression of damage to the forest subjected to the spray to delineate the area of damage, and to determine plausible restoration procedures.

The Effects of Air Pollutants from the Gas Processing Industry on the Forest Community in the Rocky Mountain Foothills

Starting date: 1971 Est. comp. date: 1975

Survey is contributing to the detection aspects of an in-depth study to determine the effects of sulphur pollutants on the forest community. This year a joint brief by Canadian Forestry Service and Environmental Protection Service was presented at a hearing conducted by the Alberta Government, concerning an application by Gulf Oil of Canada Ltd., for exemption from minimum sulphur recovery guidelines.

Pollutant Damage to the Forest Community in the Swan Hills Area

Starting date: 1972 Est. comp. date: 1975

A preliminary detection and appraisal survey revealed that the forest community is being affected by gas flaring, sulphur gas releases, hydrocarbon coating, condensate spraying, saline pipeline ruptures and oil spills.

The Effects of Air Pollutants from the Prince Albert Pulpmill on the Surrounding Forest Community

Starting date: 1972 Comp. date: 1975

Supplement 3

A small area of air pollutant damage was noted near the Prince Albert pulpmill. A preliminary appraisal survey was conducted and a report issued.

Other brief assessments of pollutant releases were conducted during the field season at the request of provincial forest management and environmental agencies. These assessments included determination and documentation of pollutant effects. The problems included a volatile hydrocarbon release in the Black Diamond area, a sulphur gas release in the Crossfield area, battery site air pollutants in the Savanna Creek area, spray drifting in the Penhold area, suspect pollutant damaged forest near the Blue Ridge gas processing plant and summertime discoloration of street trees in Prince Alberta.

14. Goals for 1973-74:

Terminate. Continued studies in 033.

15. Publications:

Up to 1972-73:

The 1970 Thompson Smoke Easement Survey

1972-73: Completed

Blauel R.A. The 1971 Thompson Smoke Easement Survey. NOR-Y-4.
18 pages. April 1972.

Blauel, R.A. Summertime Street Tree Foliage Discoloration in Prince Albert, Sask. NOR-Y-22. 4 pages. Aug. 1972.

Susut, J.P. & R.A. Blauel. Examination of a Damaged Forest Area near the Blue Ridge Gas Processing Plant, Alberta. NOR-Y-21. 9 pages. July 1972.

Blauel, R.A. Preliminary Report Concerning Escaped Volatile Hydrocarbons and the Effect on Trees & Shrubs South of Black Diamond, Alberta. File Report. 2 pages. July 1972

In progress:

Blauel, R.A. Impacts of Alberta Battery Site emissions on the surrounding forest vegetation.

Blauel, R.A. A preliminary report on the response of trees to saline solution released from a ruptured buried pipeline.

Blauel, R.A. A reported sulphur gas release in the Crossfield area of Alberta.

Smith, G.J. & R.A. Blauel. Shelterbelt trees damaged by an applied drifting spray near Penhold, Alberta.

Blauel, R.A. & K.L. Mortensen. Preliminary assessment of potash production emission damages to shelterbelts near Guernsey, Saskatchewan.

Blauel, R.A. Evaluation of the forest condition around the cement production industry located in Exshaw, Alberta.

Blauel, R.A. Current forest conditions around the sulphur dioxide monitoring stations located in the vicinity of the Alberta Tar Sands oil extraction industry.

The effects of an accidental natural gas pipeline condensate release on a mixedwood boreal forest.

I-The progression of damage to the forest - Blauel, R.A.

II-Insects in the area - Wong, H.R.

III-The effect on soil and growth properties, with reclamation proposals - Blauel, R.A. & Lesko, G.L.


Blauel, R.A. Escaped volatile hydrocarbons and their effects on trees and shrubs south of Black Diamond, Alberta.

16. Signatures:

R.A. Blauel, Investigator



Paul Reed
Program Manager



G.T. Silver, Director

8. Problem:

Severe winter damage to lodgepole pine occurs periodically in stands along the foothills in Alberta. During the winter of 1971-72, particularly severe damage occurred in the Coal Branch area. Although the extent and severity of damage was unknown it appeared to be substantial. The Coal Branch area is relatively accessible, so that salvage cutting of some stands would be feasible if the damage was severe enough to warrant it.

9. Study Objectives:

1. To assess the extent and severity damage.
2. To determine if gross symptoms of damage to individual trees can be related to the ultimate damage to the stands.

10. Resources:

- a) Starting date: 1972.
- b) Estimated year of completion: 1974.
- c) Estimated total Prof. Man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man years

Prof.	0	
Supp.	0	
Casual	<u>0</u>	
Total	0	O & M funds req'd.:

11. Progress to date: New study.12. Goals for 1972-73:

1. Obtain infra-red aerial photos of areas in which damage was suspected to occur.
2. Ground truth accessible areas to determine whether apparent damage is real. Some areas were visited in winter, as they are inaccessible during the summer.
3. Prepare a report for CCRS (Project 116) who provided the aerial photography.

13. Accomplishments in 1972-73:

A successful air photo survey technique has been devised and has been used by the Alberta Forest Service (AFS) to map red belt areas. Two sample areas have been examined three times, and some of the areas mapped by AFS have been ground checked this winter. It appears that it will be possible to relate gross symptoms of original damage to the eventual fate of some trees.

Supplement 4

14. Goals for 1973-74:

1. Continue ground truthing of aerial photos.
2. Continue to make observations on the condition of surviving trees.
3. Conduct ground and/or aerial surveys of other areas where red-belt damage has occurred.
4. Prepare a report (Info. Rept.) on red-belt.
5. Terminate. Continue study in 033.

15. Publications:

Reports

Up to 1972-73: Nil

1972-73

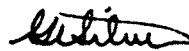
Robins, J.K. and J.P. Susut. 1972. Weather damage to lodgepole pine in the Coal Branch area of Alberta in 1972. Northern Forest Research Centre. File Report NOR-Y-18. 6 pp.

16. Signatures:

 J.K. Robins, Investigator



 Program Manager



 G.T. Silver, Director

Supplement 5

8. Problem:

Dwarf mistletoe is a parasite of large areas of jack pine in the three Prairie Provinces. However, the distribution is spotty, and since the parasite spreads very slowly, there are areas more severely affected than others. The Alberta Forest Service (AFS) requested assistance in assessing the incidence of dwarf mistletoe on jack pine in their Management Unit A7, northeast of Fort McMurray, as they were interested in the possibility of ultimately improving the quality of stands by cleaning out residuals after fire.

9. Study Objectives:

1. To develop and test an aerial survey technique for mapping the incidence of dwarf mistletoe on jack pine.

10. Resources:

- a) Starting date: 1972.
- b) Estimated year of completion: 1974.
- c) Estimated total Prof. man years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man years: Prof. 0
 Supp. 0
 Casual 0
 Total 0 0 & M funds req'd.:

11. Progress to date: New study.12. Goals for 1972-73:

1. To develop and test a technique for conducting low-level aerial surveys for the detection of dwarf mistletoe infections in stands of jack pine in AFS Management Unit A7.
2. To prepare reports describing the equipment and its application in the surveying of dwarf mistletoe infestations.

13. Accomplishments in 1972-73:

1. The equipment was designed and tested.
2. Ground checks indicated the aerial surveys to be reliable in the detection of mistletoe infections.
3. Management Unit A7 was surveyed and the data obtained supplied to the AFS, who have used it in preparing type maps of the area, in which mistletoe infection is indicated by one of three categories.

Supplement 5

14. Goals for 1973-74:

Terminate Report and promote information within Study 033.

15. Publications:

Reports:

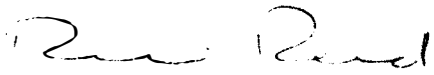
Robins, J.K. 1972. Dwarf mistletoe surveying method: Results of preliminary trials in the Athabasca Forest, March, 1972. Northern Forest Research Centre. File Report. NOR-Y-10. 6 pp.

Muir, J.A., J.K. Robins and J.P. Susut. 1972. Dwarf mistletoe survey in the Athabasca Forest, Alberta: Ground check of infestation. Northern Forest Research Centre, File Report NOR-Y-43. 19 pp.

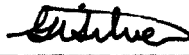
Muir, J.A., and J.K. Robins. Detection of dwarf mistletoe infestation centres in jack pine on aerial photographs. (Manuscript has been prepared for inclusion in Plant Disease Reporter) 5 pp.

16. Signatures:

J.A. Muir, Investigator



Program Manager



G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Reduction of damage from pollutants in the atmosphere.
2. Title: Effects of atmospheric effluents on the forest.
3. New Cont. X 4. No.: NOR-114
5. Study Leader: D. Hocking
6. Key Words: Sulphur gases, vegetation, lodgepole pine, white spruce.
7. Location of Work: Region-wide.
8. Problem:

Industrial effluents discharged into the atmosphere in a number of locations have a real, imagined, or potentially deleterious effect upon adjacent trees and other plant life. Government agencies and the general public at all levels are expressing concern. Industrial groups are apprehensive as to restrictions which may be applied. Regulatory agencies in many instances lack essential scientific information describing cause and effect relations. Provincial government agencies, industry and the public request involvement by the Canadian Forestry Service in this environmental problem in the form of co-operative research programs, detection and assessment surveys, and advisory services.

9. Study Objectives:
 1. Develop methods for measuring responses of forest vegetation to atmospheric effluents.
 2. Describe symptoms on forest vegetation resulting from known amounts of common atmospheric industrial effluents.
 3. Develop capability for impact and appraisal assessments of vegetative disturbances resulting from atmospheric pollution.

10. Resources:

- a) Starting date: 1971
- b) Estimated year of completion: Revised: 1978
- c) Estimated total Prof. man-years required: 40
- d) Essential new major equipment items for 1973/74 with costs: \$40,000
- e) Essential new major equipment items beyond 1974 with costs: Nil
- f) 1973-74 man-years Prof. 2.2
 Supp. 3.0
 Casual 0.3
 Total 5.5
- how
making*
- O & M funds required: Nil

11. Progress to date:

Good relations and co-operative working arrangements have been established with Provincial and Federal Government agencies involved with air pollution problems and with industry and the public in the field. The Canadian Forestry Service is regarded within the region as an important contributor of information relating to air pollution effects on vegetation. Permanent sample plots have been located and vegetation described, in vicinity of gas processing plants.

12. Goals for 1972-73:

1. Continue greenhouse study, and add the following:
 - (a) Attempt to duplicate acute symptoms, hypothesized to be a result of simple acidity of dissolved gases, by application of buffered solutions.
 - (b) Continue field surveys, and intensify damage appraisal on one site, probably Thompson, Manitoba.
2. Modify field study as follows:
 - (a) Involve other agencies (specifically the Environment Protection Service and the Research Council of Alberta) in measurements of physical parameters.
 - (b) Examine feasibility of an artificial field fumigation test to create necessary conditions for damage symptom development.
 - (c) Initiate an ecological survey to detect any possible changes in plant or arthropod communities or populations, with special reference to bryophytes and lichens (known sensitive indicators), insects, spiders, and mites.
 - (d) Develop plans for a study of predisposition to insect, disease, and/or climatic damage as a result of fumigations.

3. Issue Information Report, proposed title:

"Effects of sulfur dioxide on forest conifers: a background to research in Alberta".

4. Promote an industry-government workshop on the subject of air effluent effects on forest plant communities in order to establish scope of problem, current and future research needs.

13. Accomplishments in 1972-73:

Duplication of acute SO₂ damage symptoms in pine and spruce by application of buffered solutions of H₂SO₄ were only partially successful. The damage survey in the Thompson, Manitoba area was completed and a report is pending. Field fumigation trials were carried out and damage symptoms obtained with known amounts of SO₂ release. Field plot inventory work was mainly completed in the vicinity of the Aquataine plant. Exploratory studies on plume delineation were successfully carried out by use of plume marking techniques. The symptomatology collection of case histories including photographic and histological evidence has been established and is being expanded.

14. Goals for 1973-74:

- ① Complete bench marking of lichen populations, ground vegetation, and trees in permanent monitoring plots; ② locate plume impingement areas in vicinity of Aquataine plant; ③ set up fumigation chamber and run trials; ④ determine effect of pH of aqueous solutions of sulphur dioxide on foliar tissues.

15. Publications:

Up to 1972-73 No publications or reports

1972-73

Reports:

Loman, A.A. 1972. Atmospheric sulfur dioxide and foliar sulfur content. NOR-Y-48.

Loman, A.A., R.A. Blauel, and D. Hocking. 1972. Sulfur dioxide and forest vegetation. NOR-Y-49.

Blauel, R.A. Comments on vegetation section of the Canadian Petroleum Association submission to the Environment Conservation Authority, Alberta Department of the Environment, Edmonton. NOR-Y-73


Blauel, R.A. Intervention by CFS-EPS on application by Gulf Oil for exemption from minimum sulphur recovery efficiency guidelines of the Energy Resources Conservation Board, Government of Alberta. January 5, 1973. File Report.

16. Signatures:

D. Hocking, Investigator



Program Manager



G. T. Silver, Director

NOR-029

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1973

1. Project: Reduction of damage from diseases.
2. Title: Biology and epidemiology of dwarf mistletoe on lodgepole and jack pine.
3. New: Cont.: X 4. No.: NOR-029
5. Study Leader: J.A. Muir.
6. Key Words: Arceuthobium americanum, Pinus contorta, Pinus banksiana,
detection, damage, spread, infection, parasites, control.
7. Location of Work: Boreal Forest and Rocky Mountain Region.
8. Problem:

Dwarf mistletoe (Arceuthobium americanum Nutt. ex Engelm.), a seed plant which is parasitic on conifers, is widespread but sporadic, and occasionally causes severe damage to lodgepole pine and jack pine in western Canada. Generally, sufficient information is on hand for effective management of dwarf mistletoe on lodgepole pine appropriate to current management intensities, but very little is known of dwarf mistletoe epidemiology and biology on jack pine. Methods are needed for extensive surveys to detect and appraise infestation by dwarf mistletoe. A low-level aerial detection survey was developed recently for infested jack pine forests. For jack pine, damage caused by dwarf mistletoe is known in general terms, and in some areas of intensive management a detailed study may be required to relate damage to infestation, tree age and site quality. In high-use areas such as campgrounds, the hazards of dwarf mistletoe infested trees are unknown. Particularly large witches brooms which appear subject to wind breakage are formed on infested jack pine. Reasons for the formation of such large brooms on jack pine are unknown, and large brooms may be related to the apparently greater damage by mistletoe on jack pine than lodgepole pine.

Effective control of dwarf mistletoe infestation can be obtained by extensive clear-cutting and destruction of all infested trees. However alternative control methods are needed for situations where clear-cutting is esthetically or otherwise unacceptable, where infestation occurs in small areas, and where individual infested trees need

- 2 -

treatment. For effective control treatments and a basis for judging the priority of situations for control treatment, specific epidemiological information, such as the rate of spread of infestation, is needed for dwarf mistletoe on jack pine. Areas where dwarf mistletoe is reportedly absent, such as forest zone B19a and good quality jack pine sites in Saskatchewan, should be investigated to determine possible natural control of infestation and risks of infestation particularly in relation to management practices.

9. Study Objectives:

1. Determine and demonstrate methods for extensive surveys of dwarf mistletoe infestation.
2. Determine impact (damage) and spread of dwarf mistletoe on jack pine.
3. Determine methods to control infestation of jack pine.
4. Continue and complete previously established studies of dwarf mistletoe epidemiology on lodgepole pine.

10. Resources:

- a) Starting date: 1962.
- b) Estimated year of completion: 1973. Revised: 1975.
- c) Estimated total prof. man-years required: 2.6.
- d) Essential new major equipment items for 1973/74: Nil.
- e) Essential new major equipment items for 1973/74: Nil.
- f) 1973-74 man-years Prof. 1.0
 Supp. Nil
 Casual 0.3
 Total 1.3 O & M funds req'd.: \$1,700.00

11. Progress to Date:

Aspects of the biology and epidemiology of dwarf mistletoe in young lodgepole pine that have been determined include: rate of increase of infections; occurrence and spread of infections in relation to density of infection sources; timing, rate and distance of seed dispersal; biology of seed germination; and identification and effects of fungal parasites of dwarf mistletoe. An extensive study of the development of infections from naturally and artificially inoculated seed was established and is continuing. Progress to 1968 was summarized in three internal reports and two reports have been published recently.

In 1972 the study was expanded to include dwarf mistletoe on jack pine, and literature and field conditions in Manitoba, Saskatchewan and Alberta were examined. A survey of dwarf mistletoe infestation of jack pine was conducted.

12. Goals for 1972-73:

1. Monitor lodgepole pine field plots.
2. Complete education commitments.

13. Accomplishments in 1972-73:

A manuscript on intensification of dwarf mistletoe in young lodgepole pine was published. Observations on development of infections were continued. Evidence of reproductive decline and high mortality of young infections, and possible racial differences in behavior between dwarf mistletoe populations were noted. The project was expanded to include dwarf mistletoe on jack pine, and a literature review and preliminary survey of disease conditions in Saskatchewan and Manitoba were conducted. An extensive survey of dwarf mistletoe infestation in northeastern Alberta was conducted and a report of the ground survey prepared. The survey data were transferred to the client's maps and incorporated into the data processing and storage system. Distinctive photographic images of dwarf mistletoe infestation were determined and a report is being prepared. A project proposal for remote sensing of dwarf mistletoe infestation was submitted. Two 1-1/2-hour lectures and a 3-hour field trip on dwarf mistletoe epidemiology were presented at the University of Alberta.

14. Goals for 1973-74:

1. Publications and reports
 - a) Epidemiology of lodgepole pine dwarf mistletoe in southern Alberta and implications for control. (proposed).
 - b) Status of dwarf mistletoe of jack pine. (proposed).
 - c) Dwarf mistletoe on jack pine (proposed For. Pest Leaflet).
 - d) Cylindrocarpum gillii, a new combination for Septogloeum gil-
lii on dwarf mistletoes. (reviewed).
 - e) Detection of dwarf mistletoe infestation centres in jack pine on aerial photographs. (reviewed).
 - f) Low-level aerial survey of dwarf mistletoe infestation of jack pine. (proposed).
 - g) Incidence of dwarf mistletoe in a young lodgepole pine forest (to be revised or incorporated with "a" above).
2. Continue observations and analysis of development of dwarf mistletoe infections on lodgepole pine.
3. Complete observations of dwarf mistletoe seed dispersal on lodgepole pine.


4. Demonstrate low-level aerial survey technique for management agencies.
5. Evaluate conventional and small scale aerial photographs for detecting dwarf mistletoe infestation of jack pine.
15. Publications:
- Up to 1972-73
- Muir, J.A. 1965. (Dwarf mistletoe) Parasitic effects and reproductive ability. Can. Dep. For. Ann. Rep. For. Ent. and Path. Branch p. 130-131.
- Muir, J.A. 1967. A bibliography of recent publications on the dwarf mistletoe Arceuthobium americanum. Can. Dep. For. Inform. Rep. A-X-13. 9 p.
- Muir, J.A. 1967. Occurrence of Colletotrichum gloeosporioides on dwarf mistletoe (Arceuthobium americanum) in western Canada. Plant Dis. Repr. 51:798-799.
- Muir, J.A. 1968. Biology of dwarf mistletoe (Arceuthobium americanum) in Alberta. Can. Dep. Fish, and For., Int. Rep. A-15. 29 p.
- Muir, J.A. 1968. Epidemiology of dwarf mistletoe (Arceuthobium americanum) in Alberta. Can. Dep. Fish. and For., Int. Rep. A-16. 20 p.
- Muir, J.A. 1968. Incidence of the fungal parasite, Colletotrichum gloeosporioides and its possible effects on intensification of dwarf mistletoe (Arceuthobium americanum). Can. Dep. Fish. and For., Int. Rep. A-17. 9 p.
- Muir, J.A. 1970. Dwarf mistletoe spread in young lodgepole pine stands in relation to density of infection sources. Bi-mon. Res. Notes 26(5):49.
- Muir, J.A. 1972. Increase of dwarf mistletoe infections on young lodgepole pine. Can. J. For. Res. 2:413-416.
- Muir, J.A., J.K. Robins and J.P. Susut. 1972. Dwarf mistletoe survey in the Athabasca forest, Alberta: ground check of infestation. Can. For. Serv., Nor. For. Res. Centre NOR-Y-43. 19 p.
16. Signatures:



 J.A. Muir, Investigator



 Program Manager



 G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Reduction of damage from diseases.
2. Title: Reduction of losses from canker and dieback.
3. New Cont. X 4. No.: NOR-044
5. Study Leader: Harry Zalasky
6. Key Words: Frost burls, canker and dieback, bark pitch pocket, survival, interlocking and spiral grain, brachiate tracheids, sclereid-like ray cells, scabby bark, conifers, hardwoods.
7. Location of Work: Region-wide.
8. Problem:

A significant amount of injury is believed to accrue to trees and shrubs in the region due to low lethal temperature occurring during spring and fall when plants are in susceptible stages. All or portions of the plants may be killed by canker formations. The cankers, on outward appearance, may be ascribed to pathogenic factors when their true cause was temperature.

Studies of distribution by hosts and geographic distribution and the histology of bark and wood damaged by low temperature was undertaken in 1971 to define the impact and symptoms on trees of different species. Histological aspects included freeze-killing and its succeeding after-effects (how low temperature affects annual rejuvenating capabilities of still-living tissues such as phloem and sapwood; and how these tissues developed and matured in nature and under artificial experimentation. Any weakening of vitality would have a direct effect on storage and quality of tissues formed and on susceptibility to recurrent damage from anomalous temperature during seasonal transitions. Review of publications on all aspects of reaction wood, summary of air and soil temperature data of the region and establishment of outside contacts have also been of inestimable value.

Naturally low temperature damage may have some impact on redirection of disease appraisal, research on regeneration by natural and artificial means and on some of the cultural practices such as hardening-off of seedlings, maintaining soil fertility and form of crown and stem, selection of material adaptable to the seasonal pattern of climate.

Regardless how selective the material is, probability of low temperature damage in this region is high. The limiting factors may be fertility, physical structure of the soil, moisture and soil temperature that permits growth during the latter part of the season when the photoperiod is much shorter.

9. Study Objectives:

1. To assess variability of hardiness of poplar to physiologic canker and dieback for clones under field conditions.
2. To provide advisory services to outside agencies on establishment and maintenance of planted poplars.
3. To compile manuscript on role of winter injury and process of dieback and target canker formation.
4. To study similar dieback and canker condition in other hardwoods and in conifers affected by low temperature damage under natural and artificial conditions.

10. Resources:

- | | | |
|--|---------------|-------------------------------|
| a) Starting date: | 1965 | |
| b) Estimated year of completion: | 1973 (Rev. 1) | Revised: 1975 |
| c) Estimated total Prof. man-years required: | 3 | |
| d) Essential new major equipment items for 1973-74 with costs: | Nil | |
| e) Essential new major equipment items beyond 1974 with costs: | Nil | |
| f) 1973-74 man-years Prof. | 0.5 | |
| | Supp. 0.8 | |
| | Casual 0.0 | |
| | Total 1.3 | O & M funds required: \$1,400 |

11. Progress to date:

Histological methods of sampled field material were used earlier during development of the problem and in the present stage of experimentation in the laboratory and field. Besides field observations, a new histological technique was devised to verify mortality, proliferation and deformity of certain tissues as a result of frost injury. Air and soil temperature data were used to determine frequency of frigid days, thaw days, freeze-thaw and cold nights and to verify the timing of freeze-killing temperature, the range of which is known in cell biology. The next step required actual experimentation under controlled and natural conditions

that induce canker and dieback to verify the temperatures at which injuries occur and to what extent killing effect has on reconstruction of new cambium, phloem and xylem. Two gaseous cooling agents, CO₂ and freon under pressure, were used for this purpose to treat stems locally for a maximum time of one minute depending upon the depth of freezing to obtain a desired freeze-killing temperature and ensuing physiologic reaction. Documentation of all symptoms and cell deformities of natural and experimental material is recorded photographically.

12. Goals for 1972-73:

Investigate frost ring in relation to canker and dieback incidence in conifers and hardwoods, and prepare a technical report. Five hundred cuttings of five clones of hybrid poplar planted at Oliver Tree Nursery for rooting and production of 1-year-old stock will be transplanted for two demonstration trials: (1) to show how to reduce and prevent loss from frost ring resulting in canker and dieback under plantation conditions, (2) to show how to prevent dieback and loss of vigor as well as prolong the life span and productivity of stooling stock in the nursery, (3) to follow up studies on artificial low temperature study.

Maintain advisory services to outside agencies on problems pertaining to planted poplars.

Planned Reports, Publications and Demonstrations:

- ✓ Zalasky, H. Frost ring resulting in a destructive canker and dieback of poplar.
- ✓ Zalasky, H. Stem infections in native and hybrid poplar caused by Septoria musiva and S. populicola.
- not done Zalasky, H. Demonstration of frost ring in aspen and hybrid poplar and how to prevent it.
- not done Zalasky, H. Demonstration of an improved method of extending the life expectancy of stooling stock of poplar.
- not done. Zalasky, H. Species of Mycosphaerella and their imperfect states on poplar and willow.

13. Accomplishments in 1972-73:

1. New information in low temperature research included morphological and climatological data. Morphological data of reaction wood included tissue deformations in the burl, canker, dieback, pitch pocket and phloem necrosis of the bark in juvenile, pole-sized and mature trees. For the first time reaction wood was shown to be caused by low temperature and that it was one of the components of frost canker and dieback in nodal and internodal region of the tree. It was found in 22 native species

and 25 horticultural varieties. Regional climatological data have shown that low temperature may have a direct killing effect on new tissues or an indirect slowing down of growth in some years and an absence or presence of normal growth cycle in other years.

2. Goal only partially achieved because management at the Oliver Tree Nursery decided in early May to go ahead with a greenhouse on the site of planted trees. The decision was made to move all trees (1 yr. and 2-yr.-old) to a new location. The planting turned out to be unsatisfactory due to damage during lifting and later during summer maintenance by nursery student casual labor. I have decided to use the trees during fall of 1972 for low temperature treatments and to terminate the project in early spring of 1973.
3. Introduction of a new simple method of experimental low temperature damage under control growth chamber and natural conditions has made it possible to induce stages of canker development and reaction wood in particular. Morphological features of the latter included spiral and interlocking grain, sclereid-like cells, and abnormally thick cell walls and short branching rays, tracheids and vessels. Paucity of fibers was augmented by enrichment with ray parenchyma giving rise to sclereid-like cells in the wood and bark of some species that normally do not produce sclereids such as pine and those that produce sclereids in the bark only as in poplar.
4. Several contacts were made regarding aspects of failure in poplar, the most notable being at Calgary involving Lacombe Nursery shipment and the second at the Saskatchewan Landing. In addition, I have been consulted on the controversial shipment of Caragana to Oliver Tree Nursery from PFRA, Indian Head.
5. Only the first two reports were put out. Reports re demonstration are cancelled for reasons stated earlier under goals. Report on Mycosphaerellas has been delayed because of gaps in some life cycles of species and new taxa.

14. Goals for 1973-74:

1. Prepare manuscripts on reaction wood occurring in frost injured conifers and hardwoods with emphasis on deformed tracheids, vessels and ray parenchyma, on frost burl, canker and dieback in conifers and hardwoods and aspects of cellular polymorphism (NOR-Y-11), and on air and soil temperature anomalies related to low temperature damage.
2. To obtain pathognomic data on reconstruction of cambium, phloem and xylem of field treated trees in clear-cut areas held by North Western Pulp and Power Limited and after treatments in the spring and fall of 1973 to effect alternate freeze-killing and rejuvenation and canker development.

3 reports

3. To determine duration and time of season when occlusion wood is formed.

15. Publications:

Up to 1972-73

Journal:

Zalasky, H., O. K. Fenn and C. H. Lindquist. 1968. Reactions of poplars to infection by Septoria musiva and Diplodia tumefaciens and to injury by frost in Manitoba and Saskatchewan. Plant Disease Reports 52, 829-833

Zalasky, H. 1971 Frost ring resulting in a destructive canker of poplar. Proceedings of the Can. Phytopath. Soc. Thirty-seventh Session. Abstract, p.24.

Reports:

Zalasky, H. 1970. Disease problems of poplar in the western interior of Canada. Forest Research Laboratory, Edmonton, Alberta. Information Report A-X-39. 37 pp.

Zalasky, H. 1972. Problems in spruce relating to soil, climate and recreational land use in the Bragg Creek area, Alberta. Northern Forest Research Centre, Edmonton, Alta. Internal Report NOR-10. 16 pp.

1972-73

Reports:

Zalasky, H. 1973. Isolation and characteristics of sclereid-like cells in sapwood of Pinus and Populus. Information Report NOR-X-48. 14 pp. NFRC, Edmonton, Alta.

Zalasky, H. 1972. (Ukrainian-English translation). Winter injuries to woody species in the process of acclimatization. Ms. 14 pages. Ukrainśky Botonichyi Zhurnal 22(5) 22-30. Co-authored by Borzakivska I.V. and T.K. Maiko. 1965.

Zalasky, H. 1972. Bark and wood structure and other aspects of abiotic dieback and target canker in the genus Populus. Miscellaneous Report NOR-Y-11. 41 pp.

Zalasky, H. 1972. Bark and wood structure and process of formation of abiotic canker. File Report NOR-Y-27. 11 pp. 75 slides for presentation at 20th WIFDWC, Victoria, B. C.

Zalasky, H. 1972. Progeny tests of seedlings of native species of poplar and introduced hybrids to stem infection by two species of Septoria. Miscellaneous Report NOR-Y-12. Ms 22 pp.

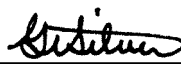
Zalasky, H. Low temperature research and induction of abiotic stem cankers in conifers and hardwoods. Miscellaneous Reports NOR-Y-33. pp.27. Presently under review for Information Report.

16. Signatures:

H. Zalasky, Investigator



Program Manager



G. T. Silver, Director

NOR-069

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 15, 1973

1. Project: Reduction of Damage from Disease.
2. Title: A Bark Disease of Poplar
3. New: Cont.: X 4. No.: NOR-069
5. Study Leader: Harry Zalasky
6. Key Words: Populus balsamifera, Rhytidiella moriformis, Phaeoseptoria,
Caliciopsis, Amphisphaeria.
7. Location of Work:
8. Problem:

Rough-bark, a newly described disease with no cambial necrosis, is common balsam poplar. An ascomycete, Rhytidiella moriformis n. gen. n. sp. first found to be associated with infection of two-year old stems, causes infection to appear at the base of the stem. Later infections occur in the upper stem and crown. On maturing trees the bark becomes dark grey and furrowed into thick ridges throughout the entire trunk and main branches. All clones are susceptible with few exceptions.

The first phase of study included pathogenicity test, host and geographic distribution in Saskatchewan and Manitoba and mycological aspects of naming and describing the causal organism. The second phase yet to be published involved the testing of several species and hybrids for susceptibility, cross inoculations and histology of infection sequences.

In progeny tests, this fungus could have some advantages over D. tumefaciens in being able to produce perithecia in greater quantity on stems rather than roots. Like D. tumefaciens a perennial fungus, it colonizes outside the active phloem system and stimulates thick corky bark in most parts of the stem except current year's growth. Its synergistic role in corky bark formation helps to insulate the living phloem and sapwood from damage by anomalous temperatures during the transition seasons and therefore improves the overall potential of survival.

Chances of success are relatively good without affecting other criteria of performance of the host.

Wide natural range of the fungus ensures its use without resorting to artificial means of inoculation.

Pathogenicity was studied in the greenhouse using juvenile trees grown and maintained in flats at controlled temperature. Distribution and mycology of the fungus was studied from collections obtained in the field. Histological data was obtained from serial cross and longitudinal sections of embedded and frozen material.

9. Study Objectives:

- 1) To provide knowledge on pathogenicity, tree damage, symptomatology, and cultural characteristics of R. moriformis.
- 2) To determine various aspects of the life history and host parasite relationship, nutritional and physiological requirements; and to describe the fungus and its related species.
- 3) To provide advisory services to outside agencies on establishment and maintenance of planted poplars.

10. Resources:

- a) Starting date: 1965.
- b) Estimated year of completion: 1969 Rev. 1: 1971 Revised: 1974.
- c) Estimated total Prof. man-years required: 0.
- d) Essential new major equipment items for 1973-74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man-years

Prof.	0.2	
Supp.	0.2	
Casual	-	
Total	0.4	O & M funds req'd.: \$200.00

11. Progress to date:

Rhytidiella moriformis, causing rough-bark of balsam poplar (Populus balsamifera) in Manitoba, Saskatchewan, and British Columbia produces pycnidia with two types of conidia, Phaeoseptoria and Phyllosticta both of which predominate on one to five-year-old infections. In older bark the perithecial production predominates persistently for about 65 years.

Cross-inoculations in the greenhouse showed that the fungus from balsam poplar infects aspen and balsam poplar but the aspen isolates inoculated into balsam poplar produced inconclusive results. Investigation of the total phenols and sugars extracted from balsam poplar bark indicates that the pathogen and two succession fungi are capable of utilizing both substances in liquid cultures.

Test plants of hybrid poplar were also successfully infected in the greenhouse. Histological studies of infected material showed conclusively that the fungus causes hypertrophy of the periderm and rough-bark.

The succession fungus Caliciopsis calicioides is now known to occur on cottonwood (P. deltoides), black cottonwood, balsam poplar, and poplar shade trees of hybrid origin in Alberta, Manitoba, Saskatchewan and eastern and western United States.

Specimens of the fungus R. moriformis have been deposited in various major herbaria in Canada, United States and Europe for study and reference. Prepared morphological data and photographed the Perfect and Imperfect States of other species of Rhytidiella collected earlier. Prepared semi-permanent slides of greenhouse inoculated poplar material for detailed histological study.

12. Goals for 1972-73:

Complete histological investigation on pathogenicity and begin preparation of proposed manuscript.

Zalasky, H. Histology of host-parasite relationships of Rhytidiella moriformis on poplar bark.

13. Accomplishments in 1972-73:

Goal not accomplished because of the transfer and higher priorities in 044 studies.

14. Goals for 1973-74:

Complete histological investigation on pathogenicity and complete preparation of manuscript.

15. Publications:

Up to 1972-73.

a) Journal Publications.

Zalasky, H. 1968. Rhytidiella moriformis n. gen., n. sp. causing rough bark of Populus balsamifera Can J. Botany 46, 1383-1387.

Zalasky, H., A. Nowawi, W.P. Ting and L.H. Tai. 1971. Dolabra nepheliae and its imperfect state associated with canker of Nephelium lappaceum and N. mutabile. Can. J. Bot. 49, 559-561. 1 Plate.

16. Signatures:

Harry Zalasky, Investigator

Program Manager



G.T. Silver, Director

NOR-070

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 15, 1973

1. Project: Reduction of damage from diseases.
2. Title: Cinder gall of poplar.
3. New: Cont.: 4. No.: NOR-070
5. Study Leader: Harry Zalasky
6. Key Words: Diplodia tumefaciens, Populus tremuloides, P. balsamifera, perfect state.
7. Location of Work: Region-wide
8. Problem:

Gall and rough-bark caused by Diplodia tumefaciens common on Populus tremuloides and P. balsamifera investigated under an earlier project designated as (PP-34 a) has been renewed during 1968-69 when the breeding program was consolidated under the Aspen and Agricultural Tree Zone committees to promote amenity and fiber use of poplar. The acquisition of the Bird's Hill Nursery stimulated progeny testing for resistance to diseases with D. tumefaciens as one of the test pathogens. The nursery ceased to serve effectively when the two regions were amalgamated in 1970. Discovery of the perfect state (perithecia) on roots infected by the same fungus validated continuity of the project in 1970 for final completion of the life cycle.

The project was expected to yield information on differential hosts important to the progeny testing program initiated during 1968-69 by Aspen and Agriculture Zone committees for fiber and amenity uses.

The chances of success were good because the fungus and the bud gall mite are known to be confined to some clones only.

Probability of results being put into practice will depend on whether progeny testing in poplar is going to be consolidated or discontinued.

In the laboratory fungi were isolated from the cinder gall by dilution plate method and examined microscopically for fructification

which would aid in identification. Infected roots containing perithecia were collected and preserved for herbarium specimens and microscopic slide records for further study. Standard pathological procedures were used in isolation and germination of ascospores on media in Petri plates. Freeze-microtome was used for histological sections of small material limited by the size of the chuck. The jung carbon knife not available earlier is preferred for large hard-cutting specimens.

9. Study Objectives:

- 1) To verify the life history of D. tumefaciens as a pycnidial state of Leptosphaeria, a perithecial state.
- 2) To do a complete histology of the woody structure in cinder gall and root infections.
- 3) To provide advisory services to outside agencies on maintenance of poplars.

10. Resources:

- a) Starting date: 1967.
- b) Estimated year of completion Orig. 1971 Rev. 1972. Revised 1973.
- c) Estimated total Prof. man-years required: 0.3.
- d) Essential new major equipment items for 1973-74 with costs: Nil.
- e) Essential new major equipment items beyond 1974: Nil.
- f) 1973-74 man-years Prof. 0.3
 Supp. 0.0
 Casual 0.0
 Total 0.3 O & M funds req'd.: \$100.00

11. Progress to date:

Cinder gall is initiated by bud gall mite and repeated attacks by the flat-headed borers in association with the fungus Diplodia tumefaciens. They are common on clones of aspen and balsam poplar that are highly susceptible to the organisms. Severe damage occurs to the main trunk, both basal and upper parts. Branch clustering occurs on balsam poplar stems as a result of the infection.

Bud gall mite also follows D. tumefaciens infections but the resulting gall does not have the cinder-like characteristics. Similar galls on main stems result when D. tumefaciens establishes in the wood of dead branch stubs and stimulates, adjacent to it, excessive healing tissue of wood and bark. Laboratory survey data seemed to suggest possibility of a succession syndrome of organisms.

12. Goals for 1972-73:

A final report should be ready by fall of this year and any further plans will be confirmed after the report is completed.

Planned reports and publications:

Zalasky, H. Incidence of D. tumefaciens in branch stubs of infected poplar. Canadian Journal Botany.

Zalasky, H. Root infections in poplar caused by D. tumefaciens. Canadian Journal Botany.

Zalasky, H. Perfect state of D. tumefaciens in poplar. Canadian Journal of Botany.

13. Accomplishments in 1972-73:

Photographed and prepared figures of perithecial state and its habitat for manuscript.

Attempt to isolate from single ascospores collected in the 1971-72 fiscal year failed because perithecia had released spores during storage. Fresh collections in 1972 did not yield any perithecia, therefore this phase must await renewed attempts hopefully with better success.

14. Goals for 1973-74:

- 1) Publish the results to date in Bi-Monthly Research Notes.
- 2) Study will be completed.

15. Publications:

Up to 1972-73

a) Journal Publications

Zalasky, H. 1964. The histopathology of Macrophoma tumefaciens infections in black poplar. Can. J. Botany 42, 385-391.

Zalasky, H. 1964. Nomenclature and description of Diplodia tumefaciens (Shear) Zalasky \equiv Macrophoma tumefaciens Shear apud Hubert. Can. J. Botany 42, 1049-1055.

Zalasky, H. 1964. Microconidial state of Cucurbitaria staphula Dearness ex R.H. Arnold and R.C. Russell. Can. J. Botany 42, 1586-1588.

Zalasky, H. 1965. Additional hosts of Diplodia tumefaciens (Shear) Zalasky (\equiv Macrophoma tumefaciens Shear). Plant Disease Reporter 4, 50.

Zalasky, H. 1965. Morphology of Ceratocystis fimbriata in aspen. Can. J. Botany 43, 625-626. 1 Plate.

Zalasky, H. 1965. Process of Ceratocystis fimbriata infection in aspen. Can. J. Botany. 43, 1157-1162.

Zalasky, H. 1967. Penetration and initial establishment of Nectria galligena in aspen and peachleaf willow. Can. J. Botany 46, 57-60.

Zalasky, H., O.K. Fenn and C.H. Lindquist. 1968. Reactions of poplars to infections by Septoria musiva and Diplodia tumefaciens. and to injury by frost in Manitoba and Saskatchewan. Plant Disease Reporter. 52, 829-833.

b) Bi-monthly Res. Notes

Zalasky, H. and O.K. Fenn. 1965. Inoculation tests with Diplodia tumefaciens (Shear) Zalasky, Can. Dept. Forestry, Bi-monthly Progress Rept. 21:3.

c) Information Reports

Zalasky, H. 1970. Disease problems of poplar in the western interior of Canada. Forest Research Laboratory, Edmonton, Alberta. Information Report A-Y-39. 37 pp.

During 1972-73

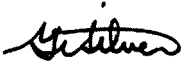
Nil.

16. Signatures:

Harry Zalasky, Investigator



Program Manager



G.T. Silver, Director

NOR-094

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March, 1973

1. Project: Reduction of Damage from Diseases.
2. Title: Aerobiology of Comandra blister rust, Cronartium comandrae
3. New: Cont.: X 4. No. NOR-094
5. Study Leader: J.M. Powell
6. Key Words: Pinus, spore dispersal, germination, viability, microflora, fauna, climate, SAI, B19.
7. Location of Work: Edmonton, Kananaskis Forest Experiment Station, forested regions of Alberta and National Parks.
8. Problem:

The rust is a disease of hard pines in North America. Although the damage of the rust is not spectacular, the infection may be heavy in trees of all ages and cause mortality by basal or stem girdling. It has recently become a plantation problem in south and south-eastern United States and mature stands of lodgepole pine in western United States have been reported with 50 to 98% of the trees infected. Little is known about the distribution and role of the rust in Canada.

Important information is lacking on influence of climatic factors upon spread and intensification of aerial borne pathogens. This rust, which has an easily recognizable aeciospore state was chosen as a suitable organism for studies on those relations, and because it is a potentially damaging organism, especially with the increase toward plantation forestry, for which little information was available. The associated fauna and microflora also play a role in affecting the production, viability and germination of aeciospores and their respective roles will be assessed.

9. Study Objectives: General.

To investigate the epidemiology and aerobiology of the comandra blister rust on lodgepole pine and its alternate hosts in Alberta.

1. Determine the duration of aeciospore production and factors affecting their release, transport, dispersal and deposition.

2. Determine the environmental factors affecting aeciospore germination and viability.
3. Determine the effect of the associated microflora and fauna on aspects of the aerobiology.
4. To conduct surveys to ascertain the distribution and damage caused by the rust in the region, and the incidence and role of the associated rodents, insects and microflora.

10. Resources:

- a) Starting date: 1964.
- b) Estimated year of completion: 1974.
- c) Estimated total Prof. man-years required:
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man-years Prof. 0.2
 Supp. -
 Casual -
 Total 0.2 O & M funds req'd.: Nil.

11. Progress to date:

Aeciospore production and duration was followed for four years in a number of locations, including production in two years from individual aecia and aecial pustules. Aecial production was limited by the activity of other fungi, insects and rodents. Sixty-four fungi and bacteria were identified as associated with the rust canker or spores; of these Tuberculina maxima and Cladosporium sp. are important in reducing the inoculum available. One hundred and sixty species of arthropods were collected in association with the rust. Of these Epuraea obliquus, Paracacoxenus guttatus and Mycodiplosis sp. play an important role, and information on their biology was obtained. Annual observations were made on the incidence of rodent, insect and microfloral organisms on 500 cankers at 23 locations, as well as observations on the growth and status of the cankers. Approximately 45% of the infected trees tagged in 1967 or earlier were dead by 1971. Special attention in 1971 was given to assessing the amount of current year and previous rodent damage on the cankers. Samples of duff material from around rust infected trees were collected on two occasions and yielded 160 species, which included 15 spiders, 21 mites, 19 Collembola, 20 Coleoptera, 43 Diptera (half Cecidomyiidae), and 22 Hymenoptera. Some of the mite material remains to be sorted and identified.

Seasonal and diurnal spore release data were collected during four years, and related to weather. Data were collected on the distance of spore dispersal from natural and experimental sources, and on the rate of spore fall in still air. Spore germination tests were made daily during the spore production period in three years. The

temperature, humidity, light and pH requirements for spore germination and their effects on spore viability were established. Different media were evaluated as spore germination substrates. The cytology of the aeciospores and aeciospore germ tubes were described. Inoculations were successful with aeciospores on Comandra, very poor on Geocaulon, and negative results were achieved on pine. Information was obtained during four years on the build-up of uredial and telial infection on eight Comandra plots.

Papers were published on the development of a modified 24-hour spore collector, on a cage for collecting insects from cankers, and the first report of the rust on P. sylvestris and of the hyperparasite Tuberculina maxima on C. comandrae and other pine stem rusts in Alberta. A Ph.D. thesis entitled "The aerobiology of the aecial state of the comandra blister rust Cronartium comandrae Peck, in Alberta" was completed in 1969. A paper was published with Y. Hiratsuka on the cytology of the aeciospores and aeciospore germ tubes of C. comandrae and C. comptoniae. Papers on (1) the distribution and hosts of C. comandrae in Canada, (2) the fungi and bacteria associated with C. comandrae, (3) the arthropod fauna collected from the rust on lodgepole pine in Alberta, (4) occurrence of Tuberculina maxima on pine stem rusts in western Canada, (5) insects collected from infected Comandra umbellata ssp. pallida plants, (6) records of Mycodiplosis larvae feeding on rust fungi, and (7) incidence and effects of Tuberculina maxima on cankers of C. comandrae, were published. A paper on the daily germination of C. comandrae aeciospores was also published, and a paper on seasonal and diurnal periodicity of release of C. comandrae aeciospores was accepted for publication. Four papers were presented at scientific meetings; (1) "Insects associated with pine stem rusts" (2) "Comandra blister rust in Alberta, and biological factors affecting aeciospore production", (3) (with Y. Hiratsuka) "Cytology and taxonomy of autoecious pine stem rusts", and (4) "Aerobiology of the aecial state of the comandra blister rust". In addition two manuscripts, (1) environmental factors affecting aeciospore germination and germ tube growth, and (2) the effect of temperature, humidity and light on viability of C. comandrae aeciospores, were prepared and reviewed locally, and a draft made of a short paper on "biological agents affecting comandra blister rust aeciospore production".

12. Goals for 1972-73:

Owing to the reassignment of the investigator to studies in forest climatology only limited time will be available to continue the preparation of papers and reports for publication. Emphasis will be given to completing the review paper with Y. Hiratsuka on the "Pine stem rusts of Canada", and the report with H.R. Wong on "Arthropods collected from cankers of stem rusts on hard pines". Drafts of other papers to satisfy the study objectives, will be revised or written if commitments to other studies allow.

Hiratsuka, Y. and J.M. Powell. Pine stem rusts of Canada. Identification, hosts, distribution, life cycle, cytology, epidemiology, and control (Proposed Departmental Publication).

Powell, J.M., H.R. Wong and J.C.E. Melvin. Arthropods collected from cankers of stem rusts on hard pines in the Canadian Prairies (Proposed Information Report).

13. Accomplishments in 1972-73:

One week was spent visiting 23 plots to obtain annual measurements of canker growth rates, mortality, and incidence of associated fungi, insects and rodent damage.

An information report on arthropods collected from cankers of stem rusts on hard pines was published. The manuscript of a proposed Departmental Publication on "Pine stem rusts of Canada" with Y. Hiratsuka was completed and reviewed by Ottawa. Revision of this manuscript is now under way. Two short notes were accepted by journals for publication, (1) Pinus mugo, a new host for comandra blister rust, and (2) additional collections of Tuberculina maxima on pine stem rusts in western Canada. The manuscript on "Environmental factors affecting germination and germ tube growth of C. comandrae aeciospores" was revised and reviewed locally. A report of serious damage caused by two pine stem rusts to a plantation was prepared with Y. Hiratsuka and has been reviewed locally.

Concerning the satisfying of the study objectives: Under objective 1, one major paper on the factors affecting aeciospore release was published, and some of the results of aeciospore dispersal and deposition experiments were presented in a Conference paper and published in the proceedings. For objective 2, one paper on daily germination studies and one on cytology have been published, but two papers on factors affecting aeciospore germination and viability require revision. Most major aspects of the studies relating to objectives 3 and 4 have been published, except for a paper on the incidence and damage of the rust in lodgepole pine stands in Alberta, and a short paper on rodent damage to the rust cankers. Several smaller aspects of the studies relating to these objectives remain to be reported on.

14. Goals for 1973-74:

1. Prepare two papers to be presented in the symposium session on "Diseases in intensively managed forests - fusiform, twist and comandra rusts" at the 2nd International Congress of Plant Pathology, Minneapolis, Sept. 6. The assigned topics are: (a) Comandra rust in Canada and the epyphytology of the rust, and (b) opportunities for control of the rust by biological organisms.

2. Undertake any necessary revisions for the papers presently submitted for publication, and for the two papers mentioned in the above section as under local review.
 3. Drafts of other papers to satisfy the study objectives, will be revised or written if commitments to other goals or studies allow.
 4. Study will be terminated in current year.
15. Publications:
- Up to 1972-73:
- Powell, J.M. and W. Morf. 1965. The occurrence of Tuberculina maxima Rost. on Cronartium rust infected trees in Alberta. Can. Dept. For., For. Ent. & Path. Br., Bi-Mon. Prog. Rept. 21(1):3.
- Powell, J.M. 1965. Studies on forest tree rusts in Alberta. pp. 129-130. In Annual Report Forest Entomology and Pathology Branch, Year Ended March 31, 1965. Can. Dept. of Forestry. 151 p.
- Elliott, D.P. and J.M. Powell. 1966. A cage for collecting insects from tree stems and branches. Can. Ent. 98:1112-1113.
- Powell, J.M. and W. Morf. 1966. Temperature and pH requirements for aeciospore germination of Peridermium stalactiforme and P. harknessii of the Cronartium coleosporioides complex. Can. J. Bot. 44:1597-1606. Can. J. Plant Sci. 47:222-224.
- Powell, J.M. and W. Morf. 1967. A 24-hour impaction spore collector.
- Powell, J.M. 1969. The aerobiology of the aecial state of the comandra blister rust, Cronartium comandrae Peck, in Alberta. Univ. British Columbia, Unpub. Ph.D. thesis, 362 p.
- Hiratsuka, Y. and J.M. Powell. 1969. Cytology and taxonomy of autoecious pine stem rusts. (Ab.) XI International Bot. Congr. Seattle, Wash. Abstracts: 91.
- Powell, J.M. 1969. Insects associated with pine stem rusts. (Ab.) Proc. 17th Annual Meeting, Ent. Soc. Alberta, Lethbridge, Alta. Oct. 24-25, 1969. pp. 8-9.
- Powell, J.M. and Y. Hiratsuka. 1969. Nuclear condition and germination characteristics of the aeciospores of Cronartium comandrae and C. comptoniae. Can. J. Bot. 47:1961-1963 + 1 plate.

- Powell, J.M. 1970. The aerobiology of the aecial state of the comandra blister rust, Cronartium comandrae Peck, in Alberta. Dissertation Abstracts B 30(9):3939-3940.
- Powell, J.M. 1970. Cronartium comandrae in Canada, its distribution and hosts. Can. Plant Dis. Survey, 50:130-135.
- Powell, J.M. 1971. Fungi and bacteria associated with Cronartium comandrae on lodgepole pine in Alberta. Phytoprotection, 52:45-51.
- Powell, J.M. 1971. The arthropod fauna collected from the comandra blister rust, Cronartium comandrae, on lodgepole pine in Alberta. Can. Entomol. 103:908-918.
- Powell, J.M. 1971. Occurrence of Tuberculina maxima on pine stem rusts in western Canada. Can. Plant Dis. Survey, 51:83-85.
- Powell, J.M. 1971. Additional records of Mycodiplosis larvae (Diptera:Cecidomyiidae) feeding on rust fungi. Can. Plant Dis. Survey, 51:86-87.
- Powell, J.M. 1971. Incidence and effect of Tuberculina maxima on cankers of the pine stem rust, Cronartium comandrae. Phytoprotection 52:104-111.
- Powell, J.M. 1971. Daily germination of Cronartium comandrae aeciospores. Can. J. Bot. 49:2123-2127.
- Powell, J.M. 1971. Aerobiology of the aecial state of the comandra blister rust. pp. 7-14. Proc. 19th Western Int. Forest Disease Work Conf., Medford, Oregon, Sept. 13-17, 1971.
- Powell, J.M. 1972. Insects collected from the toadflax Comandra umbellata ssp. pallida (Santalaceae) infected by the rust Cronartium comandrae in southern Alberta. Can. Field-Naturalist 86:81-83.
- Powell, J.M. 1972. Seasonal and diurnal periodicity in the release of Cronartium comandrae aeciospores from stem cankers on lodgepole pine. Can. J. For. Res. 2:78-88.
- 1972-73:
- (a) Journal Publications:
- Powell, J.M. and N.W. Wilkinson. Pinus mugo, a new host for comandra blister rust. Plant Dis. Rept. (in press).

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Powell, J.M. Additional collections of Tuberculina maxima on pine stem rusts in western Canada. Can. Plant Dis. Surv. (in press).

(b) Departmental Publications:

Hiratsuka, Y. and J.M. Powell. Pine stem rusts of Canada. Identification, hosts, distribution, life cycles, cytology, damage, epidemiology, and control. Ms. 98 p + 52 figs. (ms being revised).

(d) Information Reports:

Powell, J.M., H.R. Wong and J.C.E. Melvin. 1972. Arthropods collected from stem rust cankers of hard pines in western Canada. Environment Can., Northern Forest Res. Centre, Edmonton. Info. Rept. NOR-X-42. 19 p.

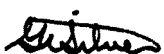
16. Signatures:



J.M. Powell, Investigator



R.W. Reid, Program Manager



G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 19, 1973

1. Project: Reduction of Losses from Insects.
2. Title: Impact, biology and control of the spruce budworm in northern Alberta and Northwest Territories.
3. New: Cont.: X 4. No.: NOR-023
5. Study Leader: H. Cerezke.
6. Key Words: Choristoneura fumiferana; C. biennis; Picea glauca; sample; defoliation; clearcutting; regeneration; pheromone.
7. Location of Work: Footner Lake Forest, Ft. McMurray, Edmonton.
8. Problem:

The most recent large-scale outbreak of the spruce budworm in the Prairie Provinces, Yukon and N.W.T. reached a peak in 1967-68 and declined rapidly during 1969-70 over large areas (Annual Reports, FIDS). Most infestations occurred in commercial mature-overmature white spruce forests such as along major river drainages in northern Alberta, Saskatchewan, Yukon and N.W.T., and in other extensive stands in central Saskatchewan and western Manitoba. Several major park and recreational areas also supported damaging populations including Riding Mountain National Park, Spruce Woods Forest, Whiteshell Provincial Park and Cypress Hills. In 1972, populations were endemic except for a few relatively small areas in northern Alberta, N.W.T., and particularly Spruce Woods Provincial Forest in Manitoba. Outbreaks in eastern Canada are currently high and outbreak periods in eastern Canada may or may not coincide with those in the west. Because of the persistence of populations on white spruce in northern latitudes of Alberta, Yukon and N.W.T., the view has been expressed that differences in the biology and behavior of C. fumiferana may exist between populations in eastern Canada and those in the west. Consequently, many of the studies in this region have been directed toward obtaining information on the life cycle development and behavior patterns of the budworm in order to determine the applicability of selected sampling, rearing and control techniques developed in eastern Canada and elsewhere. A major part of these studies

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involves the testing of sampling techniques for measuring levels of abundance of various life stages of the budworm, its damage on the host, and in maintaining annual surveillance of outbreak areas with assistance from F.I.D.S.

The studies will contribute to a better understanding of this major pest in white spruce forests (most studies in Ontario, Quebec and Maritimes have dealt with predominantly balsam fir forests) and allow for better understanding of the budworm problem as a whole. The information on biology and damage will provide a sounder basis for applying new or various techniques already developed for sampling, rearing and control strategy, for predicting changes in abundance, for assessing short and long term effects on the host tree and the forest, and for predicting behavior in various forest situations such as dispersion between timbered areas and clearcut-regeneration areas. Monetary savings, fire protection and aesthetic improvements can be made in areas where control by spraying or silvicultural management is recommended to reduce budworm hazard, save foliage and salvage damaged and weakened trees.

The results of the study could have application in any outbreak area where tree damage assessments and budworm population estimates are required, particularly for general surveys of abundance and assessment of hazard and control treatments.

9. Study Objectives:

1. Determine the biology and hazard of the budworm in northern spruce forests and suitable techniques for estimating its abundance.
2. Determine the formulation of control measures to be implemented as the need arises.

10. Resources:

- a) Starting date: 1968.
- b) Estimated year of completion: 197⁴₃.
- c) Estimated total Prof. man years required: 2.0.
- d) Essential new major equipment items for 1973/74 with costs: Nil.
- e) Essential new major equipment items beyond 1974 with costs: Nil.
- f) 1973-74 man-years

Prof.	.5	
Supp.	.7	
Casual		
Total	1.2	O & M funds req'd: \$1,300.00

11. Progress to date:

Budworm infestations in northern Alberta have been monitored annually by aircraft and ground since 1968: small infestations have remained active along the Athabasca, Chinchaga, and at a few locations in the N.W.T. Information on these infestations and their likely hazard has been communicated to provincial and federal authorities.

A collection of 360 branch samples from 30 non-infested spruce trees was analyzed for patterns of shoot length, numbers of terminal buds, branch surface area numbers of needles and dry needle weights to serve as a basis for sampling the 18-inch branch tip on different parts of the crown. Some limited comparative work was done on budworm-defoliated branches. Radial increment patterns of the sampled trees were described.

Field plots were established for budworm studies near High Level and at Ft. McMurray, Alberta. From those at High Level, collections of budworm life stages were made during 1969 to establish size range and duration of larval instars. Phenological measurements of the host were made, temperatures recorded and preliminary relationships established between host development and budworm development, and between budworm development and cumulated day-degrees. More information on second and third instar larvae and field testing is required to ensure the usefulness of these data for prediction. Collections of pupae were made for sex ratios, size variations, parasitism, adult emergence, egg-laying trials and to investigate criteria for characterizing populations. Several parasites and bird predators were identified. Studies of the distribution pattern of young larvae within tree crowns were made but the data are inconclusive because of low spruce budworm populations and the presence of the black-headed budworm.

Various sampling techniques have been applied to estimate budworm abundance including branch sampling with pole pruners, tree felling and tree climbing, and by trapping moths with attractants (virgin females and synthetic pheromone). Baited traps set out in 1969 have helped to establish daily activity pattern of males while initial trials for successful attraction to synthetic pheromone was demonstrated in 1971.

Preliminary work toward assessment of foliage loss and relating to budworm abundance was initiated. The main problems encountered here are in recognizing classes of defoliation and in sampling mature to over mature trees.

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The assessment of hazard to merchantable trees by budworm feeding involves annual measurements of budworm abundance and foliage loss, mapping areas of infestation and recording accumulated changes on trees such as dead tops and tree mortality. Studies to date have been made to determine general defoliation pattern within trees and between trees within large stands and within residual leave strips adjacent to clearcut areas; these data are incomplete. Plot areas have been tallied for incidence of dead tops and mortality, and suggest that the accumulated damage within stands progresses in a predictable pattern. Two field plots were established near High Level to study dispersal of budworms, particularly early instar larvae, from mature residual timber to adjacent regeneration, and to study the subsequent damage to the regeneration.

12. Goals for 1972-73:

1. Aerial and ground surveys of commercial forests in northern Alberta and N.W.T. will be made and a report summarizing current budworm distribution, impact and hazard will be prepared for distribution to management agencies.
2. Test two methods of sampling spruce budworm populations, one for late-instar larvae (by branch sampling), the other for adult male moths using traps baited with synthetic pheromone supplied from GLFRC.
3. Obtain estimates of current defoliation to relate to late-larval instar and adult abundance.
4. Determine the distribution of late-instar larvae within foliage of host trees.
5. Re-examine survival of spruce seedlings planted in 1971.
6. Work toward completing the following paper jointly with L. Safranyik and B. Chow: "The evaluation of the sine-wave function for heat-unit accumulations under Alberta conditions.

13. Accomplishments in 1972-73:

1. Most major spruce forests in northern Alberta and N.W.T. were surveyed for current budworm outbreaks with major input by F.I.D.S. and a summary report prepared for distribution. Information on hazard was given to provincial forestry personnel by letter regarding two infested areas.

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- 2,3,4. No larval sampling was done because of extremely low populations in the High Level area and transfers of work to Ft. McMurray area could not be arranged in time as adult stage was 1-2 weeks early. No estimates of defoliation, which were to be made on the larval sample branches, were made. Nearly all effort was applied to testing pheromone-baited traps for male moth census. Information was obtained on the effect of pheromone concentration, its duration in the field, its application to two budworm densities, problems with trap design and position in the forest for placement of traps. The pheromone was also tested on the 2-yr. cycle budworm, C. biennis in Kootenay N.P.
5. Poor survival of spruce seedlings planted in 1971 was compensated for by natural regeneration in 1972. Budworm populations in the area in 1972 were extremely low.
6. Status of this paper is unknown; all the data were transferred to Victoria by L. Safranyik.

14. Goals for 1973-74:

1. Collect samples of budworm life stages at about weekly intervals (Ft. McMurray area) for completing the studies of larval development and relating to degree-days. Pupae will be used to obtain virgin females for test comparisons with pheromone.
2. Continue field tests with pheromone in sticky traps to monitor budworm abundance and activity.
3. Prepare report summarizing foliage patterns (on 18-inch branch) on non-infested white spruce crowns.

15. Publications:

Nil to date.

Unpublished Reports:

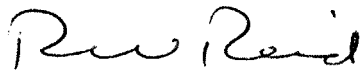
1. Cerezke, H.F. 1971. 1971 Studies of the spruce budworm in northern Alberta. Internal Report NOR-8, 17 pp.
2. Cerezke, H.F. 1971. Life cycle development of the spruce budworm (Choristoneura fumiferana) in northern Alberta. (Two tables, 5 figs.). Presented at 19th Annual Meeting of Ent. Soc. of Alberta.

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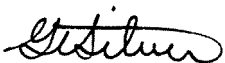
3. Cerezke, H.F.; R. Dunbrack and R. Gordey. 1971. Bird species in a spruce forest infested by the spruce budworm in northern Alberta. (typed ms, 5 pp).
 4. Cerezke, H.F. 1972. Tests of pheromone-baited traps for monitoring spruce budworm (Choristoneura fumiferana (Clem.)) populations in northern spruce forests. 18 pp. Presented at 20th Annual Meeting Ent. Soc. of Alberta.
 5. Sanders, C.J.; G.R. Daterman; R.F. Shepherd and H.F. Cerezke. attractants for two western spruce budworm, Choristoneura biennis and C. viridis. 6 pp. (Prepared for journal publication).
16. Signatures:



H. Cerezke, Investigator



Program Manager



G.T. Silver, Director

NOR-024

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 19, 1973

1. Project: Reduction of losses from insects.
2. Title: Biology and control of Warren's collar weevil.
3. New: Cont.: X 4. No.: NOR-024
5. Study Leader: H. F. Cerezke
6. Key Words: Hylobius warreni, Pinus contorta var. latifolia,
regeneration, growth reduction, stand treatments,
B19, sampling.
7. Location: Alberta foothills, Edmonton
8. Problem:

H. warreni is endemic to most spruce and pine forests in the Prairie Provinces and southern N.W.T., but has been found abundant on high productivity sites of lodgepole pine along the Alberta foothills and in moist sites of white spruce and jack pine in central Saskatchewan and western Manitoba. Invasion into young regeneration and plantations by this weevil appears to begin when the trees are less than 10 years old, and thereafter populations may persist as trees are attacked repeatedly to maturity. Trees require no pre-weakening for successful attack and damage by the larvae results in various degrees of partial to complete girdling of the lower stem and main lateral roots. In natural stands of lodgepole pine, tree mortality has not been a problem since it has rarely exceeded 5%, and mostly includes trees less than 30 years old. However, because the damage tends to cumulate with each successive attack, considerable growth loss may result throughout the life of individual trees. In some lodgepole pine stands 60 years of age and older, 90 - 100% of the trees have wounds of varying amounts, so that the net effect of growth reduction may be considerable. Estimates of growth reduction of young trees having 50% of the root-collar circumference girdled suggested 17.2% loss in radial increment and 11.5% loss in terminal shoot length during a two-year period after attack. Current studies have been to examine experimentally the relationship between degree of girdling and subsequent changes in growth pattern on young lodgepole pine.

Another aspect being investigated is the time of initial invasion into young regeneration and the weevil's subsequent pattern of spread, particularly in regeneration on clearcut sites lying adjacent to residual mature timber supporting reservoir weevil populations. Studies have also been underway to examine changes in weevil abundance and their damage patterns in young lodgepole pine following thinning. Earlier studies of the weevil had shown that the pattern of attack within stands is influenced by tree diameter, tree age, stand density and depth of duff material at tree bases. Therefore, changing these stand variables through stand manipulation such as thinning, may have an important bearing upon the amount of damage and on silvicultural control of the weevil.

The studies on the effects of partial girdling on trees will provide a better basis for quantifying the impact in natural stands and plantations. Knowing the time of invasion of weevils into young regeneration is important for recommending silvicultural control such as time of removal of residual timber and size and timing of planting stock.

Intensive management of naturally stocked lodgepole pine stands requires pre-commercial thinning in many areas, and the studies of H. warreni following such treatment will assist in formulating management policy for such areas. The information will also be applicable in artificially stocked stands in areas after clearcutting.

There is a high probability that the results of these studies will influence management policy in some sections of the Alberta foothills.

9. Study Objectives:

Broad objective is to obtain information to make concrete recommendations for weevil control in problem areas. Specific objectives are:

1. Establish the subsequent population changes and damage patterns of the weevil in a young pine stand subjected to thinning.
2. Determine experimentally the critical level of partial girdling necessary to cause tree death, and to establish a relationship between degree of girdling and amount of growth loss.

10. Resources:

- a) Starting date: 1960.
- b) Estimated year of completion: 1980.
- c) Estimated total Prof. man-years required: 3.0
- d) Essential new major equipment items for 1973/74 with costs: Nil.

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- e) Essential new major equipment items beyond 1974 with costs: Nil.
 f) 1973/74 man-years Prof. 0.3
 Supp. 0.3
 Casual -
 Total 0.6 O & M funds req'd: \$500.00

11. Progress to date:

Considerable background knowledge on the biology of H. warreni and its damage in lodgepole pine stands in Alberta has been accumulated from 1961 to 1972. Information was obtained on the geographical distribution of H. warreni, its life cycle development in the Alberta foothills, on sampling and collecting techniques and identification of some mortality factors. Data were obtained on the behavior patterns of adults in relation to mating, egg-laying, feeding, dispersion and daily and seasonal activity. Populations were studied in several different forest conditions and patterns of attack on the host were determined, history of attacks and relationships between weevil numbers and several forest parameters such as tree age and size, stand density and depth of duff material. Populations were followed over a five-year period in a pulp-cutting area to determine survival of the weevil in cut stumps and to evaluate clearcutting as a method of control. Studies were made of girdling effects on trees having 50% of the root-collar circumference girdled by larvae, and of changes in the resin duct system. These studies were followed by a field experiment in which trees were girdled various distances around the root-collar circumference to simulate the effects of weevil damage. This study was terminated in 1971-72. Two fifth-acre plots, thinned in 1967, were re-examined for weevil populations and damage in 1969 and again in 1971. Changes in weevil abundance and cumulated damage have been recorded. A thesis, several reports and publications summarize much of these data.

12. Goals for 1972-73:

No field studies are planned in 1972 but time available will be devoted toward completing the following papers.

1. "Effects of clearcutting on the survival of the weevil, Hylobius warreni Wood, in lodgepole pine stands in Alberta". Proposed Journal publication.
2. "The spacial and temporal patterns of distribution of the weevil, Hylobius warreni Wood, in lodgepole pine stands in Alberta". Proposed Journal publication.
3. "Behaviour patterns of Hylobius warreni Wood in relation to mating, egg-laying, feeding, dispersion and daily and seasonal activity. Proposed Journal publication.

4. "Effects of partial girdling of the root-collar on growth impact of stem, leader and lateral roots of lodgepole pine, with special application to damage by the weevil, Hylobius warreni". Proposed Journal publication.

13. Accomplishments in 1972-73:

Title 1. above was completed and submitted for publication with title changed to "Survival of the weevil, Hylobius warreni Wood, in lodgepole pine stumps". A 2-page summary of the main findings in this paper has been prepared and reviewed locally for submission to For. Chron.

No progress made on titles 2 and 3 due to shortage of time. Data analysis required in title 4 completed and start made on writing. Two additional papers prepared as follows:

- (a) Notes on some predators and parasites of the weevil, Hylobius warreni Wood (Coleoptera: Curculionidae). Submitted for publication.
- (b) Patterns of bark thickness and bark resin cavity characteristics on young lodgepole pine in relation to the feeding zone of the weevil, Hylobius warreni Wood. Reviewed locally.

14. Goals for 1973-74:

Goals 1, 2 and 3 are proposed journal publications; first draft copies to be completed.

1. The spacial and temporal patterns of distribution of the weevil, Hylobius warreni Wood, in lodgepole pine stands in Alberta.
2. Behavior patterns of Hylobius warreni Wood in relation to mating, egg-laying, feeding, dispersion and daily and seasonal activity.
3. Effects of partial girdling of the root-collar on growth impact of stem, leader and lateral roots of lodgepole pine, with special application to damage by the weevil, Hylobius warreni.
4. Re-examine two fifth-acre thinned plots and their control plots in a 30-yr-old lodgepole pine stand and determine the effect of thinning on weevil abundance and feeding damage since time of initial treatment (1967). This will contribute toward satisfying objective 1.

15. Publications:

Up to 1972

Cerezke, H. 1967. A method for rearing the root weevil, Hylobius warreni (Coleoptera: Curculionidae). Can. Ent. 99:1087-1090.

Cerezke, H.F. 1969. The distribution and abundance of the root weevil, Hylobius warreni Wood in relation to lodgepole pine stand conditions in Alberta. Ph.D. thesis, University of British Columbia, xvii + 221 pp.

Cerezke, H.F. 1970. A method for estimating abundance of the weevil, Hylobius warreni Wood, and its damage in lodgepole pine stands. For. Chron. 46:392-396.

Reports


Cerezke, H.F. 1970. Biology and control of Warren's collar weevil, Hylobius warreni Wood, in Alberta. Internal Report A-27, 28 pp.

Cerezke, H.F. 1970. Survey report of the weevil, Hylobius warreni Wood, in the foothills of Alberta. Internal Report A-38, 40 pp.


1972-73

Cerezke, H.F. 1972. Effects of weevil feeding on resin duct density and radial increment in lodgepole pine. Can. J. For. Res. 2:11-15.

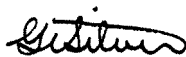
16. Signatures:



 H.F. Cerezke, Investigator



 Program Manager



 G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 19, 1973

1. Project: Reduction of Losses from Insects.
2. Title: Biology, impact and control of wood borers.
3. New: Cont. X 4. No.: NOR-025
5. Study Leader: H. F. Cerezke
6. Key Words: Cerambycidae, Monochamus, Tetropium, white spruce, pine, sampling.
7. Location: Throughout region.
8. Problem:

Several requests and enquiries are received annually from industry and provincial forest personnel for information on hazard, expected damage, life history, identification and methods of control of wood borers attacking freshly-cut timber, in decked and undecked logs, in fire-killed timber and insect material found in finished wood products. In many cases, the requests can be handled by telephone, letter or a short personal visit.

Two areas of concern require greater investigative input to provide answers sought by clients. The first is in standing fire-killed and blowdown trees which are subsequently invaded by a variety of wood borer species. Many such areas are salvage-logged, and if improperly timed, considerable monetary loss from degrade by 'worm hole' damage can result. In the Prairie provinces, Yukon and N.W.T. most worm hole damage is caused by the Cerambycids, Monochamus spp. and Tetropium spp, the former being the most economically important.

A second area of concern is the risk of degrade from wormholes in freshly-cut logs decked in mill yards and in those logs decked or left lying in the forest. Usually there is little risk to such logs as long as operators maintain a strict felling-processing plan, where all timber cut during the fall and winter is sawn into lumber before the end of the first summer. Unseen logs carried over a second summer carry a higher risk since most Monochamus larvae mature in two years and damage is maximal.

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The central problem with wood borers in this region appears to be one of applying suitable techniques to estimate population abundance their hazard and damage in logs infested in a variety of forest conditions. Information thus gained can help managers set priorities in their operations, and thereby minimize losses from degrade. To help satisfy this need, a sequential sampling technique was developed by Safranyik and Raske (1970) which classifies the severity of damage from Monochamus larval holes on scattered and decked lodgepole pine logs into light, moderate and heavy in terms of expected monetary loss. This technique appears adequate for carrying out surveys of infested decked and scattered logs but requires testing, adapting and refinement in the following areas:

- a) The sequential plan was developed from small diameter-size lodgepole pine logs and should be tested on white spruce which is generally larger and is the more important commercial lumber species. Large diameter-size logs yield more worm-hole-free lumber than small diameter logs, consequently, overestimation of loss from the sampling plan could result. The depth of larval feeding also affects the amount of degrade and should be studied further.
- b) Preliminary studies of the distribution of Monochamus holes around log surfaces suggests that the pattern of entry holes may vary with size of log and with directional orientation. These aspects have an important bearing upon selecting the position for the sampling unit.
- c) The sampling plan assumes that survival of Monochamus larvae in the wood remains relatively constant, since it is based only upon a count of the number of larval entry holes. If mortality within the wood varies widely from area to area or from year to year, then expected losses could be overestimated or underestimated.
- d) The sampling plan may also be applicable for assessment of Monochamus abundance in standing freshly fire-killed timber but needs to be field-tested. Density of holes may vary with degree of scorched bark and with directional aspect.
- e) Relating wood borer infestation level to value loss requires a knowledge of lumber grading rules as they apply to "worm hole" damage. In this respect, new rules issued in 1970-71 suggest that degrade is effected mostly in dimension lumber where the emphasis is on structural strength, rather than appearance. Some adjustment in the sequential plan may be necessary to incorporate new grading rules.

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Studies during 1970-72 have involved a detailed examination of Monochamus in white spruce logs in northern Alberta, an examination of larval hole densities in decked logs and a study of potential losses in fire-killed infested timber in central Alberta. The studies provide some of the background information for improving the sampling technique and extending its application to white spruce, and answer some of the questions raised in (a), (b), (c) and (d) above.

9. Study Objectives:

1. Develop new, or improve existing sampling systems for estimating numbers of wood borer insects in logs of different dimension, species and for fire-killed, blowdown and freshly-cut trees decked and undecked.
2. Investigate complaints of clients and make recommendations for control of woodborers where possible.

10. Resources:

- a) Starting date: 1967 by A. G. Raske and T. Szabo
1970 by H. Cerezke
- b) Estimated year of completion: Continuous Revised: 1975
- c) Estimated total Prof. man years required: 1.0
- d) Essential new major equipment items for 1973/74 with costs: Nil
- e) Essential new major equipment items beyond 1974 with costs: Nil
- f) 1973-74 man-years Prof. .2
Supp.
Casual
Total .2 O & M funds req'd \$200.00

11. Progress to date: Up to 1972-73

The following summarizes progress by Raske.

Ecological and biological studies of Monochamus spp. and Tetropium spp. in Alberta were made. Other cerambycid and buprestid species were studied to a limited extent from pine and spruce logs; identifications of these were made.

A larval rearing program of wood borer species was undertaken with Dr. Gardiner of Sault St. Marie to establish species identity in larval stages. Hybridization studies were conducted with crosses of Monochamus oregonensis and M. scutellatus to establish their taxonomic relationships. The identification of chromosome pairs was assisted by Dr. G. Lanier.

Pine and spruce logs have been sampled in various parts of Alberta to establish densities of wood borers in decked and undecked logs, and in relation to position on log and position within decks. From the pine log data a sequential sampling plan was developed, with input by L. Safranyik, for estimating the degree of Monochamus infestations. Infested logs were sawn and the lumber product graded to establish a relationship between Monochamus damage intensity and percentage value-loss.

The effect of time-of-year of log felling was studied in relation to attack density of Monochamus. The study suggested that logs cut in the fall and early winter were least attractive to Monochamus during the following summer while logs felled during late winter, spring and early summer were most attractive.

Preliminary tests of the chemical PDB (Para-dichloro benzene) were made on small experimental log decks. Results of these tests for control of wood borer larvae were promising.

Various reports and publications have been prepared which summarize much of these data.

Studies by Cerezke were confined to a comprehensive examination of white spruce logs infested with Monochamus scutellatus. The results of this study show important differences in Monochamus development, survival, size of adults, attack density and damage characteristics along tree-length logs; study and analysis not completed until 1973. Log decks were sampled for comparison of sampling unit position on north and south aspects of logs; higher populations occurred on north aspect. These results can likely improve sampling design on decked and undecked white spruce logs (objective 1) and have some application for applying and interpreting control effects.

Information on wood borer damage and potential losses was provided to several agencies.

12. Goals for 1972-73:

Preparation of the following papers and reports by A. Raske were in progress up to 1972 and plans were to complete these as much as possible during 1972-73.

1. Wood borer control with plastic sheeting and fumigation with Para-Dichloro Benzene in conifer logs. Proposed Jour. publ.
2. Distribution of Monochamus larvae and other wood borer larvae within pine logs. Proposed jour. publ.

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3. Review of biology and control of Monochamus and Tetropium; the economic wood borers in Alberta. Internal Report.
4. Relationship between felling data and larval density of Monochamus scutellatus Say (Coleoptera:Cerambycidae).
5. Notes on the biology of Tetropium parvulum Casey (Coleoptera:Cerambycidae) in Alberta.
6. Tetropium parvulum elevated to species rank and contrasted to T. cinnamopterum in morphology and host preference (Coleoptera:Cerambycidae).
7. Taxonomic relationship between Monochamus scutellatus and M. oregonensis (Coleoptera:Cerambycidae).

Goals of Cerezke 1972-73

No intensive field studies are planned in 1972 since some time will be required to complete the analysis of the 1971 log-sample data for incorporation into the existing sampling techniques to estimate Monochamus. Some time will be made available for investigating complaints by forest agencies on wood borer problems and in providing advisory services on control and damage impact losses.

13. Accomplishments in 1972-73:

1. Status of reports 1 and 2 above is unknown. Report 3 completed (NOR-9). Papers 4, 5, 6 and 7 completed and submitted to Can. Ent.; their acceptance for publication unknown.
2. Analysis of data collected in 1971 nearly complete. Main points of information contributing directly to objective 1 are as follows:
 - a) density of Monochamus holes increases along log length from butt to top, but numbers of holes per unit length of log was constant along tree length. Degrade is therefore highest in tree-top logs.
 - b) on large size logs (i.e. greater than 12 ins.) density is greater on north aspect than on south, so that orientation of logs and log decks is important for obtaining representative samples.
 - c) the average distribution pattern of larval entry holes around the log agreed generally with that observed by Raske, except that the pattern changed from butt to top

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of tree. This could influence the selection of sampling units.

- d) Ave. maximum depth of feeding was about 3 ins. but appears to vary with condition of log and probably tree species.
 - e) percentage mortality of larvae after entry into wood was about 71% and agrees closely with studies made in Ontario.
 - f) larval gallery lengths decreased from butt to top of log.
 - g) about 30% of adults emerged after one year, 70% after 2 yrs.
3. Considerable 'editorial-time' provided on papers 3, 4, 5, 6 and 7 listed under item 12.
 4. Information provided to clients for three requests; each involved personal visits. One request involved an assessment of wood borer hazard in recently burnt timber, summarized in the following file report, NOR-Y-25 (1972).

Cerezke, H.F. and F.J. Emond. "An assessment of wood borer hazard in merchantable timber after the 1972 'Martin Hills Burn' (Fire No. DS 2-18), Slave Lake Forest, Alberta" 6 pp.

14. Goals for 1973-74:

1. No major field studies are planned but limited time will be made available to investigate requests of clients (objective 2)
2. Data analysis on 1971 log-samples will be completed and a report prepared (objective 1).
3. Contact other regions for 'extension handout' information on woodborer damage hazard and control and modify these or prepare a similar handout for clients in this region.

15. Publications:

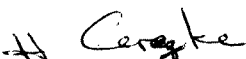
Publications and Reports up to 1972

1. Raske, A.G. 1969. Insect families common under bark in Alberta, annotated check list and keys. Internal Report A-24, 60 pp.

2. Safranyik, L. and A.G. Raske. 1970. Sequential sampling plan for larvae of Monochamus in lodgepole pine logs. Journ. Econ. Ent. 63:1903-1906.
3. Raske, A.G. and L. Safranyik. 1970. Sequential sampling plan for determining infestation and damage levels of Monochamus (Coleoptera:Cerambycidae) wood borers in decked lodgepole pine logs in Alberta. Int. Rep. A-26, 12 pp.
4. Lanier, G.N. and A.G. Raske, 1970. Multiple sex chromosomes and configuration polymorphism in the Monochamus scutellatusoregonensis complex (Coleoptera:Cerambycidae) Can. J. Genet. Cytol. 12:947-951.
5. Dahl, B.M. 1971. Mortality of Monochamus larvae in slash fires. Bi-Monthly Research Notes, 27:12.

Reports in 1972-73

1. Raske, A.G. 1972. Biology and control of Monochamus and Tetropium, the economic wood borers of Alberta (Coleoptera: Cerambycidae) Int. Rep. NOR-9, 48 pp.
 2. Cerezke, H.F. and F.J. Emond. 1972. An assessment of wood borer hazard in merchantable timber after the 1972 'Martin Hills Burn' (Fire No. DS 2-18), Slave Lake Forest, Alberta NOR-Y-25, 6 pp.
16. Signatures:



 H. Cerezke, Investigator



 Program Manager



 G.T. Silver, Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

 Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Reduction of losses from insects.
2. Title: Larch sawfly ecosystem measurement.
3. New Cont. X 4. No. NOR-8-059
5. Study Leader: W.G.H. Ives, J.A. Muldrew.
6. Key Words: Insect population dynamics life tables.
7. Location of Work: Manitoba and Edmonton.
8. Problem:

The objectives of NOR-8-098 can only be attained through analyses of a comprehensive body of data on the larch sawfly and its environment. To attain this, the major elements of the ecosystem in which the larch sawfly occurs must be monitored.

9. Study Objectives:
 1. To measure larch sawfly density in study plots.
 2. To measure the density of parasites and predators attacking the larch sawfly.
 3. To measure mortality attributable to various agents affecting the larch sawfly.
 4. To monitor weather and water level fluctuations in the study plots.
 5. To measure the amount of defoliation caused by the larch sawfly and the growth and survival of larch trees.
10. Resources:
 - a) Starting date: 1955.
 - b) Estimated year of completion: Indefinite Revised: 1972
 - c) Estimated total Prof. man-years required: 9 ?
 - d) Essential new major equipment items for 1973/74 with costs: Nil
 - e) Essential new major equipment items beyond 1974 with costs: Nil

f) 1973-74 man-years	Prof.	0	
	Supp	0	
	Casual	0	
	Total	0	0 & M funds req'd. 0

11. Progress to Date:

Sampling techniques for eggs, larvae, cocoons and adults of the larch sawfly were developed and standardized. Problems in measuring weather were solved by adapting available equipment for use in inaccessible areas without line power. Simple methods of measuring water table fluctuations and of estimating tree defoliation were developed. Most data have been processed, placed on punch cards, and preliminary summaries and analyses completed.

12. Goals for 1972-73:

Monitor larch sawfly populations and mortality factors, especially the parasite complex, in sufficient detail in three study plots to provide data for assessing the impact of Oleisicampe benefactor, Mesochorus dimidiatus and the Bavarian strain of Mesoleius tenthredinis on population trends.

13. Accomplishments in 1972-73:

Estimates of sawfly adult and cocoon populations on three study plots were obtained. The cocoons have been placed in rearing and will provide information on parasites and other mortality factors affecting the overwintering stage of the larch sawfly. Hygrothermograph and water level records for the three plots were also obtained.

14. Goals for 1973-74:

Nil. Study is terminated. Any monitoring of sawfly or parasite populations in previously established study plots will be undertaken in Study NOR-8-098.

15. Publications:

Up to 1972-73

Journal Publications:

Buckner, C.H. 1959. The assessment of larch sawfly cocoon predation by small mammals. Can. Ent. 91:275-282.

Heron, R.J. 1966. The reproductive capacity of the larch sawfly and some factors of concern in its measurement. Can. Ent. 98:561-578.

- Heron, R.J. 1968. Vital dyes as markers for behavioral and population studies of the larch sawfly, Pristiphora erichsonii (Hymenoptera:Tenthredinidae). Can. Ent. 100:470-475.
- Hinks, J.D. and J.A. Muldrew. 1968. Clearing and staining insect larvae to detect internal parasites. Manitoba Ent. 2:81-84.
- Ives, W.G.H. 1955. Estimation of egg populations of the larch sawfly. Can. J. of Zool. 33:370-388.
- Ives, W.G.H. 1959. A technique for estimating tamarack foliage production, a basis for detailed population studies of the larch sawfly. Can. Ent. 91:513-519.
- Ives, W.G.H. 1962. Population and mortality assessment during the egg and larval stages of the larch sawfly, Pristiphora erichsonii (Htg.) Can. Ent. 94:256-268.
- Ives, W.G.H. 1967. Determination of premature larval drop and other causes of larch sawfly mortality. Can. Ent. 99:1121-1131.
- Ives, W.G.H. and W.J. Turnock. 1959. Estimation of cocoon populations of the larch sawfly, Pristiphora erichsonii (Htg.) Can. Ent. 91:650-661.
- Ives, W.G.H., W.J. Turnock, C.H. Buckner, R.J. Heron and J.A. Muldrew. 1968. Larch sawfly population dynamics: techniques. Manitoba Ent. 2:5-36.
- Kemp, J.G., W.G.H. Ives and G. Hergert. 1965. A machine to prepare coniferous foliage samples for analysis. For. Chron. 48:248-251.
- Turnock, W.J. 1957. A trap for insects emerging from the soil. Can. Ent. 89:455-456.
- Turnock, W.J. 1960. Estimation of adult populations of the larch sawfly, Pristiphora erichsonii (Htg.) Can. Ent. 92:659-662.
- Turnock, W.J. and W.G.H. Ives. 1957. An instrument for measuring the radii of tree crowns. For. Chron. 33:355-357.
- Turnock, W.J. and W.G.H. Ives. 1962. Evaluation of mortality during the cocoon stage of the larch sawfly, Pristiphora erichsonii (Htg.) Can. Ent. 94:897-902.

Reports:

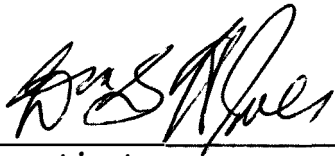
- Heron, R.J. and J.A. Drouin. 1969. Methods of collecting, rearing and handling the larch sawfly for experimental studies. Information Report MS-X-15 Forest Research Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., M.T. Onysko and D.G.H. Ray. 1964. Annual report of forest research technicians: larch sawfly populations dynamics studies, 1963. Interim Research Report, Forest Entomology Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., D.G.H. Ray and R. Smith. 1965. Annual report of forest research technicians: larch sawfly population dynamics studies, 1964. Interim Research Report, Forest Research Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., D.G.H. Ray and R.M. Smith. 1966. Annual report of forest research technicians: larch sawfly population dynamics study, 1965. Internal Report MS-32, Forest Research Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., R.M. Smith and M.J. Pocatello. 1966. Procedures manual for larch sawfly population dynamics studies, 1966. Internal Report MS-38 Forest Research Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., D.G.H. Ray, R.M. Smith and M.J. Pocatello. 1967. Annual report of forest research technicians; larch sawfly population dynamics studies, 1966. Internal Report MS-40, Forest Research Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., D.G.H. Ray, R.M. Smith, L. Campbell, and P. Mandziuk. 1968. Annual report of forest research technicians: larch sawfly population dynamics study, 1967. Internal report MS-65, Forest Research Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., R.M. Smith, D.G.H. Ray, R. Bilodeau and P. Mandziuk. 1969. Annual report of forest research technicians: larch sawfly population dynamics study, 1968. Internal Report MS-95, Forest Research Laboratory, Winnipeg, Manitoba.
- Drouin, J.A., R.M. Smith, R. Bilodeau and P. Mandziuk. 1970. Annual report of forest research technicians: larch sawfly population dynamics studies, 1969. File Report, Forest Research Laboratory, Winnipeg, Manitoba.
- Ives, W.G.H. 1958. Preliminary studies on the estimation of larval populations of the larch sawfly, Pristiphora erichsonii (Htg.). Interim Report 1958-3, Forest Biology Laboratory, Winnipeg, Manitoba.

Ives, W.G.H. 1960. Estimation of larval populations of the larch sawfly, Pristiphora erichsonii (Htg.). Interim Report, Forest Biology Laboratory, Winnipeg, Manitoba.

Ray, D.G.H. 1967. A portable automatic camera system for recording animal activity. Information Report MS-X-5. Forest Research Laboratory, Winnipeg, Manitoba.

1972-73: Nil.

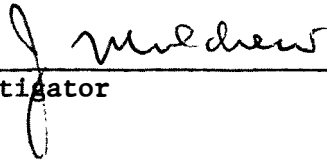
16. Signatures:



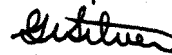
Investigator



Program Manager



Investigator



Director

CANADIAN FORESTRY SERVICE
STUDY STATEMENT
1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February 1973

1. Project: Reduction of losses from insects.
2. Title: Larch sawfly biological control.
3. New Cont. X 4. No.: NOR-8-061
5. Study Leader: J.A. Muldrew.
6. Key Words: Pristiphora erichsonii, Olesicampe benefactor,
Mesoleius tenthredinis, Mesochorus dimidiatus,
parasites, encapsulation, hyperparasites, Larix,
Boreal Region "B".
7. Location of Work: Throughout Northern Forest Region.
8. Problem:

This study is an attempt to control the larch sawfly by the introduction of exotic biotic natural enemies. Tamarack is the fastest growing conifer in the Boreal forest. If protection from the larch sawfly could be obtained there would undoubtedly be an increased use of tamarack for pulpwood, sawtimber, piling, poles, ties, veneer, etc., and its use in forest plantings would increase. Moreover, with sawfly control, Larix spp. would be used more frequently in park, boulevard and home-ground ornamental plantings. The benefits from success would be reduced mortality of tamarack and appreciable increases in the total incremental growth of tamarack and western larch. The increased vigor of tamarack would allow it to better fulfill its role in the ecology of the forest as a pioneer species invading areas not previously occupied by trees.

The project is a success to date in that host populations have been reduced to a low level in the areas where the parasite has been present for five or more years.

Because of the success in Manitoba, releases of O. benefactor have been made in New Brunswick, Nova Scotia, Prince Edward Island, Maine and Minnesota and consideration is being given to making releases in British Columbia and in the larch plantations of southern Ontario.

9. Study Objectives:
 1. To achieve control of the larch sawfly in North America.

2. To contribute to the population dynamics study of the larch sawfly by determining the factors affecting parasite effectiveness, abundance and impact. (This objective has been re-worded to reduce overlap with the objective of NOR-8-09 8).

The following two objectives are now included as a result of incorporating the former study NOR-088 into this one:

3. To monitor the spread of Olesicampe benefactor from release points in Manitoba and Saskatchewan.
4. To monitor the incidence of parasitism of O. benefactor by the hyperparasite Mesochorus dimidiatus Holmgren.

10. Resources:

- a) Starting date: 1950
- b) Estimated year of completion: 1975 Revised:
- c) Estimated total Prof. man-years required: 3
- d) Essential new major equipment items for 1973/74 with costs: Nil
- e) Essential new major equipment items beyond 1974 with costs: Nil
- f) 1973-74 man-years Prof. J.A. Muldrew 0.6
 Supp. R.M. Smith 0.4
 Casual -
 Total 1.0 0 & M funds req'd.\$400.00

11. Progress to Date:

The death of Mesoleius tenthredinis eggs in the resistant larch sawfly strain was found to be due to their encapsulation by host blood cells. The spread of the resistant strain from Manitoba almost to the limits of tamarack was monitored. A strain of M. tenthredinis from Bavaria was found to have a greater ability to avoid encapsulation in the resistant sawfly than had the "native" strain. Hybridization experiments showed this ability was transmitted as a dominant factor. Releases of this strain in Manitoba have resulted in lower levels of encapsulation and a progressively increasing percentage parasitism by M. tenthredinis. From 1961 to 1964, six species of parasites from overseas were released. One of these, Olesicampe benefactor, is well established. Parasites reared from hosts collected in Manitoba have been successfully relocated in Saskatchewan, New Brunswick, Nova Scotia and Maine. Where first released, parasitism reached a high level within three to four years and has remained high. Host densities have progressively decreased and life table data indicate that O. benefactor has played a key role in causing this. The parasite is dispersing well. Studies were completed on differentiating the smaller hosts parasitized by O. benefactor from the larger normal hosts. The hyperparasite Mesochorus dimidiatus, which attacks O. benefactor in Europe, was recovered from three release points in Manitoba. Studies in co-operation with the Entomology Research Institute, Ottawa, revealed that the hyperparasite had a holarctic distribution before O. benefactor was released in America.

In 1967, O. benefactor was recovered 1.7 miles north of the Pine Falls release point and 1.8 miles south. Corresponding figures for 1968 were 7.2 and 8.3 miles. In 1969 it was recovered about 45 miles from the release point and in 1970 had reached the Rennie life table plot, a distance of 65 miles. In 1971 a spectacular population explosion accompanied by long range dispersal was detected. The known distribution covered an egg-shaped area extending from Lake Winnipeg to Fort Frances and Ignace in Ontario, a maximum distance of about 225 miles from the point of release. The rates of parasitism averaged 90% for nearly half of the total area.

12. Goals for 1972-73:

1. As O. benefactor is rapidly invading the area selected as a possible site for a demonstration release, as mentioned above, the material collected in 1971 will be released near Pibroch, Wembley and Cold Lake in Alberta, and Hay River in N.W.T. At these locations cocoons typically parasitized by O. benefactor, as determined by size, will be placed out in screen cages in mid-May -- approximately 4,000 cocoons per location.
2. Mass collections of larch sawfly larvae in Manitoba to provide O. benefactor material for release in Alberta and Saskatchewan in 1973.
3. Continuation of impact and dispersal studies for O. benefactor, M. dimidiatus and the Bavarian strain of M. tenthredinis, as time permits.
4. Studies on the increase in percentage parasitism by O. benefactor as larch sawfly larval development proceeds to determine whether this is due to a greater rate of mortality amongst the "normal" sized host larvae and whether this is related to bird predation, as time permits.
5. Studies to determine the fecundities of O. benefactor and M. dimidiatus, as time permits.
6. Monitoring the Agassiz plot releases of 1971 and the St. Labre releases of 1970 and 1971.

13. Accomplishments in 1972-73:

1. The numbers of "small" larch sawfly cocoons, most of which contained hosts parasitized by O. benefactor, placed out in cages in the fall of 1972, and the numbers of parasites emerging were:

Location	No. of cocoons placed out	No. from which parasites emerged	Estimated* No. of	
			<u>Olesicampe benefactor</u>	<u>Mesochorus dimidiatus</u>
Jarvie, Alberta	4,573	1,203	1,139	64
Primrose Lake, Alta.	3,579	1,355	1,283	72
Grovedale, Alta.	4,366	495	469	26
Hay River, N.W.T.	4,269	904	856	48

* These estimates were based on rearings of representative samples made in May of 1972.

- Host larvae were scarce in 1972 in locations where collecting was excellent in 1971. From the larvae collected only 3,752 cocoons were reared of which approximately 55% were parasitized by O. benefactor.
- Most of the samples collected in the 1972 O. benefactor dispersal study have yet to be analyzed by the clearing technique but preliminary results indicate that O. benefactor has spread eastward and southward from the Pine Falls release site about 50 miles beyond the known 1971 boundary. The maximum distance of detected dispersal is now approximately 275 miles. Levels of parasitism by O. benefactor at points near the 1971 boundary of occurrence (Ignace, Fort Frances, etc.) increased from close to 0 in 1971 to about 50% in 1972.

The evidence to date indicates that O. benefactor is having a marked impact on larch sawfly density in areas where it has been present for five or more years. At the Pine Falls plot there has been a progressive decrease in host cocoons per acre from over 500,000 in 1964 to 871 in 1972. Accompanying this decline in host density has been a drop in percentage of hosts attacked from 91 to 85 to 50 in 1970, 71 and 72 respectively, indicating perhaps a state of balance will be reached at or near the present level of host density.

This degree of impact has occurred in spite of heavy attack by the hyperparasite Mesochorus dimidiatus in the Pine Falls plot (90% of the Olesicampe larvae were attacked by this secondary in 1971).

The Bavarian strain of Mesoleius tenthredinis which was attacking 63% of the sawflies in the Rennie plot by 1969 increased to an attack rate of 80% in 1970 (5% of hosts showing resistance). With the onset of high rates of parasitism by O. benefactor in this plot, however, (2% in 1970, 85% in 1971 and 72% in 1972), M. tenthredinis parasitism dropped to 43% in 1971 (23% of hosts showing resistance)

and to only 8% in 1972 (25% of hosts showing resistance). It seems evident that M. tenthredinis discriminates against hosts already attacked by O. benefactor, as was found by Pschorn-Walcher and Zinnert in Europe.

4. Analysis of special collections not yet completed.
5. Cage studies not carried out, due to insufficient time.
6. O. benefactor parasitism at the Agassiz plot increased from 69% in 1971 to 91% in 1972 indicating that the simultaneous release of M. dimidiatus had no detrimental effect. At St. Labre parasitism by O. benefactor is 47% but the estimation of parasitism by Bavarian M. tenthredinis here awaits rearings.

14. Goals for 1973-74:

1. The emphasis in 1973-74 will be on completing publications, the tentative titles of which are:
 - a) History and etiology of two major continental outbreaks of the larch sawfly in North America.
 - b) Dispersal of the introduced larch sawfly parasite, Olesicampe benefactor from the Pine Falls release point, 1966 to 1972.
 - c) Characteristics of Bessa harveyi (Diptera:Tachinidae) suggesting the historic introduction of the larch sawfly to North America. (By W.J. Turnock and J.A. Muldrew).
 - d) A literature review of parasites of the larch sawfly, worldwide.
 - e) Releases of Olesicampe benefactor in Alberta and the Northwest Territories in 1972. (Information Report).
2. Release of O. benefactor adults reared in Edmonton near Ellscoff, Alberta, where defoliation of large tamaracks was medium to heavy in 1972.
3. Monitoring the 1972 release points in Alberta and the N.W.T. for establishment of O. benefactor by collecting larvae both for rearing to the cocoon stage and for preservation for parasitism estimation by the clearing technique.
4. To monitor the dispersal of O. benefactor and M. dimidiatus in western Manitoba and Saskatchewan. (Responsibility for monitoring dispersal through Ontario will be given to the G.L.F.R.C.).

15. Publications:

Up to 1972-73

Journal publications:

Muldrew, J.A. 1950. Mesoleius aulicus, a parasite of the larch sawfly, Bi-mon. Prog. Rep., Can. Dep. Agric. 6(6):2.

- Muldrew, J.A. 1953. The natural immunity of the larch sawfly (Pristiphora erichsonii (Htg.)) to the introduced parasite (Mesoleius tenthredinis Morley), in Manitoba and Saskatchewan. *Can. J. Zool.* 31:313-332.
- _____ 1955. Parasites and insect predators of the larch sawfly. *Can. Ent.* 87:117-120.
- _____ 1956. Some problems in the protection of tamarack against the larch sawfly, Pristiphora erichsonii (Htg.) *For. Chron.* 32:20-29.
- _____ 1964. Liberation of Bavarian Mesoleius tenthredinis (Morl.) against the larch sawfly. *Bi-mon. Prog. Rep.*, *Can. Dep. For.* 20(2):2-3.
- Turnock, W.J. and J.A. Muldrew. 1964. Liberations of additional species of parasites against the larch sawfly. *Bi-mon. Prog. Rep. Can. Dep. For.* 20(2):3.
- Muldrew, J.A. 1964. The biological control program against the larch sawfly. *Proc. Ent. Soc. Man.* 20:63.
- _____ 1965. The biological control program against the larch sawfly. *Proc. North Cent. Br. Ent. Soc. Amer.* 20:157.
- _____ 1967. Biology and initial dispersal of Olesicampe (Holocremmus) sp. nr. nematorum (Hymenoptera:Ichneumonidae), a parasite of the larch sawfly recently established in Manitoba. *Can. Ent.* 99:312-321.
- Elliott, K.R. and J.A. Muldrew. 1967. A knockdown metal cage for rearing larch sawfly larvae. *Can. Ent.* 99(3):321-323.
- Hinks, J.D. and J.A. Muldrew. 1968. Clearing and staining insect larvae to detect internal parasites. *Manitoba Ent.* 2:81-84.
- Turnock, W.J. and J.A. Muldrew. 1971. Pristiphora erichsonii (Hartig), larch sawfly (Hymenoptera:Tenthredinidae). *In* Biological control programmes against insects and weeds in Canada 1959-1968. *Commonw. Inst. Biol. Contr. Tech. Commun.* 4, pp. 175-194.
- _____ 1971. Parasites. *In* Toward Integrated Control. Proceedings of the third Annual Northeastern Forest Insect Work Conference, New Haven, Connecticut. Feb. 17-19, 1970.

Reports:

Muldrew, J.A. 1953. Population studies on Bessa harveyi Bi-mon.
Prog. Rep. Dep. of Agric. 9(3):2.

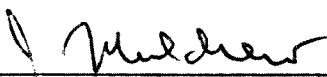
_____ 1959. Studies on the distribution and inheritance
of the resistance of the larch sawfly to Mesoleius
tenthredinis Morley. Interim Rept. For. Biol. Lab.,
Wpg. 52 pp.

Turnock, W.J. and J.A. Muldrew. 1964. Biological control attempts
against the larch sawfly, Pristiphora erichsonii (Htg.)
in Manitoba, 1961-1963. Information Rept. For. Ent. Lab.,
Wpg. 40 pp.

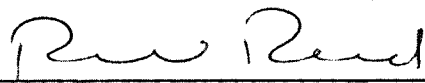
Muldrew, J.A. and W.J. Turnock. 1965. Biological control attempts
against the larch sawfly, Pristiphora erichsonii (Hartig),
1964. Interim Res. Rept. Forest Ent. Lab., Wpg. 35 pp.

Muldrew, J.A. 1965. Biological control against the larch sawfly
Pristiphora erichsonii (Htg.) in Canada. Interim Res.
Rept. Forest Ent. Lab., Wpg. 73 pp.

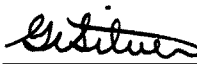
16. Signatures:



Investigator



Program Manager



Director

CANADIAN FORESTRY SERVICE

STUDY STATEMENT

1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: February, 1973

1. Project: Reduction of losses from insects.
2. Title: Natural control of the larch sawfly.
3. New Cont. X 4. No.: NOR-8-098
5. Study Leader: W.G.H. Ives and J.A. Muldrew.
6. Key Words: Pristiphora erichsonii, Larix, population dynamics, ecosystem modelling, biological control.
7. Location of Work: Manitoba and Edmonton.
8. Problem:

Since 1940, defoliation by the larch sawfly has severely affected larch growth and survival throughout Canada. Because of these attacks, larger trees have died - younger trees have failed to produce normal growth. Unless methods of preventing larch sawfly attacks can be developed, large areas of land will continue to be unproductive and planting programs utilizing larch for fibre production or aesthetic purposes cannot be encouraged.

The large body of data amassed since the study of larch sawfly population dynamics was started in 1956 has never been thoroughly analyzed. This study was established to undertake these analyses.

9. Study Objectives:
 1. To elucidate the population dynamics of the larch sawfly by exploring the ecological relationships between the insect and its environment.
 2. To expose possible methods of reducing the damage done by the larch sawfly.
 3. To determine the effects of sawfly defoliation of host stands.
10. Resources:
 - a) Starting date: 1966
 - b) Estimated year of completion: Original: Indefinite. Revised: 1976

c)	Estimated total Prof. man-years required:	26	
d)	Essential new major equipment items for 1973/74 with costs:	Nil	
e)	Essential new major equipment items beyond 1974 with costs:	Nil	
f)	1973-74 man-years Prof.		
	W.G.H. Ives	0.2	
	J.A. Muldrew	0.2	
	Supp. R.M. Smith	0.4	
	Casual	0	
	Total	.8	O & M funds req'd. \$600.00

11. Progress to Date:

The major effort within this project has been in planning and directing the implementation of projects designed to develop and test sampling techniques, to determine the relationships between variables in the system, and to apply existing analytical procedures to the population data. Comprehensive syntheses have been delayed because the sawfly populations were declining throughout most of the history of the project. A minor peak of populations occurred in the years 1965-1968 and the data now cover an almost complete gradation.

Sampling procedures have been thoroughly reviewed. Essential data for studying the impact of Olesicampe benefactor, Mesochorus dimidiatus and the Bavarian strain of Mesoleius tenthredinis can be collected with less staff than previously utilized by eliminating time-consuming or specialized sampling procedures. The first category has been dictated by cuts in student support, the latter by loss of key personnel.

Flow charts have been prepared outlining procedures to be followed for calculating the proportions falling into various categories for data collected on larvae at three periods in the life cycle: 1) feeding larvae; 2) falling larvae; and 3) larvae in cocoons. These data sources provide a comprehensive set of estimates of the various parameters and require approximately 300 different estimates to give all possible combinations of factors. Summaries of mortality and survival based on samples of feeding larvae, falling larvae and larvae in cocoons have been prepared. Data on adult populations have been coded and have been sent to Biometrics Research Services for key punching.

12. Goals for 1972-73:

1. To determine the relative importance of various mortality factors affecting the immature stages of the large sawfly.
2. To analyze larch sawfly population and mortality data to determine the relationships between population trends and the biological and physical components of the environment.
3. To evaluate the role of recently introduced parasites in population regulation.

13. Accomplishments in 1972-73:

Limited technical support is available for this study, and work has only just started (Feb.6) on the first goal. By the end of the current fiscal year, considerable progress should have been achieved towards meeting Goals 1 and 3, but little progress will have been made on Goal 2.

14. Goals for 1973-74:

1. To complete preliminary investigations on the relative importance of various mortality factors affecting the immature stages of the larch sawfly.
2. To initiate preliminary analyses of larch sawfly population and mortality data to determine the relationships between population trends and the biological and physical components of the environment.
3. To complete preliminary evaluations of the role of recently introduced parasites in population regulation.
4. To obtain cocoon population and mortality estimates for three study plots in Manitoba (Pine Falls, Rennie and Seddon's Corner).

15. Publications:

Up to 1972-73:

Journal Publications:

Anonymous. 1964. Larch Investigation Team of Winnipeg. Population dynamics of the larch sawfly Can. Ent. 96:160-161.

Buckner, C.H. 1957. Population studies on small mammals of south-eastern Manitoba. Jour. Mammal. 38:87-97.

Buckner, C.H. 1957. Home range of Synaptomys cooperi. J. Mammal. 38:132.

Buckner, C.H. 1958. Mammalian predators of the larch sawfly in eastern Manitoba. Proc. Tenth Internat. Congr. Ent. (1956) 4:353-361.

Buckner, C.H. 1959. Mortality of cocoons of the larch sawfly, Pristiphora erichsonii (Htg.) in relation to distance from small-mammal tunnels. Can. Ent. 91:535-542.

Buckner, C.H. 1964. Metabolism, food capacity and feeding behavior in four species of shrews. Can. J. Zool. 42:259-279.

- Buckner, C.H. 1966. Populations and ecological relationships of shrews in tamarack bogs of southeastern Manitoba. *J. Mammal.* 47:181-194.
- Buckner, C.H. and W.J. Turnock. 1965. Avian predation on the larch sawfly *Pristiphora erichsonii* (Htg.) (Hymenoptera: Tenthredinidae). *Ecology* 46:223-236.
- Heron, R.J. 1960. The relative effects of cocoon submergence on the mortality of the larch sawfly, *Pristiphora erichsonii* (Hymenoptera:Tenthredinidae) and its parasite *Bessa harveyi* (Diperta:Tachinidae). *Ann. Ent. Soc. Am.* 53:476-481.
- Heron, R.J. 1961. A note on temperature and postdiapause development of the larch sawfly and its parasite *Bessa harveyi* (Tnsd.) *Can. Ent.* 93:431-433.
- Heron, R.J. 1967. Heat tolerance of last-instar larvae of the larch sawfly. *Can. Ent.* 99:1150-1156.
- Heron, R.J. 1971. Temperature tolerance of pronymphs and pupae of the larch sawfly. *Can. Ent.* 103:1153-1155.
- Ives, W.G.H. 1958. Foliage and shoot production of tamarack as factors in population studies of the larch sawfly, *Pristiphora erichsonii* (Hartig). *Proc. Tenth Int. Congr. Ent.* (1956) 4:407-416.
- Ives, W.G.H. 1960. Developmental rates of larch sawfly (*Pristiphora erichsonii* (Htg.)). Larvae in an insectary and in field shelters. *Can. Ent.* 92:668-674.
- Ives, W.G.H. 1963. Effects of defoliation on survival of the larch sawfly *Pristiphora erichsonii* (Htg.) *Can. Ent.* 95:887-892.
- Ives, W.G.H. 1967. Relations between invertebrate predators and prey associated with larch sawfly eggs and larvae on tamarack. *Can. Ent.* 99:607-622.
- Ives, W.G.H. 1968. Larch sawfly survival in relation to water levels and microtopography in tamarack bogs. *Can. Ent.* 100:373-385.
- Ives, W.G.H. and L.D. Nairn. 1966. Effects of water levels on overwintering survival and emergence of the larch sawfly in a bog habitat. *Can. Ent.* 98:768-777.
- Ives, W.G.H. and L.D. Nairn. 1966. Effects of defoliation on young upland tamarack in Manitoba. *For. Chron.* 42:137-142.
- Mott, D.G., L.D. Nairn and J.A. Cook. 1957. Radial growth in forest trees and effects of insect defoliation. *Forest Sci.* 3:286-304.

- Nairn, L.D., W.J. Turnock, W.G.H. Ives and C.H. Buckner. 1961. Investigations of the population dynamics of the larch sawfly in Manitoba. Proc. Ent. Soc. Manitoba. 17:31-46.
- Turnock, W.J. 1960. Ecological life history of the larch sawfly, Pristiphora erichsonii (Htg.) (Tenthredinidae:Hymenoptera) in Manitoba and Saskatchewan. Can. Ent. 92:500-516.
- Turnock, W.J. and J.C.E. Melvin. 1963. The status of Bessa harveyi (Tnsd.) (Diptera:Tachinidae) Can. Ent. 95:646-654.

Reports:

- Ives, W.G.H. 1960. A preliminary study of the wandering of starved larch sawfly larvae. Interim Rept., For. Biol. Lab., Wpg. 9 pp.
- Ives, W.G.H. 1964. Temperatures on or near an exposed tamarack tree. Interim Res. Rept., For. Entomol. Lab.; Wpg. 12 pp.
- Ives, W.G.H. 1968. Weather and larch sawfly survival. Inform. Rept. MS-X-11, For. Res. Lab., Wpg. 28 pp.
- Turnock, W.J. 1956. Preliminary life tables for the larch sawfly. Interim Rept. 1955-7, For. Biol. Lab., Wpg. 15 pp.
- Turnock, W.J. 1959. Emergence of the larch sawfly, Pristiphora erichsonii (Htg.), in relation the soil temperature and weather patterns. Interim Rept. 1958-5, For. Biol. Lab., Wpg. 130 pp.
- Turnock, W.J. 1963. Cocooning behavior of larch sawfly larvae in a wet environment. Interim Res. Rept., For. Ent. Lab., Wpg. 12 pp.
- Turnock, W.J. 1963. Soil temperatures in an upland and two bog habitats. Interim. Res. Rept., For. Ent. Lab., Wpg. 29 pp.
- Turnock, W.J. 1963. Effects of partial starvation on larch sawfly larvae. Interim Res. Rept., For. Ent. Lab., Wpg. 11 pp.
- Turnock, W.J. 1964. Prolonged diapause in the larch sawfly. Interim Res. Rept., For. Ent. Lab., Wpg. 15 pp.
- Turnock, W.J. and J.A. Garland. 1965. Coleopterous predators of larch sawfly cocoons. Int. Rept. MS-9, For. Res. Lab., Wpg. 24 pp.


1972-73:

Journal Publications:

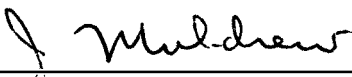
Heron, R.J. 1972. Differences in postdiapause development among geographically distinct populations of the larch sawfly, Pristiphora erichsonii (Hymenoptera:Tenthredinidae) Can. Ent. 104:1307-1312.

Turnock, W.J. 1972. Geographical and historical variability in population patterns and life systems of the larch sawfly. (Hymenoptera:Tenthredinidae). Can. Ent. 104:1883-1900.

16. Signatures:


Investigator


Program Manager


Investigator


Director

CANADIAN FORESTRY SERVICE
STUDY STATEMENT
1973 - 74

Responsibility Centre: NORTHERN FOREST RESEARCH CENTRE

Date: March 1973

1. Project: Reduction of losses from insects.
2. Title: Biological control of forest tent caterpillar.
3. New: X Cont.: 4. No.: NOR-8-133
5. Study Leader: J. A. Muldrew.
6. Key Words: Malacosoma disstria, Sarcophaga aldrichi, Pseudosarcophaga affinis, parasites, nuclear-polyhedrosis virus, Boreal Region "B", trembling aspen (Populus tremuloides).
7. Location of Work: Northern Forest Research Centre and Region.
8. Problem:

The forest tent caterpillar shows large population fluctuations with outbreaks of 3 - 6 years duration occurring at intervals of 6 - 16 years. Successive complete defoliation for three or more years can cause death of aspen but the more common effect is a reduction of diameter growth of up to 90%. Aesthetic benefits in recreation areas and home sites are reduced. Complaints and requests for control are common during outbreaks. Probability of success: good to excellent. Probability of results being put into practice: high.

9. Objectives:

To control outbreaks of the forest tent caterpillar in selected areas and reduce the duration and severity of outbreaks over larger areas by the introduction of large numbers of virus-carrying parasites to initiate epizootics.

It is planned to develop methods of mass-rearing adults of Sarcophaga aldrichi and Pseudosarcophaga affinis and release them in considerable numbers during the initial stages of an outbreak in selected localities. Areas where outbreaks of the host are likely to occur will be determined using the method outlined by W.G.H. Ives (1973, In Press) using weather data. Adult parasites will be contaminated with nuclear and possibly cytoplasmic polyhedrosis virus shortly before releasing them into a population (possibly by spraying them with a suspension of the viruses). Since only the early stages of the host are susceptible to the N.P.V., increased control from this disease would be hoped for in the generation following the spraying. Since third to fifth instar hosts are susceptible to the C.P.V., this disease may produce more control in the year

of release. Control populations will be studied. G. R. Stairs (Can. Ent. 98:1100) sprayed virus over small areas of an infestation in 1963 and found that it had spread over 700 square miles by 1965. He concluded further that "S. aldrichi in the system may be essential to the rapid development of epizootics" (Ann. Rev. Ent. 1972, 17:355). The possibility of obtaining contaminated parasite adults by incorporating virus in the larval food medium will be studied.

10. Resources:

- a) Starting date: 1973
 - b) Estimated year of completion: 1976
 - c) Estimated total Prof. man-years required: 4
 - d) Essential new major equipment items for 1973/74 with costs: Nil
 - e) Essential new major items beyond 1974 with costs:
 - f) 1973-74 man-years

Prof. J.A. Muldrew	.2	
Supp. R.M. Smith	.2	
Casual		
Total		0.4
- O & M funds required: \$100

11. Progress to Date: Nil results prior to 1972-73.

12. Goals for 1972-73:

- 1. Make a literature survey, select potential experimental sites and establish the experiment design.
- 2. Collect puparia of S. aldrichi and P. affinis (up to 500) for preliminary testing of the rearing method during the winter of 1972-73.

13. Accomplishments in 1972-73:

- 1. The literature survey is well along. Consultation with the Insect Pathology Research Institute is to be initiated to work up the experimental design.
- 2. Fourteen collections of forest tent caterpillar cocoons were made (averaging 278) in eastern Manitoba. They were reared until adult host and parasite emergence was complete and then examined. Parasite larvae found feeding in the cocoons were reared on salmon and liver to the puparium stage. Adult moth emergence averaged 40%, hymenopterous parasitism 11% and dipterous parasitism 50%. Well over 500 dipterous puparia were obtained.


14. Goals for 1973-74:


- 1. To develop laboratory rearing methods for the dipterous parasites.
- 2. To obtain virus material and investigate laboratory propagation.


3. To collect a supply of dipterous parasite puparia for further experimentation.

15. Publications: Nil

16. Signatures:


Investigator


Program Manager


Director