# Report of the Seventeenth Annual Forest Pest Control Forum

Government Conference Centre, Ottawa, Ontario

November 14-16, 1989

# Rapport du dix-septième colloque annuel sur la répression des ravageurs forestiers

Centre des conférences du Gouvernement, Ottawa (Ontario)

Du 14 au 16 novembre 1989



Forestry Canada Forêts Canada

**Report of the**
**Seventeenth Annual Forest Pest Control Forum**
**Government Conference Centre**
Ottawa, Ontario
November 14-16, 1989

**Rapport du**
**Dix-septième colloque annuel**
**sur la répression des ravageurs forestiers**
**Centre de conférences du Gouvernement**
Ottawa (Ontario)
Du 14 au 16 novembre 1989

The Forest Pest Control Forum is held under the aegis of Forestry Canada to provide the opportunity for representatives of provincial and federal governments and private agencies to review and discuss forest pest control operations in Canada and related research.

Le colloque sur la répression des ravageurs forestiers de déroule sous l'égide du Forêts Canada dans le but de donner l'opportunité aux représentants des gouvernements fédéral et provinciaux ainsi qu'aux organismes privés de passer en revue et de discuter les activités relatives à la répression des ravageurs forestiers, de même que la recherche connexe.

B.H. Moody
Forestry Canada/Forêts Canada
Ottawa, Ontario/Ottawa (Ontario)
June 1990 / Juin 1990

## CONTENTS/TABLE DES MATIÈRES

## LIST OF ATTENDEES
## LISTE DES PERSONNES PRÉSENTES

**United States Forest Service**
Dan R. Kucera, Broomall, PA

**Maine Forest Service**
H. Trial, Augusta

**Newfoundland Department of Forest Resources and Lands**
H. Crummey, St. John's

**Nova Scotia Department of Lands and Forests**
T.D. Smith, Truro

**New Brunswick Department of Natural Resources**
N.E. Carter, Fredericton

**New Brunswick Department of Environment**
Wendy Sexsmith, Fredericton

**Quebec Department of Energy and Resources**
Michel Auger, Quebec
Pierre-M. Marotte, Quebec
Louis Dorais, Quebec

**Ontario Ministry of Natural Resources**
J. Churcher, Sault Ste. Marie
G. Munro, Sault Ste. Marie

**Department of Natural Resources Manitoba**
R. Westwood, Winnipeg (Chairperson)

**Saskatchewan Department of Parks and Renewable Resources**
M. Pandila, Prince Albert

**Research and Productivity Council**
Charles J. Wiesner, Fredericton

**J.D. Irving Limited**
B. Brunsdon, Saint John

**Canadian Pulp and Paper Association**
Jean-Pierre Martel, Montreal

**Syndicat Producteur Debois BSL**
D. Pineault

**University of Toronto**
R. Carrow

**Department of Fisheries and Oceans**
Barry Hobden, Winnipeg

**Environment Canada**
Ian Nicholson, Pesticides Division, Ottawa

**Environmental Protection Service**
Bill Ernst, Dartmouth, N.S.

**Canadian Wildlife Service**
Peter A. Pearce, Fredericton

**Federal Pesticide Registration Review**
G. Leblond

**Agriculture Canada**
D. Walter, Plant Health Division, Ottawa
H. Krehm, Plant Health Division, Ottawa
Rosalyn McNeil, Plant Health Division, Ottawa
Al Schmidt, Plant Health Division, Ottawa
J.A. Garland, Plant Health Division, Ottawa
R.G. Taylor, Pesticides Directorate, Ottawa
J.E. Irvin, Pesticides Directorate, Ottawa
A. MacDonald, Pesticides Directorate, Ottawa
M. Sarazin, Biosystematics, Ottawa
J.S. Kelleher, Biosystematics, Ottawa

**Forestry Canada**
G.A. Van Sickle, Victoria
R.F. Shepherd, Victoria
H. Cerezke, Edmonton
L. Magasi, Fredericton
P.C. Nigam, Fredericton
E. Kettela, Fredericton
L.J. Lanteigne, Fredericton
A. Juneau, Ste. Foy
D. Lachance, Ste. Foy
G.M. Howse, Sault Ste. Marie
A. Retnakaran, Sault Ste. Marie
B.V. Helson, Sault Ste. Marie
K. Barber, Sault Ste. Marie
E.T. Caldwell, Sault Ste. Marie (chairperson)
R.A. Campbell, Sault Ste. Marie
B.L. Cadogan, Sault Ste. Marie
Gary Grant, Sault Ste. Marie
Mike Power, PNFI
C.J. Sanders, Sault Ste. Marie
John Hudak, St. John's
Les Carlson, Ottawa
Peter Hall, Ottawa

John Cunningham, Sault Ste. Marie
J.C. Mercier, Ottawa
Denyse Rousseau, Ottawa (chairperson)
B.H. Moody, Ottawa (secretary)

**Other**
C. Buckner
M. Stemeroff

## NOTICE OF 1990 MEETING

The Eighteenth Annual Forest Pest Control Forum

will be held in

Centennial Room, 5th Floor

Government Conference Centre

2 Rideau Street, Ottawa

November 20, 21, 22, 1990

(8:30 a.m. - 4:00 p.m.)

## Avis de la réunion de 1990

Le dix-huitième colloque annuel

sur la répression des ravageurs forestiers

aura lieu dans le

Salon Centennial, 5e étage

Centre de conférence du Gouvernement

2, rue Rideau, Ottawa

du 20, 21, 22 novembre 1990

(de 8:30 h à 16:00 h)

# Agenda

**Seventeenth Annual Forest Pest Control Forum**
**Government of Canada Conference Centre**
**2 Rideau Street**
**Sussex Room, 1st Floor**
**Ottawa, Ontario**

**November 14, 15, 16, 1989**
**8:30 a.m. - 5:00 p.m.**

**Tuesday, November 14**

**Session I** - Chairperson - Denyse Rousseau, Forestry Canada, Director of Protection

8:30 - 9:00 1.1 Introductory Address - J.C. Mercier, Forestry Canada Deputy Minister

1.2 Remarks and Introductions - B. Moody, Forum Secretary

**Session II** - Forest Insect and Disease Status and Control Operation Summaries - D. Rousseau (Session Chairperson)

9:00 - 10:00 This Session will consist of round-the-table summary reports from each regional FIDS head on all pests of significance and control operation summaries from provincial representatives. Presenters should limit their talks to max. of 15 minutes.

| Order (to be reversed in 1990) | FIDS Report | Control Operation Summary |
|---|---|---|
| 2.1 | Nfld.- J. Hudak | H. Crummey - Nfld. |
| 2.2 | Maritimes- L. Magasi | N. Carter - N.B.<br>T. Smith - N.S.<br>L. Magasi - P.E.I. |
| 2.3 | Quebec- D. Lachance | M. Auger - Que.<br>L. Dorais - Que.<br>A. Juneau - Que. |
| 2.4 | Ontario- G. Howse | G. Munro - Ont.<br>C. Howard - Ont.<br>T. Meyer - Ont. |

| Order (to be reversed in 1990) | FIDS Report | Control Operation Summary |
|---|---|---|
| 2.5 | Prairies- H. Cerezke & NWT | R. Westwood - Man. M. Pandila - Sask. |
| 2.6 | B.C.-G. van Sickle and Yukon | G. van Sickle for B. Deboo - B.C. |
| 2.7 | United States - D. Kucera, H. Trial, D. Struble | |
| 2.8 | Discussion & Summary | Director, Protection, Forestry Canada, FIDS Chairperson & participants |

10:00 - 10:15 Coffee

10:15 - 12:00 Session II continues

12:00 - 1:00 Lunch

1:00 - 3:00 Session II continues

3:00 - 3:15 Coffee

Session III - Issues Debate Chairperson - G. Munro

3:15 - 5:00 3.1 - Report on progress for 1988 recommendations
3.2 - Discussion and debate on selected items
NOTE: Forum members should ensure that issues/recommendations for debate are properly documented and submitted to the Forum Secretary before the Forum so that these can be discussed at the Steering Committee meeting the day prior to the Forum.

Wednesday, November 15

Session IV

8:30 - 10:00 Vegetation Management Summaries - R. Campbell (Session Chairperson)

4.1 Summary report from ECW - R. Campbell
4.2 Report from Canadian Forest Nursery Weed Management Association - L. Lanteigne
4.3 Report from Canadian Vegetation Management Association - P. Reynolds
4.4 Round-the-table regional summaries of vegetation management problems and control operations - provincial and regional Forestry Canada representatives
B.C., Prairies, Ont., Que., Maritimes, Nfld., United States
4.5 General Discussion

10:00 - 10:15 Coffee

10:15 - 12:00 Session III continues

12:00 - 1:00 Lunch

<u>Session V</u> Regulatory Considerations - Errol Caldwell (Session Chairperson)

1:00 - 3:00
5.1 Registration and regulatory update - J. Irvine, R. Taylor
5.2 Update on Registration Review Process - G. Leblond
5.3 Report on Forest Pesticide Economic Benefit Assessments - M. Stemeroff
5.4 Minor Use of Pesticides Program - R. McNeil
5.5 Pest Risk Assessment - B. Blangez
5.6 CPPA Activity Update - J.-P. Martel

3:00 - 3:15 Coffee

3:15 - 5:00 Session III Issues Debate continues - G. Munro

<u>Thursday, November 16</u>

<u>Session VI</u> Research, Monitoring and Other Reports - E. Kondo (Session Chairperson)

General

8:30 - 10:00 6.1 FPMI Research Highlights - E. Kondo, E. Caldwell
6.2 Biotechnology Activities - E. Kondo
6.3 FC-Maritimes Insect Management Research - E. Kettela
6.4 SERG - A Reveiew of Current and Proposed Research - C.J. Wiesner
6.5 Report on Forest Pesticides Caucus Activities - R. Carrow

Insect Control Research

6.6 Results of 1989 Gypsy Moth Trial - J. Cunningham
6.7 Timing Permethrin Applications for Spruce Budmoth Control - B. Helson
6.8 White Pine Weevil and Spruce budmoth Control: some new findings - A. Retnakaran
6.9 The use of entomophilic nematodes in 1989 field experiments against *Zeiraphera canadensis* and *Hylobius congener* - E. Kettela for D. Eidt

Vegetation Control Research

6.10 Herbicide Trials to Control *Kalmia* in Newfoundland in 1989 - B. Titus
6.11 Other

Environmental Research and Monitoring

6.12 *B.t.* nontarget Impact Studies - K. Barber
6.13 Round-the-table monitoring reports, specific environmental research projects and reports relating to environmental concerns of forest pest managment practices are to be covered here.

10:00 - 10:15 Coffee

10:15 - 12:00 Session VI continues

12:00 - 1:00 Lunch

1:00 - 2:00 Session VI continues

2:00 - 3:00 Session III Issues Debate - continues

Forum Wrap-up & Concluding remarks - Director, Protection - Forestry Canada

3:00 - 5:00 Steering Committee meets

## WORKSHOPS

Monday, Nov. 13, Laurier Room, Centennial Bldg., 200 Kent Street

- Committee for Review and Improvement of Survey Assessment Techniques - CRISAT - M. Auger (Chairperson)
- Pheromone Trapping Working Group - G. Grant (Chairperson) joint meeting with CRISAT 9:00 a.m. - 3:00 p.m.
- Pest Control Forum Steering Committee - D. Rousseau (Chairperson) - 3:00 p.m. - 5:00 p.m.

Thursday, Nov. 16, Conference Centre, 2 Rideau Street

- Environmental Monitoring Committee Eastern Spruce Budworm Council
- Approaches to the evaluation of the merits and value of *B.t.* products for forest pest management: Panel Discussion and Open Forum - J. Irvine (Chairperson) - 1 p.m.

Friday, Nov. 17, Conference Centre, 2 Rideau Street

- FIDS Heads Meeting (closed session) - D. Rousseau (Chairperson) - 8:30 a.m. - 5:00 p.m.
- National Forestry Pesticides Caucus meeting - E. Caldwell - 9:00 a.m. - 12:00 p.m.

**NOTE**: 1) Other meetings can be scheduled for Friday, Nov. 17 if required. Please inform the Secretary of requirements.

2) There is a possibility that the formal presentations may be completed by Thursday morning; and Friday workshops and FIDS meeting could commence on the Thursday afternoon.

# Ordre du jour

17e Forum annuel sur la répression des ravageurs forestiers
Centre des conférences du gouvernement du Canada
2, rue Rideau
Salle Sussex, 1er étage
Ottawa (Ontario)

Les 14, 15 et 16 novembre 1989
De 8 h 30 à 17 h

## Le mardi 14 novembre

**Première séance** - Présidente: Denyse Rousseau, Forêts Canada, directrice de la Protection

8 h 30 à 9 h — 1.1 Allocution liminaire - J.C. Mercier, sous-ministre de Forêts Canada

1.2 Observations et présentations - B. Moody, secrétaire du forum

**Deuxième séance** - Renseignements d'actualité sur les insectes et les maladies des arbres et résumés des activités de répression - D. Rousseau (présidence de la séance)

9 h à 10 h — Tour de table donnant lieu à la présentation des rapports sommaires de chaque chef régional du RIMA sur les ravageurs d'intérêt et des résumés des activités de répression par les représentants provinciaux. Temps maximal alloué par présentation: 15 minutes.

| Ordre de présentation (à être inversé en 1990) | Rapport du RIMA | Résumé des activités de répression |
|---|---|---|
| 2.1 | Terre-Neuve-J. Hudak | H. Crummey - T.-N. |
| 2.2 | Maritimes - L. Magasi | N. Carter - N.-B.<br>T. Smith - N.-É<br>L. Magasi - I. P.-É |
| 2.3 | Québec - D. Lachance | M. Auger - Qc<br>L. Dorais - Qc<br>A. Juneau - Qc |
| 2.4 | Ontario - G. Howse | G. Munro - Ont.<br>C. Howard - Ont.<br>T. Meyer - Ont. |

| Ordre de présentation (à être inversé en 1990) | Rapport du RIMA | Résumé des activités de répression |
|---|---|---|
| 2.5 | Prairies et Territoires du Nord-Ouest- H. Cerezke | R. Westwood - Man. M. Pandila - Sask. |
| 2.6 | Colombie-Britannique et Yukon - G. van Sickle | G. van Sickle, pour B. Deboo - C.-B. |
| 2.7 | États-Unis - D. Kucera, H. Trial et D. Struble | |
| 2.8 | Discussion et résumé | Directrice de la Protection, Forêts Canada, porte-parole du RIMA et participants |

10 h à 10 h 15 Pause-café

10 h 15 à 12 h Reprise de la séance

12 h à 13 h Repas du midi

13 h à 15 h Reprise de la séance

15 h à 15 h 15 Pause-café

Troisième séance - Débat des questions - Président: G. Munro

15 h 15 à 17 h 3.1 Rapport sur les suites données aux recommandations de 1988

3.2 Discussion et débat de certaines questions
**NOTA** - Les questions et recommandations à débattre doivent être bien étoffées et transmises à l'avance au secrétaire du forum pour qu'elles soient discutées à la réunion du Comité directeur le jour précédant le forum.

Le mercredi 15 novembre

Quatrième séance

8 h 30 à 10 h Résumés portant sur la répression de la végétation - R. Campbell (Président de la séance)

4.1 Rapport sommaire du CEM - R. Campbell

| | | |
|---|---|---|
| | 4.2 | Rapport de la Canadian Forest Nursery Weed Management Association - L. Lanteigne |
| | 4.3 | Rapport de la Canadian Vegetation Management Association - P. Reynolds |
| | 4.4 | Table ronde donnant lieu à la présentation de résumés régionaux des problèmes de répression de la végétation et des activités de répression - représentants provinciaux et régionaux de Forêts Canada, C.-B., Prairies, Ont., Qc, Maritimes, T.-N., É.-U. |
| | 4.5 | Discussion générale |

10 g à 10 15 — Pause-café

10 h 15 à 12 — Reprise de la séance

12 h à 13 h — Repas du midi

<u>Cinquième séance</u> — Considérations sur la églementation - Errol Caldwell (Président de la séance)

13 h à 15 h

5.1 Renseignements d'actualité sur l'homologation et la réglementation - J. Irvine et R. Taylor
5.2 Renseignements d'actualité sur le processus d'examen de l'homologation - G. Leblond
5.3 Rapport sur l'évaluation des avantages économiques des pesticides forestiers - M. Stemeroff
5.4 Utilisation mineure du programme concernant les pesticides - R. McNeil
5.5 Évaluation des risques posés par les ravageurs - B. Blangez
5.6 Renseignements d'actualité sur les activités de l'Association canadienne des producteurs de pâtes et papiers - J.-P. Martel

15 h à 15 h 15 — Pause-café

15 h 15 à 17 h — Reprise de la séance sur le débat des questions - G. Munro

<u>Le jeudi 16 novembre</u>

<u>Sixième séance</u> — Recherche, surveillance et autres rapports - E. Kondo (président de la séance)

## Généralités

8 h 30 à 10 h

6.1 Points saillants de la recherche du RIMA - E. Kondo et E. Caldwell
6.2 Activités biotechnologiques - E. Kondo
6.3 Forêts Canada - recherche sur la répression des insectes dans les Maritimes - E. Kettela
6.4 Groupe de recherche sur l'efficacité des épandages - examen des travaux de recherche courants et proposés - C.J. Wiesner
6.5 Rapport sur les activités du comité des pesticides forestiers - R. Carrow

## Recherche sur la répression des insectes

6.6 Résultats des essais de 1989 pour la spongieuse - J. Cunningham
6.7 Détermination des périodes d'application de la perméthrine pour la répression de la tordeuse des bourgeons de l'épinette - B. Helson
6.8 Quelques découvertes au sujet de la répression du charançon du pin blanc et de la tordeuse des bourgeons de l'épinette - A. Retnakaran
6.9 Utilisation de nématodes entomophiles dans les expériences sur le terrain effectuées en 1989 pour la répression de *Zeiraphera canadensis* et de *Hylobius congener* - E. Kettela, pour D. Eidt

## Recherche su la répression de la végétation

6.10 Essais d'herbicides en vue de la répression de *Kalmia* à Terre-Neuve en 1989 - B. Titus
6.11 Autre

## Recherche et surveillance environnementales

6.12 Études portant sur les effets de *B.t.* sur les organismes non visés - K. Barber
6.13 Table ronde donnant lieu à la présentation de rapports de surveillance, de certains projets de recherche dans le domaine de

l'environnement et de rapports concernant les problèmes d'environnement posés par les méthodes de répression des ravageurs forestiers.

| | |
|---|---|
| 10 h à 10 h 15 | Pause-café |
| 10 h 15 à 12 h | Reprise de la sixième séance |
| 12 h à 13 h | Repas du midi |
| 13 h à 14 h | Reprise de la sixième séance |
| 14 h à 15 h | Reprise de la troisième séance sur le débat des questions |
| | Clôture du forum et mot de la fin - directrice de la Protection, Forêts Canada |
| 15 h à 17 h | Réunion du comité directeur |

<u>Le lundi 13 novembre, salle Laurier, Édifice du Centenaire, 200, rue Kent</u>

- Comité d'examen et d'amélioration des techniques d'évaluation des relevés (CEATER) - M. Auger (président)
- Groupe de travail sur les piège à phéromone - G. Grant (président) - réunion conjointe avec le CEATER de 9 h à 15 h
- Comité directeur du Forum sur la répression des ravageurs - D. Rousseau (présidente) - de 15 h à 17 h

<u>Le jeudi 16 novembre, Centre des conférences, 2, rue Rideau</u>

- Comité de surveillance environnementale du Conseil de la tordeuse des bourgeons de l'épinette
- Méthodes d'homologation des produits à base de <u>B</u>.<u>t</u>. - J. Irvine (président)

<u>Le vendredi 17 novembre, Centre des conférences, 2, rue Rideau</u>

- Réunion des chefs du RIMA (séance à huis clos) - D. Rousseau (présidente) - 8 h 30 à 17 h
- Réunion du comité national des pesticides forestiers - E. Caldwell - 9 h à 12 h

**NOTA** - 1) D'autres réunions peuvent être prévues au besoin pour le vendredi 17 novembre. Veuillez en aviser le secrétaire.

2) Il est possible que les présentations officielles se terminent le jeudi matin; les ateliers du vendredi et la réunion du RIMA pourraient alors commencer le jeudi après-midi.

## SUMMARY OF OPENING REMARKS

### Seventeenth Forest Pest Control Forum
### Ottawa, Ontario — November 14, 1989

The attendees at the forum were honored this year by the presence of Deputy Minister Jean Claude Mercier, Forestry Canada, who welcomed members of the forum on behalf of Forestry Canada.

Mr. Mercier highlighted some of the significant changes that have occurred during the past year. The major one is the legislation (Bill C-29) to establish the Department of Forestry. Bill C-29 cleared third and final reading in the House of Commons on November 1, 1989, and was sent to the senate for approval.

The new department's mandate will include:

- national leadership in the development and coordination of forest policy and programs, consistent with the government's commitment to the principle of sustainable development;
- conducting and fostering forest sector research and development; and
- close cooperation with industry, universities, provinces, and territories in a wide range of areas of forest management and protection.

Mr. Mercier then referred to a nationwide survey of Canadians on behalf of Forestry Canada, which has shown that the public's major concern was the future of our forest and the environment. The Federal Government will table, shortly, legislation to strengthen application of the federal Environmental Assessment and Review Process (EARP). The new law stipulates that the government will not approve, without a rigorous environmental assessment, initiatives that could have an impact on the environment.

More specifically concerning Forestry Canada, Mr. Mercier mentioned some changes in the National Strategic Plan on Pest Management and Biotechnology. Forestry Canada will strengthen its role as the lead forest sector agency responsible for the development of forest pest management techniques. Strategic initiatives will include:

- development of a Forestry Canada policy on pest and vegetation management methods;
- acceleration of research and development in the use of parasites, predators, insect pathogens, and physiological and genetic mechanisms for insect pest management;

- increased emphasis on the development of techniques to prevent insect outbreaks rather than controlling them after they occur;

- research on biological and silviculture methods of weed control; and

- development of integrated pest management systems.

Forestry Canada will play an increasingly important role in national and international forest biotechnology research and development. Strategic initiatives will include:

- research on reducing forest and solid wood product losses from insects and disease, through the development of resistant trees and biological control agents; and

- cooperation with other agencies on regulatory and release issues for genetically engineered trees and biological pest control agents.

To conclude, Mr. Mercier said that the information, discussions, and problems raised by the Pest Control Forum for 17 years have provided interesting data for analyses. Also, Mr. Mercier found the 17th forum agenda most interesting, particularly the session on "Regulatory Considerations." He believed that the exchanges during the forum would be most beneficial.

## Résumé de l'allocution d'ouverture

**Dix-septième Forum sur la répression des ravageurs forestiers**
**Ottawa (Ontario) — 14 novembre 1989**

Les participants au Forum ont été honorés cette année par la présence de Jean Claude Mercier, sous-ministre de Forêts Canada, qui leur a souhaité le bienvenue au nom du ministère.

M. Mercier a souligné certains changements majeurs qui sont survenus au cours de l'année écoulée. Le principal est le projet de loi C-29 constituant le ministère de Forêts. Le projet de loi a passé le cap de la troisième et dernière lecture à la Chambre des communes le 1er novembre 1989 et a été envoyé au Sénat pour approbation.

Le nouveau ministère aura notamment pour mandat:

- d'être le maître d'oeuvre national de l'établissement et de la coordination de la politique et des programmes forestiers, conformément à l'adhésion du gouvernement au principe du développement durable;

- d'effectuer et d'encourager la recherche-développement dans le secteur forestier; et

- de collaborer étroitement, dans de nombreux aspects de l'aménagement et de la protection des forêts, avec l'industrie, les universités, les provinces et les territoires.

M. Mercier a ensuite parlé d'une enquête, menée à l'échelle nationale auprès des Canadiens pour le compte de Forêts Canada, qui a montré que la principale préoccupation du public porte sur l'avenir de nos forêts et sur l'environnement. Le gouvernement fédérale déposera sous peu un projet de loi visant à renforcer l'application du Processus d'évaluation et d'examen en matière d'environnement (PEEE). En vertu de la nouvelle loi, le gouvernement n'approuvera pas, sans évaluation environnementale rigoureuse, les initiatives susceptibles d'avoir une incidence sur l'environnement.

En ce qui concerne plus particulièrement Forêts Canada, M. Mercier a mentionné certaines modifications du Plan stratégique national sur la gestion des ravageurs et la biotechnologie. Forêts Canada renforcera son rôle d'organisme responsable au premier chef de la mise au point de technique de gestion des ravageurs forestiers. Les initiatives stratégiques seront notamment les suivantes:

- élaboration d'une politique de Forêts Canada sur les méthodes de gestion des ravageurs et de la végétation;

- accélération de la recherche-développement en utilisation des parasites, des prédateurs, des agents pathogènes des insectes et des mécanismes physiologiques et génétiques pour la gestion des insectes nuisibles;

- accent accru sur la mise au point de techniques visant à empêcher les pullulements d'insectes au lieu de les combattre après coup;

- recherche sur les méthodes biologiques et sylvicoles de la lutte contre les mauvaises herbes; et

- mise au point de systèmes intégrés de gestion des ravageurs.

Forêts Canada jouera un rôle de plus en plus grand dans la recherche-développement en biotechnologie forestière à l'échelle nationale et internationale. Les initiatives stratégiques seront notamment les suivantes:

- recherche sur la réduction des pertes de matière ligneuse dues aux insectes et aux maladies par la mise au point d'arbres résistants et de biopesticides; et

- collaboration avec d'autres organismes sur des questions de réglementation et de diffusion pour les biopesticides et les arbres obtenus par ingénierie génétique.

En conclusion, M. Mercier at dit que les renseignements, les discussions et les problèmes que le Forum sur la répression des ravageurs forestiers a permis de dégager depuis 17 ans ont fourni de précieuses données pour les analyses. M. Mercier a également constaté que les points à l'ordre du jour du 17$^{e}$ Forum sont des plus intéressants, notamment la séance consacrée aux "facteurs réglementaires". Il ne doutait pas que les échanges au cours du Forum seraient fort bénéfiques.

## ABSTRACTS/RÉSUMÉS

### THE BLACKHEADED BUDWORM IN NEWFOUNDLAND IN 1989
J. Hudak, L.J. Clarke and A.G. Raske

In 1987 an infestation of about 3500 ha was recorded during the aerial survey in the Ten Mile Lake area on the Northern Peninsula and another small infestation of about 1 ha on the Avalon Peninsula.

In 1988 the infestation expanded along the Roddickton Road and defoliation by the blackheaded budworm occurred on 8100 ha.

### LA TORDEUSE À TÊTE NOIRE DE L'ÉPINETTE À TERRE-NEUVE EN 1989
J. Hudak, L.J. Clarke et A.G. Raske

La relevé aérien de 1987 a permis de détecter un foyer d'infestation d'environ 3 500 hectares dans la région du lac Ten Mile, sur la péninsule Northern, et un autre foyer plus petit d'environ un hectare sur la presqu'île Avalon.

En 1988, l'infestation a gagné du terrain le long de la route Roddickton et la tordeuse à tête noire de l'épinette a défolié 8 100 hectares.

### THE BALSAM WOOLLY ADELGID IN NEWFOUNDLAND IN 1989
J. Hudak, L.J. Clarke and A.G. Raske

In 1989 the Island was intensively surveyed to delineate the distribution of the adelgid and its damage throughout western and central areas. Samples are being processed.

### LE PUCERON LANIGÈRE DU SAPIN À TERRE-NEUVE EN 1989
J. Hudak, L.J. Clarke et A.G. Raske

En 1989, l'île de Terre-Neuve a fait l'objet d'un relevé intensif afin de déterminer la répartition du puceron lanigère et les dégâts qu'il cause dans les parties ouest et centre. Des échantillons sont actuellement à l'étude.

### THE SCLERODERRIS CANKER IN NEWFOUNDLAND IN 1988
J. Hudak, G.R. Warren and G.C. Carew

The infested Sitka spruce plantation at Roddickton was inspected in 1989 and there were no signs of new or spreading canker infections.

The incidence of Scleroderris canker increased in and around St. John's in 1989 with new infections at two locations. Infected branches were pruned and destroyed.

In 1989 the survey of the 16 Scots pine plantations established with stock from the Salmonier Nursery was completed. Only the plantation at Colliers Ridge is infected with this disease.

## LE CHANCRE SCLÉRODERRIEN À TERRE-NEUVE EN 1988
**J. Hudak, G.R. Warren et G.C. Carew**

Une plantation d'épinettes de Sitka infestée située à Roddickton a été inspectée en 1989 et aucun signe de nouvelles infections ou de propagation de la maladie n'y a été décelé.

L'incidence du chancre scléroderrien a augmenté dans la ville de St. John et près de celle-ci en 1989, deux nouveaux foyers d'infection ayant été découverts. Le branches infectées ont été élaguées et détruites.

En 1989, le relevé effectué dans les seize plantations de pins sylvestres établies à partir de matériels provenant de la pépinière de salmonier a été achevé. Seule la plantation de Colliers Ridge était infectée par cette maladie.

## PINEWOOD NEMATODE SURVEYS
**W.W. Bowers and A.G. Raske**

A total of 17 nematode genera were found in Newfoundland including the 'm' form of the pinewood nematode, Bursaphelenchus xylophilus.

The vector survey has added much new data on the nematode fauna in Canada and its potential vectors; however, it did not establish a pinewood nematode vector association. This survey reinforced the conclusion that the pinewood nematode is not abundant in Canada.

## RELEVÉS DU NEMATODE DU PIN
**W.W. Bowers et A.G. Raske**

Au total, 17 genres de nématodes ont été découverte à Terre-Neuve, y compris la forme 'm' du nématode du pin, Bursaphelenchus xylophilus.

Une relevé des vecteurs a permis d'opbtenir un grand nombre de nouvelles données sur la faune du nématode au Canada et sur ses vecteurs éventuels, bien qu'il n'ait pas établi de lien entre le nématode du pin et ses vecteurs. Ce relevé vient corroborer la conclusion à l'effet que le nématode du pin n'est pas abondant au Canada.

## INSECT CONTROL PROGRAMS IN NEWFOUNDLAND IN 1989
H. Crummey

No spray operation was conducted against the Black Army cutworm and the spruce budworm, due to low population levels. A total of eight blocks (5 362 ha) were treated with B.t. for the hemlock looper.

## PROGRAMMES DES RÉPRESSIONS DES RAVAGEURS À TERRE-NEUVE EN 1989
H. Crummey

Aucune pulvérisation n'a été effectuée pour lutter contre la légionnaire noire et la tordeuse des bourgeons de l'épinette, en raison des faibles populations de ces ravageurs. Au total, huit blocs (5 362 hectares) ont été traités au B.t. afin d'y lutter contre l'arpenteuse de la pruche.

## FOREST PEST CONDITIONS IN THE MARITIMES IN 1989
L.P. Magasi

Significant forest pest conditions which occurred in the Maritimes Region in 1989 have been reported in Forestry Canada-Maritimes Technical Notes 217, 218, 220 and 221. Copies of these are included in the Forum Report.

## INSECTES ET MALADIE DES ARBRES DANS LES MARITIMES EN 1989
L.P. Magasi

Les Notes techniques 217, 218, 220 et 221 de Forêts Canada-Maritimes portent sur les insectes et maladies des arbres d'importance qui ont été observés dans les Maritimes en 1989. Les exemplaires de ces notes ont été annexés au compte rendu du Colloque.

## SPRUCE BUDWORM POPULATION
T.D. Smith, R. Guscott, and E. Georgeson

The area of spruce budworm population in Nova Scotia expanded by 30 percent with patches of moderate population densities, a total of 37 250 ha, single areas of high (10 000 ha) and extreme (3 250 ha) were noted and these areas will require careful monitoring.

## POPULATION DE LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE
T.D. Smith, E. Guscott et E. Georgeson

La superficie où se retrouvaient les populations de la tordeuse des bourgeons de l'épinette en Nouvelle-Écosse a augmenté de 30% pour atteindre un total de 37 250 hectares. Les îlots de population modérée s'y retrouvaient également. Deux endroits où les populations étainet éléves (10 000 hectares) et extrêmes (3 250 hectares) ont été relevés et exigeront une surveillance attentive.

**STATUS OF BALSAM TWIG APHID**
**(Mindarus abietinus Koch)**
**and Balsam Gall Midge**
**(Paradiplosis tumifex Gagné)**
**in Nova Scotia, 1989.**
**T.D. Smith**

From a Provincial viewpoint populations of balsam twig aphid and balsam gall midge are considered to be trace or low. There were, however, 61 locations of low and 14 locations of moderate levels of balsam twig aphid and 25 low areas of balsam gall midge in the Province. Christmas tree growers should, however, monitor their stands for the presence of these two insects.

**ÉTAT DES POPULATIONS DU PUCERON DES POUSSES DU SAPIN**
**(Mindarus abietinus Koch)**
**et de la cécidomyie du sapin**
**(Paradiplosis tumifex Gagné)**
**en Nouvelle-Écosse en 1989**
**T.D. Smith**

Les populations du puceron des pousses du sapin et de la cécidomyie du sapin sont jugées minimes ou faibles à l'échelle provinciale. On a toutefois dénombré 61 endroits où les populations du puceron des pousses du sapin étaient faibles et 14 autres où elles étaient modérées; les populations de la cécidomyie du sapin étainet faibles dans 25 endroits. Les producteurs d'arbres de Noël devrainet toutefois surveiller de près leurs peuplements afin d'y déceler la présence de ces deux ravageurs.

**THE SPRUCE BUDWORM IN QUEBEC 1989**
**Michel Auger**

The spraying program against spruce budworm carried out in 1989 covered an area of 165 034 ha located entirely within the Bas-Saint-Laurent - Gaspésie region. This represents a slight decrease compared to 1987 and 1988.

**LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE AU QUÉBEC EN 1989**
**Michel Auger**

Le programme de pulvérisation pour lutter contre la tordeuse des bourgeons de l'épinettte mené en 1989 a permis de traiter une superficie de 165 034 hectares située entièrement dans la région du Bas-Saint-Laurent-Gaspésie. Il s'agit d'une légère diminution comparativement à 1987 et 1988.

## SPRUCE BUDWORM IN ONTARIO, 1989

**G.M. Howse and J.J. Churcher**

A steady decline in spruce budworm populations has been evident in Ontario for the past several years. This trend reversed itself in 1989 when the overall area of moderate-to-severe defoliation increased by slightly over a million ha to 6 239 636 ha. Infestations remain confined to the Northwestern and North Centreal regions. A total of 30 516 ha was aerially sprayed (with B.t.) in 1989 in the North Central Region.

## LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE EN ONTARIO EN 1989

**G.M. Howse et J.J. Churcher**

Un déclin régulier des populations de la tordeuse des bourgeons de l'épinette a été constaté en Ontario au cours des dernières années. Cette tendance s'est inversé en 1989 lorsque la superficie totale de défoliation modérée à grave a augmenté, passant d'un peu plus d'un million d'hectares à 6 239 636 hectares. Les foyers d'infestation restent confinés aux régions du Nord-Ouest et du Centre-Nord. Au total, 30 516 hectares ont été pulvérisés par voie aérienne (au B.t.) en 1989 dans la région du Centre-Nord. Au total, 30 516 hectares ont été pulvérisés par voie aérienne (au B.t.) en 1989 dans la région du Centre-Nord.

## JACK PINE BUDWORM IN ONTARIO 1989

**G.M. Howse and J.J. Churcher**

Jack pine budworm populations declined dramatically in 1989 with the total area of moderate-to-severe defoliation reduced from 734,482 ha to 248,311 ha. All of the defoliation this year was confined to areas in the Red Lake and Sioux Lookout districts. A total of 4 763 ha was sprayed with B.t. in 1989.

## TORDEUSE DU PIN GRIS EN ONTARIO EN 1989

**G.M. Howse et J.J. Churcher**

Les populations de la tordeuse du pin gris ont décliné de façon spectaculaire en 1989, la superficie totale modérément à gravement défoliée passant de 734 482 hectares à 248 311 hectares. Cette année, toute la défoliation était confinée à des secteurs des districts de Red Lake et de Sioux Lookout. Au total, 4 763 hectares ont été traités au B.t. en 1989.

## GYPSY MOTH IN ONTARIO, 1989
### G.M. Howse and J.J. Churcher

The area of moderate to severe defoliation by the gypsy moth increased substantially for the second consecutive year in 1989. Altogether, some 81 640 ha of defoliation were mapped in southern Ontario, up from 29 693 ha last year.

In 1989, the Ontario Ministry of Natural Resources aerially sprayed with B.t. a total of 12 951 ha of forest in southern Ontario to protect stands from defoliation by gypsy moth.

## LA SPONGIEUSE EN ONTARIO EN 1989
### G.M. Howse et J.J. Churcher

En 1989, la superficie modérément à gravement défoliée par la spongieuse a énormément augmenté pour une deuxième année consécutive. Au total, près de 81 640 hectares de défoliation ont été cartographiés dans le sud de l'Ontario, comparativement à 29 693 hectares l'an dernier.

En 1989, le ministère des Richesses naturelles de l'Ontario a procédé à des arrosages aériens sur 12 951 hectares du sud de la province afin de protéger des peuplements contre l'action défoliante de la spongieuse.

## ONTARIO INSECT CONTROL OPERATIONS, 1989
### Geoff Munro and Joe Churcher

The Ministry of Natural Resources conducted spray operations for the contol of three insect species during 1989. The largest was the spruce budworm program, with the gypsy moth and jack pine budworm programs comprising the remaining two. In addition an extensive public information campaign was undertaken to advise on the forest tent caterpillar infestation in Ontario. Details of the control operations are found in the three papers by G.M. Howse and J.J. Churcher found elsewhere in these proceedings.

As expected the forest tent caterpillar infestation increased dramatically in 1989 to cover 7.9 million hectares.

## OPÉRATION DE LUTTE CONTRE LES RAVAGEURS EN ONTARIO EN 1989
### Geoff Munro et Joe Churcher

En 1989, le ministère des Richesses naturelles de l'Ontario a mené des opérations de lutte contre trois espèces de ravageurs. Le programme de pulvérisation le plus important était celui contre la tordeuse des bourgeons de l'épinette, la spongieuse et la tordeuse du pin gris étant les deux autres programmes. De plus, une vaste campagne de sensibilisation du public a été entreprise afin de l'informer sur l'infestation de la livrée des forêts en Ontario. Trois documents rédigés par

G.M. Howse et J.J. Churcher figurant ailleurs dans ce compte rendu présentent de plus amples détails sur les opérations de lutte.

Comme prévu, l'infestation de la livrée des forêts a augmenté de façon spectaculaire en 1989, atteignant 7,9 millions d'hectares.

## NORTHWEST REGION
## STATUS OF IMPORTANT FOREST PESTS AND EXPERIMENTAL CONTROL PROJECT
**H. Cerezke**

This report summarizes information on the current status of: Spruce Budworm, Mountain Pine Beetle, Jack Pine Budworm, Forest Tent Caterpillar, Pinewood Nematode and several lesser important pest species, distribution and pest management.

## RÉGION DU NORD-OUEST
## ÉTAT DES POPULATIONS DES RAVAGEURS FORESTIERS D'IMPORTANCE ET PROJET DE LUTTE EXPÉRIMENTALE
**H. Cerezke**

Ce rapport résume les données existantes sur l'état actuel des populations de la tordeuse des bourgeons de l'épinette, du dendroctone du pin ponderosa, de la tordeuse du pin gris, de la livré des forêts, du nématode du pin et de plusieurs autres espèces de ravageurs moins importantes et précise l'aire de distribution connue de ces insectes et les mesures de lutte dont ils font l'objet.

## STATUS OF FOREST INSECT PESTS IN SASKATCHEWAN 1989
**M. Pandila**

The status of forest insect pests including the spruce budworm, aspen defoliators, poplar leaf beetle, and jack pine budworm is discussed.

## ÉTAT DES POPULATIONS DES RAVAGEURS FORRESTIERS EN SASKATCHEWAN EN 1989
**M. Pandila**

L'état des populations des ravageurs forestiers, dont la tordeuse des bourgeons de l'épinette, les défoliateurs du peuplier faux-tremble, la chrysomèle du peuplier et la tordeuse du pin gris est examiné.

**STATUS OF FOREST TREE DISEASES IN SASKATCHEWAN 1989**
**M. Pandila**

The status of the following forest diseases in Saskatchewan is discussed: needle rust on spruce, armillaria rootrot, drought injury, western gall rust and others.

**SITUATION PHYTOSANITAIRE EN SASKATCHEWAN EN 1989**
**M. Pandila**

La situation phytosanitaire des maladies des arbres suivantes en Saskatchewan est examinée : la rouille des aiguilles de l'épinette, le pourridié-agaric, les blessures causées par la sécheresse, la rouille-tumeur globuleuse et autres.

**FOREST PESTS IN MANITOBA, 1989**
**Y. Beaubien, T. Boyce, L. Christianson**
**K. Knowles, I. Pines, M. Slivitzky**

Reports included summarize the following: Spruce budworm, jack pine budworm; pine root collar weevil; pest surveys in renewed forests, dwarf mistletoe management, Dutch Elm Disease management; Armillaria root rot; and testing superior jack pine stock for resistance to western gall rust.

**RAVAGEURS FORESTIERS EN MANITOBA EN 1989**
**Y. Beaubien, T. Boyce, L. Christianson**
**K. Knowles, I. Pines, M. Slivitsky**

Parmi les rapport récapitulatifs présentés, mentionnons ceux portant sur la tordeuse des bourgeons de l'épinette, la tordeuse du pin gris, le charançon du collet du pin, les relevés des ravageurs dans les forêts régénérées, la répression du faux gui et de la maladie hollandaise de l'orme, le pourridié-agaric et l'essai de pins gris génétiquement supérieurs pour connaître leur résistance à la rouille-tumeur globuleuse.

**PACIFIC AND YUKON REGION - 1989**
**STATUS OF IMPORTANT FOREST PESTS,**
**EXPERIMENTAL CONTROL PROJECTS AND**
**VEGETATION MANAGEMENT RESEARCH**
**G.A. Van Sickle**

The status of more than 18 major forest pests in 1989 is presented with some forecasts for 1990. These include the declining but continuing populations and significant damage by mountain pine beetle and western budworms, the decline in black army cutworm, increasing levels of Rhizina root disease, blackheaded budworm and eastern budworm, and slight increases in Douglas-fir tussock moth and gypsy moth.

Current research progress and control trials of some of these pests include: biological control research directed to spruce weevil, larch casebearer, winter moth and vegetation management; B. t. trials against western budworm and blackheaded budworm; pathogenicity testing with pinewood nematode and hazard rating and model systems for mountain pine beetle.

## RÉGION DU PACIFIQUE ET DU YUKON - 1989 ÉTAT DES POPULATIONS DES RAVAGEURS FORESTIERS D'IMPORTANCE, PROJETS EXPÉRIMENTAUX DE LUTTE ET RECHERCHE SUR LA RÉPRESSION DE LA VÉGÉTATION

G.A. Van Sickle

L'état des populations de plus de 18 ravageurs forestiers d'importance en 1989 est présenté, ainsi que certaines prévisions pour 1990. Parmi les sujets abordés, mentionnons les populations à la baisse, mais toujours présentes et les dommages importants causés par le dendrotons du pin ponderosa et les tordeuses occidentales, le déclin des populations de la légionnaire noire, l'accroissement des taux d'infection par le pourridié rhizinéan et des infestations par la tordeuse à tête noire et la tordeuse des bourgeons de l'épinette et les légères augmentations des populations de la chenille à houppes du douglas et de la spongieuse.

Parmi les recherches en cours et les essais de répression de certains ravageurs, mentionnons la recherche sur la lutte biologique contre le charançon de l'épinette, le porte-case du mélèze et l'arpenteuse tardive ainsi que les essais de répression de la végétation, les pulvérisations expérimentales de B.t. pour lutter contre la tordeuse occidentale et la tordeuse à tête noire, les essais de pathogénécité du nématode du pin et la classification des risques et l'établissement de modèles pour le dendroctone du pin ponderosa.

## 1989 PEST CONTROL FORUM - B.C. MINISTRY OF FORESTS REPORT

P.M. Hall and J.A. Muir

Pest management programs continue to address specific pest problems relating to insects, diseases, vertebrate pests and others. The name of the section has ben changed from Pest Management to Forest Health.

Mountain pine beetle remains the most important pest in many areas of the province. The total area affected has declined somewhat in 1989.

## COLLOQUE DE 1989 SUR LA RÉPRESSION DES RAVAGEURS - RAPPORT DU MINISTÈRE DES FORÊTS DE LA C.-B.

P.M. Hall et J.A. Muir

Les programmes de répression des ravageurs continuent de viser des problèmes particuliers causés par des insectes, des maladies, des ravageurs vertébrés et autres. La section de répression des ravageurs s'appelle maintenant la section de santé des forêts.

Le dendroctone du pin ponderosa reste le ravageur le plus important dans bon nombre d'endroits de la province. La superficie totale infestée a diminué légèrement en 1989.

## GYPSY MOTH IN NEW BRUNSWICK IN 1989
**N. Carter**

No aerial spray programs against Gypsy Moth were conducted this year. Instead, efforts were concentrated on: detection/delimitation pheromone trap surveys and intensive male moth trapping, and egg-mass searches.

## LA SPONGIEUSE AU NOUVEAU-BRUNSWICK EN 1989
**N. Carter**

Aucun programme de pulvérisation aérienne pour lutter contre la spongieuse n'a été mené cette année. Les efforts ont plutôt porté sur la détection/la délimitation des périmètres d'infestation, des relevée à l'aide de pièges à phéromone et le piégeage intensif de papillons mâles, ainsi que des recherches de masses d'oeufs.

## EASTERN HEMLOCK LOOPER IN NEW BRUNSWICK
**N. Carter**

For the first time in reported history in New Brunswick defoliation caused by hemlock looper was mapped from an aerial survey in 1989. Defoliation covered a total of 3 824 ha in the following categories: Trace to Light, 1 488 ha; Moderate, 2 184 ha; and Severe, 152 ha. These pockets of defoliation occurred in the northwest central part of the Province in Northumberland County.

## L'ARPENTEUSE DE LA PRUCHE AU NOUVEAU-BRUNSWICK
**N. Carter**

Pour la première fois dans l'histoire du Nouveau-Brunswick, la défoliation attribuable à l'arpenteuse de la purche a été cartographiée dans le cadre d'un relevé aérien effectué en 1989. La défoliation couvrait une superficie totale de 3 824 hectares et se répartissait dans les catgories suivantes : minime à légère : 1 488 hectares;modérés : 2 184 hectares; et grave : 152 hectares. Ces îlots de défoliation se retrouvaient dans le nord-ouest de la partie centrale de la province, dans le comté de Northumberland.

## FOREST PEST CONDITIONS IN QUEBEC IN 1989

**Denis Lachance**

This report reviews the status of major forest insects and diseases in Quebec in 1989 and includes the spruce budworm, forest tent caterpillar, pear thrips, gypsy moth, scleroderris canker and others.

## SITUATION DE QUELQUES RAVAGEURS FORESTIERS AU QUÉBEC EN 1989

**Denis Lachance**

Ce rapport fait le bilan des insectes et des maladies des arbres au Québec en 1989 et comprend la tordeuse des bourgeons de l'épinette, la livrée des forêts, le thrips du poirier, la spongieuse, le chancre scléroderrien du pin et autres.

## FOREST PEST CONDITIONS IN THE UNITED STATES - 1989

**Daniel R. Kucera**

Reports on the following major forest pests in 1989 in the U.S.A. are summarized: the spruce budworms, forest tent caterpillar, hemlock, woolly adelgid, pear thrips and the gypsy moth. In 1989, nearly 3,000,000 acres of hardwood forest were defoliated by the gypsy moth in the eastern United States compared to 719,300 acres defoliated in 1988.

## INSECTES ET MALADIES DES ARBRES AUX ÉTATS-UNIS EN 1989

**Daniel R. Kucera**

Les rapports sur les principaux ravageurs forestiers signalés en 1989 aux États-Unis sont résumés et portent notamment sur les tordeuses des bourgeons de l'épinette, la livrée des forêts, le puceron lanigère de la pruche, le thrips du poirier et la spongieuse. En 1989, près de 3 millions d'acres de forêts feuillues ont été défoliées par la spongieuse dans l'est des États-Unis, comparativement à 719 300 acres en 1988.

## SPRUCE BUDWORM IN MAINE - 1989

**Henry Trail, Jr.**

The spruce budworm infestation in Maine remained at a very low level in 1989. The Insect and Disease Management staff of the Maine Forest Service continued to look for areas of budworm activity throughout the state as part of the normal Forest Insect Survey.

There were 1 300 acres of moderate defoliation and an additional 3 500 acres had light damage. Damage throughout the mapped area was extremely spotty.

## LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE DANS LE MAINE EN 1989
**Henry Trail, Jr.**

L'infestation de la tordeuse des bourgeons de l'épinette dans le Maine est restée à un niveau très faible en 1989. Le personnel chargé de la lutte contre les insectes et les maladies au service des forêts du Maine a continué d'être à l'affût des secteurs d'activités de la tordeuse des bourgeons partout dans l'État dans le cadre de son relevé annuel habituel.

1 300 acres de défoliation moderée ont été signalées ainsi que 3 500 acres de défoliation légère. Les dégâts relevés dans l'ensemble de la superficie cartographiée étaient très disséminés.

## GYPSY MOTH
## MAINE CONDITIONS 1989
**Dick Bradbury**

Gypsy moth defoliated 34,286 acres in 1989, representing a significant increase from endemic populations of 1988 when only 100 acres were detected.

## LA SPONGIEUSE DANS LE MAINE EN 1989
**Dick Bradbury**

La spongieuse a défolié 34 286 acres en 1989, une augmentation importante comparativement à la centainra d'acres de 1988, année pendant laquelle les populations étaient endémiques.

# I. FOREST INSECT AND DISEASE STATUS AND CONTROL OPERATION SUMMARIES/RENSEIGNEMENTS D'ACTUALITÉ SUR LES INSECTES ET LES MALADIES DES ARBRES ET RÉSUMÉS DES ACTIVITÉS DE RÉPRÉSSION

**THE SPRUCE BUDWORM IN NEWFOUNDLAND IN 1989**

Hudak, J., K.P. Lim, L.J. Clarke and A.G. Raske

REPORT TO THE 17TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 14-16 NOVEMBER 1989

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
ST. JOHN'S, NEWFOUNDLAND
A1C 5X8

# THE SPRUCE BUDWORM IN NEWFOUNDLAND IN 1989

by

Hudak, J., K.P. Lim, L.J. Clarke and A.G. Raske

__Larval Development and Defoliation__ - Two new infestations of this budworm were recorded in 1989, one near the North Branch of the Codroy River in western Newfoundland, where moderate and severe defoliation of current year's foliage of balsam fir occurred on an area of 744 ha, and the other occurring on 270 ha along the La Poile River on the South Coast (Fig. 1). The three small older infestations, two in the Codroy Valley and one on the Baie Verte Peninsula, were reduced in size and all had reduced population levels in 1989. These three infestations have continued since the collapse of the last budworm outbreak. Outside of the infestation areas larval populations were extremely low.

__Control Program__ - There was no experimental or operational control program against the spruce budworm in 1989.

__Biological Mortality Factors__ - In 1989 larvae were intensively sampled in the area of infestations and extensively throughout the Island. In the declining infestation on the Baie Verte Peninsula 30% of the 323 larvae sampled were parasitized by __Glypta fumiferana__, 18% were dead and contained __Aureobasidium pullulans__, 4% were killed by the fungus __Entomophaga aulicae__, about 1% were infected with __Nosema fumiferana__, and about 7% died containing unidentified organisms for a total late-larval mortality of 60%.

Larval mortality of samples from non-infested areas throughout the Island was only 1.4% of 71 larvae collected.

**Pheromone Trapping of Moths** - Pheromone traps were placed at 50 permanent sample locations throughout the Island. The total number of moths trapped increased from 186 in 1988 to 3130 in 1989. The highest number recorded were along the west coast, but not near areas of infestations. The trap locations with the highest numbers were near Stephenville 454, Gros Morne National Park 447, Daniels Harbour 881, and Hawkes Bay 643. Almost all of the 21 trap locations in central Newfoundland caught at least a few moths but of 8 trap locations in eastern Newfoundland moths were trapped only in St. John's (two moths). We believe almost all moths trapped had been transported into Newfoundland by warm air-masses from Atlantic Canada, because many moths were found in traps before local moths had emerged.

**Forecast of Spruce Budworm Defoliation for 1990** - Overwintering populations are being sampled in conjunction with the hemlock looper egg sampling in mid to late October. A forecast will be made when the samples have been processed.

Table 1. Areas (ha) of defoliation caused by the spruce budworm in productive forests of Newfoundland in 1989.

| Management Unit No. | Defoliation Class | | | Total |
|---|---|---|---|---|
| | Light | Moderate | Severe | |
| 7 | - | - | 270 | 270 |
| 14 | 66 | 35 | 699 | 800 |
| Total | 66 | 35 | 969 | 1 070 |

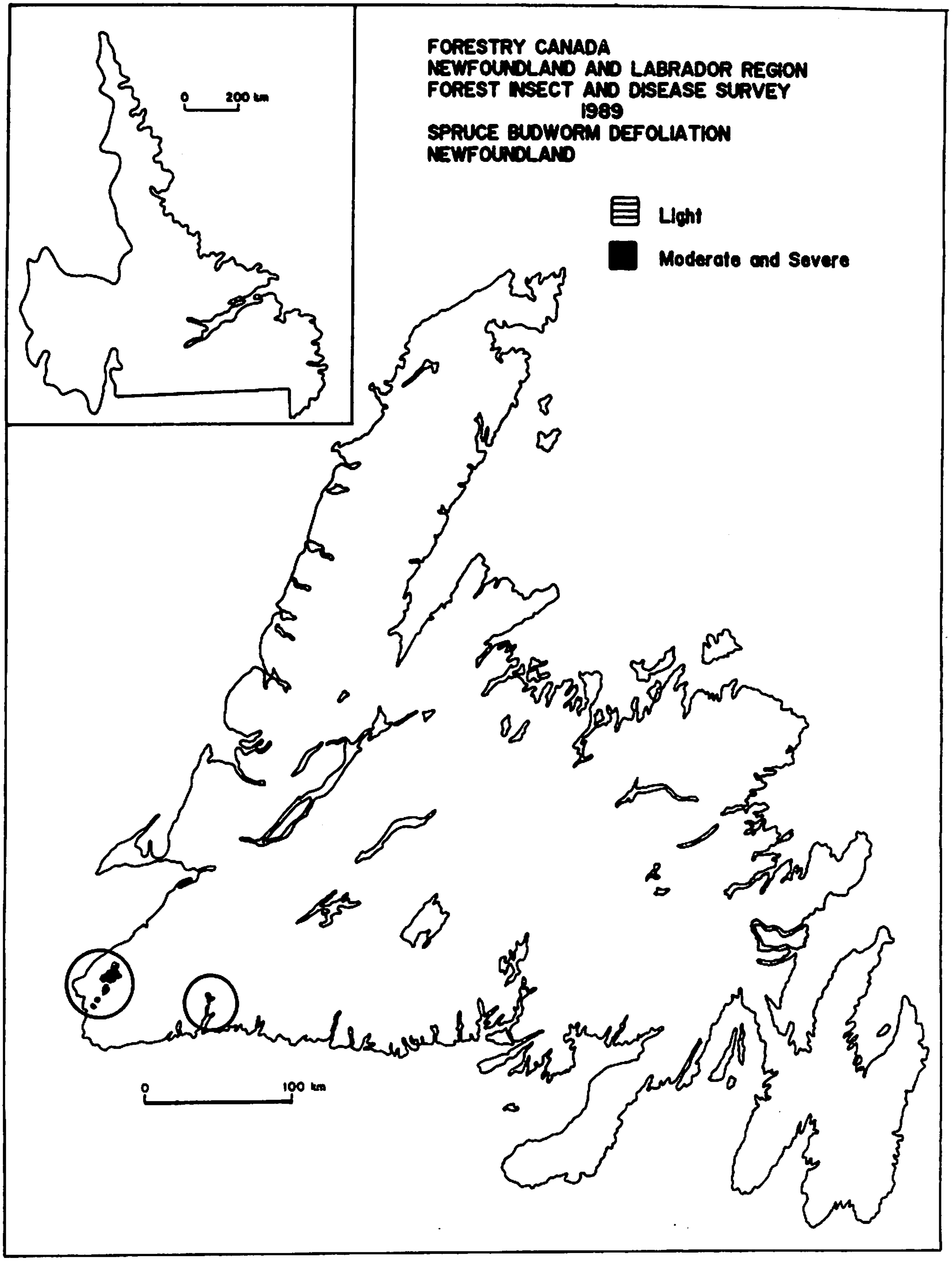



Figure 1. Areas of defoliation caused by the spruce budworm in Newfoundland in 1989.

# THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1989

by Hudak, J., K.P. Lim, L.J. Clarke and A.G. Raske

REPORT TO THE 17TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 14-16 NOVEMBER 1989

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
ST. JOHN'S, NEWFOUNDLAND
A1C 5X8

# THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1989

by

Hudak, J., K.P. Lim, L.J. Clarke and A.G. Raske

**Larval Development and Defoliation** - Spring and early summer weather was warm and dry throughout most of the Province initiating tree and insect development about one week ahead of 1988. Early July tended to be sunny, windy and cool, but warm and humid for the remainder. August was mostly warm and wet.

The general decline of looper populations forecast from fall egg sampling occurred in much of the 1988 infestation. However localized areas of moderate and severe defoliation occurred on the Northern Peninsula and the Avalon Peninsula (Fig. 1). The infestation continued in three separate areas on the Northern Peninsula near Ten Mile Lake, along Main Brook and near Roddickton. In addition, looper larvae were also interspersed with blackheaded budworm populations in the Castor River and Leg Pond area. Existing pockets of infestation on the Avalon collapsed except along Shoe Cove Brook. However three new but small infestations developed on the Island, one along White Bear River on the South Coast and the others on the Avalon, near Flatrock and near Greens Harbour. High numbers of looper moths were reported in the Argentia-Placentia area in September, but a local infestation, if it occurred, was not detected. Aspects of the reproductive biology were studied in the infestation near Flatrock to devise a moth trapping system to forecast impending looper infestations.

**Control Program** - The Department of Forestry and Agriculture treated about 1600 ha of infestation with *B.t.* on the Northern Peninsula.

**Biological Mortality Factors** - In 1989 hemlock looper larvae and pupae were sampled at two locations. Pupae were also sampled at one additional site on the Avalon Peninsula. Of the 780 larvae reared 3% were parasitized by ichneumonid parasites, 2% were killed by fungi (mainly fungi imperfecti), 11% contained *Aureobasidium pullans*, less than 1% were infected with a microsporidian tentatively identified as *Pleistiphora schubergi*, and 3% died of unknown causes for a total larval mortality of 20%. Approximately 4200 pupae collected on the Northern Peninsula were 4% parasitized by tachinids, and of 1100 pupae collected on the Avalon Peninsula 35% were parasitized by tachinids.

**Damage Assessment** - Most of new tree mortality occurred near Leg Pond where looper populations were the highest and were feeding in conjunction with the blackheaded budworm. Generally the intensity of defoliation was not as severe as several years ago, and little new mortality is expected. The total area of moderate and severe defoliation on the Island was 9500 ha, with an additional 3900 ha of light defoliation. The damage will be assessed at the inventory level by the Newfoundland Department of Forestry and Agriculture.

**Forecast of Hemlock Looper Infestations for 1990** - Overwintering egg numbers will be sampled beginning in mid to late October. A forecast will be made when the samples have been processed.

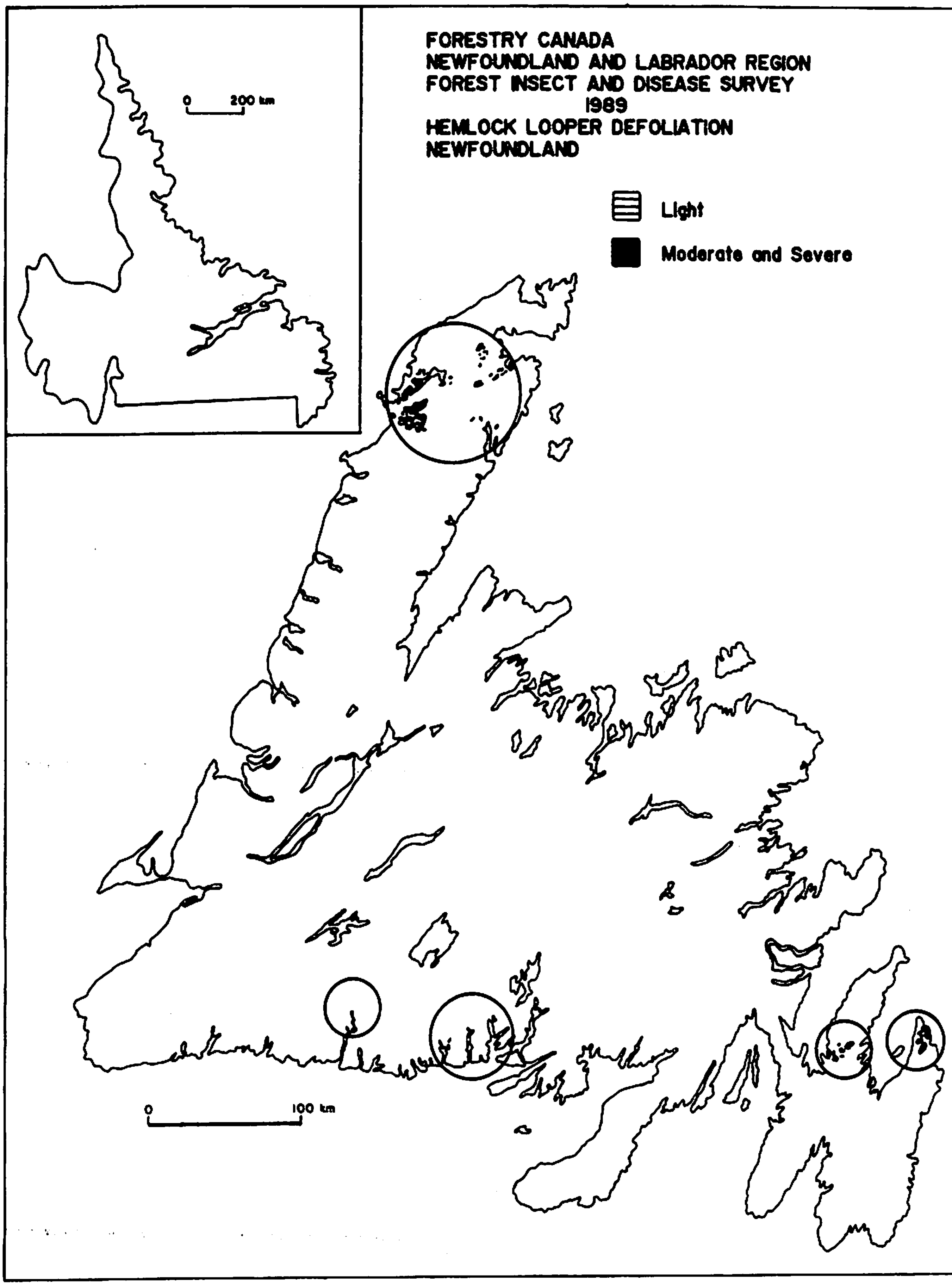



Figure 1. Areas of defoliation caused by the hemlock looper in Newfoundland in 1989.

Table 1. Areas of defoliation caused by the hemlock looper in productive forests of Newfoundland in 1989.

| Management Unit No. | Defoliation Class* | | | |
|---|---|---|---|---|
| | Light | Moderate | Severe | Total |
| 1 | 410 | 229 | 111 | 750 |
| 7 | - | - | 199 | 199 |
| 14 | - | - | 1 023 | 1 023 |
| 17 | 2 959 | 296 | 5 412 | 8 667 |
| 18 | 525 | 143 | 2 086 | 2 754 |
| Total | 3894 | 668 | 8 831 | 13 393 |

*Light = 1-25%.
Moderate = 26-75%.
Severe = 100%.

# THE BLACKHEADED BUDWORM IN NEWFOUNDLAND IN 1989

by Hudak, J., L.J. Clarke and A.G. Raske

REPORT TO THE 17TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 14-16 NOVEMBER 1989

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
ST. JOHN'S, NEWFOUNDLAND
A1C 5X8

# THE BLACKHEADED BUDWORM IN NEWFOUNDLAND IN 1989

by

Hudak, J., L.J. Clarke and A.G. Raske

The blackheaded budworm was considered a minor pest in Newfoundland since it was first recorded in 1938. In Newfoundland blackheaded budworm infestations generally occur at intervals of 5 to 10 years and usually overlap the declining phase of hemlock looper outbreaks. As in other parts of Canada high population levels are generally concentrated in tree tops. Outbreaks of this budworm usually subside after about 2 to 3 years in Newfoundland without causing tree mortality. Parasites are thought to play a major role in the collapse of these infestations.

In 1987 an infestation of about 3500 ha was recorded during the aerial survey in the Ten Mile Lake area on the Northern Peninsula and another small infestation of about 1 ha on the Avalon Peninsula. The blackheaded budworm was mostly responsible for the infestation on the Northern Peninsula, but in some areas the hemlock looper contributed to the total defoliation, and in a few small areas the spruce budworm was also abundant.

In 1988 the infestation expanded along the Roddickton Road and defoliation by the blackheaded budworm occurred on 8100 ha. Population levels ranged up to 168 larvae per tree sample (Ave = 25.3) and caused from 20% to 100% defoliation on current foliage throughout the whole crown in overmature stands of balsam fir. In some stands trees were moribund and tree mortality seemed imminent. About 5% of the larvae collected in the infested area were parasitized. In the small infestation on the Avalon Peninsula parasitism of larvae was 67%.

The infestation continued to increase in size to over 35 000 ha (Table 1) and in severity on the Northern Peninsula in 1989; extending across the Peninsula from St. Barbe to Main Brook (Fig. 1). High numbers of larvae, up to 315 per tree sample (Ave = 45.3), were collected throughout the infestation. Moderate and severe defoliation occurred throughout the crowns and mainly in overmature stands, and only light defoliation occurred in the precommercially-thinned stands. Larval parasitism increased to 16% by hymenopterous parasites plus 8% by dipterous parasites in 1989. However levels of parasitism are still low and the outbreak will likely continue in 1990. In several areas this budworm was feeding in association with the hemlock looper with both insects contributing to tree mortality. The small infestation on the Avalon Peninsula collapsed in 1989, and presumably parasitism was the major factor.

A spray program planned for the Northern Peninsula in 1989 against the hemlock looper was not as successful as expected because in some areas the blackheaded budworm had caused considerable defoliation before the hemlock looper had emerged and before the sprays were applied.

Branch samples were collected in this fall throughout the infestation, and these are being processed to obtain estimates of overwintering egg populations. A forecast based on egg numbers per branch will be made when all the samples have been completed.

Table 1. Areas (ha) of defoliation caused by the blackheaded budworm in productive forests of Newfoundland from 1987 to 1989.

| Year | Defoliation Class** | | | |
|---|---|---|---|---|
| | Light | Moderate | Severe | Total |
| 1987 | 1 600 | - | 2 300 | 3 900* |
| 1988 | 4 389 | 721 | 2 999 | 8 109 |
| 1989 | 6 764 | 2 239 | 26 260 | 35 263 |

* Defoliation caused by three species: the blackheaded budworm, to a lesser extent the hemlock looper and a small contribution in local areas by the spruce budworm.

**Light = 1-25%.
Moderate = 26-75%.
Severe = 76-100%.

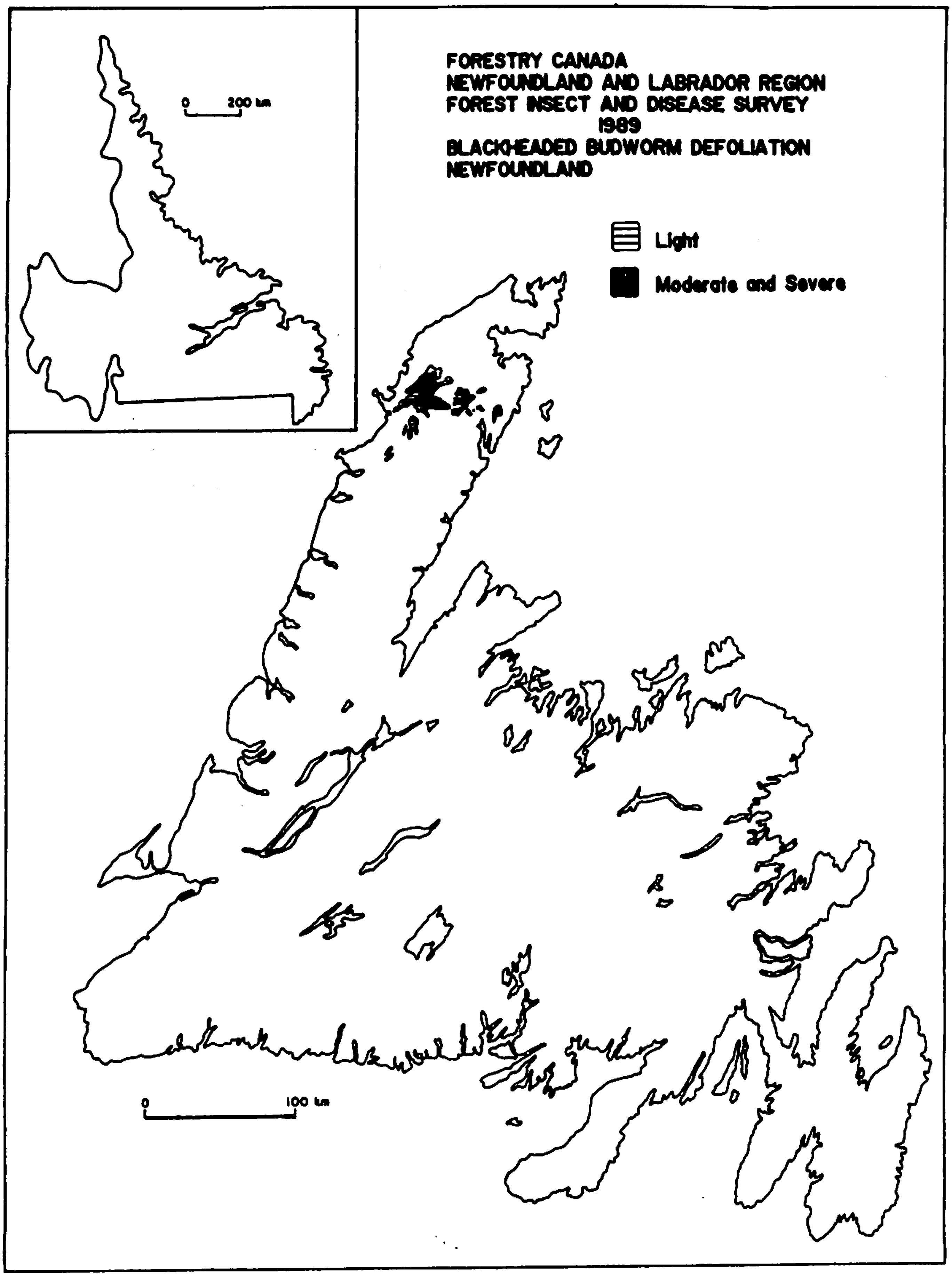



Figure 1. Areas of defoliation caused by the blackheaded budworm in Newfoundland in 1989.

# THE BALSAM WOOLLY ADELGID IN NEWFOUNDLAND IN 1989

Hudak, J., L.J. Clarke and A.G. Raske

REPORT TO THE 17TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 14-16 NOVEMBER 1989

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
ST. JOHN'S, NEWFOUNDLAND
A1C 5X8

## THE BALSAM WOOLLY ADELGID IN NEWFOUNDLAND IN 1989

by

Hudak, J., L.J. Clarke and A.G. Raske

The last adelgid outbreak, from 1949 to 1967, caused considerable damage and tree mortality in fir stands throughout southwestern areas of the Island.

The present outbreak of this pest began in 1979 and populations have been steadily increasing. Balsam woolly adelgid populations have been surveyed throughout the Island over the past several years and populations of this adelgid have been increasing annually in young stands of balsam fir and have recently caused damage, with about 90% of damaged stands occurring in western Newfoundland. In 1988 a preliminary survey of active infestations in thinned stands established base-line population data for such stands.

In 1989 the Island was intensively surveyed to delineate the distribution of the adelgid and its damage throughout western and central areas. Samples are being processed.

In 1988-89 research to develop effective, practical controls have also been initiated by staff in the Newfoundland & Labrador Region in cooperation with the Forest Pest Management Institute (see Annual Forest Pest Control Forum Report, 1988).

# THE SCLERODERRIS CANKER IN NEWFOUNDLAND IN 1989

by Hudak, J., G.R. Warren and G.C. Carew

REPORT TO THE 17TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 14-16 NOVEMBER 1989

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
ST. JOHN'S, NEWFOUNDLAND
A1C 5X8

# THE SCLERODERRIS CANKER IN NEWFOUNDLAND IN 1988

by

Hudak, J., G.R. Warren and G.C. Carew

Scleroderris canker was first recorded in Newfoundland in 1979 on five ornamental Austrian pine trees near St. John's. In 1980 and 1981 several new infections were found on ornamental pines throughout the city. In cooperation with Agriculture Canada, these trees were pruned or cut and burnt in an effort to eradicate the disease. An Island-wide intensive survey did not detect the disease outside of the St. John's area and the Provincial Department of Forest Resources and Lands established a quarantine area in 1980 (Figure 1). A severe outbreak of the disease occurred in 1981 in a 2 ha experimental red pine plantation near Torbay in the vicinity of St. John's. Disease development was extremely rapid and nearly all trees, about 6 000, in the plantation showed severe reddening throughout their crowns. All trees were cut and burnt in the fall of 1981 in an effort to eradicate the disease. Regular inspection of the area since 1981 showed no infection of any other adjacent tree species which include planted Sitka spruce, Norway spruce, and natural regeneration of black spruce and balsam fir. In 1982 the disease was found on ornamental Scots pine, Jack pine and red pine on the Salmonier Line, about 30 km west of St. John's. This was the first record of the disease outside the quarantine area. The trees were cut and burnt. The disease recurred on other trees in 1984 and these were cut and burnt. Subsequent inspections showed no new infections in the area.

A branch sample taken in late 1985 from a Sitka spruce grown in an experimental provenance plantation established in 1969 near Roddickton was confirmed in early 1986 to be damaged by Scleroderris canker. In 1969 and 1970 eight other provenance plantations were also established throughout the Island using the same stock of seedlings imported from New Brunswick (Figure 1). The examination of these plantations in 1986 showed various amounts of old mortality, recent branch dieback and topkill. The development of these symptoms appeared to be very gradual. Branch samples were taken from these plantations for cultural identification of the disease and subsequent determination of its race. However, these isolation attempts to date proved to be positive only for the Roddickton plantation. All trees in this plantation were examined in June 1987 and infection of the various provenances varied from 90-100%. The infected trees were pruned or cut in an attempt to eradicate the disease in this area.

The incidence of Scleroderris canker increased in and around St. John's in 1987. Continued surveys in 1987 also recorded four new locations of this disease. Three of these are in St. John's involving Scots pine and Austrian pine and one in an old Scots pine plantation (abandoned nursery) on the Salmonier Line. This pine plantation was examined in previous years but no symptoms of infection were recorded. This is the third time that Scleroderris canker was found on the Salmonier Line, outside the quarantine area.

In 1987 additional efforts were made to locate all Sitka spruce plantations established using seedlings from New Brunswick.

To date 19 additional plantations have been identified (Figure 1). Some of these plantations have been inspected in 1987 and many of the trees were in poor condition.

In 1988 all Sitka spruce plantations were examined for Scleroderris canker and suspected samples were collected for cultural identification of the disease. This survey showed that only the Roddickton plantation had typical symptoms of infection among the Sitka spruce plantations.

In 1988 the incidence of Scleroderris canker continued to increase in and around St. John's. Surveys recorded three new locations of the disease: one near Quidi Vidi Lake, where 10% of mature ornamental Austrian pines were infected, one on the Bay Bulls road and one at the Goulds where Austrian pines were infected.

In 1988 an effort was made to identify all locations where pines were planted from the Salmonier nursery. Inspection of historical records showed that "Sixteen permanent plantations with a total area of 2000 acres were established on the Avalon, Burin and Bonavista Peninsulas between 1938 and 1951. Scots pine was the favoured species and over 1 600 000 seedlings of this variety were planted in the sixteen plantations." Inspection of some of these plantations in 1988 showed that Scots pine planted in 1944 and 1949 on Colliers Ridge were infected with Scleroderris canker.

In August 1988 the Forest Insect and Disease Survey of the Canadian Forestry Service organized a field trip with the participation of representatives from the Newfoundland Department of Forestry, Agriculture Canada, and the Laurentian Forestry Centre to assess the status of Scleroderris canker in Newfoundland. Many of the Sitka spruce and pine plantations were inspected throughout the Island. This field trip confirmed the presence of the disease in the vicinity of St. John's on ornamental pines, on Scots pine at Salmonier nursery and at Colliers Ridge and on Sitka spruce at Roddickton. In addition extensive, hidden stem cankers were found on Scots pine at Salmonier nursery and Colliers Ridge indicating that the disease has been present for at least 10 years at these locations.

In 1989 the survey of the 16 Scots pine plantations established with stock from the Salmonier Nursery was completed. Only the plantation at Colliers Ridge is infected with this disease. Both the Salmonier Nursery and Colliers Ridge sites were sampled for stem cankers to determine the age and spread of the infection. Analysis of these samples are in progress.

The infested Sitka spruce plantation at Roddickton was inspected in 1989 and there were no signs of new or spreading canker infections.

The incidence of Scleroderris canker increased in and around St. John's in 1989 with new infections at two locations. Infected branches were pruned and destroyed.

Cultures of all Scleroderris isolates in Newfoundland made before 1987 were serologically diagnosed as the European race. In the fall of 1987 cultures from Austrian pine, Scots pine, red pine and Sitka spruce were shipped to the Laurentian Forestry Centre for race determination using electrophoresis. Cultures from the pines were identified as the European race, but those from Sitka spruce were not of the European race. They may be of the North American race or something else. A research program is planned in cooperation with the Laurentian Forestry Centre to elucidate the etiology of Scleroderris canker in Newfoundland.

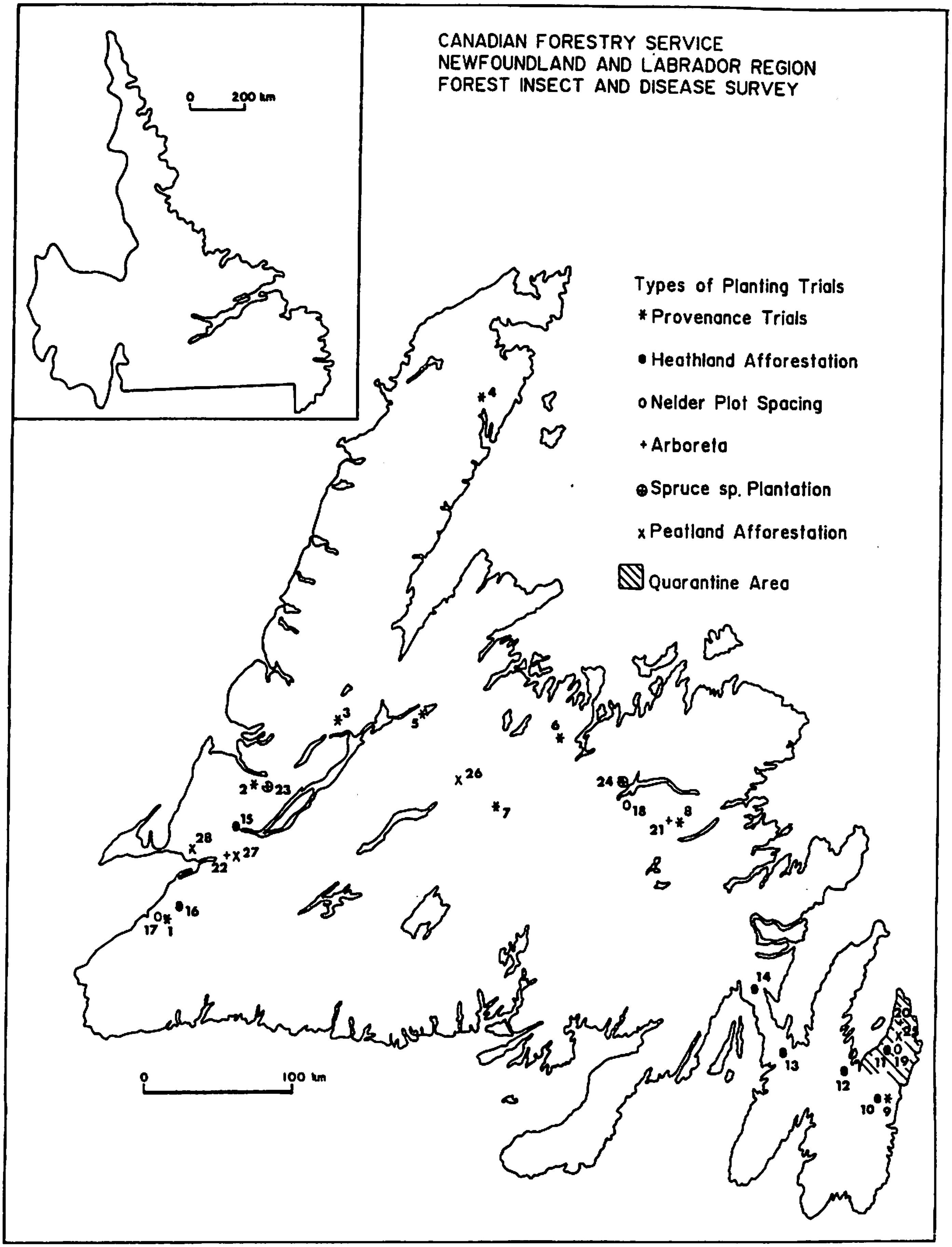



Figure 1. Locations of Scleroderris canker quarantine area and the Sitka spruce experimental plantations in Newfoundland using seedlings from Acadia Forest Nursery, N.B.

# PINEWOOD NEMATODE SURVEYS

by Bowers, W.W. and A.G. Raske

REPORT TO THE 17TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 14-16 NOVEMBER 1989

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
ST. JOHN'S, NEWFOUNDLAND
A1C 5X8

## PINEWOOD NEMATODE SURVEYS

by

Bowers, W.W. and A.G. Raske

The presence of the pinewood nematode in Canada and in Newfoundland has major regional, national and international implications for the forest sector. A regional survey for the PWN and its potential vector(s) were initiated in Newfoundland in 1985 in Newfoundland, and the national survey began in 1987. Final reports of these contracts have been received and the results are summarized below.

Regional Survey - Host Survey in Newfoundland

Wood samples were collected from healthy, moribund and dead trees of balsam fir (241 samples), black spruce (130), eastern larch (65), white spruce (43), Sitka spruce (17), white pine (15), Scots pine (12), and red pine (1) for a total of 525 samples from insular Newfoundland. Wood samples collected from Labrador consisted of 49 from balsam fir, 72 from black spruce, 29 from eastern larch and 4 from white spruce, for a total of 154 samples.

A total of 17 nematode genera were found in Newfoundland including the 'm' form of the pinewood nematode, *Bursaphelenchus xylophilus*. By host the distribution of genera is:

**Balsam Fir**

- *Bursaphelenchus xylophilus*, 'm' form - dead trees
- *Rhabditis* spp. - moribund, dead trees
- *Aphalenchoides rhytium* - moribund trees
- *Aphalenchoides* spp. - healthy, moribund, dead trees
- *Parasitaphelenchus* spp. - dead trees
- *Ektaphelenchus* spp. - moribund trees
- *Cryptaphelenchus* spp. - moribund, dead trees
- *Deladenus* spp. - healthy, moribund, dead trees
- *Diplogaster* spp. - dead trees
- *Protorhabditis* spp. - dead trees
- *Plectus* spp. - dead trees
- *Laimaphelenchoides* spp. - healthy trees

**Black Spruce**

- *Bursaphelenchus xylophilus*, 'm' form - healthy, dead trees
- *Rhabditis* spp. - moribund, dead trees
- *Aphalenchoides rhytium* - dead trees
- *Aphalenchoides* spp. - healthy, moribund, dead trees
- *Parasitaphelenchus* spp. - dead trees
- *Ekatphelenchus* spp. - moribund trees
- *Cryptaphelenchus* spp. - moribund, dead trees
- *Deladenus* spp. - healthy, moribund, dead trees
- *Plectus* spp. - healthy, dead trees
- *Laimaphelenchoides* spp. - healthy trees

**Eastern Larch**

- *Bursaphelenchus xylophilus*, 'm' form - healthy trees
- *Rhabditis* spp. - moribund, dead trees
- *Aphalenchoides* spp. - healthy, moribund, dead trees
- *Tylaphelenchus* spp. - healthy trees
- *Ektaphelenchus* spp. - healthy, moribund trees
- *Kornaria* spp. - healthy trees
- *Deladenus* spp. - healthy trees
- *Laimaphelenchus* spp. - healthy trees
- *Teratocephalus* spp. - dead trees

**White Spruce**

- *Rhabditis* spp. - dead trees
- *Aphelenchoides* spp. - healthy trees
- *Cryptaphelenchus* spp. - healthy trees
- *Tylaphelenchus* spp. - dead trees
- *Kornea* spp. - healthy trees
- *Neotylenchus* spp. - healthy trees

**Sitka Spruce**

Aphelenchoides spp. - moribund trees

**Scots Pine**

Rhabditis spp. - dead trees
Cryptaphelenchoides spp. - dead trees

**White Pine**

Rhabditis spp. - dead trees
Parasitorhabditis spp. - moribund trees
Cryptaphelenchus spp. - moribund trees
Tylaphelenchus spp. - healthy, dead trees
Ektaphelenchus spp. - healthy trees

The pathogenic 'r' form of the pinewood nematode was not found in Newfoundland and Labrador, though the non-pathogenic 'm' form was found at eight locations from insular Newfoundland. There it occurred in recently dead balsam fir, in healthy and recently dead black spruce, and healthy dead larch (see map 1988 Pest Control Forum Report). Neither form of the pinewood nematode was found in Labrador.

**National Survey - Potential Insect Vectors of the Pinewood Nematode**

In 1987 and 1988 the Forest Insect and Disease Survey contracted Dr. Jean Finney-Crawley, Memorial University of Newfoundland to extract and identify nematodes from insects that potentially could vector the pinewood nematode. FIDS staff collected the insects and sent them to Memorial University for processing. In all 5005 insect samples were processed at Memorial University: 218 from British Columbia, 109 from Alberta, 1454 from Ontario, 1268 from Quebec, 519 from New Brunswick, 1057 from Nova Scotia, 34 from Prince Edward Island, and 346 from

Newfoundland and Labrador. A total of 966 Monochamus spp. were examined, which is the genus of beetles most likely to vector the pinewood nematode.

The pinewood nematode, Bursaphelenchus xylophilus, did not occur in any of the insects examined, however one Monochamus sp. from Ontario harboured a nematode tentatively identified as Bursaphelenchus sp. (but not xylophilus).

Other genera of nematodes in living and dead trees were at times associated with the insects examined. These included: Cryptaphelenchus, Ektaphelenchus, Contortylenchus, Deladenus, Parasitorhabitis, Cryptaphelenchoides and Aphelenchoides.

This survey has added much new data on the nematode fauna in Canada and its potential vectors, however it did not establish a pinewood nematode vector association. This survey reinforced the conclusion that the pinewood nematode is not abundant in Canada.

# INSECT CONTROL PROGRAMS IN NEWFOUNDLAND IN 1989

by H. Crummey

(Prepared for the 1989 Annual Forest Pest Control Forum,
Ottawa - November 14 - 16, 1989)

BLACK ARMY CUTWORM - *Actebia fennica* (Tausch.)

The Department of Forestry and Agriculture had anticipated that control of this insect on a number of newly established black spruce plantations would be required again in 1989. Although preferred host plants had become established at many of these sites during 1988, sampling was initiated in early May, 1989 to determine cutworm numbers. Control options were in place, to be used if necessary. Low numbers of cutworm larvae were identified at several sites, but because of adequate vegetation and the absence of any feeding on the seedlings, the decision was made to forego any control program.

It is anticipated that the cutworm will be present at several sites again in 1990. These will be closely monitored in the spring and control will be initiated as required.

SPRUCE BUDWORM - *Choristoneura fumiferana* (Clem.)

The Forestry Canada forecast for 1989 indicated that a total of 10 389 ha were expected to be defoliated, with 1 245 ha of this in the moderate and severe defoliation class. Because of the locations of these infestations, and based on additional sampling of some of the area, no control program was proposed.

The forecast for 1990 is not yet available. Branch samples were collected in mid-October and processing will be completed by the end of this year. The results will form the basis of whether or not a control program will be required in 1990.

HEMLOCK LOOPER - *Lambdina fiscellaria fiscellaria* (Guen.)

This was the sixth year of the present hemlock looper outbreak in insular Newfoundland. An initial forecast was provided by Forestry Canada which was further fine-tuned based on extra samples collected in areas of priority stands by Department of Forestry & Agriculture staff and processed by Forestry Canada. The revised forecast was for defoliation to mainly occur on approximately 27 500 ha throughout insular Newfoundland with about 10 500 ha in the moderate to severe defoliation category. All the moderate to severe forecast was expected in the north-western part of the Island in the Castors River area (about 13 000 ha total, with about 7 600 ha in the moderate to severe defoliation category) and an additional 6 900 ha (with 2 900 ha in moderate to severe) to occur in the Main Brook - Roddickton area, all on the Great Northern Peninsula. As well, there were a few scattered areas of light defoliation forecast to occur elsewhere on the Island, being residual pockets from the peak of the infestation.

Based on this forecast, the Department of Forestry & Agriculture, in conjunction with two pulp and paper companies, planned a control program to protect the forest resource from the looper. The proposed program involved between 5 000 and 6 000 ha of predicted moderate to severe defoliation and some predicted light defoliation in silviculture areas. However, additional areas were to be monitored to determine population levels and to assess if treatment of these would be necessary.

Monitoring of insect population levels was carried out prior to spraying to determine where and when areas were to receive treatment. The net result was that a total of eight (8) blocks (5 362 ha), all in the Castors River - Leg Pond area, were treated using the biological insecticide B.t.(Futura XLV) [Figure 1]. Six (6) blocks (3 738 ha or 69.7 % of the total treated area) received two (2) applications of insecticide and two (2) blocks (1 624 ha or 30.3 %) received a single application of B.t. One of these blocks had a low looper population against which a second application was not deemed necessary, and the other block did not receive the second application due to poor spray weather at the end of the program.

One single-engine spray aircraft (a Bull Thrush contracted from Agric Air Inc. of Quebec), equipped with AU4000 Micronair spray atomizers, was used to apply treatment. Spraying began on the evening of July 2 and terminated on the morning of July 23. It was anticipated that the project could be completed in about two weeks or less if there was favourable spray weather. However, because of poor weather, particularly during the latter ten (10) days of the program, this had to be extended to three (3) weeks. In fact, a scheduled second application to one block had to be cancelled. Of the twenty-two (22) days duration, spraying occurred on eleven (11) (50 %) of the days. Out of a possible forty-two (42) spray periods, spraying only took place on twelve (12) (29 %) of the periods.

Sampling for the program was initiated in mid-June (around the expected time of hatch of looper larvae from the eggs) to assess looper population levels. There was difficulty encountered in finding adequate sample sites, as the area infested was inaccessible by ground and only had limited access by helicopter. Plots were established wherever possible in both proposed spray areas and adjacent unsprayed check areas. In many cases, these accessible areas were not ideal locations in terms of tree class (to facilitate the sampling methodology, i.e. beating, used to assess population levels) or in terms of block boundaries. In a few instances, only a small section of the total block could be sampled. These problems also influenced the availability of suitable check areas, and since most of the forecast area was scheduled to receive treatment, as was the objective, this left few areas for establishing checks.

Only a few pockets of looper infestation were identified up until the last week of June. Sampling had been delayed by poor weather and by this time, looper numbers, sufficient to warrant treatment, were detected. However, defoliation of the current years needles had become quite evident, and seemed to have occurred over a few days when there was no sampling. This amount of defoliation, so early in the season, is not typical of looper and was not consistent with observations from the area in previous years. Further investigation determined that much of this defoliation was probably being caused by the presence of a second insect, the blackheaded budworm (Acleris variana Fern.). This insect periodically attacks fir and spruce, and can cause from light to severe defoliation of the current years growth depending on population levels. The blackheaded budworm also overwinters in the egg stage, but larvae hatch one (1) to two (2) weeks earlier than the hemlock looper, and so are actively feeding on the new foliage by the time of looper hatch. Thus feeding by this insect would become evident earlier than for looper. Usually outbreaks of this insect only last a few years and generally there is not much tree mortality. An infestation of this insect had been identified in 1988 to the north and east of Castors River and was expected to occur again in the area as well as around the spray blocks, but not to cause extensive defoliation. Although the sampling methodology used for the looper was not adequate to determine the true population levels of budworm (sampling would require a different sampling procedure and set-up) this insect was detected in and around all spray blocks with the methodology used. Thus the level of defoliation of new foliage throughout the area prior to treatment was considered to be due to both blackheaded budworm and hemlock looper, with budworm suspected of causing much of this early visible defoliation. No attempt was made to control the budworm as there are no insecticides registered for use and no trials have been conducted in Newfoundland to test the effectiveness of presently available control products. These trials should be carried out prior to attempting large-scale operational control measures.

Therefore, with respect to the looper, only one check plot could be established by spray date with sufficient population to indicate spray success. A few other pockets of infestation were identified later in the program based on observed defoliation, but too late to collect necessary data to determine efficacy. A second small pocket of looper infestation was identified by Forestry Canada, (F.I.D.S.). However, data collected on the looper population level at this location can only be used as an indication of success in terms of mortality, since only one tree was sampled, but, defoliation estimates were recorded at the end of larval feeding at this location.

Pre-spray and post-spray data collected from spray blocks and check area were used to determine hemlock looper population levels and percent defoliation, to judge the effectiveness of the control program. The average number of looper larvae per sample unit per plot for all treated areas was 128 (range 29 to 289 with the higher count sufficient to cause moderate to severe defoliation). This variability between plots is not unusual with the looper, more so during a declining outbreak when numbers can vary greatly. Prior to spraying, estimates of tree defoliation of current years needles averaged twenty-one percent (21 %) over all blocks (range 0 to 58 %). There was more defoliation in the higher populated plots, as would be expected. As mentioned, because sampling was not carried out for the blackheaded budworm, it is unknown what proportion of the observed pre-spray defoliation could be attributed to budworm and what proportion to the looper.

After treatment, the uncorrected mortality of looper larvae averaged eighty percent (80 %) (range 42 to 99 %). Because of the small size of the program and therefore the limited data, it was not possible to determine any difference between one (1) application of B.t., two (2) applications applied at the designated time, and a delayed second application.

Tree defoliation of current years growth after treatment averaged forty-four percent (44 %) (range 7 to 97 %). It is believed that the higher observed defoliation in some plots resulted from intensive feeding by the blackheaded budworm, as well as the looper.

Assessment of tree defoliation of older needles (other than current years needles) indicated there was an average of seven percent (7 %) (range 0 to 35 %) pre-spray and twelve percent (12 %) (range 0 to 27 %) post-spray defoliation. Thus indicating only a slight increase over that period, but probably not significant.

Overall then, there was a difference of about twenty-five percent (25 %) in current years needle defoliation and a difference of about five percent (5 %) in older needle defoliation over the program in the treated areas, between pre-spray and post-spray assessments.

Of interest, were observations that indicated that after treatment, budworm larvae were still quite active compared with looper larvae which generally were inactive in contrast to pre-spray observations.

Data from the single check plot indicated that with an average population of 443 larvae per sample unit, there was ninety-two percent (92 %) mortality. However, this resulted from a lack of foliage on the sample trees. At post-spray assessment, there was one hundred percent (100 %) current years needle defoliation and ninety percent (90 %) old needle defoliation which would mean that the larvae originally there either starved or were forced to feed on ground vegetation, in either case resulting in a large decrease in larval numbers on sampled trees, compared to pre-spray counts.

In the other 'check' area, sampled by Forestry Canada, there were 216 larvae per sample unit pre-spray and 130 larvae post-spray (only one tree sampled at both times), resulting in forty percent (40 %) mortality. There was also seventy percent (70 %) current defoliation and twenty percent (20 %) old needle defoliation estimated at the above post-spray date. A number of trees in the general vicinity had ninety percent (90 %) tree defoliation. A later assessmernt of tree defoliation in this plot was made by the Departmental sample crew at final post-spray (same time as for treated blocks) and results indicated that there was seventy-two percent (72 %) current years needle defoliation and sixty-seven percent (67 %) old needle defoliation. This can be compared with data from the treated plots.

An aerial survey conducted by the Department to assess the overall defoliation in and adjacent to the treated areas indicated that, on average, moderate to severe total tree defoliation occurred on about eleven percent (11 %) (range 0 % to 27 %) of the treated area. The higher defoliation figures occurred in the block receiving one (1) application (the second application not applied due to poor spray weather) and in areas with more blackheaded budworm. Defoliation in treated blocks can be compared to an adjacent block which was initially proposed to be treated but was not sprayed because of lower priority and logistics. This block had forty percent (40 %) of its area in the moderate to severe defoliation class. The remaining percentage of the area of the treated blocks had some light tree defoliation due to both looper and budworm. There was also extensive defoliation outside of that recorded in the vicinity of the spray blocks particularly to the north and east, caused by the blackheaded budworm. This was not mapped during the spray block assessment.

Observations during the survey also indicated substantial numbers of looper moths outside of the treated areas in contrast to few moths inside. There were numerous blackheaded budworm moths in both treated and untreated areas.

The 1989 hemlock looper spray program was considered a qualified success in terms of limiting defoliation and minimizing tree mortality compared with untreated areas. Factors which complicated the analysis of collected data were: the influence of blackheaded budworm larvae in all sprayed blocks as well as throughout the general area, the amount of pre-spray defoliation present, the sampling difficulties associated with the treated and untreated areas and in establishing plots. In addition, there were areas of severe defoliation and some tree mortality present from previous year(s).

If one compares 1989 results with those from the 1988 program, in 1988 there was an average uncorrected mortality of single-application B.t. plots of fifty-two percent (52 %) and the average uncorrected mortality of eighty-one percent (81 %) in plots receiving two (2) applications of fenitrothion. Therefore, the 1989 results of uncorrected mortality of two (2) applications of B.t. (80 %) seem to compare favourably with two (2) applications of fenitrothion in 1988. In 1988, data indicated relatively little defoliation overall due to good tree growth early in the season. However, there was a difference of about twenty-five percent (25 %) between pre- and post-spray defoliation of current years needles in the B.t. areas and about eight percent (8 %) in the chemical plots in 1988. There was also very low old needle defoliation in 1988. In 1989, the corresponding figures were a twenty-five percent (25 %) difference in current years defoliation between pre-and post-spray estimates and a difference of about five percent (5 %) in older needle defoliation over the same period. Caution has to be expressed in that two different years are involved with differing conditions which could affect results obtained. No chemical was used in 1989.

The forecast for 1990 will be available in early January. Sampling has just been completed by Forestry Canada and Departmental personnel. Any control options will be assessed once the forecast is received.

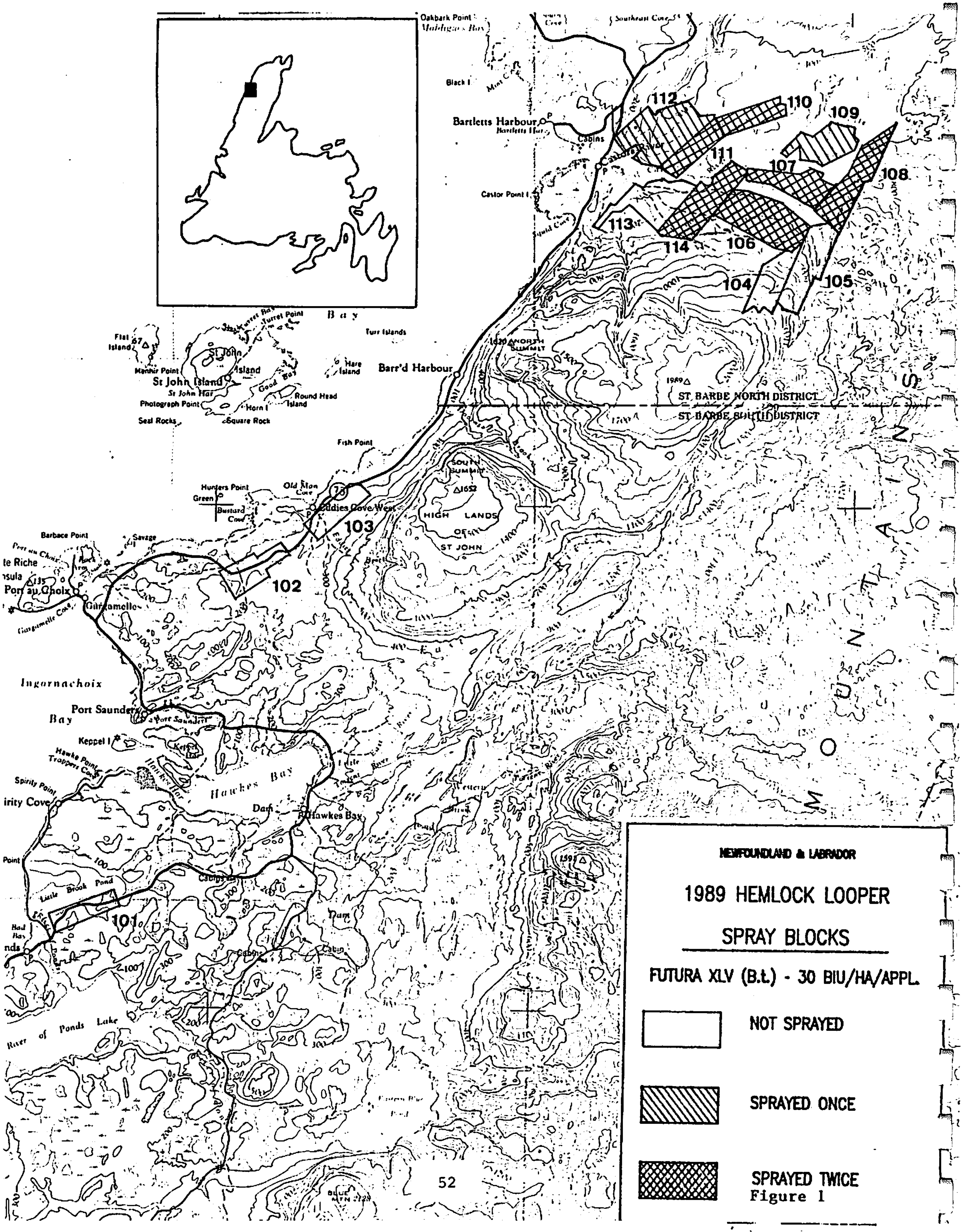

NEWFOUNDLAND & LABRADOR
1989 HEMLOCK LOOPER
SPRAY BLOCKS
FUTURA XLV (B.t.) - 30 BIU/HA/APPL.
NOT SPRAYED
SPRAYED ONCE
SPRAYED TWICE
101
102
103
104
105
106
107
108
109
110
111
112
113
114
ST. BARBE NORTH DISTRICT
ST. BARBE SOUTH DISTRICT
Bartletts Harbour
Barr'd Harbour
Eddies Cove West
St John Island
Port au Choix
Port Saunders
Hawkes Bay
Ingornachoix
Bay
HIGH LANDS OF ST JOHN
Oakbark Point
Black I
Castor Point
Flat Island
Turr Islands
Fish Point
Hunters Point
Old Man Cove
Barbace Point
Keppel I
Spirity Point
Photograph Point
Seal Rocks
Square Rock
Round Head Island
Little Brook Pond
River of Ponds Lake
Dam
Cabins

Figure 1

Forestry Canada | Forêts Canada

NO. 217

# Forestry Canada - Maritimes Region
# TECHNICAL NOTE

## HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES IN MID-JUNE 1989

For our clients' information, we will again issue periodic reports on major forest pest conditions in 1989. Our aim is to highlight the more significant problems as they occur and give updates on their development. This report includes information on forest pest conditions, as currently known, in the Maritimes in mid-June 1989.

Weather, once again, influenced the development of both trees and pests. At one point, the season was almost two weeks behind normal. Precipitation in May and the early part of June was above normal and resulted in lush vegetation (and record high populations of mosquitoes).

Gypsy moth egg mass hunts (search and destroy activities) were conducted this spring in several communities where their presence was noted during last fall's preliminary surveys. Numerous egg masses were destroyed in Annapolis Royal, Nova Scotia, and in St. Andrews and St. Stephen, New Brunswick. A few larvae were observed during the second half of May at some of the infested localities. Control efforts are being organized by the various agencies involved in keeping this serious pest in check; over 8500 pheromone traps will be deployed during the summer.

Oak leafroller, a perennial problem in red oak stands in much of western Nova Scotia in recent years, was active again and caused considerable defoliation. The insect, in some areas in combination with the oak leaf shredder, also caused defoliation of oak in parts of New Brunswick and Prince Edward Island. Repeated severe defoliation during past years has already seriously weakened many trees in numerous stands.

Scleroderris canker (European race) has been identified in a Scots pine Christmas tree plantation near Edmunston, New Brunswick. The disease was found there in 1988 but test results were not available until recently. Discussions regarding control measures of this plant quarantine related situation are under way.

- NURSERIES ☐
- PLANTATIONS ☐
- SILVICULTURE ☐
- UTILIZATION ☐
- ECONOMICS ☐
- TREE IMPROVEMENT ☐
- INSECTS AND DISEASES ■

Forestry Canada - Maritimes Region
P.O. Box 4000, Fredericton, N.B. E3B 5P7
P.O. Box 667, Truro, N.S. B2N 5E5
P.O. Box 190, Charlottetown, P.E.I. C1A 7K2

Overwintering seedling mortality in nurseries is one of the most serious problems observed so far this year.The loss of seedlings may have effects reaching far into the future. The exact cause of the condition is unknown but it is the result of a combination of factors, made more severe by the lack of snow cover last winter. Root development of seedlings was impaired and the seedlings were doomed in spite of the fact that their above-ground portion still appeared green. Thousands of seedlings were lost in several nurseries. One nursery lost an entire year's production of at least one species (over a million trees).

Larch casebearer populations are higher than last year and foliage discoloration was observed throughout Prince Edward Island, in much of New Brunswick, and parts of Nova Scotia. The level of discoloration is variable, only a trace in many areas, but some severely affected trees were also observed.

Eastern tent caterpillar tents are common in southern and eastern New Brunswick and in parts of Prince Edward Island. The insect is widespread in Nova Scotia but the number of tents found is low. Tents are found mostly, but not exclusively, on roadside cherry and apple trees. In some areas in southern New Brunswick, several tents were removed from single ornamental trees. The increase in the number of tents produced by the eastern tent caterpillar this year, reawakened memories of the forest tent caterpillar outbreak of a few years ago and resulted in a great number of inquiries from the public. However, the forest tent caterpillar, in spite of its name, does not build tents and there is no danger of an outbreak of that insect in 1989.

Pine leaf adelgid, a pest which alternates between white pine and spruce, caused the formation of great numbers of cone-like galls on red spruce in western Nova Scotia, especially in Queens, Lunenburg, Shelburne and Annapolis counties.

Pear thrips infestations in parts of New England in 1988 have caused alarm, especially among maple syrup producers. The pest has been found in Maine in the spring of 1989 but has caused no damage. In the Maritimes, several suspect samples were collected on sugar maple; however, since positive identification is still pending on these, no statement is possible this time, other than to state that no damage to date has been associated with these samples.

Other pests found active in the Region in the early part of the season included: balsam wooly adelgid, jack pine needle rust, poplar serpentine leafminer, maple leaf roller, birch casebearer, poplar leafmining sawfly, cedar leafminer, Armillaria root rot, Sirococcus shoot blight, satin moth, spruce budworm and browning of coniferous foliage due to roadside salt damage.

**L.P. Magasi**
**Forest Insect and Disease Survey**

**June 19, 1989**

Forestry Canada Forêts Canada

NO. 218

# Forestry Canada - Maritimes Region
# TECHNICAL NOTE

## HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES AT THE END OF JUNE 1989

In this, the second report of 1989, we briefly discuss forest pest conditions as they appeared in the Maritimes at the end of June 1989.

The lack of major pest problems on a large scale, especially on hardwoods, is one of the most noteworthy items. Although the number of forest pests, both insects and diseases, active this time of the year is considerable, most problems are of a localized nature.

Gypsy moth larvae were found, in considerable numbers in some places, at several locations both in New Brunswick and Nova Scotia. The highest numbers observed in New Brunswick were at St. Stephen, where larvae were present in at least four areas of the town. As many as 70 late instar larvae were counted on a single oak tree. In spite of the numbers, no appreciable defoliation occurred before the end of the month. In Nova Scotia, at New Minas, an apple orchard was found infested, larvae were numerous, and the trees were defoliated to various degrees. Control traps are in place in 4 areas in New Brunswick and in 5 areas in Nova Scotia. Monitoring, detection, and delimitation traps will be deployed around the end of July, bringing the number of traps in the Maritimes to well over 8500 as part of the multi-agency gypsy moth program in 1989.

Spruce budworm has largely completed its feeding period for the year and aerial surveys for defoliation are getting under way. It appears that severe and moderate defoliation will be mapped in parts of northern New Brunswick and in patches in eastern and central Prince Edward Island (after a two-year absence). No defoliation is expected to be recorded in Nova Scotia.

NURSERIES ☐
PLANTATIONS ☐
SILVICULTURE ☐
UTILIZATION ☐
ECONOMICS ☐
TREE IMPROVEMENT ☐
INSECTS AND DISEASES ■

Forestry Canada - Maritimes Region
P.O. Box 4000, Fredericton, N.B. E3B 5P7
P.O. Box 667, Truro, N.S. B2N 5E5
P.O. Box 190, Charlottetown, P.E.I. C1A 7K2



Cette publication est aussi disponible en français sur demande

Pear thrips have been added to the ever-growing list of forest pests present in the Maritimes. The insect was identified in samples of sugar maple leaves, from trees showing signs of stress, in widely separated locations in New Brunswick. Samples came from Madawaska, Carleton, York, Albert, and Gloucester counties. However, populations in all cases were low and no foliage damage occurred. Further surveys will be necessary to establish the distribution of this pest in the Region.

Root collar weevil, probably Hylobius warreni, found in a jack pine plantation in Albert County, New Brunswick, last year, continues to damage and kill trees in 1989. The problem is more widespread, and more serious, than last year. A number of plantations of various tree sizes are affected and as much as 15% new tree mortality was observed. Surveys to establish the extent of the problem are pending and possibilities for control are under investigation.

Heavy seed crop on some hardwoods, especially red maple and elm, caused trees in many areas to appear brown from a distance due to the delayed development of foliage. Even after the leaves expand they are often much smaller than normal and the trees look "thin". The combination of seed production and the weaker foliage will undoubtedly cause a stress situation. Cedar trees also appear discolored; this is due, in most places, to the abundance of maturing cones that have turned brown.

Other forest pests of note include: **birch casebearer** causing varying levels of foliage discoloration, mostly on white birch, in all three provinces; **birch leafminer** on wire birch in parts of New Brunswick and Nova Scotia; **satin moth** on ornamental silver poplar trees; **uglynest caterpillar** along roadside in all three provinces; **elm leafminer** causing moderate or severe foliage discoloration of exotic elms in the Region; **needle rusts** on pines, spruces, and balsam fir; **cedar borer** in the Saint John area of New Brunswick; **Dutch elm disease**, infecting both residual old trees and younger ones in New Brunswick and Nova Scotia, so far found only within the area of known distribution; **spruce beetle**, **cherry blight** common in all three provinces; **Sirococcus shoot blight** damaging red pine trees in both plantations and natural stands; **balsam twig aphid**; **spruce budmoth**; **spruce bud midge**; **yellow witches' broom** on balsam fir; various **gall midges** and **mites** on hardwood foliage, and many others.

L.P. Magasi
Forest Insect and Disease Survey

June 30, 1989

Canada

Forestry Canada Forêts Canada

NO. 220

Forestry Canada - Maritimes Region

TECHNICAL NOTE

## HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES AT THE END OF JULY 1989

In this, the third report of 1989, forest pest conditions as they appeared in the Maritimes at the end of July 1989 are briefly discussed. There is also a statement correcting an error in two previously published FIDS reports.

<u>CORRECTION</u> - Due to an unfortunate oversight, an error crept into the 1988 FIDS annual report (Forest pest conditions in the Maritimes in 1988; M-X-174) and the same error was carried over to the Technical Note (No. 210) dealing with the Multi-agency plantation pest surveys in New Brunswick in 1988. In the table, "Summary of plantation assessments by tree species and organization conducting field work in the various resource management regions in New Brunswick in 1988," the organizations CBI and JDI have been inadvertently reversed in the table heading. The correct figures are: 55 plantations assessed by J.D. Irving Ltd. (JDI) and 9 plantations by Consolidated Bathurst Inc. (CBI). My apologies for any confusion or embarrassment my error may have caused.

<u>Hemlock looper</u> - Severe or moderate defoliation of balsam fir occurred as a result of a serious infestation of hemlock looper in the Christmas Mountain area of northwestern Northumberland County, New Brunswick. No precise figures are available yet, but the area affected is considerable and covers some 10 000 ha within which defoliation occurred. This is the first serious outbreak of hemlock looper in the Maritimes since 1977-1978, when the insect killed large numbers of trees in Prince Edward Island. There has never been a recorded hemlock looper outbreak in New Brunswick since the establishment of the Forest Insect and Disease Survey in 1936.

<u>Discoloration of hardwood foliage on Cape Breton Island</u> - Severe or moderate foliage discoloration of most hardwood species occurred over extensive areas of Cape Breton Island, Nova Scotia at the end of June. Leaf browning occurred in a coastal strip along the entire

NURSERIES ☐

PLANTATIONS ☐

SILVICULTURE ☐

UTILIZATION ☐

ECONOMICS ☐

TREE IMPROVEMENT ☐

INSECTS AND DISEASES ■

Forestry Canada - Maritimes Region
P.O. Box 4000, Fredericton, N.B. E3B 5P7
P.O. Box 667, Truro, N.S. B2N 5E5
P.O. Box 190, Charlottetown, P.E.I. C1A 7K2



Cette publication est aussi disponible en français sur demande

length of Inverness and the northern tip of Victoria counties. Stands were mostly affected on the upper elevations of hills or along ridges. The area affected is in excess of 20 000 ha. The extensive damage was almost certainly the result of the heavy southeasterly winds that were recorded on Cape Breton Island a few days before browning became evident. Although foliage injury is most serious on sugar maple, other hardwoods, such as red maple, birch, beech, alder, cherry, are also discolored. Most of the affected leaves showed signs of physical damage, being torn or shredded to various degrees, while others exhibited symptoms of water deficiency. The type of leaf injury and the resultant stand discoloration are consistent with damage caused by strong winds. On sugar maple, wind damage was compounded by the presence of a fungus causing the leaf disease called anthracnose.

**Gypsy moth** - A single first instar larva, found on a red maple tree near Lake Paul, Kings County in Nova Scotia, constitutes the only new location for the insect so far this year. Almost all of the 8000 pheromone traps have been placed on time, no information on catches is available - but then it is early in the trapping season yet.

**Sirococcus shoot blight** was found damaging white spruce trees in a central Nova Scotia seed orchard. The damage was severe on many of the trees, with most shoots red and dead on numerous branches. The fungus causing the disease is well developed and will become the source of further infection. Finding the disease on spruce at this severity, especially in a seed orchard setting, is unusual, and this may cause future problems in reforestation programs as the disease is partly seed transmitted.

**Dutch elm disease** is present in all three provinces although, to date, no change occurred in the known distribution. Infected trees are common in the St. Stephen and St. Andrews area of New Brunswick after a few years of a relatively stable, low infection rate.

**Other forest pests of importance** in July included: **spruce beetle** killing numerous trees in northwestern New Brunswick, also active elsewhere; **Stillwell's syndrome**, the sudden death of conifers, was common in New Brunswick; **ash rust** causing dieback in Digby County and concomitant mortality in Yarmouth County, Nova Scotia; **alder flea beetle** common in New Brunswick and Nova Scotia; **a leaf beetle** (*Pyrrhalta* sp.) on balsam poplar common in southeastern New Brunswick; **fall webworm** common in western Nova Scotia; **whitemarked tussock moth** causing noticeable defoliation in Yarmouth and Digby counties, Nova Scotia; plantation black spruce suffering damage by **yellowheaded spruce sawfly** at 5 plantations in Kings County, New Brunswick and one small plantation at Conway, Prince County, Prince Edward Island; a species of **Conophthorus** damaged 50% of eastern white pine shoots at a York County location in New Brunswick; **elm leaf beetle** common on elm in parts of Fredericton, New Brunswick; and **white pine weevil** damage is more common and widespread in the Region with a high of 36% young eastern white pine suffering leader damage at Cains River, Northumberland County, New Brunswick.

August, 1989

L.P. Magasi
Forest Insect and Disease Survey

Forestry Canada Forêts Canada

# NO. 221

## Forestry Canada - Maritimes Region

# TECHNICAL NOTE

NURSERIES

PLANTATIONS

SILVICULTURE

UTILIZATION

ECONOMICS

TREE IMPROVEMENT

INSECTS AND DISEASES

### HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES IN MID-SEPTEMBER, 1989

In this, the fourth report of 1989, forest pest conditions as they appeared in the Maritimes in mid-September 1989 are briefly discussed.

**LACK OF RAIN** in most areas of the Region in much of the first half of September has added to the already droughty conditions. All reporting weather stations in Nova Scotia and Prince Edward Island registered less than average precipitation for the July 15-September 7 period. As much as 124 mm less than the 30-year average was reported at Middle Musquodoboit, N.S. Trees, especially along roadsides and in urban situations, are reacting to this added stress: discoloration and leaf drop are occurring earlier than is normal in many areas.

**GYPSY MOTH** - Collection of the approximately 8000 pheromone traps is nearing completion. Early returns indicate that catches will be higher than last year in many areas, however, blow-in of moths from increased populations in the United States rather than increase in local populations may be the reason for this. Egg mass surveys will be conducted by the various cooperating agencies throughout the fall. Several egg masses have already been found in both New Brunswick and Nova Scotia. (This is the final request for immediate submission of gypsy moth traps - or information on results - to FIDS in Fredericton).

Forestry Canada - Maritimes Region
P.O. Box 4000, Fredericton, N.B. E3B 5P7
P.O. Box 667, Truro, N.S. B2N 5E5
P.O. Box 190, Charlottetown, P.E.I. C1A 7K2



Cette publication est aussi disponible en français sur demande

**EARLY BROWNING OF WHITE BIRCH** occurred along the Bay of Fundy shore in both New Brunswick and Nova Scotia. Browning was present but generally only at trace to light intensity in late August. Discoloration intensified quickly in early September, resulting in considerable browning which was distinguishable from autumn leaf coloration.

Similar symptoms were also observed in other parts of both provinces in groups of trees, while white birch trees in other areas were still green. Specific areas noted were in York and Victoria counties in New Brunswick, Halifax and Cumberland counties in Nova Scotia.

**HEMLOCK LOOPER** - The area affected by defoliation in the Christmas Mountain area of Northumberland County, New Brunswick, has been determined as approximately 3 800 ha, of which about 2 300 ha were in the severe and moderate defoliation categories. The insect populations survived well in this area, as indicated by the large numbers of moths flying in the early fall. Populations may also be on the increase elsewhere in the Region, judging from the higher than usual moth activity. Preparatory to possible control action, field surveys in the outbreak area are being conducted by the Department of Natural Resources & Energy.

**FALL WEBWORM** nests were obvious, common, and in some areas, numerous on hardwoods throughout Nova Scotia, Prince Edward Island, and southern New Brunswick. They were present but less common in the rest of the province.

**ALDER FLEA WEEVIL** and **WILLOW FLEA WEEVIL** caused severe browning on their respective hosts throughout most of the Maritimes. The browning was very obvious, especially on alder, along long stretches of highways.

**OTHER FOREST PESTS OF NOTE** include: birch skeletonizer, in Nova Scotia, spruce bark beetle, Armillaria root rot in plantations, eastern dwarf mistletoe, leaf blotch of horse chestnut, ash rust, pine leaf adelgid on white pine, balsam woolly adelgid, Dutch elm disease, balsam gall midge, etc.

L.P. Magasi
Forest Insect and Disease Survey

September 18, 1989

**Seventeenth Annual Forest Pest Control Forum**
**Ottawa, Ontario**
**November 14-16, 1989**

## FOREST PEST CONDITIONS IN THE MARITIMES IN 1989

Significant forest pest conditions which occurred in the Maritimes Region in 1989 have been reported in Forestry Canada-Maritimes Technical Notes 217, 218, 220 and 221. Copies of these are attached.

Insects discussed in some detail included: gypsy moth, spruce budworm, hemlock looper, pear thrips, oak leafroller, larch casebearer, eastern tent caterpillar, pine leaf adelgid, root collar weevil, fall webworm, alder flea beetle, and willow flea weevil; diseases discussed were: Sirococcus shoot blight, Dutch elm disease, Scleroderris canker; and abiotic conditions mentioned were: wind damage to hardwood foliage, white birch foliage browning and the effects of heavy seed crop and drought in causing additional stress to trees.

Operational control measures were carried out against the spruce budworm, spruce bud moths, seedling debarking weevil, gypsy moth and Dutch elm disease. Experimental trials were conducted against a number of pests including the spruce budworm, spruce bud moths, Sirococcus shoot blight, and Scleroderris canker. Details on pest control are presented elsewhere during the Forest Pest Control Forum. In addition, the spread of the European larch canker is being controlled by the prohibition of transport of larch material from the established quarantine zone.

L.P. Magasi
Forest Insect and Disease Survey
Forestry Canada - Maritimes Region

# Spruce Budworm Population
# In Nova Scotia, 1989

by

Dr. T. D. Smith
Mr. R. Guscott
Mr. E. Georgeson

Entomological Services, Nova Scotia Lands and Forests
P.O. Box 68, Truro, Nova Scotia, Canada B2N 5B8
Misc. Publ. No. 18.

Deputy Minister
Mr. J. Mullally

Minister
Hon. C.W. MacNeil MD.

November 1989

## TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES



## LIST OF APPENDICES

## ACKNOWLEDGEMENTS

I wish to thank the Pest Detection Officers and the Bowater Mersey personnel for collecting the field samples. I am greatful to the Insectary Staff, M. LeBlanc, P. Geddes. C. Norrie and J. Smith for processing the samples and to Ms. L. Lorraine for typing the 1988 report. I am very greatful to Ms. A. Walker for typing previous Entomological Services reports.

## I. INTRODUCTION

There are three major surveys of spruce budworm (Choristoneura fumiferana (Clemens, 1865)) in Nova Scotia. The three surveys are: (1) Aerial Defoliation Survey, (2) Moth Flight Survey, and (3) Survey of Overwintering Larvae (L-2 survey). These surveys are both descriptive and predictive in nature. In 1985, the L-2 survey superceded the spruce budworm egg-mass survey.

The L-2 survey of 1989 noted the end of the decline of infestation in the Province. There was a general increase, except in Cumberland County, of areas with low population densities. (Appendix 1).

## II. AERIAL DEFOLIATION SURVEY

The Aerial Defoliation Survey is conducted by the Forest Insect and Disease Survey of Foresrty Canada (Truro) with assistance from the Department of Lands and Forest. In summary, no visible defoliation was noted by aerial observers (Magasi 1989 pers. comm.).

## III. MOTH FLIGHT SURVEY

The Department in conjunction with Agriculture Canada, Environment Canada, Forestry Canada, Transport Canada, Nova Scotia Department of Education, Nova Scotia Agriculture and Marketing operate a system of light traps to sample photopositive night flying insects. The Department's light traps are operated during flying insects. The Department's light traps are operated during the time of moth flights of spruce budworm. This year weather conditions were favorable for adult migration but no spruce budworm or hemlock looper moth flights were noted.

## IV. L-2 SURVEY

The objective of the L-2 survey is predictive in nature. The data from this survey are used to forecast expected population densities and define areas of risk. The spruce budworm larvae migrate after eclosion and before hibernation. For this reason the L-2 data are better estimators of the current population densities than are those data of the egg-mass survey or those from a proposed pheromone trap survey.

### A. Methods

#### 1. Field

There were 240 sample locations used for this years survey. Field samples from 215 locations were collected by Departmental personnel whereas, samples from 25 locations were collected from Bowater Mersey personnel. The number of sample points used for this year's survey is a reflection of the past status of the spruce budworm in various parts of the Province (Smith and Georgeson 1988).

#### 2. Laboratory

The Insectary at Debert has been modified to process L-2 samples. Hibernating spruce budworm larvae are removed from foliage by treating softwood foliage with a hot (66 °C) solution from plant debris by a differential wetting technique using hexane. Larvae were enumerated on gridded filter papers under a Wild-Leitz M5 stereo microscope (Miller et. al. 1971, Miller and Kettela 1982, Dorais and Kettela 1982, and Trial 1984).

In the Maritimes, L-2 data have been traditionally expressed on number of larvae per 45 cm mid-crown balsam fir branch. When dealing with spruce species it is more convenient to sample longer branches (75 cm) and express these data as number of larvae per 10 square meters as does Maine, Quebec, and Newfoundland (Table 1) (Dorais and Kettela, 1982). Sample areas with similar population densities are grouped to produce the L-2 map for 1988 (Figure 1) and for 1989 (Figure 2).

Table 1. Population assessment and infestation levels of second instar spruce budworm larvae.

| Regions | Population Assessment Larvae/branch | Larvae/10 $m^2$ | Infestation Level |
|---|---|---|---|
| Maritimes | 1- 6 | -- | Low |
| | 7-20 | -- | Medium |
| | 21-40 | -- | High |
| | 41- + | -- | Extreme |
| Ontario | 1-25 | -- | Low |
| | 26-65 | -- | Medium |
| | 66- + | -- | High |
| | -- | 0 | None |
| Maine | -- | 1-100 | Low |
| Quebec | -- | 101-300 | Medium |
| Newfoundland | -- | 301-650 | High |
| | -- | 651- + | Extreme |

(Dorais and Kettela 1982)

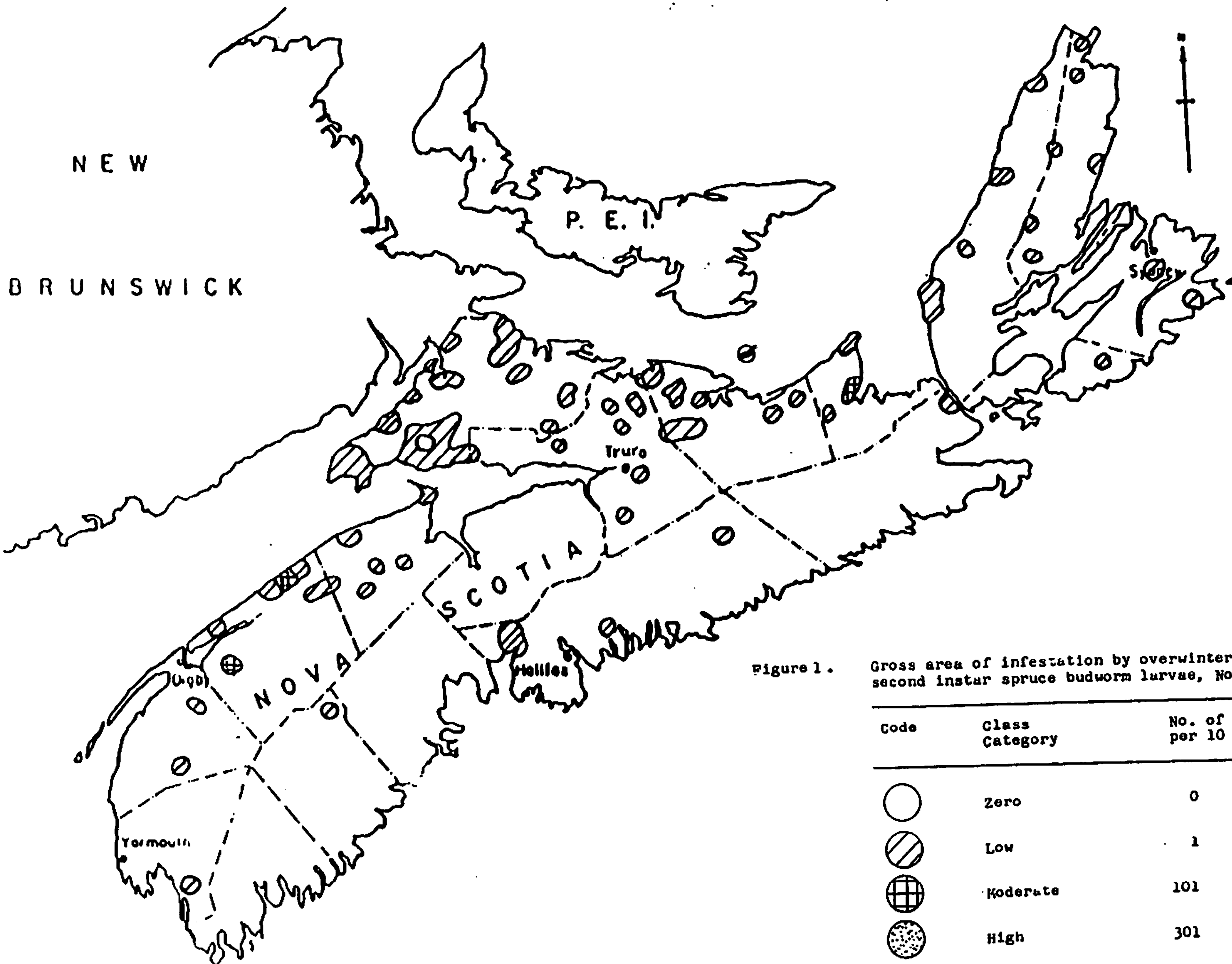



Figure 1. Gross area of infestation by overwintering (1988-1989) second instar spruce budworm larvae, Nova Scotia, 1988.

| Code | Class Category | No. of larvae per 10 m² | | |
|---|---|---|---|---|
| | Zero | 0 | | |
| | Low | 1 | - | 100 |
| | Moderate | 101 | - | 300 |
| | High | 301 | - | 650 |
| | Extreme | 651 | + | |

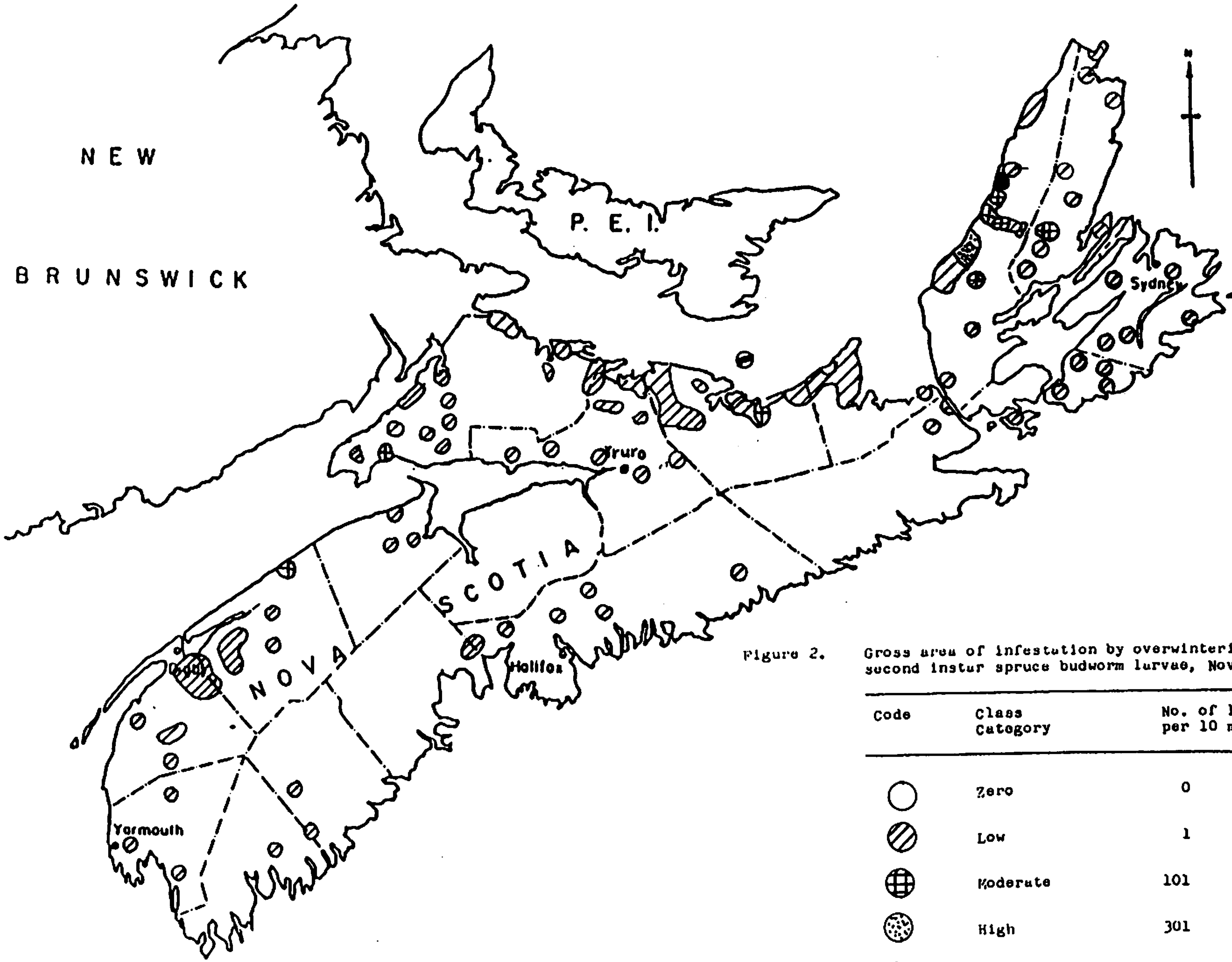



Figure 2. Gross area of infestation by overwintering (1989-1990) second instar spruce budworm larvae, Nova Scotia, 1989.

| Code | Class Category | No. of larvae per 10 m$^2$ |
|---|---|---|
| | Zero | 0 |
| | Low | 1 - 100 |
| | Moderate | 101 - 300 |
| | High | 301 - 650 |
| | Extreme | 651 + |

## B. Results

### 1. Microspordia

Monitoring of the gut parasite of spruce budworm <u>Nosema fumiferanae</u> (Thomas) will be done at a later date.

### 2. Frequency of occurrences of infestation classes

For 1989 the proportion of the number of samples in the zero (45.4%) and low (49.2%) changed from to those of 1988, 61.2 percent and 37.5 percent respectively; whereas, those of moderate (4.2%) tripled from those of 1988; and, those of high (0.8%) and extreme (0.4%) changed from those of null in 1988, (Appendix 2). On the northern Mainland there was a slight increase in the number of locations with low populations. (Table 2).

### 3. Gross area of infestation

#### a. Cape Breton Island

There is a net increase in the gross area infested on Cape Breton Island was 87 750 ha and these increases occurred in all counties. There were increases in areas of moderate populations in Inverness (18 500 ha) and in Victoria (7 750 ha) Counties and increases of high (10 000 ha) and extreme (3 250 ha) in Inverness County (Appendix 3).

#### b. Mainland

##### i. Southern

For the exception of Hants and Kings Counties all Counties in the Southern Mainland had increases in areas of low population densities. In Annapolis County the area of moderate population

Table 2. Comparsion of the gross area of infestation by over-wintering spruce budworm larvae for Antigonish, Colchester, Cumberland and Pictou Counties, Nova Scotia, 1988 and 1989.

| County | Gross area (ha) of infestation class category | | | | |
|---|---|---|---|---|---|
| | Low | Moderate | High | Extreme | Total |
| **Antigonish** | | | | | |
| 1988 | 10000 | 5000 | 0 | 0 | 15000 |
| 1989 | 60750 | 3000 | 0 | 0 | 63750 |
| Diff. | 50750 | -2000 | 0 | 0 | 48750 |
| % Diff. (1988) | 507.50 | -40.00 | 0.00 | 0.00 | 325.00 |
| **Colchester** | | | | | |
| 1988 | 31000 | 0 | 0 | 0 | 31000 |
| 1989 | 54250 | 0 | 0 | 0 | 54250 |
| Diff. | 23250 | 0 | 0 | 0 | 23250 |
| % Diff. (1988) | 75.00 | 0.00 | 0.00 | 0.00 | 75.00 |
| **Cumberland** | | | | | |
| 1988 | 153250 | 0 | 0 | 0 | 153250 |
| 1989 | 62500 | 3250 | 0 | 0 | 65750 |
| Diff. | -90750 | 3250 | 0 | 0 | -87500 |
| % Diff. (1988) | -59.22 | +100 | 0.00 | 0.00 | -57.10 |
| **Pictou** | | | | | |
| 1988 | 36750 | 0 | 0 | 0 | 36750 |
| 1989 | 60750 | 3000 | 0 | 0 | 63750 |
| Diff. | 24000 | 3000 | 0 | 0 | 27000 |
| % Diff. (1988) | 65.31 | +100 | 0.00 | 0.00 | 73.47 |
| **Total** | | | | | |
| 1988 | 231000 | 5000 | 0 | 0 | 236000 |
| 1989 | 238250 | 9250 | 0 | 0 | 247500 |
| Diff. | 7250 | 4250 | 0 | 0 | 11500 |
| % Diff. (1988) | 3.14 | 85.00 | 0.00 | 0.00 | 4.87 |
| **Total for Moderate+High+Extreme** | | | | | |
| 1988 | | | | | 5000 |
| 1989 | | | | | 9250 |
| Diff. | | | | | 4250 |
| % Diff. (1988) | | | | | 85.00 |

density decreased by half.

ii. Northern

The infestation in the Northern Mainland continues to be in a state of flux. There was a significant decline in the area of lowpopulation density in Cumberland County (90 750 ha) . Whereas, the area of low population density increased in Antigonish, Colchester and Pictou Counties (Tables 2 and 3). There was no area of moderate population in Antigonish in 1989 but one area was noted in Pictou and Cumberaland Counties. There were no areas of high or extreme noted on the Northern Mainland.

3. Other pests

Care must be taken to monitor possible range overlaps and combined effects of defoliation by the spruce budworm and other spruce-fir defoliators. No significant populations of spruce coneworm (Dioryctria reniculelloides Mut. & Mun.) or spruce budmoth (Zeiraphera canadensis Mut. & Free.) were noted in 1989. The hemlock looper (Lambdina fiscellaria (Guen.)) occupies a similar ecological niche as the spruce budworm. It does, however, utilize a greater variety of host and feeds from mid-July to mid-August. Tree mortality can occur after one year of severe defoliation. A limited egg-mass survey will be done in the near future.

V. Summary

The area of spruce budworm population in Nova Scotia expanded by 30 percent with patches of moderate population densities, a

Table 2. Frequency of the number of occurrences of L-2 class categories for Antigonish, Colchester, Cumberland and Pictou Counties, Nova Scotia, from 1985 to 1989.

Frequency of the number of Occurrences

Antigonish

| Class Category | 1985 No. | 1985 % | 1986 No. | 1986 % | 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 2 | 10.5 | 6 | 23.1 | 12 | 44.4 | 10 | 71.4 | 3 | 21.4 |
| Low | 7 | 36.8 | 12 | 46.2 | 13 | 48.1 | 3 | 21.4 | 11 | 78.6 |
| Moderate | 5 | 26.3 | 6 | 23.1 | 1 | 3.7 | 1 | 7.1 | 0 | 0.0 |
| High | 4 | 21.1 | 1 | 3.8 | 1 | 3.7 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 1 | 5.3 | 1 | 3.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 19 | 100.0 | 26 | 100.0 | 27 | 100.0 | 14 | 100.0 | 14 | 100.0 |

Frequency of the number of Occurrences

Colchester

| Class Category | 1985 No. | 1985 % | 1986 No. | 1986 % | 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 7 | 23.3 | 10 | 27.0 | 18 | 45.0 | 14 | 63.6 | 6 | 33.3 |
| Low | 10 | 33.3 | 16 | 43.2 | 17 | 42.5 | 8 | 36.4 | 12 | 66.7 |
| Moderate | 5 | 16.7 | 6 | 16.2 | 3 | 7.5 | 0 | 0.0 | 0 | 0.0 |
| High | 1 | 3.3 | 5 | 13.5 | 2 | 5.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 7 | 23.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 30 | 100.0 | 37 | 100.0 | 40 | 100.0 | 22 | 100.0 | 18 | 100.0 |

Frequency of the number of Occurrences

Cumberland

| Class Category | 1985 No. | 1985 % | 1986 No. | 1986 % | 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 11 | 14.1 | 14 | 13.7 | 52 | 51.5 | 20 | 41.7 | 33 | 63.5 |
| Low | 23 | 29.5 | 40 | 39.2 | 39 | 38.6 | 28 | 58.3 | 18 | 34.6 |
| Moderate | 18 | 23.1 | 28 | 27.5 | 6 | 5.9 | 0 | 0.0 | 1 | 1.9 |
| High | 9 | 11.5 | 13 | 12.7 | 2 | 2.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 17 | 21.8 | 7 | 6.9 | 2 | 2.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 78 | 100.0 | 102 | 100.0 | 101 | 100.0 | 48 | 100.0 | 52 | 100.0 |

Frequency of the number of Occurrences

Pictou

| Class Category | 1985 No. | 1985 % | 1986 No. | 1986 % | 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 3 | 11.5 | 12 | 29.3 | 27 | 61.4 | 15 | 57.7 | 10 | 38.5 |
| Low | 4 | 15.4 | 13 | 31.7 | 11 | 25.0 | 11 | 42.3 | 15 | 57.7 |
| Moderate | 4 | 15.4 | 11 | 26.8 | 6 | 13.6 | 0 | 0.0 | 1 | 3.8 |
| High | 3 | 11.5 | 3 | 7.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 12 | 46.2 | 2 | 4.9 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 26 | 100.0 | 41 | 100.0 | 44 | 100.0 | 26 | 100.0 | 26 | 100.0 |

Frequency of the number of Occurrences

Northern Mainland Nova Scotia

| Class Category | 1985 No. | 1985 % | 1986 No. | 1986 % | 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 23 | 15.0 | 42 | 20.4 | 109 | 51.4 | 59 | 53.6 | 52 | 47.3 |
| Low | 44 | 28.8 | 81 | 39.3 | 80 | 37.7 | 50 | 45.5 | 56 | 50.9 |
| Moderate | 32 | 20.9 | 51 | 24.8 | 16 | 7.5 | 1 | 0.9 | 2 | 1.8 |
| High | 17 | 11.1 | 22 | 10.7 | 5 | 2.4 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 37 | 24.2 | 10 | 4.9 | 2 | 0.9 | 0 | 0.0 | 0 | 0.0 |
| Total | 153 | 100.0 | 206 | 100.0 | 212 | 100.0 | 110 | 100.0 | 110 | 100.0 |

total of 37 250 ha, in five Counties Single areas of high (10 000 ha) and extreme (3 250 ha) ane noted in Inverness County and these areas will require careful monitoring. Neither spruce budworm nor hemlock looper moth flights were noted in 1989.

## VI REFERENCES


Dorais, L. and E.G. Kettela. 1982. A review of entomological survey and assessment techniques used in regional spruce budworm, Choristoneura fumiferana (Clem.) surveys and in the assessment of operational spray programs. Eastern Spruce budworm Council. Misc. publ. 43 pp.

Magasi, L. 1989. Personal Communication.

Miller, C.A. and E.G. Kettela. 1972. An additional note on sampling overwintering Spruce Budworm larvae. Can. For. Ser. Fredericton, N.B., Inf. Report. M-X-34.

Miller, C.A. and E.G. Kettela and G.A. McDougall. 1971. A sampling technique for overwintering Spruce Budworm and its applicability to population surveys. Can. For. Serv. Fredericton, N.B., Inf. Report M-X-25. No. 31. 332 pp.

Smith, T.D. and Georgeson, E. 1988. Spruce Budworm populations ni Nova Scotia, 1988. Entomol. Serv., N.S. Lands and Forests, P.O. Box 68, Truro, N.S., Canada, B2N 5B8. Misc. Publ. # 14. 24 pp. incl. 3 app.

Trial, H. Jr. 1984. L2-surveys-soda wash for new and improved techniques for monitoring and evaluating spruce budworm pp 37-39. In Grimble, D.G. and D.R. Kucera (Co-ch) 1984 Proceedings: new and improved techniques for monitoring and evaluating spruce budworm populations. Canusa Symposium, Burlington, Vermont, USA, September 13-15, 1983. USDA. Forest Service, Northeastern For. Exp. Stn. 370 Reed Rd., Broomall, PA, USA, 19008, Gen. Tech. Rep. NE-88, 71 pp.

## Appendix 1

Population densities of overwintering second instar spruce budworm larvae by County, Nova Scotia, 1989 - 1990.

DATA ENTRY: DATE:16 Oct. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annis, J. | Annapolis | | | | | | | | | | | | |
| Annis, J. | Annapolis | Albany Cross | 3394953 | 26 Sept. | bF | 4 | 0.48 | 0 | 0 | 3 | 0 | 0 | Z |
| Annis, J. | Annapolis | Corey Rd. | 3014962 | 25 Sept. | wS | 4 | 0.42 | 0 | 0 | 3 | 1 | 24 | L |
| Annis, J. | Annapolis | Crisp Rd. | 3354966 | 26 Sept. | bF | 4 | 0.49 | 0 | 0 | 3 | 0 | 0 | Z |
| Annis, J. | Annapolis | Douglas Rd. | 3324981 | 25 Sept. | wS | 4 | 0.51 | 0 | 1 | 3 | 7 | 137 | M |
| Annis, J. | Annapolis | East Arlington | 3254977 | 25 Sept. | wS | 4 | 0.41 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Annapolis | E.Virginia | 3004945 | 12 Sept. | rS | 4 | 0.70 | 0 | 1 | 3 | 1 | 14 | L |
| Annis, J. | Annapolis | Halfway Rd. | 3494942 | 26 Sept. | bF | 4 | 0.37 | 0 | 0 | 3 | 0 | 0 | Z |
| Annis, J. | Annapolis | Hampton | 3164973 | 25 Sept. | bF | 4 | 0.66 | 0 | 0 | 3 | 0 | 0 | Z |
| Annis, J. | Annapolis | Hollow Mtn. Rd. | 2924957 | 25 Sept. | wS | 4 | 0.49 | 0 | 0 | 3 | 0 | 0 | Z |
| Annis, J. | Annapolis | Lake LaRose | 3034953 | 26 Sept. | wS | 4 | 0.46 | 0 | 0 | 3 | 1 | 22 | L |
| Bowater-Mersey | Annapolis | Long Lake | 3234944 | 12 Sept. | bF | 4 | 0.83 | 0 | 0 | 3 | 1 | 12 | L |
| Bowater-Mersey | Annapolis | Maitland Bridge | 3214926 | 12 Sept. | bF | 4 | 1.50 | 0 | 1 | 3 | 0 | 0 | Z |
| Annis, J. | Annapolis | Nictaux | 3394975 | 26 Sept. | bF | 4 | 0.44 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Annapolis | Round Lake | 3434926 | 16 Sept. | bF | 4 | 0.93 | 0 | 3 | 0 | 0 | 0 | Z |
| Bowater-Mersey | Annapolis | Torbrook | 3504975 | 16 Sept. | bF | 4 | 1.50 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Annapolis | Victory | 3024937 | 12 Sept. | bF | 4 | 0.86 | 0 | 1 | 3 | 1 | 12 | L |
| Bowater-Mersey | Annapolis | West Dalhousie | 3244958 | 16 Sept. | bF | 4 | 0.96 | 3 | 2 | 0 | 1 | 10 | L |
| Annis, J. | Annapolis | Youngs Mtn. Rd. | 3074965 | 25 Sept. | wS | 4 | 0.43 | 0 | 0 | 3 | 0 | 0 | Z |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:27 Sept. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree | Sp.No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Murphy, G. | Antigonish | | | | | | | | | | | | |
| Lab. Sum. | Antigonish | Arisaig | 5645066 | 12 Sept. | wS | 4 | 0.98 | 0 | 2 | 3 | 1 | 10 | L |
| Lab. Sum. | Antigonish | Beaver Meadow | 5695044 | 12 Sept. | wS | 4 | 0.98 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Antigonish | Black Avon | 5945044 | 13 Sept. | wS | 4 | 1.13 | 0 | 1 | 3 | 1 | 9 | L |
| Lab. Sum. | Antigonish | Cape George | 5815078 | 13 Sept. | wS | 4 | 1.03 | 0 | 1 | 3 | 1 | 10 | L |
| Lab. Sum. | Antigonish | Dunmaglass | 5625061 | 12 Sept. | wS | 4 | 1.07 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Antigonish | Dunmore | 5835042 | 13 Sept. | wS | 4 | 1.06 | 1 | 1 | 3 | 1 | 9 | L |
| Lab. Sum. | Antigonish | Georgeville | 5775074 | 12 Sept. | wS | 4 | 0.91 | 0 | 1 | 3 | 5 | 55 | L |
| Lab. Sum. | Antigonish | Greendale | 5745069 | 12 Sept. | wS | 4 | 0.97 | 0 | 1 | 0 | 9 | 93 | L |
| Lab. Sum. | Antigonish | Havre Boucher | 6155058 | 13 Sept. | wS | 4 | 0.93 | 0 | 1 | 3 | 5 | 54 | L |
| Lab. Sum. | Antigonish | Lanark | 5825056 | 13 Sept. | wS | 4 | 0.94 | 0 | 1 | 3 | 2 | 21 | L |
| Lab. Sum. | Antigonish | Maple Ridge | 5685059 | 12 Sept. | wS | 4 | 1.00 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Antigonish | Maryvale | 5745065 | 12 Sept. | wS | 4 | 0.86 | 0 | 1 | 3 | 5 | 58 | L |
| Lab. Sum. | Antigonish | North Grant | 5755058 | 12 Sept. | wS | 4 | 0.95 | 1 | 1 | 3 | 2 | 21 | L |
| Lab. Sum. | Antigonish | West Lakevale | 5835068 | 13 Sept. | wS | 4 | 0.88 | 0 | 1 | 3 | 1 | 11 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:4 Oct. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adams, M. | Cape Breton | | | | | | | | | | | | |
| Lab. Sum. | Cape Breton | Ben Eoin | 6985094 | 13 Sept. | bF | 4 | 1.15 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cape Breton | Big Ridge | 7135088 | 13 Sept. | bF | 4 | 1.26 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cape Breton | Frenchvale | 7025109 | 19 Sept. | bF | 4 | 1.14 | 0 | 1 | 3 | 2 | 18 | L |
| Lab. Sum. | Cape Breton | Louisbourg | 7355091 | 19 Sept. | bF | 4 | 0.81 | 0 | 1 | 3 | 1 | 12 | L |
| Lab. Sum. | Cape Breton | Morrison Rd. | 7245106 | 19 Sept. | wS | 4 | 0.95 | 0 | 1 | 3 | 2 | 21 | L |
| Lab. Sum. | Cape Breton | North Glen | 6925078 | 13 Sept. | bF | 4 | 0.99 | 0 | 1 | 3 | 2 | 20 | L |
| Lab. Sum. | Cape Breton | Silvermine | 7015081 | 13 Sept. | bF | 4 | 1.13 | 0 | 0 | 3 | 2 | 18 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
16 Oct. 1989

DATA ENTRY: DATE:16 Oct. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blinn, A. | Colchester | | | | | | | | | | | | |
| Lab. Sum. | Colchester | Balfron | 4845058 | 18 Sept. | rS | 4 | 1.27 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Colchester | Barrachois | 4785063 | 18 Sept. | wS | 4 | 1.14 | 0 | 1 | 3 | 4 | 35 | L |
| Lab. Sum. | Colchester | Bayhead | 4685065 | 18 Sept. | wS | 4 | 1.08 | 1 | 1 | 3 | 3 | 28 | L |
| Lab. Sum. | Colchester | Belmont | 4725029 | 19 Sept. | wS | 4 | 1.12 | 2 | 1 | 3 | 1 | 9 | L |
| Lab. Sum. | Colchester | Denmark | 4875060 | 18 Sept. | rS | 4 | 1.20 | 0 | 1 | 3 | 6 | 50 | L |
| Lab. Sum. | Colchester | Earltown | 4875050 | 18 Sept. | bF | 4 | 1.31 | 0 | 1 | 3 | 4 | 30 | L |
| Lab. Sum. | Colchester | East Earltown | 4905057 | 18 Sept. | wS | 4 | 1.22 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Colchester | Irwin Lk. | 4725016 | 19 Sept. | bF | 4 | 0.92 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Colchester | Lansburg | 5055028 | 19 Sept. | rS | 4 | 1.21 | 0 | 0 | 3 | 1 | 8 | L |
| Lab. Sum. | Colchester | Lornevale | 4505035 | 18 Sept. | rS | 4 | 1.06 | 0 | 0 | 3 | 6 | 57 | L |
| Lab. Sum. | Colchester | New Annan | 4765053 | 18 Sept. | rS | 4 | 1.29 | 0 | 2 | 3 | 1 | 8 | L |
| Lab. Sum. | Colchester | Newton Mills | 5075009 | 19 Sept. | wS | 4 | 1.18 | 0 | 0 | 3 | 2 | 17 | L |
| Lab. Sum. | Colchester | Nuttby | 4825043 | 18 Sept. | rS | 4 | 1.00 | 2 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Colchester | Stewiacke | 4754997 | 19 Sept. | rS | 4 | 1.16 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Colchester | Tatamagouche | 4745058 | 18 Sept. | rS | 4 | 1.03 | 0 | 2 | 3 | 0 | 0 | Z |
| Lab. Sum. | Colchester | Up.Stewiacke | 4985006 | 19 Sept. | rS | 4 | 1.17 | 0 | 0 | 3 | 1 | 9 | L |
| Lab. Sum. | Colchester | Valley | 4855025 | 19 Sept. | rS | 4 | 1.54 | 0 | 0 | 3 | 2 | 13 | L |
| Lab. Sum. | Colchester | Warwick Mtn. | 4695051 | 18 Sept. | wS | 4 | 1.04 | 1 | 1 | 3 | 5 | 48 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY

DATA ENTRY: DATE:4 Oct.

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Bran | Population Density 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wolfe, R. | Cumberland East | | | | | | | | | | | | |
| Lab. Sum. | Cumberland East | Beecham Sett. | 4235089 | 27 Sept. | rS | 4 | 0.68 | 0 | 0 | 3 | 3 | 44 | L |
| Lab. Sum. | Cumberland East | Chapman Sett. | 4285085 | 27 Sept. | bF | 4 | 0.85 | 0 | 1 | 3 | 1 | 12 | L |
| Lab. Sum. | Cumberland East | Cleveland Brook | 4205045 | 25 Sept. | bF | 4 | 1.38 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Conns Mills | 4445069 | 27 Sept. | rS | 4 | 0.90 | 0 | 0 | 3 | 1 | 11 | L |
| Lab. Sum. | Cumberland East | Fort Lawrence | 4055082 | 27 Sept. | rS | 4 | 0.76 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Gulf Shore | 4545078 | 27 Sept. | wS | 4 | 0.78 | 0 | 0 | 3 | 1 | 13 | L |
| Lab. Sum. | Cumberland East | Lake Killarney | 4315078 | 27 Sept. | rS | 4 | 1.24 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | MacLellans Brook | 4135081 | 27 Sept. | rS | 4 | 0.62 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Mahoneys Corner | 4535060 | 27 Sept. | rS | 4 | 0.79 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Malagash | 4695069 | 27 Sept. | wS | 4 | 0.68 | 0 | 1 | 3 | 2 | 29 | L |
| Lab. Sum. | Cumberland East | Malagash Point | 4785071 | 27 Sept. | wS | 4 | 0.92 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Middleboro | 4545068 | 27 Sept. | rS | 4 | 0.90 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | North Wallace | 4655075 | 27 Sept. | rS | 4 | 0.94 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Oxford Junction | 4325059 | 25 Sept. | rS | 4 | 0.87 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Pugwash | 4465077 | 27 Sept. | rS | 4 | 0.83 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Ripley Loop | 4305073 | 27 Sept. | rS | 4 | 1.24 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Roslin | 4395066 | 27 Sept. | | 4 | 1.30 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland East | Salt Springs | 4215057 | 25 Sept. | rS | 4 | 0.99 | 0 | 0 | 3 | 1 | 10 | L |
| Lab. Sum. | Cumberland East | West Leicester | 4125071 | 25 Sept. | rS | 4 | 0.86 | 0 | 0 | 3 | 2 | 23 | L |
| Lab. Sum. | Cumberland East | Westchester Stn. | 4445052 | 27 Sept. | rS | 4 | 0.94 | 0 | 0 | 3 | 0 | 0 | Z |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:4 Oct. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | Branch Area M^2 | (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leighton, E. | Cumberland West | | | | | | | | | | | |
| Lab. Sum. | Cumberland West | Allen Hill | 3655027 | 18 Sept. | rS 4 | 0.87 | 3 | 2 | 2 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Beaver Brook | 4225030 | 8 Sept. | rS 4 | 0.50 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | CMU Camp | 3945050 | 13 Sept. | rS 4 | 0.88 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Eatonville | 3545028 | 18 Sept. | bF 4 | 0.86 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Five Islands Park | 4185027 | 8 Sept. | rS 4 | 0.51 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Fowler Brook | 3625032 | 18 Sept. | rS 4 | 0.69 | 0 | 1 | 3 | 1 | 15 | L |
| Lab. Sum. | Cumberland West | Harrison Rd. | 4015066 | 11 Sept. | wS 4 | 0.76 | 0 | 1 | 3 | 5 | 66 | L |
| Lab. Sum. | Cumberland West | Harrison Settlement | 3925040 | 13 Sept. | rS 4 | 0.87 | 0 | 1 | 2 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Henning Brook | 3665034 | 18 Sept. | rS 4 | 0.69 | 1 | 2 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Lakelands | 3935037 | 12 Sept. | rS 4 | 0.64 | 0 | 2 | 3 | 2 | 31 | L |
| Lab. Sum. | Cumberland West | Little Forks | 4095063 | 25 Sept. | rS 4 | 0.82 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Lynn Mtn. | 4135035 | 8 Sept. | bF 4 | 0.81 | 0 | 1 | 2 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Minudie | 3965071 | 13 Sept. | rS 4 | 1.00 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Murphy Brook | 4305039 | 8 Sept. | rS 4 | 1.05 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | New Prospect | 4015030 | 8 Sept. | bF 4 | 0.84 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Newton Lk. Rd. | 4295031 | 12 Sept. | bF 4 | 0.74 | 0 | 1 | 3 | 1 | 14 | L |
| Lab. Sum. | Cumberland West | North Grenville | 3785031 | 12 Sept. | rS 4 | 0.64 | 0 | 1 | 3 | 7 | 110 | M |
| Lab. Sum. | Cumberland West | Ragged Reef | 3855058 | 13 Sept. | rS 4 | 0.62 | 0 | 1 | 3 | 1 | 16 | L |
| Lab. Sum. | Cumberland West | Ramshead | 3835031 | 13 Sept. | rS 4 | 0.71 | 0 | 2 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Sand River | 3665039 | 8 Sept. | rS 4 | 0.71 | 0 | 2 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Scuderack | 4085050 | 12 Sept. | wS. 4 | 0.76 | 1 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Shulie | 3785051 | 13 Sept. | rS 4 | 0.77 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Smith Hollow | 3935031 | 12 Sept. | rS 4 | 0.59 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | South Athol # 1 | 4045053 | 25 Sept. | rS 4 | 0.51 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | South Athol # 2 | 4045053 | 11 Sept. | rS. 4 | 0.77 | 0 | 1 | 3 | 5 | 65 | L |
| Lab. Sum. | Cumberland West | Station Rd. | 4025044 | 12 Sept. | bF 4 | 0.87 | 0 | 1 | 3 | 6 | 69 | L |
| Lab. Sum. | Cumberland West | Twelve Mile | 3845044 | 13 Sept. | rS 4 | 0.91 | 0 | 1 | 3 | 1 | 11 | L |
| Lab. Sum. | Cumberland West | Two Rivers | 3835056 | 13 Sept. | rS 4 | 0.73 | 0 | 1 | 3 | 4 | 55 | L |
| Lab. Sum. | Cumberland West | Upper Bass River | 4385032 | 8 Sept. | rS 4 | 0.87 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | West Apple River | 3545034 | 18 Sept. | rS 4 | 0.89 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Wilton Lake # 1 | 3825038 | 12 Sept. | rS 4 | 0.66 | 0 | 1 | 2 | 0 | 0 | Z |
| Lab. Sum. | Cumberland West | Wilton Lake # 2 | 3825038 | 14 Sept. | rS 4 | 0.66 | 0 | 1 | 2 | 0 | 0 | Z |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
16 Oct. 1989
DATA ENTRY: DATE:27 Sept. 1989

Comeau, A. Digby

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bowater-Mersey | Digby | Barris Deadwater | 2744898 | 6 Sept. | bF | 4 | 1.64 | 0 | 2 | 2 | 1 | 6 | L |
| Bowater-Mersey | Digby | Lake Jolly | 2854928 | 11 Sept. | bF | 4 | 1.75 | 1 | 2 | 2 | 1 | 6 | L |
| Bowater-Mersey | Digby | Langford Bog | 2754910 | 6 Sept. | bF | 4 | 1.41 | 0 | 2 | 2 | 2 | 14 | L |
| Comeau, A. | Digby | Lansdowne | 2884939 | 11 Sept. | bF | 4 | 0.98 | 0 | 1 | 3 | 1 | 10 | L |
| Comeau, A. | Digby | New France | 2754910 | 11 Sept. | bF | 4 | 1.06 | 0 | 1 | 3 | 1 | 9 | L |
| Comeau, A. | Digby | North Range | 2734930 | 11 Sept. | bF | 4 | 1.12 | 0 | 2 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Digby | Tom Wallace | 2894930 | 11 Sept. | bF | 4 | 1.29 | 0 | 1 | 3 | 2 | 16 | L |
| Bowater-Mersey | Digby | Tusket Falls | 2604862 | 6 Sept. | rS | 4 | 2.13 | 0 | 0 | 3 | 3 | 14 | L |
| Bowater-Mersey | Digby | Wentworth Lake | 2744897 | 11 Sept. | bF | 4 | 1.49 | 0 | 1 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Digby | Weymouth Mills | 2674924 | 11 Sept. | bF | 4 | 1.28 | 0 | 1 | 3 | 2 | 16 | L |

84

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
16 Oct. 1989
DATA ENTRY: DATE:3 Oct. 1989

Baker, D. St. Marys

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dort, R. | Guysborough | Boylston | 6155031 | 13 Sept. | bF | 4 | 1.21 | 0 | 1 | 3 | 0 | 0 | Z |
| Dort, R. | Guysborough | Country Harbour | 5905018 | 13 Sept. | bF | 4 | 1.26 | 0 | 1 | 3 | 0 | 0 | Z |
| Baker, D. | St. Marys | Goldenville | 5774996 | 14 Sept. | bF | 4 | 1.34 | 0 | 1 | 3 | 0 | 0 | Z |
| Dort, R. | Guysborough | Lincolnville | 6135040 | 13 Sept. | bF | 4 | 1.52 | 0 | 1 | 3 | 14 | 92 | L |
| Dort, R. | Guysborough | Mulgrave | 6255051 | 13 Sept. | wS | 4 | 1.28 | 0 | 1 | 3 | 2 | 16 | L |
| Dort, R. | Guysborough | Ogden | 6075027 | 13 Sept. | bF | 4 | 0.97 | 0 | 1 | 3 | 0 | 0 | Z |
| Baker, D. | St. Marys | Smithfield | 5685013 | 14 Sept. | wS | 4 | 1.14 | 0 | 1 | 3 | 0 | 0 | Z |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:21 Sept. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kew, M. & Coady, M. | Halifax | | | 6 Sept. | | | | | | | | |
| Kew, M. & Coady, M. | Halifax | Anti Dam Flowage | 5384995 | 6 Sept. | bF 4 | 1.16 | 0 | 0 | 1 | 0 | 0 | Z |
| Kew, M. & Coady, M. | Halifax | Indian Hill | 4124951 | 6 Sept. | bF 4 | 1.06 | 0 | 0 | 1 | 4 | 38 | L |
| Kew, M. & Coady, M. | Halifax | MacLeod Lake | 5024988 | 6 Sept. | bF 4 | 0.95 | 0 | 0 | 1 | 0 | 0 | Z |
| Kew, M. & Coady, M. | Halifax | Muskrat Lake | 4254957 | 6 Sept. | bF 4 | 0.92 | 0 | 0 | 1 | 1 | 11 | L |
| Kew, M. & Coady, M. | Halifax | Oldham | 4594973 | 6 Sept. | bF 4 | 1.00 | 0 | 0 | 1 | 1 | 10 | L |
| Kew, M. & Coady, M. | Halifax | Porters Lake | 4734956 | 6 Sept. | bF 4 | 1.31 | 0 | 0 | 1 | 1 | 8 | L |
| Kew, M. & Coady, M. | Halifax | River Lake | 5194974 | 6 Sept. | bF 4 | 1.77 | 0 | 0 | 1 | 1 | 6 | L |
| Kew, M. & Coady, M. | Halifax | Ship Harbour | 5114962 | 6 Sept. | bF 4 | 0.97 | 0 | 0 | 1 | 0 | 0 | Z |
| Kew, M. & Coady, M. | Halifax | Stillwater Lake | 4334950 | 6 Sept. | bF 4 | 1.02 | 0 | 0 | 1 | 0 | 0 | Z |
| Kew, M. & Coady, M. | Halifax | Waverley | 4544958 | 6 Sept. | bF 4 | 1.10 | 0 | 0 | 1 | 1 | 9 | L |



NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:03 Oct. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Myers, I.B. | Hants | | | | | | | | | | | |
| Lab. Sum. | Hants | Admiral Rock | 4675002 | 12 Sept. | bF 4 | 1.65 | N/A | N/A | N/A | N/A | 0 | Z |
| Lab. Sum. | Hants | Cape Tenney | 4385012 | 12 Sept. | bF 4 | 1.31 | N/A | N/A | N/A | N/A | 0 | Z |
| Lab. Sum. | Hants | Lacy Mill Lk. | 4344964 | 12 Sept. | bF 4 | 1.04 | N/A | N/A | N/A | N/A | 0 | Z |
| Lab. Sum. | Hants | Stanley | 4255000 | 12 Sept. | bF 4 | 1.27 | N/A | N/A | N/A | N/A | 0 | Z |
| Lab. Sum. | Hants | Upper Falmouth | 4014977 | 12 Sept. | bF 4 | 1.08 | N/A | N/A | N/A | N/A | 0 | Z |
| Lab. Sum. | Hants | Upper Kennetcook | 4495006 | 12 Sept. | bF 4 | 1.47 | N/A | N/A | N/A | N/A | 0 | Z |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY

18 Oct. 1989

FILE.DMBWS089.WK1

DATA ENTRY: DATE:3 Oct. 1989

MacNeil, D. Inverness

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MacNeil, D. | Inverness | Belle Cote | 6485145 | 29 Sept. | wS | 4 | 0.86 | 1 | 2 | 3 | 16 | 187 | M |
| MacNeil, D. | Inverness | Belle Cote | 6555147 | 29 Sept. | bF | 4 | 0.99 | 0 | 2 | 3 | 0 | 0 | Z |
| LeBlanc & Guscott | Inverness | Big Intervale | 6595147 | 23 Oct. | wS | 4 | 0.49 | 0 | 1 | 3 | 14 | 285 | M |
| LeBlanc & Guscott | Inverness | Black River | 6295110 | 23 Oct. | wS | 4 | 0.70 | 0 | 1 | 3 | 10 | 144 | M |
| MacNeil, D. | Inverness | Boyles Hill | 6325116 | 18 Sept. | wS | 4 | 1.10 | 2 | 1 | 3 | 9 | 82 | L |
| MacNeil, D. | Inverness | Creignish Mtn. | 6235062 | 20 Sept. | bF | 4 | 1.30 | 0 | 2 | 3 | 9 | 69 | L |
| LeBlanc & Guscott | Inverness | Dunvegan | 6355129 | 23 Oct. | wS | 4 | 0.62 | 1 | 1 | 3 | 34 | 552 | H |
| LeBlanc & Guscott | Inverness | East Margaree | 6485138 | 23 Oct. | bF | 4 | 0.77 | 0 | 1 | 3 | 7 | 90 | L |
| LeBlanc & Guscott | Inverness | Emerald | 6485132 | 23 Oct. | wS | 4 | 0.72 | 0 | 1 | 3 | 1 | 14 | L |
| MacNeil, D. | Inverness | Hays River | 6345107 | 29 Sept. | wS | 4 | 1.14 | 1 | 1 | 3 | 2 | 18 | L |
| LeBlanc & Guscott | Inverness | Inverside | 6325121 | 23 Oct. | wS | 4 | 0.61 | 0 | 1 | 3 | 34 | 554 | H |
| MacNeil, D. | Inverness | Little Judique | 6185089 | 20 Sept. | wS | 4 | 1.23 | 0 | 1 | 3 | 7 | 57 | L |
| MacNeil, D. | Inverness | Mabou Highlands | 6235109 | 18 Sept. | bF | 4 | 1.30 | 0 | 1 | 3 | 1 | 8 | L |
| MacNeil, D. | Inverness | Margaree Forks | 6555132 | 29 Sept. | bF | 4 | 1.18 | 0 | 0 | 3 | 13 | 110 | M |
| MacNeil, D. | Inverness | Melford | 6345082 | 20 Sept. | wS | 4 | 1.02 | 1 | 1 | 3 | 5 | 49 | L |
| MacNeil, D. | Inverness | N. E. Margaree | 6545131 | 29 Sept. | bF | 4 | 0.83 | 0 | 1 | 3 | 8 | 96 | L |
| MacNeil, D. | Inverness | Plateau | 6525161 | 29 Sept. | wS | 4 | 0.77 | 1 | 2 | 3 | 6 | 78 | L |
| MacNeil, D. | Inverness | Pleasant Bay | 6665187 | 29 Sept. | wS | 4 | 1.03 | 2 | 2 | 3 | 6 | 58 | L |
| MacNeil, D. | Inverness | Port Hood | 6155096 | 18 Sept. | wS | 4 | 0.96 | 0 | 1 | 3 | 0 | 0 | Z |
| LeBlanc & Guscott | Inverness | Scotch Hill | 6455140 | 23 Oct. | bF | 4 | 1.02 | 1 | 1 | 3 | 3 | 30 | L |
| LeBlanc & Guscott | Inverness | St. Jos. du Moine | 6505154 | 23 Oct. | bF | 4 | 0.55 | 0 | 0 | 3 | 45 | 825 | E |
| LeBlanc & Guscott | Inverness | St. Rose | 6415134 | 23 Oct. | wS | 4 | 0.61 | 1 | 1 | 3 | 15 | 247 | M |
| MacNeil, D. | Inverness | Tower Rd. | 6625178 | 29 Sept. | wS | 4 | 0.59 | 1 | 2 | 3 | 4 | 67 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY

18 Oct. 1989

FILE PMBWS089.WK1

DATA ENTRY: DATE:3 Oct. 1989

Murphy, P. Lunenburg

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Murphy, P. | Lunenburg | East River | 4034938 | 19 Sept. | rS | 4 | 0.92 | 0 | 0 | 3 | 0 | 0 | Z |
| Murphy, P. | Lunenburg | Garber Rd. | 3714912 | 19 Sept. | rS | 4 | 1.06 | 0 | 0 | 3 | 0 | 0 | Z |
| Murphy, P. | Lunenburg | Hemford | 3584928 | 19 Sept. | rS | 4 | 1.13 | 0 | 0 | 3 | 0 | 0 | Z |
| Murphy, P. | Lunenburg | Lake Darling | 3834952 | 19 Sept. | rS | 4 | 0.93 | 0 | 0 | 3 | 0 | 0 | Z |
| Murphy, P. | Lunenburg | Windsor Rd. | 3994938 | 19 Sept. | rS | 4 | 0.96 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Lunenburg | Whitford Lk. | 4084942 | 10 Aug. | rS | 4 | 1.25 | 0 | 0 | 3 | 2 | 16 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:20 Sept. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Harley, R. | Kings | | | 31 Aug. | | | | | | | | |
| Lab. Sum. | Kings | Aylesford Lk. | 3684981 | 31 Aug. | rS 4 | 0.91 | 0 | 0 | 3 | 1 | 11 | L |
| Lab. Sum. | Kings | Bishop Mtn. | 3434989 | 31 Aug. | wS 4 | 0.95 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Kings | East Dalhousie | 3604951 | 31 Aug. | rS 4 | 0.97 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Kings | Forest Hill | 3934989 | 31 Aug. | wS 4 | 0.86 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Kings | Lake Paul | 3674970 | 31 Aug. | rS 4 | 0.98 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab: Sum. | Kings | Scotts Bay | 3925017 | 31 Aug. | rS 4 | 1.10 | 1 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Kings | South Alton | 3794986 | 31 Aug. | rS 4 | 0.96 | 0 | 0 | 3 | 1 | 10 | L |
| Lab. Sum. | Kings | Torbrook East | 3504975 | 31 Aug. | rS 4 | 0.92 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Kings | ictoria Harbour | 3534996 | 31 Aug. | wS 4 | 0.87 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Kings | White's Corner | 3665001 | 31 Aug. | wS 4 | 0.85 | 0 | 0 | 3 | 1 | 12 | L |

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:25 Sept. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Bran | Population Density 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gunn, R. | Pictou | | | 12 Sept. | | | | | | | | | |
| Lab. Sum. | Pictou | Alma | 5185046 | 18 Sept. | bF | 4 | 0.88 | 0 | 3 | 1 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Avondale | 5535055 | 12 Sept. | wS | 4 | 0.94 | 1 | 0 | 3 | 4 | 43 | L |
| Lab. Sum. | Pictou | Benbie Brook | 5105040 | 12 Sept. | wS | 4 | 0.92 | 0 | 0 | 3 | 1 | 11 | L |
| Lab. Sum. | Pictou | Black River | 5015056 | 16 Sept. | rS | 4 | 0.78 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Cape John | 4925070 | 14 Sept. | wS | 4 | 0.92 | 0 | 3 | 2 | 1 | 11 | L |
| Lab. Sum. | Pictou | Dalhousie Mtn. | 4995045 | 14 Sept. | wS | 4 | 1.04 | 0 | 2 | 3 | 1 | 10 | L |
| Lab. Sum. | Pictou | Egerton | 5405051 | 12 Sept. | wS | 4 | 0.96 | 0 | 3 | 2 | 10 | 104 | M |
| Lab. Sum. | Pictou | Elgin | 5255030 | 12 Sept. | wS | 4 | 0.76 | 0 | 0 | 3 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Granton | 5205050 | 12 Sept. | wS | 4 | 0.89 | 0 | 1 | 3 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Gunn Rd. | 4975060 | 14 Sept. | wS | 4 | 0.79 | 0 | 1 | 3 | 7 | 89 | L |
| Lab. Sum. | Pictou | Hardwood Hill | 5125056 | 16 Sept. | wS | 4 | 0.88 | 0 | 1 | 3 | 2 | 23 | L |
| Lab. Sum. | Pictou | Hedgeville | 4985066 | 14 Sept. | wS | 4 | 1.02 | 0 | 2 | 2 | 1 | 10 | L |
| Lab. Sum. | Pictou | Loch Broom | 5175054 | 12 Sept. | wS | 4 | 0.94 | 0 | 3 | 2 | 1 | 11 | L |
| Lab. Sum. | Pictou | Loganville | 4965052 | 14 Sept. | wS | 4 | 0.80 | 0 | 1 | 3 | 5 | 63 | L |
| Lab. Sum. | Pictou | Meadowville | 5075058 | 16 Sept. | bF | 4 | 0.97 | 0 | 1 | 2 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Old Woodburn Rd. | 5325051 | 12 Sept. | rS | 4 | 0.66 | 0 | 1 | 3 | 1 | 15 | L |
| Lab. Sum. | Pictou | Otter Rd. | 5175064 | 16 Sept. | rS | 4 | 1.06 | 1 | 1 | 2 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Pictou Island | 5325073 | 18 Sept. | wS | 4 | 0.86 | 1 | 1 | 2 | 1 | 12 | L |
| Lab. Sum. | Pictou | Piedmont | 5485050 | 12 Sept. | wS | 4 | 0.69 | 0 | 1 | 2 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Ponds | 5575059 | 12 Sept. | wS | 4 | 0.89 | 0 | 2 | 2 | 4 | 45 | L |
| Lab. Sum. | Pictou | Porter Rd. | 5035051 | 18 Sept. | wS | 4 | 0.89 | 0 | 2 | 2 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Protection Rd. | 5085064 | 16 Sept. | bF | 4 | 0.92 | 0 | 2 | 1 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Roys Island | 5375056 | 12 Sept. | wS | 4 | 0.83 | 0 | 3 | 2 | 0 | 0 | Z |
| Lab. Sum. | Pictou | Six Mile Brook | 5055046 | 18 Sept. | wS | 4 | 0.78 | 0 | 1 | 2 | 1 | 13 | L |
| Lab. Sum. | Pictou | Sutherland River | 5395046 | 12 Sept. | rS | 4 | 0.86 | 0 | 1 | 2 | 1 | 12 | L |
| Lab. Sum. | Pictou | Upper Mt.Thom | 5005038 | 12 Sept. | wS | 4 | 0.68 | 1 | 0 | 3 | 1 | 15 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:25 Sept. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Murray, T. | Richmond | | | | | | | | | | | |
| Lab. Sum. | Richmond | Barra Head | 6725060 | 12 Sept. | bF 4 | 1.07 | 0 | 0 | 3 | 4 | 37 | L |
| Lab. Sum. | Richmond | Lochside | 6835071 | 12 Sept. | bF 4 | 0.96 | 1 | 0 | 3 | 1 | 10 | L |
| Lab. Sum. | Richmond | Lower St. Esprit | 6975061 | 14 Sept. | bF 4 | 0.92 | 0 | 0 | 3 | 7 | 76 | L |
| Lab. Sum. | Richmond | MacLeods Lake | 6935067 | 14 Sept. | bF 4 | 1.05 | 0 | 0 | 3 | 1 | 10 | L |
| Lab. Sum. | Richmond | Martinique | 6505046 | 11 Sept. | bF 0 | 1.10 | 0 | 0 | 3 | 3 | 27 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:27 Sept. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | Branch Area M^2 | (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hebb, F. | Queens | | | | | | | | | | | |
| Bowater-Mersey | Queens | Bon Mature Brook | 3484886 | 8 Sept. | bF 4 | 1.07 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Queens | Conway Brook | 3274885 | 8 Sept. | bF 4 | 1.00 | 0 | 0 | 3 | 3 | 30 | L |
| Bowater-Mersey | Queens | Masons Road | 3224901 | 8 Sept. | bF 4 | 0.98 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Queens | Ten Mile Lake | 3534894 | 7 Sept. | bF 4 | 1.06 | 0 | 0 | 3 | 0 | 0 | Z |
| Hebb, F. | Queens | Wilkins Siding | 3404864 | 13 Sept. | rS 4 | 0.89 | 0 | 0 | 3 | 1 | 11 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY

DATA ENTRY: LeBlanc DATE:21 Sep.89

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp.No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Barkhouse, M. | Shelburne | | | | | | | | | | | |
| Barkhouse, M. | Shelburne | Four Mile Brook | 3204881 | 7 Sept. | bF 4 | 0.79 | 0 | 0 | 3 | 1 | 13 | L |
| Barkhouse, M. | Shelburne | Upper Ohio | 3044872 | 7 Sept. | bF 4 | 0.93 | 0 | 0 | 3 | 0 | 0 | Z |
| Barkhouse, M. | Shelburne | Upper Clyde River | 3034862 | 7 Sept. | bF 4 | 1.04 | 0 | 0 | 3 | 0 | 0 | Z |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY
18 Oct. 1989

DATA ENTRY: DATE:12 Oct. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bos, J. | Victoria | | | | | | | | | | | | |
| Bos, J. | Victoria | Branch Pond | 6945181 | 3 Oct. | bF | 4 | 0.84 | 0 | 1 | 3 | 0 | 0 | Z |
| Bos, J. | Victoria | Cape North | 6895194 | 2 Oct. | bF | 4 | 0.68 | 0 | 1 | 2 | 1 | 15 | L |
| Bos, J. | Victoria | Crowdis Mtn. Ap. | 6685120 | 29 Sept. | bF | 4 | 0.81 | 0 | 1 | 3 | 10 | 123 | M |
| Bos, J. | Victoria | Green Cove | 7015181 | 3 Oct. | bF | 4 | 1.01 | 0 | 2 | 2 | 5 | 50 | L |
| LeBlanc & Guscott | Victoria | Gold Brook | 6595122 | 23 Oct. | bF | 4 | 0.64 | 0 | 1 | 3 | 15 | 233 | M |
| Bos, J. | Victoria | Highlands | 6775157 | 28 Sept. | bF | 4 | 0.84 | 0 | 2 | 3 | 6 | 72 | L |
| Bos, J. | Victoria | Highlands | 6685140 | 29 Sept. | bF | 4 | 0.56 | 0 | 2 | 2 | 0 | 0 | Z |
| Bos, J. | Victoria | Highlands Mile 2 | 6645112 | 29 Sept. | bF | 4 | 0.92 | 0 | 1 | 3 | 6 | 65 | L |
| Bos, J. | Victoria | Kellys Mtn. | 6915124 | 3 Oct. | bF | 4 | 0.97 | 0 | 2 | 2 | 1 | 10 | L |
| Bos, J. | Victoria | Oxford Lake | 6795137 | 29 Sept. | bF | 4 | 0.72 | 0 | 1 | 3 | 6 | 83 | L |
| Bos, J. | Victoria | Shore Rd. | 6975155 | 28 Sept. | bF | 4 | 0.78 | 0 | 1 | 3 | 0 | 0 | Z |
| Bos, J. | Victoria | St. Columba | 6665094 | 2 Oct. | bF | 4 | 0.84 | 0 | 1 | 3 | 0 | 0 | Z |
| Bos, J. | Victoria | St. Margarets Vil | 6925206 | 2 Oct. | bF | 4 | 0.64 | 0 | 2 | 2 | 4 | 63 | L |
| Bos, J. | Victoria | Wreck Cove | 6895159 | 28 Sept. | bF | 4 | 0.67 | 0 | 1 | 2 | 0 | 0 | Z |
| Bos, J. | Victoria | W. Middle River | 6585106 | 3 Oct. | bF | 4 | 0.74 | 0 | 1 | 3 | 1 | 13 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 FIELD SHEET
18 Oct. 1989

DATA ENTRY: DATE:3 Oct. 1989

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gordon, D. | Yarmouth | | | | | | | | | | | | |
| Bowater-Mersey | Yarmouth | Kemptville | 2724881 | 11 Sept. | bF | 4 | 1.42 | 0 | 1 | 2 | 4 | 28 | L |
| Gordon, D. | Yarmouth | Kemptville | 2724881 | 20 Sept. | bF | 4 | 0.54 | 0 | 0 | N/A | 0 | 0 | Z |
| Bowater-Mersey | Yarmouth | Pubnico | 2784844 | 6 Sept. | bF | 4 | 1.75 | 0 | 1 | 3 | 1 | 6 | L |
| Bowater-Mersey | Yarmouth | Quinan | 2754873 | 6 Sept. | bF | 4 | 2.07 | 0 | 1 | 3 | 0 | 0 | Z |
| Gordon, D. | Yarmouth | Quinan | 2754873 | 20 Sept. | bF | 4 | 0.48 | 0 | 1 | N/A | 0 | 0 | Z |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

NOVA SCOTIA SPRUCE BUDWORM L-2 LABORATORY SUMMARY

DATA ENTRY: DATE:21 Sep.89

| Crew | District | Location | UTM GRID Number | Date 1989 | Tree Sp. | No. | Branch Area M^2 | Defoliation (LAB SUM ONLY) Curr | Past | Recv | Population Density Bran | 10 m^2 | Cat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bowater-Mersey | | | | | | | | | | | | | |
| Bowater-Mersey | Annapolis | East Virginia | 3004945 | 12 Sept. | rS | 4 | 0.70 | 0 | 1 | 3 | 1 | 14 | L |
| Bowater-Mersey | Annapolis | Long Lake | 3234944 | 12 Sept. | bF | 4 | 0.83 | 0 | 0 | 3 | 1 | 12 | L |
| Bowater-Mersey | Annapolis | Maitland Bridge | 3214926 | 12 Sept. | bF | 4 | 1.50 | 0 | 1 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Annapolis | Round Lake | 3434926 | 16 Sept. | bF | 4 | 0.93 | 0 | 3 | 0 | 0 | 0 | Z |
| Bowater-Mersey | Annapolis | Torbrook | 3504975 | 16 Sept. | bF | 4 | 1.50 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Annapolis | Victory | 3024937 | 12 Sept. | bF | 4 | 0.86 | 0 | 1 | 3 | 1 | 12 | L |
| Bowater-Mersey | Annapolis | West Dalhousie | 3244958 | 16 Sept. | bF | 4 | 0.96 | 3 | 2 | 0 | 1 | 10 | L |
| Bowater-Mersey | Digby | Barris Deadwater | 2744898 | 6 Sept. | bF | 4 | 1.64 | 0 | 2 | 2 | 1 | 6 | L |
| Bowater-Mersey | Digby | Lake Jolly | 2854928 | 11 Sept. | bF | 4 | 1.75 | 1 | 2 | 2 | 1 | 6 | L |
| Bowater-Mersey | Digby | Langford Bog | 2754910 | 6 Sept. | bF | 4 | 1.41 | 0 | 2 | 2 | 2 | 14 | L |
| Bowater-Mersey | Digby | Tom Wallace | 2894930 | 11 Sept. | bF | 4 | 1.29 | 0 | 1 | 3 | 2 | 16 | L |
| Bowater-Mersey | Digby | Tusket Falls | 2604862 | 6 Sept. | rS | 4 | 2.13 | 0 | 0 | 3 | 3 | 14 | L |
| Bowater-Mersey | Digby | Wentworth Lake | 2744897 | 11 Sept. | bF | 4 | 1.49 | 0 | 1 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Digby | Weymouth Mills | 2674924 | 11 Sept. | bF | 4 | 1.28 | 0 | 1 | 3 | 2 | 16 | L |
| Bowater-Mersey | Lunenburg | Whitford Lake | 4084942 | 10 Aug. | rS | 4 | 1.25 | 0 | 0 | 3 | 2 | 16 | L |
| Bowater-Mersey | Queens | Bon Mature Brook | 3484886 | 8 Sept. | bF | 4 | 1.07 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Queens | Conway Brook | 3274885 | 8 Sept. | bF | 4 | 1.00 | 0 | 0 | 3 | 3 | 30 | L |
| Bowater-Mersey | Queens | Masons Road | 3224901 | 8 Sept. | bF | 4 | 0.98 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Queens | Ten Mile Lake | 3534894 | 7 Sept. | bF | 4 | 1.06 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Shelburne | Four Mile Brook | 3204881 | 7 Sept. | bF | 4 | 0.79 | 0 | 0 | 3 | 1 | 13 | L |
| Bowater-Mersey | Shelburne | Upper Ohio | 3044872 | 7 Sept. | bF | 4 | 0.93 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Shelburne | Upper Clyde River | 3034862 | 7 Sept. | bF | 4 | 1.04 | 0 | 0 | 3 | 0 | 0 | Z |
| Bowater-Mersey | Yarmouth | Kemptville | 2724881 | 11 Sept. | bF | 4 | 1.42 | 0 | 1 | 2 | 4 | 28 | L |
| Bowater-Mersey | Yarmouth | Pubnico | 2784844 | 6 Sept. | bF | 4 | 1.75 | 0 | 1 | 3 | 1 | 6 | L |
| Bowater-Mersey | Yarmouth | Quinan | 2754873 | 6 Sept. | bF | 4 | 2.07 | 0 | 1 | 3 | 0 | 0 | Z |

## Appendix 2

The frequency of the number of occurrences of L-2 class categories by County for Nova Scotia, 1987-1989

Frequency of the number of occurrences of L-2 class categories by County, Nova Scotia, from 1987 to 1989.

| Class Category | Annapolis 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % | Antigonish 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 20 | 69.0 | 10 | 62.5 | 11 | 11.0 | 12 | 44.4 | 10 | 71.4 | 3 | 21.4 |
| Low | 9 | 31.0 | 4 | 25.0 | 6 | 6.0 | 13 | 48.1 | 3 | 21.4 | 11 | 78.6 |
| Moderate | 0 | 0.0 | 2 | 12.5 | 1 | 1.0 | 1 | 3.7 | 1 | 7.1 | 0 | 0.0 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 3.7 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 29 | 100.0 | 16 | 100.0 | 18 | 100.0 | 27 | 100.0 | 14 | 100.0 | 14 | 100.0 |

| Class Category | Cape Breton 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % | Colchester 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 13 | 100.0 | 5 | 71.4 | 2 | 28.6 | 18 | 45.0 | 14 | 63.6 | 6 | 33.3 |
| Low | 0 | 0.0 | 2 | 28.6 | 5 | 71.4 | 17 | 42.5 | 8 | 36.4 | 12 | 66.7 |
| Moderate | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 3 | 7.5 | 0 | 0.0 | 0 | 0.0 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 5.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 13 | 100.0 | 7 | 100.0 | 7 | 100.0 | 40 | 100.0 | 22 | 100.0 | 18 | 100.0 |

| Class Category | Cumberland 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % | Digby 1987 No. | 1987 % | 1988 No. | 1988 % | 1989 No. | 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 52 | 51.5 | 20 | 41.7 | 33 | 63.5 | 18 | 94.7 | 5 | 71.4 | 2 | 20.0 |
| Low | 39 | 38.6 | 28 | 58.3 | 18 | 34.6 | 1 | 5.3 | 2 | 28.6 | 8 | 80.0 |
| Moderate | 6 | 5.9 | 0 | 0.0 | 1 | 1.9 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| High | 2 | 2.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 2 | 2.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 101 | 100.0 | 48 | 100.0 | 52 | 100.0 | 19 | 100.0 | 7 | 100.0 | 10 | 100.0 |

Frequency of the number of Occurrences

| Class Category | Guysborough 1987 No. | % | 1988 No. | % | 1989 No. | % | Halifax 1987 No. | % | 1988 No. | % | 1989 No. | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 10 | 100.0 | 6 | 85.7 | 5 | 71.4 | 6 | 33.3 | 6 | 60.0 | 4 | 40.0 |
| Low | 0 | 0.0 | 1 | 14.3 | 2 | 28.6 | 12 | 66.7 | 4 | 40.0 | 6 | 60.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 10 | 100.0 | 7 | 100.0 | 7 | 100.0 | 18 | 100.0 | 10 | 100.0 | 10 | 100.0 |

Frequency of the number of Occurrences

| Class Category | Hants 1987 No. | % | 1988 No. | % | 1989 No. | % | Inverness 1987 No. | % | 1988 No. | % | 1989 No. | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 13 | 92.9 | 6 | 100.0 | 6 | 100.0 | 17 | 58.6 | 8 | 57.1 | 2 | 8.7 |
| Low | 1 | 7.1 | 0 | 0.0 | 0 | 0.0 | 12 | 41.4 | 6 | 42.9 | 13 | 56.5 |
| Moderate | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 5 | 21.7 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 8.7 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 4.3 |
| Total | 14 | 100.0 | 6 | 100.0 | 6 | 100.0 | 29 | 100.0 | 14 | 100.0 | 23 | 100.0 |

Frequency of the number of Occurrences

| Class Category | Kings 1987 No. | % | 1988 No. | % | 1989 No. | % | Lunenburg 1987 No. | % | 1988 No. | % | 1989 No. | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 7 | 41.2 | 4 | 40.0 | 7 | 70.0 | 8 | 66.7 | 6 | 100.0 | 5 | 83.3 |
| Low | 10 | 58.8 | 6 | 60.0 | 3 | 30.0 | 4 | 33.3 | 0 | 0.0 | 1 | 16.7 |
| Moderate | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 17 | 100.0 | 10 | 100.0 | 10 | 100.0 | 12 | 100.0 | 6 | 100.0 | 6 | 100.0 |

Frequency of the number of Occurrences

| Class Category | Pictou 1987 No. | Pictou 1987 % | Pictou 1988 No. | Pictou 1988 % | Pictou 1989 No. | Pictou 1989 % | Queens 1987 No. | Queens 1987 % | Queens 1988 No. | Queens 1988 % | Queens 1989 No. | Queens 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 27 | 61.4 | 15 | 57.7 | 10 | 38.5 | 12 | 70.6 | 4 | 80.0 | 3 | 60.0 |
| Low | 11 | 25.0 | 11 | 42.3 | 15 | 57.7 | 5 | 29.4 | 1 | 20.0 | 2 | 40.0 |
| Moderate | 6 | 13.6 | 0 | 0.0 | 1 | 3.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 44 | 100.0 | 26 | 100.0 | 26 | 100.0 | 17 | 100.0 | 5 | 100.0 | 5 | 100.0 |

Frequency of the number of Occurrences

| Class Category | Richmond 1987 No. | Richmond 1987 % | Richmond 1988 No. | Richmond 1988 % | Richmond 1989 No. | Richmond 1989 % | Shelburne 1987 No. | Shelburne 1987 % | Shelburne 1988 No. | Shelburne 1988 % | Shelburne 1989 No. | Shelburne 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 6 | 100.0 | 4 | 80.0 | 0 | 0.0 | 1 | 20.0 | 3 | 100.0 | 2 | 66.7 |
| Low | 0 | 0.0 | 1 | 20.0 | 5 | 100.0 | 4 | 80.0 | 0 | 0.0 | 1 | 33.3 |
| Moderate | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 6 | 100.0 | 5 | 100.0 | 5 | 100.0 | 5 | 100.0 | 3 | 100.0 | 3 | 100.0 |

Frequency of the number of Occurrences

| Class Category | Victoria 1987 No. | Victoria 1987 % | Victoria 1988 No. | Victoria 1988 % | Victoria 1989 No. | Victoria 1989 % | Yarmouth 1987 No. | Yarmouth 1987 % | Yarmouth 1988 No. | Yarmouth 1988 % | Yarmouth 1989 No. | Yarmouth 1989 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zero | 15 | 75.0 | 8 | 57.1 | 5 | 33.3 | 7 | 77.8 | 3 | 75.0 | 3 | 60.0 |
| Low | 5 | 25.0 | 6 | 42.9 | 8 | 53.3 | 2 | 22.2 | 1 | 25.0 | 2 | 40.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 | 2 | 13.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| High | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Extreme | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 14 | 100.0 | 15 | 100.0 | 9 | 100.0 | 4 | 100.0 | 5 | 100.0 |

Frequency of the number of Occurrences

| Class Category | Nova Scotia 1987 | | Nova Scotia 1988 | | Nova Scotia 1989 | | Blank 1987 | | Blank 1988 | | Blank 1989 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Zero | 242 | 60.5 | 137 | 61.2 | 109 | 45.4 | | 0.0 | | 0.0 | | 0.0 |
| Low | 137 | 34.3 | 84 | 37.5 | 118 | 49.2 | | 0.0 | | 0.0 | | 0.0 |
| Moderate | 17 | 4.3 | 3 | 1.3 | 10 | 4.2 | | 0.0 | | 0.0 | | 0.0 |
| High | 2 | 0.5 | 0 | 0.0 | 2 | 0.8 | | 0.0 | | 0.0 | | 0.0 |
| Extreme | 2 | 0.5 | 0 | 0.0 | 1 | 0.4 | | 0.0 | | 0.0 | | 0.0 |
| Total | 400 | 100.0 | 224 | 100.0 | 240 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |

## Appendix 3

Gross area of infestation by overwintering second instar spruce budworm larvae, by County, Nova Scotia, 1987-1989

Gross area of infestation by overwintering second instar spruce budworm larvae by County, Nova Scotia, 1987-1989.

| County | Low | | | Moderate | | | High | | | Extreme | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Gross area (ha) of infestation class category | | | | | | | | | | | | | | |
| | 1987 | 1988 | 1989 | 1987 | 1988 | 1989 | 1987 | 1988 | 1989 | 1987 | 1988 | 1989 | 1987 | 1988 | 1989 |
| **A. Cape Breton Island** | | | | | | | | | | | | | | | |
| Cape Breton | 0 | 8000 | 19500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8000 | 19500 |
| Inverness | 93500 | 31250 | 43750 | 0 | 0 | 18500 | 0 | 0 | 10000 | 0 | 0 | 3250 | 93500 | 31250 | 75500 |
| Richmond | 0 | 4000 | 18500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4000 | 18500 |
| Victoria | 21250 | 18750 | 28500 | 0 | 0 | 7750 | 0 | 0 | 0 | 0 | 0 | 0 | 21250 | 18750 | 36250 |
| **B. Mainland** | | | | | | | | | | | | | | | |
| Southern | | | | | | | | | | | | | | | |
| Annapolis | 46500 | 26750 | 32000 | 0 | 9000 | 4750 | 0 | 0 | 0 | 0 | 0 | 0 | 46500 | 35750 | 36750 |
| Digby | 5750 | 7750 | 34750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5750 | 7750 | 34750 |
| Guysborough | 0 | 4250 | 7000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4250 | 7000 |
| Halifax | 56250 | 20750 | 24750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56250 | 20750 | 24750 |
| Hants | 5750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5750 | 0 | 0 |
| Kings | 56000 | 27750 | 12000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56000 | 27750 | 12000 |
| Lunenburg | 28250 | 0 | 7750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28250 | 0 | 7750 |
| Queens | 29750 | 4000 | 7500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29750 | 4000 | 7500 |
| Shelburne | 30750 | 0 | 4500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30750 | 0 | 4500 |
| Yarmouth | 11500 | 4000 | 12000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11500 | 4000 | 12000 |
| Northern | | | | | | | | | | | | | | | |
| Antigonish | 35000 | 10000 | 44250 | 2500 | 5000 | 0 | 2500 | 0 | 0 | 0 | 0 | 0 | 40000 | 15000 | 44250 |
| Colchester | 84750 | 31000 | 54250 | 10250 | 0 | 0 | 4750 | 0 | 0 | 0 | 0 | 0 | 99750 | 31000 | 54250 |
| Cumberland | 138000 | 153250 | 62500 | 13000 | 0 | 3250 | 6250 | 0 | 0 | 6250 | 0 | 0 | 163500 | 153250 | 65750 |
| Pictou | 42000 | 36750 | 60750 | 11250 | 0 | 3000 | 0 | 0 | 0 | 0 | 0 | 0 | 53250 | 36750 | 63750 |
| Total Area (ha) | 685000 | 388250 | 474250 | 37000 | 14000 | 37250 | 13500 | 0 | 10000 | 6250 | 0 | 3250 | 741750 | 402250 | 524750 |
| % Change from | | -296750 | 86000 | | -23000 | 23250 | | -13500 | 10000 | | -6250 | 3250 | | -339500 | 122500 |
| Previous Year | | -43.32 | 22.15 | | -62.16 | 166.07 | | -100 | +100 | | -100 | +100 | | -45.77 | 30.45 |

# Status of Balsam Twig Aphid (*Mindarus abietinus* Koch) and Balsam Gall Midge (*Paradiplosis tumifex* Gagné) in Nova Scotia, 1989.

By

T. D. Smith

Entomological Services, N.S. Lands and Forests, P.O. Box 68, Truro, Nova Scotia, Canada, B2N 5B8. Misc. Publ. No. 17. 32 pp.

Deputy Minister
Mr. J. Mullally

Minister
Hon. C.W. MacNeil MD.

October 1989

## TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

# LIST OF APPENDICES

# I INTRODUCTION

The balsam twig aphid (Minderus abietinus Koch) and the balsam gall midge (Paradiplosis tumifex Gagnè) attack the shoots and needles of balsam fir respectively. Periodically these species reach epidemic proportions. The life of the tree is usually not threatened by the presence of these insects, but their feeding does cause premature needle drop. This can significantly reduce the aesthetic and market value of affected trees, in particular, those intended for the Christmas tree market; as such affected trees may be graded lower or rejected (Smith et al. 1981, Martineaeu 1984).

# II PEST SPECIES

## A) Balsam Twig Aphid

### 1. Range

Martineau (1984) describes the range and hosts of the balsam twig aphid as follows. " The balsam twig aphid, Mindarus abietinus Koch, is usually not a forest pest, because it prefers ornamental and edge trees, or plants in nurseries and plantations. It occurs throughout Europe and North America. On the North American Continent, this aphid is found throughout the range of fir, from the Atlantic to the Pacific Ocean. Balsam fir and white spruce are the only hosts in Canada, but elsewhere this aphid has been found on four other species of fir and on juniper."

### 2. Life History

The insect has three and sometimes four generations between early May and mid-June; throughout the rest of the year, it is in the egg stage. The nymphs of the first generation, developing from the overwintering eggs, are small (2 mm long) and wingless. They feed around the bud, mostly on the old needles, and do little or no damage. They occur in small numbers and are not often noticed. However, each adult produces 40 to 60 offspring (nymphs) mostly in early June.

The second and third generation aphids suck the juice from the new needles and cause permanent deformation: the second is the peak generation. The young aphids secrete masses of waxy wool and large quantities of 'honeydew' which makes the shoot 'woolly' and sticky. The aphids mature in the second half of June as winged but wool-free adults about 3 mm long. After flying on other balsam fir trees, each adult produces about ten living young.

The fourth generation consists of males and females. They are minute (1 mm or smaller), wingless, and lightly 'woolly'. They conceal themselves in the shoots, feed lightly, and become adults about 1 week after birth. Each female lays one or two black eggs around the buds and covers them with white wax scales. These eggs hatch in May the next year.

3. Effect on Trees

The balsam twig aphid feeds on the new shoots and needles of balsam fir causing the ends of the shoots to twist and the needles to curl. Severe infestations give the foliage a ruffled appearance. Trees growing in the open are more susceptible to attack than those in closed stands. Severe infestations occur every four or five years in the Maritimes and become obvious in late June when many fir shoots are covered with a sticky woolly substance. The insect is usually of little economic importance as it seldom damages forest trees. It does, however, sometimes greatly lower the quality of Christmas trees.

B) Balsam Gall Midge

Smith (1985) has reviewed its range history and habits, and its effects on trees.

1. Range

The balsam gall midge, Paradiplosis tumifex Gagné, a native insect that periodically occurs in large numbers over wide areas of Canada and the northeastern United States, causes subglobular swellings or galls on the new needles of balsam fir.

2. Life History

The insect overwinters in the soil as a mature larva. It pupates in the spring and the adults emerges about 20 May to 20 June. The female lays eggs between the needles of partly opened buds. The young larva settles down near the base of a needle and, through mechanical or chemical stimuli or both, causes the needle to swell and entomb it. The larva develops within the gall during the summer. Between mid-September and mid-November, the larva leaves the gall and drops to the soil where it hibernates.

3. Effect on Trees

Trees of all heights may become infested but those up to 8 m are most severely attacked. In light infestations, there is usually only one gall per needle but when population levels are high there may be as many as six per needle. Most galled needles become yellow, and drop after the larvae have left them. Severe infestations cause significant defoliation making the trees unfit for the Christmas market. The insect seldom causes serious injury and the trees usualy recover and become suitable for the Christmas trade within 3 years. Infested needles are usually shed in October and November and trees cut with a noticeable number of galls may be rejected at the grading or shipping yard because of excessive needle drop.

## III SURVEY

### A) History

From 1979 to 1984 these two species were surveyed jointly with the spruce budworm (Kettela 1979). In 1985 the spruce budworm egg-mass survey was replaced by the survey of overwintering second instar spruce budworm larvae, commonly known as the L-2 survey. Moreover, the tree specie sampled for the L-2 survey was changed from balsam fir to spruce species as spruces were supporting the spruce budworm epidemic on the northern Mainland. With the advent of the L-2 survey the survey of balsam twig aphid and balsam gall midge lapsed. (Smith and Georgeson 1985). The balsam twig aphid and balsam gall midge are serious problems to Christmas tree industry and for this reason a separate survey of these two species was initiated in 1988 (Smith and Georgeson, 1988).

### B) Selection of Sample Plots

The sample locations were selected by the Pest Detection Officer (PDO) in each district. The PDO was to select ten sample locations from the natural forest, one or two from his Permanent Sample Area, and the remaining either adjacent to or in Christmas tree areas.

### C) Sampling Regime

The sampling regime for this survey is to provide data on the status of these insects in the natural forest but be sensitive to the needs of the Christmas Tree Industry. Sampling techniques used by the Pest Detection Officer are those historically used by the Forest Insect and Disease Survey personnel of the Canadian Forestry Service (Kettela 1979). In 1989 samples collected from the lower part of the crown of natural forest trees. Field data were stored, compiled and sorted electronically using a spread sheet program [Lotus 1.2.3] (Figures 1 and 2).

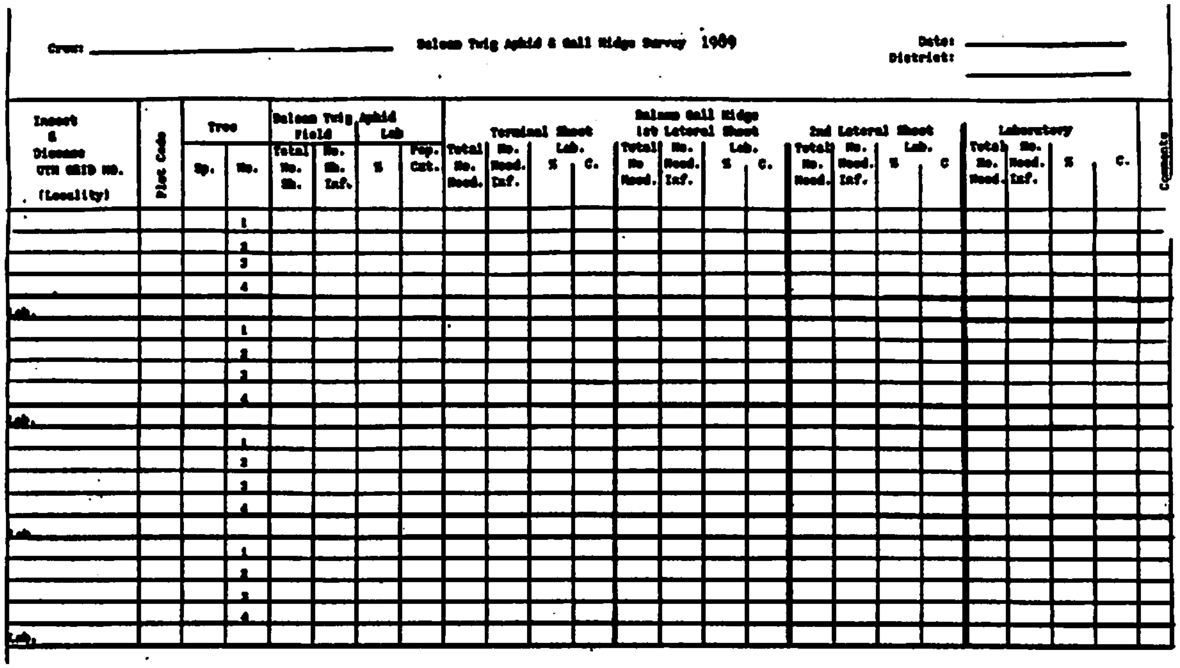



**Figure 1. Field tally sheet used for balsam twig aphid and balsam gall midge survey.**

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS — BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infest Need. | % | C. | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. Adams | | Cape Bret. | | 9 Aug. | | bF | | | | | | | | | | |
| Lab. Sum. | Beechmont North | Cape Bret. | 7095109 | 9 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 950 | 0 | 0 | T | |
| Lab. Sum. | Belfry Lake | Cape Bret. | 7155074 | 9 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 1034 | 0 | 0 | T | |
| Lab. Sum. | Benacadie Pond | Cape Bret. | 6765090 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 1040 | 6 | 1 | T | |
| Lab. Sum. | Bengal Rd. | Cape Bret. | 7215093 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 785 | 0 | 0 | T | |
| Lab. Sum. | Canoe Lake | Cape Bret. | 7145083 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 861 | 0 | 0 | T | |
| Lab. Sum. | East Bay | Cape Bret. | 7045100 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 751 | 1 | 0 | T | |
| Lab. Sum. | Enon Salem Rd. | Cape Bret. | 6905077 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 993 | 0 | 0 | T | |
| Lab. Sum. | Eskasoni | Cape Bret. | 6805089 | 9 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 864 | 0 | 0 | T | |
| Lab. Sum. | Fiddler's Lake | Cape Bret. | 7175084 | 9 Aug. | 1 | bF | 5 | 100 | 11 | 11 | L | 724 | 0 | 0 | T | |
| Lab. Sum. | Frenchvale | Cape Bret. | 6925106 | 9 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 979 | 0 | 0 | T | |
| Lab. Sum. | Gabarous Lake | Cape Bret. | 7155075 | 9 Aug. | 2 | bF | 5 | 100 | 1 | 1 | T | 1028 | 0 | 0 | T | |
| Lab. Sum. | Gillis's Lake | Cape Bret. | 7015103 | 9 Aug. | 2 | bF | 5 | 100 | 5 | 5 | T | 1070 | 0 | 0 | T | |
| Lab. Sum. | Grand Mira North | Cape Bret. | 7085080 | 9 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 737 | 1 | 0 | T | |
| Lab. Sum. | Hillside Mira | Cape Bret. | 7195098 | 9 Aug. | 2 | bF | 5 | 100 | 1 | 1 | T | 1139 | 1 | 0 | T | |
| Lab. Sum. | Hornes Rd. Mira | Cape Bret. | 7305104 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 945 | 0 | 0 | T | |
| Lab. Sum. | MacAdam's Lake | Cape Bret. | 6995100 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 1087 | 0 | 0 | T | |
| Lab. Sum. | North Glen | Cape Bret. | 6995079 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 1007 | 0 | 0 | T | |
| Lab. Sum. | Oceanview | Cape Bret. | 7205085 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 718 | 0 | 0 | T | |
| Lab. Sum. | Rear Boisdale | Cape Bret. | 6935106 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 710 | 1 | 0 | T | |
| Lab. Sum. | Victoria Bridge | Cape Bret. | 7105075 | 9 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 1080 | 4 | 0 | T | |

**Figure 2. Summary data of the status of balsam twig aphid and balsam gall midge.**

## D. Infestation Classes

The degree of infestation for both the balsam twig aphid and the balsam gall midge is shown in Table 1 (Kettela 1979).

Table 1: Infestation classes for balsam twig aphid and balsam gall midge.

| Infestation Class | | | |
|---|---|---|---|
| Name | Symbol | Percent Limits lower | upper |
| Trace | T | 0 | 5 |
| Low | L | 6 | 29 |
| Moderate | M | 30 | 69 |
| High | H | 70 | 100 |

While this survey presents the Provincial status of these insects it may be insensitive to the needs of individual Christmas Tree growers. Renault (1983) has proposed a detailed method for assessing these species in individual Christmas Tree Plantations. Individual Christmas Tree Growers should check their stands for these insects (Renault 1988, pers. comm.).

# IV RESULTS

## A) Submitted Data

Survey data were submitted from all Districts. Samples were collected from 391 sample locations. A limited surveys were done in Digby and Colchester Countys (Appendix 1).

## B) Sample Universe

Sample locations were divided equally between natural forest and Christmas tree areas. For the Province balsam twig aphid was at trace level for 80.8 percent, low at 15.9 percent and moderate at 3.3 percent of the sample locations; whereas, the balsam gall midge was at trace level for 93.9 percent and low level for 6.1 percent of the sample location (Table 2, Appendix 1). Annapolis

Table 2. Summary of balsam twig aphid and balsam gall midge survey, frequency of occurrences of infestation classes, Nova Scotia, 1989.

Annapolis

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 0 | 0.0 | 20 | 100.0 |
| Low | 9 | 45.0 | 0 | 0.0 |
| Moderate | 11 | 55.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

Antigonish

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 7 | 35.0 | 20 | 100.0 |
| Low | 13 | 65.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

Cape Breton

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 19 | 95.0 | 20 | 100.0 |
| Low | 1 | 5.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

Colchester (Limited Survey)

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 15 | 100.0 | 15 | 100.0 |
| Low | 0 | 0.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 15 | 100.0 | 15 | 100.0 |

Cumberland East (Oxford)

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 19 | 95.0 | 19 | 95.0 |
| Low | 1 | 5.0 | 1 | 5.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

Cumberland West (Parrsboro)

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 19 | 100.0 | 13 | 68.4 |
| Low | 0 | 0.0 | 6 | 31.6 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 19 | 100.0 | 19 | 100.0 |

continued

**Digby (Limited Survey)**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 0 | 0.0 | 10 | 100.0 |
| Low | 10 | 100.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 10 | 100.0 | 10 | 100.0 |

**Guysborough**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 18 | 90.0 | 19 | 95.0 |
| Low | 2 | 10.0 | 1 | 5.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

**Halifax East**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 18 | 90.0 | 19 | 95.0 |
| Low | 2 | 10.0 | 1 | 5.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

**Halifax West**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 20 | 100.0 | 16 | 80.0 |
| Low | 0 | 0.0 | 4 | 20.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

**Hants**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 13 | 92.9 | 14 | 100.0 |
| Low | 1 | 7.1 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 14 | 100.0 | 14 | 100.0 |

**Inverness**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 15 | 100.0 | 15 | 100.0 |
| Low | 0 | 0.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 15 | 100.0 | 15 | 100.0 |

**Kings**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 17 | 85.0 | 20 | 100.0 |
| Low | 3 | 15.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

**Lunenburg**

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 20 | 100.0 | 20 | 100.0 |
| Low | 0 | 0.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

continued

### Pictou

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 19 | 95.0 | 16 | 80.0 |
| Low | 0 | 0.0 | 4 | 20.0 |
| Moderate | 1 | 5.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

### Queens

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| | 9 | 47.4 | 19 | 100.0 |
| | 10 | 52.6 | 0 | 0.0 |
| | 0 | 0.0 | 0 | 0.0 |
| | 0 | 0.0 | 0 | 0.0 |
| | 19 | 100.0 | 19 | 100.0 |

### Richmond

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 20 | 100.0 | 19 | 95.0 |
| Low | 0 | 0.0 | 1 | 5.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

### Shelburne

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| | 12 | 60.0 | 16 | 80.0 |
| | 7 | 35.0 | 4 | 20.0 |
| | 1 | 5.0 | 0 | 0.0 |
| | 0 | 0.0 | 0 | 0.0 |
| | 20 | 100.0 | 20 | 100.0 |

### St. Mary's

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 20 | 100.0 | 20 | 100.0 |
| Low | 0 | 0.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

### Victoria

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| | 18 | 94.7 | 17 | 89.5 |
| | 1 | 5.3 | 2 | 10.5 |
| | 0 | 0.0 | 0 | 0.0 |
| | 0 | 0.0 | 0 | 0.0 |
| | 19 | 100.0 | 19 | 100.0 |

### Yarmouth

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 18 | 90.0 | 20 | 100.0 |
| Low | 2 | 10.0 | 0 | 0.0 |
| Moderate | 0 | 0.0 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |

### Nova Scotia

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| | 316 | 80.8 | 367 | 93.9 |
| | 62 | 15.9 | 24 | 6.1 |
| | 13 | 3.3 | 0 | 0.0 |
| | 0 | 0.0 | 0 | 0.0 |
| | 391 | 100.0 | 391 | 100.0 |

County had the highest occurrences of balsam twig aphid (Figure 3, Table 2, and Appendix 1). The situation is similar to that of last year except for Annapolis County.

In summary and from a Provincial viewpoint populations of balsam twig aphid and balsam gall midge are considered to be trace or low. There were, however, 61 locations of low and 14 locations of moderate levels of balsam twig aphid and 25 low areas of balsam gall midge in the Province. Christmas tree growers should, however, monitor their stands for the presence of these two insects.

## V REFERENCES


Kettela, E. G. 1979. Instructions for spruce budworm egg-mass survey. unpublished document.

Martineau, R. 1984. Insects Harmful to Forest Trees. Agric. Canada. Canadian Forestry Service. FO 64-321 1984E. 261 pp.

Renault, T. R., 1983. Balsam twig aphid and balsam gall midge (control update 1983). Environment Canada. Canadian Forestry Service. Maritimes Forest Resources Centre, Technical Note #80 8 pp.

Renault, T. R., 1988. Personal Communication.

Smith, C.C. 1985. Balsam Gall Midge Canadian Forestry Service Maritime Forest Research Centre Tree Pest Control Leaflet - Balsam Gall Midge 4 pp.

Smith, C.C. 1985. Balsam Twig Aphid Canadian Forestry Service, Maritime Forest Research Centre. Tree Pest Control Leaflet - Balsam Twig Aphid. 4 pp.

Smith, C.C. Newell, W.R., et. Renault, T. R., 1981. Maladies et insectes communs du sapin baumier cultivé comme arbre de Noël. Environment Canada, Canadian Forestry Service. FO47-132811981F 64 pp.

Smith, T. D. and Georgeson, E. 1985. Spruce budworm population in Nova Scotia 1985. N.S. Lands and Forests Entomological Services. Misc. Publ. 8., 20 pp.

Smith, T.D. and Georgeson, E. 1988. Status of Balsam Twig Aphid (Mindarus abietinus Koch) and Balsam Gall Midge (Paradiplosis tumifex Gagné) in Nova Scotia. Entomological Services, P.O. Box 68, Truro, Nova Scotia, Canada, B2N 5B8, Misc. Publ. 15., 18 pp.

Infestation Classes for balsam twig aphid (BTA) and balsam gall midge (BGM)

| Name | Symbol BTA | Symbol BGM | Percent |
|---|---|---|---|
| Trace | | | 0 - 5 |
| Low | • | △ | 6 - 29 |
| Moderate | ● | ▲ | 30 - 69 |
| High | ⬤ | ▲ | 70 - 100 |
| ns | not sampled | | |

Nova Scotia

| Class | Twig Aphid No. | Twig Aphid % | Gall Midge No. | Gall Midge % |
|---|---|---|---|---|
| Trace | 316 | 80.8 | 367 | 93.9 |
| Low | 61 | 15.6 | 24 | 6.1 |
| Moderate | 14 | 3.6 | 0 | 0.0 |
| Severe | 0 | 0.0 | 0 | 0.0 |
| Total | 391 | 100.0 | 391 | 100.0 |

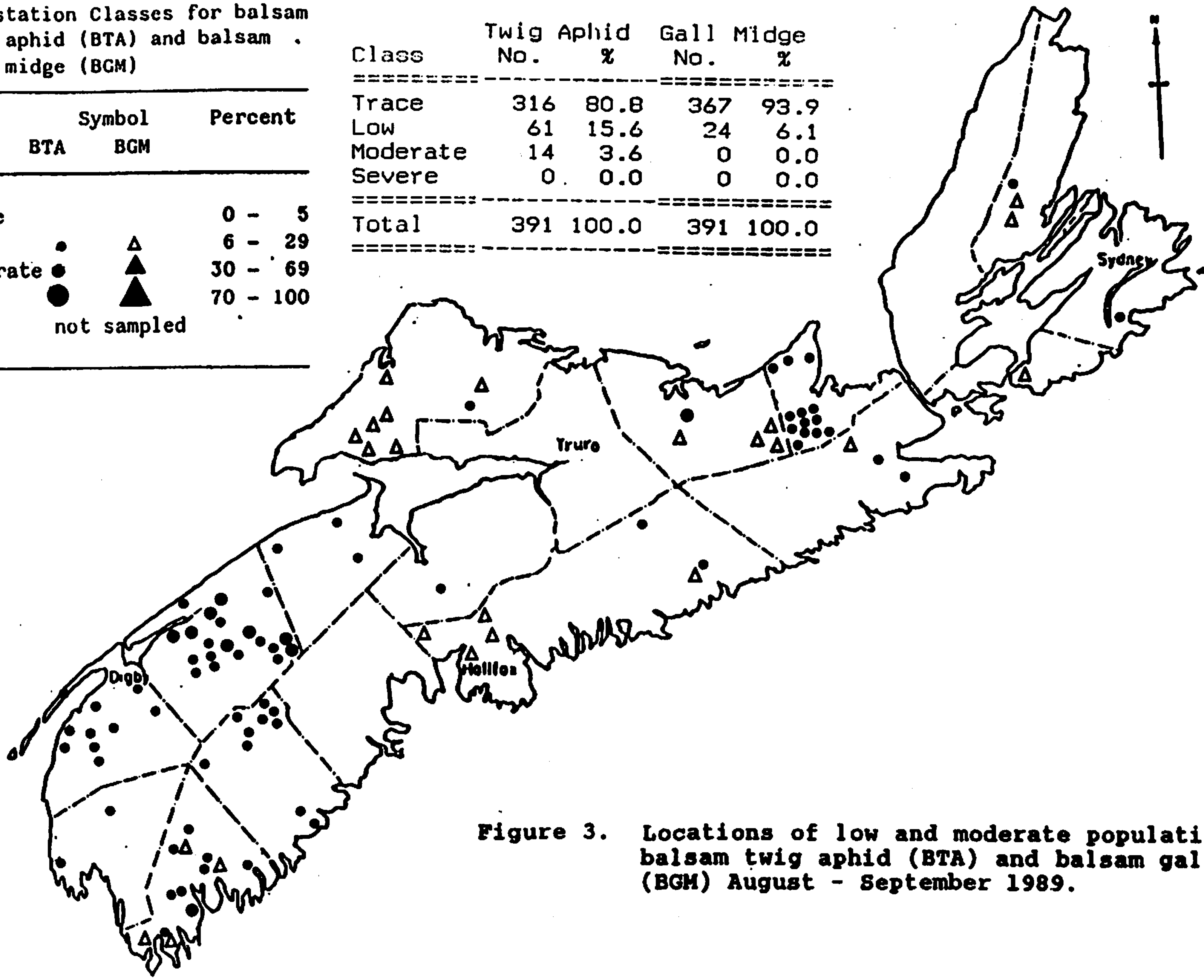



**Figure 3. Locations of low and moderate populations of balsam twig aphid (BTA) and balsam gall midge (BGM) August - September 1989.**

## LIST OF APPENDICES

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J. Annis | | Annapolis | | 16 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Albany Cross | Annapolis | 3384952 | 16 Aug. | 3 | bF | 5 | 100 | 41 | 41 | M | 325 | 3 | 1 | T |
| Lab. Sum. | Alpena | Annapolis | 3364968 | 16 Aug. | 1 | bF | 5 | 100 | 13 | 13 | L | 310 | 5 | 2 | T |
| Lab. Sum. | Bloomington | Annapolis | 3414971 | 16 Aug. | 3 | bF | 5 | 100 | 30 | 30 | M | 316 | 11 | 3 | T |
| Lab. Sum. | East Dalhousie | Annapolis | 3534951 | 16 Aug. | 1 | bF | 5 | 100 | 34 | 34 | M | 357 | 12 | 3 | T |
| Lab. Sum. | East Torbrook | Annapolis | 3464975 | 16 Aug. | 1 | bF | 5 | 100 | 8 | 8 | L | 308 | 3 | 1 | T |
| Lab. Sum. | E. Dalhousie Rd. | Annapolis | 3534951 | 16 Aug. | 3 | bF | 5 | 100 | 44 | 44 | M | 315 | 3 | 1 | T |
| Lab. Sum. | E. Dalhousie Rd. | Annapolis | 3564952 | 16 Aug. | 3 | bF | 5 | 100 | 35 | 35 | M | 354 | 7 | 2 | T |
| Lab. Sum. | Falcon Ridge | Annapolis | 3544945 | 16 Aug. | 3 | bF | 5 | 100 | 51 | 51 | M | 347 | 2 | 1 | T |
| Lab. Sum. | Halfway Road | Annapolis | 3484941 | 16 Aug. | 3 | bF | 5 | 100 | 45 | 45 | M | 312 | 5 | 2 | T |
| Lab. Sum. | Hampton | Annapolis | 3154972 | 16 Aug. | 1 | bF | 5 | 100 | 22 | 22 | L | 269 | 14 | 5 | T |
| Lab. Sum. | Lake La Rose | Annapolis | 3054954 | 16 Aug. | 1 | bF | 5 | 100 | 44 | 44 | M | 344 | 5 | 1 | T |
| Lab. Sum. | Lilly Lake | Annapolis | 3344982 | 16 Aug. | 1 | bF | 5 | 100 | 32 | 32 | M | 308 | 0 | 0 | T |
| Lab. Sum. | Morse Road #1 | Annapolis | 3224956 | 16 Aug. | 1 | bF | 5 | 100 | 23 | 23 | L | 312 | 17 | 5 | T |
| Lab. Sum. | Morse Road #2 | Annapolis | 3224953 | 16 Aug. | 1 | bF | 5 | 100 | 20 | 20 | L | 346 | 8 | 2 | T |
| Lab. Sum. | Ridge Road | Annapolis | 3504948 | 16 Aug. | 3 | bF | 5 | 100 | 17 | 17 | L | 294 | 2 | 1 | T |
| Lab. Sum. | Spur Road | Annapolis | 3124955 | 16 Aug. | 3 | bF | 5 | 100 | 37 | 37 | M | 365 | 2 | 1 | T |
| Lab. Sum. | Squirreltown #1 | Annapolis | 3384958 | 16 Aug. | 3 | bF | 5 | 500 | 136 | 27 | L | 1604 | 32 | 2 | T |
| Lab. Sum. | Squirreltowm #2 | Annapolis | 3384958 | 16 Aug. | 3 | bF | 5 | 100 | 19 | 19 | L | 270 | 12 | 4 | T |
| Lab. Sum. | Squirreltown PSA | Annapolis | 3384958 | 16 Aug. | 5 | bF | 5 | 100 | 35 | 35 | M | 280 | 7 | 3 | T |
| Lab. Sum. | Thorne Road | Annapolis | 3304954 | 16 Aug. | 3 | bF | 5 | 100 | 26 | 26 | L | 368 | 4 | 1 | T |

115

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R.G. Murphy | | Anti. | | 10 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Afton | Anti. | 6025048 | 10 Aug. | 1 | bF | 5 | 100 | 4 | 4 | T | 661 | 21 | 3 | T |
| Lab. Sum. | Caledonia Mills | Anti. | 5945038 | 10 Aug. | 3 | bF | 5 | 100 | 4 | 4 | T | 608 | 5 | 1 | T |
| Lab. Sum. | College Grant | Anti. | 5715028 | 10 Aug. | 1 | bF | 5 | 100 | 8 | 8 | L | 396 | 14 | 4 | T |
| Lab. Sum. | Dunmagcass | Anti. | 5615063 | 10 Aug. | 1 | bF | 5 | 100 | 11 | 11 | L | 645 | 16 | 2 | T |
| Lab. Sum. | Fraser's Grant | Anti. | 5005035 | 10 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 649 | 0 | 0 | T |
| Lab. Sum. | Fraser's Mills | Anti. | 5815040 | 10 Aug. | 3 | bF | 5 | 100 | 12 | 12 | L | 653 | 38 | 6 | T |
| Lab. Sum. | Georgeville | Anti. | 5785071 | 10 Aug. | 5 | bF | 5 | 100 | 5 | 5 | T | 464 | 7 | 2 | T |
| Lab. Sum. | Glen Road | Anti. | 5775044 | 10 Aug. | 2 | bF | 5 | 100 | 6 | 6 | L | 795 | 5 | 1 | T |
| Lab. Sum. | Harve Boucher | Anti. | 6155058 | 10 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 704 | 8 | 1 | T |
| Lab. Sum. | Keppoch | Anti. | 5685039 | 10 Aug. | 1 | bF | 5 | 100 | 17 | 17 | L | 633 | 14 | 2 | T |
| Lab. Sum. | Lakevale | Anti. | 5805069 | 10 Aug. | 2 | bF | 5 | 100 | 13 | 13 | L | 507 | 20 | 4 | T |
| Lab. Sum. | Locharbor | Anti. | 5765035 | 10 Aug. | 3 | bF | 5 | 100 | 14 | 14 | L | 574 | 2 | 0 | T |
| Lab. Sum. | Maple Ridge | Anti. | 5655061 | 10 Aug. | 3 | bF | 5 | 100 | 12 | 12 | L | 498 | 25 | 5 | T |
| Lab. Sum. | Merland | Anti. | 6005048 | 10 Aug. | 2 | bF | 5 | 100 | 4 | 4 | T | 588 | 26 | 4 | T |
| Lab. Sum. | Middleton | Anti. | 5795030 | 10 Aug. | 3 | bF | 5 | 100 | 15 | 15 | L | 535 | 22 | 4 | T |
| Lab. Sum. | Pinevale | Anti. | 5805038 | 10 Aug. | 3 | bF | 5 | 100 | 6 | 6 | L | 469 | 7 | 1 | T |
| Lab. Sum. | Purlbrook | Anti. | 5755046 | 10 Aug. | 3 | bF | 5 | 100 | 14 | 14 | L | 581 | 4 | 1 | T |
| Lab. Sum. | South Side Hbr. | Anti. | 5865052 | 10 Aug. | 2 | bF | 5 | 100 | 3 | 3 | T | 675 | 5 | 1 | T |
| Lab. Sum. | St. Josephs | Anti. | 5705043 | 10 Aug. | 3 | bF | 5 | 100 | 7 | 7 | L | 615 | 16 | 3 | T |
| Lab. Sum. | Up. South River | Anti. | 5825035 | 10 Aug. | 3 | bF | 5 | 100 | 11 | 11 | L | 501 | 15 | 3 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. Adams | | Cape Bret. | | 9 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Beechmont North | Cape Bret. | 7095109 | 9 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 950 | 0 | 0 | T |
| Lab. Sum. | Belfry Lake | Cape Bret. | 7155074 | 9 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 1034 | 0 | 0 | T |
| Lab. Sum. | Benacadie Pond | Cape Bret. | 6765090 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 1040 | 6 | 1 | T |
| Lab. Sum. | Bengal Rd. | Cape Bret. | 7215093 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 785 | 0 | 0 | T |
| Lab. Sum. | Canoe Lake | Cape Bret. | 7145083 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 861 | 0 | 0 | T |
| Lab. Sum. | East Bay | Cape Bret. | 7045108 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 751 | 1 | 0 | T |
| Lab. Sum. | Enon Salem Rd. | Cape Bret. | 6905077 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 993 | 0 | 0 | T |
| Lab. Sum. | Eskasoni | Cape Bret. | 6805089 | 9 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 864 | 0 | 0 | T |
| Lab. Sum. | Fiddler's Lake | Cape Bret. | 7175084 | 9 Aug. | 1 | bF | 5 | 100 | 11 | 11 | L | 724 | 0 | 0 | T |
| Lab. Sum. | Frenchvale | Cape Bret. | 6925106 | 9 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 979 | 0 | 0 | T |
| Lab. Sum. | Gabarous Lake | Cape Bret. | 7155075 | 9 Aug. | 2 | bF | 5 | 100 | 1 | 1 | T | 1028 | 0 | 0 | T |
| Lab. Sum. | Gillis's Lake | Cape Bret. | 7015103 | 9 Aug. | 2 | bF | 5 | 100 | 5 | 5 | T | 1070 | 0 | 0 | T |
| Lab. Sum. | Grand Mira North | Cape Bret. | 7085080 | 9 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 737 | 1 | 0 | T |
| Lab. Sum. | Hillside Mira | Cape Bret. | 7195098 | 9 Aug. | 2 | bF | 5 | 100 | 1 | 1 | T | 1139 | 1 | 0 | T |
| Lab. Sum. | Hornes Rd. Mira | Cape Bret. | 7305104 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 945 | 0 | 0 | T |
| Lab. Sum. | MacAdam's Lake | Cape Bret. | 6995100 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 1087 | 0 | 0 | T |
| Lab. Sum. | North Glen | Cape Bret. | 6995079 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 1007 | 0 | 0 | T |
| Lab. Sum. | Oceanview | Cape Bret. | 7205085 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 718 | 0 | 0 | T |
| Lab. Sum. | Rear Boisdale | Cape Bret. | 6935106 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 710 | 1 | 0 | T |
| Lab. Sum. | Victoria Bridge | Cape Bret. | 7105075 | 9 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 1083 | 4 | 0 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp.No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Blinn | | Colchester | | 8 August | | bF | | | | | | | | |
| Lab. Sum. | Bayhead | Colchester | 4685065 | 8 August | 1 | bF | 100 | 0 | 0 | T | 622 | 0 | 0 | T |
| Lab. Sum. | Delaney Sett. | Colchester | 4765033 | 8 August | 1 | bF | 100 | 0 | 0 | T | 583 | 2 | 0 | T |
| Lab. Sum. | Denmark | Colchester | 4875060 | 8 August | 1 | bF | 100 | 0 | 0 | T | 756 | 0 | 0 | T |
| Lab. Sum. | Earltown | Colchester | 4875050 | 8 August | 1 | bF | 100 | 0 | 0 | T | 732 | 0 | 0 | T |
| Lab. Sum. | East Earltown | Colchester | 4905057 | 8 August | 1 | bF | 93 | 0 | 0 | T | 708 | 0 | 0 | T |
| Lab. Sum. | Irwin Lake | Colchester | 4725016 | 8 August | 1 | bF | 100 | 0 | 0 | T | 632 | 8 | 1 | T |
| Lab. Sum. | Lansberg | Colchester | 5055028 | 8 August | 1 | bF | 100 | 0 | 0 | T | 806 | 0 | 0 | T |
| Lab. Sum. | Lornevale | Colchester | 4495038 | 8 August | 1 | bF | 100 | 0 | 0 | T | 858 | 0 | 0 | T |
| Lab. Sum. | New Annan | Colchester | 4775052 | 8 August | 1 | bF | 100 | 0 | 0 | T | 828 | 0 | 0 | T |
| Lab. Sum. | Nuttby | Colchester | 4815045 | 8 August | 1 | bF | 100 | 0 | 0 | T | 791 | 0 | 0 | T |
| Lab. Sum. | Oliver | Colchester | 4765055 | 8 August | 1 | bF | 100 | 0 | 0 | T | 392 | 0 | 0 | T |
| Lab. Sum. | Otter Brook | Colchester | 4985010 | 8 August | 1 | bF | 100 | 0 | 0 | T | 646 | 2 | 0 | T |
| Lab. Sum. | Stewiacke | Colchester | 4754997 | 8 August | 1 | bF | 100 | 0 | 0 | T | 882 | 0 | 0 | T |
| Lab. Sum. | Valley | Colchester | 4855025 | 8 August | 1 | bF | 100 | 0 | 0 | T | 754 | 0 | 0 | T |
| Lab. Sum. | Waugh's River | Colchester | 4845058 | 8 August | 1 | bF | 100 | 0 | 0 | T | 696 | 0 | 0 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R. Wolfe | | Oxford | | 15 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Beecham Road | Oxford | 4245086 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 405 | 0 | 0 | T |
| Lab. Sum. | Birch Wood | Oxford | 4385060 | 15 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 418 | 33 | 8 | L |
| Lab. Sum. | Conns Mills | Oxford | 4455067 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 537 | 0 | 0 | T |
| Lab. Sum. | Greenville Stn. | Oxford | 4485055 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 408 | 13 | 3 | T |
| Lab. Sum. | Higgins Mtn. | Oxford | 4515048 | 15 Aug. | 3 | bF | 5 | 100 | 4 | 4 | T | 536 | 1 | 0 | T |
| Lab. Sum. | Kerrs Mills Rd. | Oxford | 4585076 | 15 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 535 | 4 | 1 | T |
| Lab. Sum. | Little Forks | Oxford | 4105061 | 15 Aug. | 0 | bF | 5 | 103 | 0 | 0 | T | 565 | 2 | 0 | T |
| Lab. Sum. | Mansfield | Oxford | 4265073 | 15 Aug. | 3 | bF | 5 | 69 | 2 | 3 | T | 347 | 0 | 0 | T |
| Lab. Sum. | Pumping Stn. Rd. | Oxford | 4105074 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 472 | 3 | 1 | T |
| Lab. Sum. | River Philip | Oxford | 4285055 | 15 Aug. | 5 | bF | 5 | 100 | 1 | 1 | T | 310 | 0 | 0 | T |
| Lab. Sum. | Saltsprings Stn. | Oxford | 4205060 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 421 | 1 | 0 | T |
| Lab. Sum. | Scotch Hill | Oxford | 4385050 | 15 Aug. | 3 | bF | 5 | 76 | 8 | 11 | L | 777 | 2 | 0 | T |
| Lab. Sum. | Shinimicas Bridge | Oxford | 4305079 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 400 | 0 | 0 | T |
| Lab. Sum. | Southampton | Oxford | 4045048 | 15 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 418 | 14 | 3 | T |
| Lab. Sum. | Streets Ridge | Oxford | 4505062 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 495 | 0 | 0 | T |
| Lab. Sum. | Sutherland Lk. | Oxford | 4445042 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 827 | 1 | 0 | T |
| Lab. Sum. | Tidnish Bridge | Oxford | 4165088 | 15 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 482 | 0 | 0 | T |
| Lab. Sum. | Wallace Bay | Oxford | 4585076 | 15 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 419 | 2 | 0 | T |
| Lab. Sum. | Wentworth | Oxford | 4575053 | 15 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 514 | 1 | 0 | T |
| Lab. Sum. | Windham Hill | Oxford | 4225048 | 15 Aug. | 3 | bF | 5 | 91 | 1 | 1 | T | 607 | 0 | 0 | T |

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | BALSAM TWIG APHID No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | BALSAM GALL MIDGE Laboratory No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E. Leighton | | Cumb. West | | 10 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Allen Hill | Cumb. West | 3655028 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 567 | 10 | 2 | T |
| Lab. Sum. | Cannan | Cumb. West | 4015043 | 10 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 578 | 14 | 2 | T |
| Lab. Sum. | Carr's Brook | Cumb. West | 4265029 | 10 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 845 | 23 | 3 | T |
| Lab. Sum. | Creighton Rd. | Cumb. West | 3955049 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 889 | 4 | 0 | T |
| Lab. Sum. | Five Islands Park | Cumb. West | 4195027 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 322 | 25 | 8 | L |
| Lab. Sum. | Green Hill | Cumb. West | 3995026 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 705 | 121 | 17 | L |
| Lab. Sum. | Lakelands | Cumb. West | 3955033 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 828 | 7 | 1 | T |
| Lab. Sum. | Lower Maccan | Cumb. West | 3965065 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 733 | 114 | 16 | L |
| Lab. Sum. | Lynn Mountain | Cumb. West | 4145032 | 10 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 1041 | 38 | 4 | T |
| Lab. Sum. | Old Town Resevior | Cumb. West | 4005031 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 649 | 10 | 2 | T |
| Lab. Sum. | Pleasant Hills | Cumb. West | 4355030 | 10 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 738 | 4 | 1 | T |
| Lab. Sum. | Ramshead River | Cumb. West | 3835083 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 682 | 7 | 1 | T |
| Lab. Sum. | Sand River Rd. | Cumb. West | 3715045 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 453 | 18 | 4 | T |
| Lab. Sum. | Smith Hollow | Cumb. West | 3935032 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 565 | 61 | 11 | L |
| Lab. Sum. | Southampton | Cumb. West | 4035049 | 10 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 777 | 55 | 7 | L |
| Lab. Sum. | Southampton Dump | Cumb. West | 4025047 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 464 | 3 | 1 | T |
| Lab. Sum. | Spencer's Island | Cumb. West | 3635022 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 786 | 13 | 2 | T |
| Lab. Sum. | Station Rd. | Cumb. West | 4025044 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 715 | 160 | 22 | L |
| Lab. Sum. | Upper Bass River | Cumb. West | 4395032 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 627 | 25 | 4 | T |

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Comeau | | Digby | | 5 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Bear River | Digby | 2854932 | 5 Aug. | 3 | bF | 5 | 75 | 13 | 17 | L | 252 | 0 | 0 | T |
| Lab. Sum. | Church Point | Digby | 2534914 | 5 Aug. | 3 | bF | 5 | 150 | 36 | 24 | L | 509 | 0 | 0 | T |
| Lab. Sum. | Comeauville | Digby | 2524906 | 5 Aug. | 3 | bF | 5 | 225 | 55 | 24 | L | 776 | 12 | 2 | T |
| Lab. Sum. | Corberrie | Digby | 2634903 | 5 Aug. | 3 | bF | 5 | 300 | 75 | 25 | L | 1043 | 12 | 1 | T |
| Lab. Sum. | Havelock | Digby | 2684909 | 5 Aug. | 3 | bF | 5 | 450 | 101 | 22 | L | 1596 | 18 | 1 | T |
| Lab. Sum. | Lake Jolly | Digby | 2954928 | 5 Aug. | 3 | bF | 5 | 525 | 114 | 22 | L | 1854 | 18 | 1 | T |
| Lab. Sum. | Uniacke | Digby | 2804923 | 5 Aug. | 3 | bF | 5 | 750 | 153 | 20 | L | 2623 | 39 | 1 | T |
| Lab. Sum. | Danvers | Digby | 2704918 | 5 Aug. | 3 | bF | 5 | 375 | 83 | 22 | L | 1305 | 18 | 1 | T |
| Lab. Sum. | Little River | Digby | 2524927 | 5 Aug. | 3 | bF | 5 | 600 | 125 | 21 | L | 2133 | 39 | 2 | T |
| Lab. Sum. | North Range | Digby | 2724931 | 5 Aug. | 3 | bF | 5 | 675 | 141 | 21 | L | 2388 | 39 | 2 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R. Dort | | Guys. | | 11 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Alder River | Guys. | 6005037 | 11 Aug. | 1 | bF | 5 | 100 | 4 | 4 | T | 885 | 17 | 2 | T |
| Lab. Sum. | Bonnet Lake Rd. | Guys. | 6215013 | 11 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 236 | 1 | 0 | T |
| Lab. Sum. | Cocrane Lake | Guys. | 5865022 | 11 Aug. | 1 | bF | 5 | 100 | 5 | 5 | T | 1018 | 9 | 1 | T |
| Lab. Sum. | Cotter Lake | Guys. | 6145028 | 11 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 837 | 28 | 3 | T |
| Lab. Sum. | Giants Lake | Guys. | 5865028 | 11 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 851 | 41 | 5 | T |
| Lab. Sum. | Giants Lake Rd. | Guys. | 5915027 | 11 Aug. | 2 | bF | 5 | 100 | 4 | 4 | T | 733 | 116 | 16 | L |
| Lab. Sum. | Glenkeen (J.M.) | Guys. | 6195029 | 11 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 888 | 18 | 2 | T |
| Lab. Sum. | Goose Hbr. Lake | Guys. | 6255046 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 860 | 4 | 0 | T |
| Lab. Sum. | Half Island Cove | Guys. | 6395022 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 875 | 0 | 0 | T |
| Lab. Sum. | Isaccs Har. Fr. R | Guys. | 6025003 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 596 | 0 | 0 | T |
| Lab. Sum. | Lincolnville | Guys. | 6125043 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 942 | 15 | 2 | T |
| Lab. Sum. | Loon Lake | Guys. | 6125019 | 11 Aug. | 1 | bF | 5 | 100 | 6 | 6 | L | 1031 | 5 | 0 | T |
| Lab. Sum. | Lundy Tower Road | Guys. | 6185019 | 11 Aug. | 2 | bF | 5 | 100 | 2 | 2 | T | 948 | 1 | 0 | T |
| Lab. Sum. | Mosher Lake | Guys. | 5925019 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 913 | 1 | 0 | T |
| Lab. Sum. | New Harbour | Guys. | 6195029 | 11 Aug. | 2 | bF | 5 | 100 | 5 | 5 | T | 649 | 3 | 0 | T |
| Lab. Sum. | North Ogden | Guys. | 6035025 | 11 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 952 | 1 | 0 | T |
| Lab. Sum. | North River | Guys. | 6145035 | 11 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 1233 | 26 | 2 | T |
| Lab. Sum. | Ogden (G.G.) | Guys. | 6035021 | 11 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 843 | 5 | 1 | T |
| Lab. Sum. | South Brook | Guys. | 6055034 | 11 Aug. | 3 | bF | 5 | 100 | 6 | 6 | L | 958 | 3 | 0 | T |
| Lab. Sum. | West Erinville | Guys. | 5955026 | 11 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 874 | 22 | 3 | T |

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. Baker | | St. Mary's | | 10 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Aspen | St. Mary's | 5745015 | 10 Aug. | 5 | bF | 5 | 100 | 2 | 2 | T | 617 | 26 | 4 | T |
| Lab. Sum. | Barren Brook | St. Mary's | 5525017 | 10 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 545 | 3 | 1 | T |
| Lab. Sum. | Big Meadow | St. Mary's | 5705025 | 10 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 460 | 2 | 0 | T |
| Lab. Sum. | Camp Lake | St. Mary's | 5634994 | 10 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 692 | 13 | 2 | T |
| Lab. Sum. | Eight Island Lk. | St. Mary's | 5825022 | 10 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 579 | 8 | 1 | T |
| Lab. Sum. | Fishers Mills | St. Mary's | 5745021 | 10 Aug. | 3 | bF | 5 | 100 | 5 | 5 | T | 539 | 10 | 2 | T |
| Lab. Sum. | Gegogan | St. Mary's | 5804992 | 10 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 597 | 7 | 1 | T |
| Lab. Sum. | Goshen 'Tower' | St. Mary's | 5815025 | 10 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 599 | 22 | 4 | T |
| Lab. Sum. | Governor Lake | St. Mary's | 5305011 | 10 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 387 | 3 | 1 | T |
| Lab. Sum. | Indian Hbr. Lk. | St. Mary's | 5874997 | 10 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 522 | 18 | 3 | T |
| Lab. Sum. | Liscomb River | St. Mary's | 5664999 | 10 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 552 | 2 | 0 | T |
| Lab. Sum. | Long John Lk. | St. Mary's | 5375013 | 10 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 638 | 1 | 0 | T |
| Lab. Sum. | Marie Joseph | St. Mary's | 5704981 | 10 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 498 | 2 | 0 | T |
| Lab. Sum. | New Chester | St. Mary's | 5614986 | 10 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 450 | 7 | 2 | T |
| Lab. Sum. | Newtown | St. Mary's | 5665024 | 10 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 504 | 1 | 0 | T |
| Lab. Sum. | Palmer Lake | St. Mary's | 5845016 | 10 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 486 | 12 | 2 | T |
| Lab. Sum. | Rabbit Plain | St. Mary's | 5494905 | 10 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 441 | 5 | 1 | T |
| Lab. Sum. | Stillwater | St. Mary's | 5815004 | 10 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 706 | 7 | 1 | T |
| Lab. Sum. | Wallace Lake | St. Mary's | 5735018 | 10 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 656 | 6 | 1 | T |
| Lab. Sum. | Yankee Lake | St. Mary's | 5665002 | 10 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 516 | 5 | 1 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | BALSAM TWIG APHID No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | BALSAM GALL MIDGE Laboratory No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. Coady | | Hfx. East | | 17 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | 4th Lake Quoddy | Hfx. East | 5514979 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 823 | 16 | 2 | T |
| Lab. Sum. | College Lake | Hfx. East | 5155008 | 17 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 361 | 10 | 3 | T |
| Lab. Sum. | Cross Lake Road | Hfx. East | 5404985 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 546 | 1 | 0 | T |
| Lab. Sum. | Elmsvale | Hfx. East | 4924996 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 752 | 0 | 0 | T |
| Lab. Sum. | Glenmore | Hfx. East | 4894990 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 657 | 3 | 0 | T |
| Lab. Sum. | Indian Lake | Hfx. East | 5285008 | 17 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 568 | 3 | 1 | T |
| Lab. Sum. | Jacket Lake | Hfx. East | 5234971 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 737 | 48 | 7 | L |
| Lab. Sum. | Lake Alma | Hfx. East | 5184982 | 17 Aug. | 5 | bF | 5 | 100 | 6 | 6 | L | 532 | 5 | 1 | T |
| Lab. Sum. | Lemmon Hill | Hfx. East | 5095004 | 17 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 658 | 2 | 0 | T |
| Lab. Sum. | Long Lake | Hfx. East | 5034983 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 592 | 2 | 0 | T |
| Lab. Sum. | Marinette | Hfx. East | 5264980 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 325 | 18 | 6 | T |
| Lab. Sum. | Moose Hill | Hfx. East | 5584977 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 497 | 17 | 3 | T |
| Lab. Sum. | Moser River | Hfx. East | 5544986 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 416 | 13 | 3 | T |
| Lab. Sum. | Mullen Mtn. | Hfx. East | 4934992 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 1033 | 4 | 0 | T |
| Lab. Sum. | Scraggy Lake | Hfx. East | 5124976 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 711 | 0 | 0 | T |
| Lab. Sum. | Sheet Harbour | Hfx. East | 5354974 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 510 | 0 | 0 | T |
| Lab. Sum. | Sherlock Lake | Hfx. East | 5104991 | 17 Aug. | 3 | bF | 5 | 100 | 5 | 5 | T | 627 | 11 | 2 | T |
| Lab. Sum. | Spry Harbour | Hfx. East | 5284963 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 803 | 14 | 2 | T |
| Lab. Sum. | Ten Mile Lake | Hfx. East | 5244908 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 398 | 0 | 0 | T |
| Lab. Sum. | Upper Musquodboit | Hfx. East | 5034998 | 17 Aug. | 3 | bF | 5 | 100 | 12 | 12 | L | 646 | 9 | 1 | T |

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | BALSAM TWIG APHID No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | BALSAM GALL MIDGE Laboratory No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. Kew | | Halifax W. | | 8 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Indian Hill | Halifax W. | 4094950 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 571 | 36 | 6 | L |
| Lab. Sum. | Oldham Road | Halifax W. | 4584974 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 476 | 8 | 2 | T |
| Lab. Sum. | Sandy Lake Dam | Halifax W. | 4284952 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 344 | 12 | 3 | T |
| Lab. Sum. | Walsh Brook | Halifax W. | 4244961 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 413 | 31 | 8 | L |
| Lab. Sum. | Beaver Lake Trail | Halifax W. | 4344958 | 8 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 367 | 2 | 1 | T |
| Lab. Sum. | Island Lake | Halifax W. | 4264953 | 8 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 390 | 30 | 8 | L |
| Lab. Sum. | Kehob Hill | Halifax W. | 4334966 | 8 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 451 | 11 | 2 | T |
| Lab. Sum. | Laurie Park | Halifax W. | 4524969 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 281 | 3 | 1 | T |
| Lab. Sum. | Long Lake | Halifax W. | 4404949 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 381 | 9 | 2 | T |
| Lab. Sum. | Long Lake | Halifax W. | 4324944 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 429 | 4 | 1 | T |
| Lab. Sum. | McGrath Hill | Halifax W. | 4354929 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 388 | 4 | 1 | T |
| Lab. Sum. | Mill Lake Dam | Halifax W. | 4224949 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 480 | 6 | 1 | T |
| Lab. Sum. | Minister Hill | Halifax W. | 4344950 | 8 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 324 | 3 | 1 | T |
| Lab. Sum. | North Beaverbank | Halifax W. | 4444970 | 8 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 432 | 4 | 1 | T |
| Lab. Sum. | Peter's Lake | Halifax W. | 4444937 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 485 | 6 | 1 | T |
| Lab. Sum. | Pockwock Lake | Halifax W. | 4314961 | 8 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 392 | 19 | 5 | T |
| Lab. Sum. | Spryfield | Halifax W. | 4494938 | 8 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 340 | 0 | 0 | T |
| Lab. Sum. | Upper Tantallon | Halifax W. | 4324948 | 8 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 458 | 43 | 9 | L |
| Lab. Sum. | Vinegar Lake | Halifax W. | 4174945 | 8 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 340 | 1 | 0 | T |
| Lab. Sum. | Waverley | Halifax W. | 4534960 | 8 Aug. | 1 | bF | 5 | 100 | 4 | 4 | T | 292 | 1 | 0 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No: Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Myers | | Hants | | 22 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Admiral Rock | Hants | 4685002 | 22 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 447 | 0 | 0 | T |
| Lab. Sum. | Densmore Mills | Hants | 4455017 | 22 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 605 | 0 | 0 | T |
| Lab. Sum. | Horton I.R. | Hants | 4024958 | 22 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 374 | 3 | 1 | T |
| Lab. Sum. | Moose Brook | Hants | 4385003 | 22 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 486 | 1 | 0 | T |
| Lab. Sum. | Mt. Uniacke | Hants | 4344964 | 22 Aug. | 3 | bF | 5 | 100 | 9 | 9 | L | 424 | 3 | 1 | T |
| Lab. Sum. | Pine Lake | Hants | 4014976 | 22 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 361 | 1 | 0 | T |
| Lab. Sum. | Pinnacle Hill | Hants | 4265000 | 22 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 561 | 1 | 0 | T |
| Lab. Sum. | Rawdon Gold Mines | Hants | 4394999 | 22 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 726 | 14 | 2 | T |
| Lab. Sum. | Shady Lake | Hants | 4164967 | 22 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 317 | 0 | 0 | T |
| Lab. Sum. | Starratt Pt. | Hants | 4125006 | 22 Aug. | 1 | bF | 5 | 100 | 5 | 5 | T | 460 | 1 | 0 | T |
| Lab. Sum. | Stillwater | Hants | 4224974 | 22 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 514 | 3 | 1 | T |
| Lab. Sum. | Uniacke Lake | Hants | 4324972 | 22 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 579 | 1 | 0 | T |
| Lab. Sum. | Upper Kennetcook | Hants | 4435006 | 22 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 297 | 0 | 0 | T |
| Lab. Sum. | Wet Meadow | Hants | 4385004 | 22 Aug. | 1 | bF | 5 | 100 | 5 | 5 | T | 307 | 7 | 2 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. MacNeil | | Inverness | | 30 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Barberton Rd. | Inverness | 6315058 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 892 | 17 | 2 | T |
| Lab. Sum. | Belle Cote Highl. | Inverness | 6545148 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 836 | 0 | 0 | T |
| Lab. Sum. | Cape Mabou | Inverness | 6235110 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 799 | 0 | 0 | T |
| Lab. Sum. | Caribou Rd. | Inverness | 6625137 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 678 | 1 | 0 | T |
| Lab. Sum. | Centennial Rd. | Inverness | 6185076 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 646 | 15 | 2 | T |
| Lab. Sum. | Coady Sett. Rd. | Inverness | 6455127 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 878 | 20 | 2 | T |
| Lab. Sum. | Creignish Rear Rd | Inverness | 6215066 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 648 | 0 | 0 | T |
| Lab. Sum. | Glengarry | Inverness | 6195100 | 30 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 887 | 0 | 0 | T |
| Lab. Sum. | Hays River Rd. | Inverness | 6345107 | 30 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 726 | 0 | 0 | T |
| Lab. Sum. | MacArthur | Inverness | 6355068 | 30 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 764 | 8 | 1 | T |
| Lab. Sum. | Melford | Inverness | 6335079 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 733 | 8 | 1 | T |
| Lab. Sum. | Park Spur Rd. | Inverness | 6715157 | 30 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 805 | 0 | 0 | T |
| Lab. Sum. | Rankinville | Inverness | 6255102 | 30 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 775 | 0 | 0 | T |
| Lab. Sum. | West Lake Rd. | Inverness | 6455100 | 30 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 793 | 0 | 0 | T |
| Lab. Sum. | Whycocomagh Park | Inverness | 6465091 | 30 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 1292 | 44 | 3 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R. Harley | | Kings | | 11 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Aylesford Mtn. | Kings | 3534992 | 11 Aug. | 3 | bF | 5 | 100 | 5 | 5 | T | 618 | 2 | 0 | T |
| Lab. Sum. | Black Rock | Kings | 3654998 | 11 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 698 | 10 | 1 | T |
| Lab. Sum. | Blomidon Park | Kings | 3935013 | 11 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 543 | 19 | 3 | T |
| Lab. Sum. | Burgess Mtn. | Kings | 3684999 | 11 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 817 | 9 | 1 | T |
| Lab. Sum. | Centreville Mtn. | Kings | 3775002 | 11 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 798 | 6 | 1 | T |
| Lab. Sum. | Frog Lake | Kings | 3554967 | 11 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 467 | 0 | 0 | T |
| Lab. Sum. | Garland | Kings | 3594996 | 11 Aug. | 3 | bF | 5 | 100 | 8 | 8 | L | 656 | 0 | 0 | T |
| Lab. Sum. | Glenmont | Kings | 3845004 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 638 | 18 | 3 | T |
| Lab. Sum. | Lake Paul | Kings | 3964961 | 11 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 635 | 0 | 0 | T |
| Lab. Sum. | Lakeview | Kings | 3904957 | 11 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 772 | 0 | 0 | T |
| Lab. Sum. | Murphy Lake | Kings | 3814976 | 11 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 434 | 0 | 0 | T |
| Lab. Sum. | North Kingston | Kings | 3434989 | 11 Aug. | 1 | bF | 5 | 100 | 7 | 7 | L | 631 | 29 | 5 | T |
| Lab. Sum. | Pelton Mtn. | Kings | 3724999 | 11 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 650 | 15 | 2 | T |
| Lab. Sum. | Rockland | Kings | 3934983 | 11 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 296 | 1 | 0 | T |
| Lab. Sum. | Rockville Notch | Kings | 3514979 | 11 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 379 | 8 | 2 | T |
| Lab. Sum. | South Alton | Kings | 3804986 | 11 Aug. | 3 | bF | 5 | 100 | 8 | 8 | L | 615 | 5 | 1 | T |
| Lab. Sum. | Sunken Lake | Kings | 3894983 | 11 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 587 | 2 | 0 | T |
| Lab. Sum. | S. River Lake | Kings | 3924972 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 602 | 1 | 0 | T |
| Lab. Sum. | Two Mile Lake | Kings | 3714976 | 11 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 570 | 2 | 0 | T |
| Lab. Sum. | W. Brooklyn Mtn. | Kings | 4014990 | 11 Aug. | 1 | bF | 5 | 100 | 5 | 5 | T | 774 | 0 | 0 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS — BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID: Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE (Laboratory): Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P. Murphy & F. Hebb | | Lunenburg | | 9 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Camperdown Rd. | Lunenburg | 3754902 | 9 Aug. | 1 | bF | 5 | 92 | 0 | 0 | T | 457 | 0 | 0 | T |
| Lab. Sum. | Crousetown | Lunenburg | 3794901 | 9 Aug. | 3 | bF | 5 | 93 | 1 | 1 | T | 1018 | 28 | 3 | T |
| Lab. Sum. | Gaber Rd. | Lunenburg | 3714912 | 9 Aug. | 1 | bF | 5 | 99 | 0 | 0 | T | 498 | 0 | 0 | T |
| Lab. Sum. | Glengarry | Lunenburg | 3834952 | 9 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 626 | 0 | 0 | T |
| Lab. Sum. | Hemford | Lunenburg | 3584928 | 9 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 384 | 2 | 1 | T |
| Lab. Sum. | Lapland | Lunenburg | 3644904 | 9 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 712 | 6 | 1 | T |
| Lab. Sum. | Leville Rd. | Lunenburg | 3874955 | 9 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 840 | 0 | 0 | T |
| Lab. Sum. | Monk Road | Lunenburg | 3664916 | 9 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 697 | 0 | 0 | T |
| Lab. Sum. | New Cumberland | Lunenburg | 3824903 | 9 Aug. | 3 | bF | 5 | 96 | 0 | 0 | T | 1417 | 0 | 0 | T |
| Lab. Sum. | New Elm | Lunenburg | 3574917 | 9 Aug. | 3 | bF | 5 | 98 | 0 | 0 | T | 646 | 0 | 0 | T |
| Lab. Sum. | Newburne | Lunenburg | 3724934 | 9 Aug. | 3 | bF | 5 | 94 | 0 | 0 | T | 811 | 0 | 0 | T |
| Lab. Sum. | North River | Lunenburg | 3604940 | 9 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 650 | 0 | 0 | T |
| Lab. Sum. | Northwest Rd. | Lunenburg | 3884917 | 9 Aug. | 3 | bF | 5 | 99 | 0 | 0 | T | 695 | 0 | 0 | T |
| Lab. Sum. | Parkdale | Lunenburg | 3674945 | 9 Aug. | 3 | bF | 5 | 98 | 3 | 3 | T | 579 | 0 | 0 | T |
| Lab. Sum. | Rhodenizer Rd. | Lunenburg | 3764921 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 620 | 2 | 0 | T |
| Lab. Sum. | Seffernville | Lunenburg | 3984943 | 9 Aug. | 5 | bF | 5 | 100 | 1 | 1 | T | 477 | 0 | 0 | T |
| Lab. Sum. | Sherbrook Lk. Rd. | Lunenburg | 3754945 | 9 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 681 | 0 | 0 | T |
| Lab. Sum. | Simpsons Corner | Lunenburg | 3524933 | 9 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 524 | 0 | 0 | T |
| Lab. Sum. | Windsor Road | Lunenburg | 3984952 | 9 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 499 | 0 | 0 | T |
| Lab. Sum. | Windsor Road L-2 | Lunenburg | 3974950 | 9 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 486 | 0 | 0 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS    BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R. Gunn | | Pictou | | 7 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Avondale | Pictou | 5535054 | 7 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 480 | 6 | 1 | T |
| Lab. Sum. | Blanchard | Pictou | 5405039 | 7 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 485 | 2 | 0 | T |
| Lab. Sum. | Blue Mtn. Tower | Pictou | 5445034 | 7 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 395 | 10 | 3 | T |
| Lab. Sum. | Caledonia Rd. | Pictou | 5455020 | 7 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 460 | 18 | 4 | T |
| Lab. Sum. | Eden Lake | Pictou | 5575026 | 7 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 480 | 0 | 0 | T |
| Lab. Sum. | Ellen Brown Rd. | Pictou | 5225015 | 7 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 510 | 0 | 0 | T |
| Lab. Sum. | E. Ri. St. Marys | Pictou | 5655027 | 7 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 431 | 47 | 11 | L |
| Lab. Sum. | Garden of Eden | Pictou | 5535030 | 7 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 505 | 35 | 7 | L |
| Lab. Sum. | Greens Brook | Pictou | 5625028 | 7 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 435 | 1 | 0 | T |
| Lab. Sum. | Groveland | Pictou | 5615050 | 7 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 490 | 18 | 4 | T |
| Lab. Sum. | Keppoch | Pictou | 5675038 | 7 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 530 | 34 | 6 | L |
| Lab. Sum. | Lovat | Pictou | 5125041 | 7 Aug. | 3 | bF | 5 | 100 | 4 | 4 | T | 472 | 16 | 3 | T |
| Lab. Sum. | McLellans Brook | Pictou | 5115045 | 7 Aug. | 3 | bF | 5 | 100 | 35 | 35 | M | 411 | 3 | 1 | T |
| Lab. Sum. | Mid. Barney's Ri. | Pictou | 5545037 | 7 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 530 | 16 | 3 | T |
| Lab. Sum. | Millbrook | Pictou | 5155039 | 7 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 414 | 34 | 8 | L |
| Lab. Sum. | Millstream | Pictou | 5265032 | 7 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 530 | 20 | 4 | T |
| Lab. Sum. | Moose River PSA | Pictou | 5485034 | 7 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 510 | 8 | 2 | T |
| Lab. Sum. | Rossfield | Pictou | 5575041 | 7 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 570 | 17 | 3 | T |
| Lab. Sum. | Upper Mt. Thom | Pictou | 5025038 | 7 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 497 | 28 | 6 | T |
| Lab. Sum. | Vanderveen Rd. | Pictou | 4975044 | 7 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 425 | 0 | 0 | T |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | BALSAM TWIG APHID No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F. Hebb | | Queens | | 11 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Beech Hill | Queens | 3534872 | 11 Aug. | 3 | bF | 5 | 92 | 12 | 13 | L | 1124 | 0 | 0 | T |
| Lab. Sum. | Broad River | Queens | 3524870 | 11 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 1094 | 0 | 0 | T |
| Lab. Sum. | Caledonia | Queens | 3394914 | 11 Aug. | 1 | bF | 5 | 98 | 9 | 9 | L | 632 | 0 | 0 | T |
| Lab. Sum. | Camp Road | Queens | 3294887 | 11 Aug. | 1 | bF | 5 | 99 | 4 | 4 | T | 527 | 0 | 0 | T |
| Lab. Sum. | Harmony | Queens | 3334916 | 11 Aug. | 1 | bF | 5 | 97 | 0 | 0 | T | 724 | 0 | 0 | T |
| Lab. Sum. | Kempt | Queens | 3324920 | 11 Aug. | 3 | bF | 5 | 92 | 6 | 7 | L | 1092 | 0 | 0 | T |
| Lab. Sum. | Milton Fire Tower | Queens | 3584877 | 11 Aug. | 1 | bF | 5 | 100 | 22 | 22 | L | 692 | 0 | 0 | T |
| Lab. Sum. | New Albany | Queens | 3334924 | 11 Aug. | 3 | bF | 5 | 88 | 0 | 0 | T | 1052 | 0 | 0 | T |
| Lab. Sum. | North Brookfield | Queens | 3464920 | 11 Aug. | 2 | bF | 5 | 82 | 4 | 5 | T | 1056 | 0 | 0 | T |
| Lab. Sum. | North Brookfield | Queens | 3464920 | 11 Aug. | 3 | bF | 5 | 63 | 0 | 0 | T | 1272 | 0 | 0 | T |
| Lab. Sum. | Old Annap. Rd. #1 | Queens | 3434928 | 11 Aug. | 1 | bF | 5 | 87 | 1 | 1 | T | 1032 | 0 | 0 | T |
| Lab. Sum. | Old Annap. Rd. #2 | Queens | 3454924 | 11 Aug. | 3 | bF | 5 | 91 | 11 | 12 | L | 984 | 0 | 0 | T |
| Lab. Sum. | Old Annap. Rd. #3 | Queens | 3444922 | 11 Aug. | 2 | bF | 5 | 94 | 7 | 7 | L | 865 | 0 | 0 | T |
| Lab. Sum. | Old Annap. Rd. #4 | Queens | 3444922 | 11 Aug. | 3 | bF | 5 | 93 | 13 | 14 | L | 872 | 0 | 0 | T |
| Lab. Sum. | Pleasant River #1 | Queens | 3484921 | 11 Aug. | 3 | bF | 5 | 100 | 9 | 9 | L | 832 | 0 | 0 | T |
| Lab. Sum. | Pleasant River #2 | Queens | 3474921 | 11 Aug. | 3 | bF | 5 | 81 | 0 | 0 | T | 1320 | 0 | 0 | T |
| Lab. Sum. | Prince John Brook | Queens | 3174902 | 11 Aug. | 1 | bF | 5 | 100 | 9 | 9 | L | 544 | 0 | 0 | T |
| Lab. Sum. | South Road | Queens | 3284904 | 11 Aug. | 1 | bF | 5 | 100 | 4 | 4 | T | 668 | 0 | 0 | T |
| Lab. Sum. | Whiteburn Rd. | Queens | 3354911 | 11 Aug. | 1 | bF | 5 | 100 | 23 | 23 | L | 576 | 0 | 0 | T |

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T.F. Murray | | St. Peters | | 17 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Cannes | St. Peters | 6595055 | 17 Aug. | 3 | bF | 5 | 95 | 0 | 0 | T | 789 | 3 | 0 | T |
| Lab. Sum. | Cap La Ronde | St. Peters | 6635048 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 505 | 2 | 0 | T |
| Lab. Sum. | E. Br. Murch. Br. | St. Peters | 6815072 | 17 Aug. | 5 | bF | 5 | 95 | 0 | 0 | T | 631 | 21 | 3 | T |
| Lab. Sum. | Framboise | St. Peters | 7045066 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 444 | 0 | 0 | T |
| Lab. Sum. | Framboise Cove | St. Peters | 7105065 | 17 Aug. | 1 | bF | 5 | 98 | 0 | 0 | T | 414 | 2 | 0 | T |
| Lab. Sum. | Grand River #1 | St. Peters | 6835059 | 17 Aug. | 1 | bF | 5 | 98 | 0 | 0 | T | 605 | 0 | 0 | T |
| Lab. Sum. | Grand River #2 | St. Peters | 6835057 | 17 Aug. | 1 | bF | 5 | 90 | 0 | 0 | T | 719 | 0 | 0 | T |
| Lab. Sum. | Irish Cove | St. Peters | 6795075 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 621 | 2 | 0 | T |
| Lab. Sum. | Johnsons Hbr. | St. Peters | 6765070 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 562 | 4 | 1 | T |
| Lab. Sum. | Lennox | St. Peters | 6545050 | 17 Aug. | 1 | bF | 5 | 96 | 0 | 0 | T | 548 | 0 | 0 | T |
| Lab. Sum. | Lewis Cove Rd. | St. Peters | 6805058 | 17 Aug. | 1 | bF | 5 | 89 | 0 | 0 | T | 1213 | 4 | 0 | T |
| Lab. Sum. | Little River Res. | St. Peters | 6365052 | 17 Aug. | 1 | bF | 5 | 93 | 0 | 0 | T | 563 | 12 | 2 | T |
| Lab. Sum. | Long Lake | St. Peters | 6635059 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 664 | 2 | 0 | T |
| Lab. Sum. | Macleods Lake | St. Peters | 6935067 | 17 Aug. | 1 | bF | 5 | 85 | 0 | 0 | T | 722 | 1 | 0 | T |
| Lab. Sum. | Rear Sporting Mtn | St. Peters | 6595063 | 17 Aug. | 1 | bF | 5 | 98 | 0 | 0 | T | 524 | 3 | 1 | T |
| Lab. Sum. | Ri.Tillard Tower | St. Peters | 6615056 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 638 | 9 | 1 | T |
| Lab. Sum. | Soldiers Cove | St. Peters | 6765063 | 17 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 648 | 57 | 9 | L |
| Lab. Sum. | St Peters | St. Peters | 6665057 | 17 Aug. | 3 | bF | 5 | 66 | 0 | 0 | T | 312 | 4 | 1 | T |
| Lab. Sum. | Steels Brook | St. Peters | 6405057 | 17 Aug. | 1 | bF | 5 | 99 | 0 | 0 | T | 580 | 5 | 1 | T |
| Lab. Sum. | St. Georges Chan. | St. Peters | 6535064 | 17 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 662 | 21 | 3 | T |

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W. DesChamp | | Shelburne | | 10 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Beaver Dam Lake | Shelburne | 3084863 | 10 Aug. | 5 | bF | 5 | 100 | 3 | 3 | T | 267 | 0 | 0 | T |
| Lab. Sum. | Birchtown | Shelburne | 3084846 | 10 Aug. | 3 | bF | 5 | 100 | 38 | 38 | M | 256 | 0 | 0 | T |
| Lab. Sum. | Campbells Hill | Shelburne | 3004852 | 10 Aug. | 3 | bF | 5 | 100 | 11 | 11 | L | 317 | 1 | 0 | T |
| Lab. Sum. | Courtneys Lake | Shelburne | 3084852 | 10 Aug. | 1 | bF | 5 | 100 | 10 | 10 | L | 186 | 15 | 8 | L |
| Lab. Sum. | Four Mile Brook | Shelburne | 3214860 | 10 Aug. | 1 | bF | 5 | 100 | 8 | 8 | L | 126 | 0 | 0 | T |
| Lab. Sum. | Freshwater Brook | Shelburne | 3374854 | 10 Aug. | 2 | bF | 5 | 100 | 2 | 2 | T | 234 | 8 | 3 | T |
| Lab. Sum. | Goose Lake | Shelburne | 2964829 | 10 Aug. | 1 | bF | 5 | 100 | 17 | 17 | L | 245 | 6 | 2 | T |
| Lab. Sum. | Johnsons Pond | Shelburne | 3414851 | 10 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 258 | 6 | 2 | T |
| Lab. Sum. | Lake George | Shelburne | 3154851 | 10 Aug. | 1 | bF | 5 | 100 | 4 | 4 | T | 232 | 2 | 1 | T |
| Lab. Sum. | Lower Shag Hbr. | Shelburne | 2824820 | 10 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 367 | 37 | 10 | L |
| Lab. Sum. | Lower Woods Hbr. | Shelburne | 2804823 | 10 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 271 | 13 | 5 | T |
| Lab. Sum. | Middle Ohio | Shelburne | 3064866 | 10 Aug. | 3 | bF | 5 | 100 | 13 | 13 | L | 413 | 14 | 3 | T |
| Lab. Sum. | Oak Park Lake | Shelburne | 2864831 | 10 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 254 | 3 | 1 | T |
| Lab. Sum. | Port Clyde | Shelburne | 3024830 | 10 Aug. | 3 | bF | 5 | 100 | 1 | 1 | T | 318 | 17 | 5 | T |
| Lab. Sum. | Roseway River Dam | Shelburne | 3104856 | 10 Aug. | 3 | bF | 5 | 100 | 6 | 6 | L | 794 | 8 | 1 | T |
| Lab. Sum. | Sable River West | Shelburne | 3334855 | 10 Aug. | 3 | bF | 5 | 100 | 3 | 3 | T | 363 | 16 | 4 | T |
| Lab. Sum. | Tidney Meadows | Shelburne | 3374857 | 10 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 300 | 13 | 4 | T |
| Lab. Sum. | Upper Clyde River | Shelburne | 3034862 | 10 Aug. | 1 | bF | 5 | 100 | 11 | 11 | L | 255 | 17 | 7 | L |
| Lab. Sum. | Upper Ohio | Shelburne | 3034873 | 10 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 309 | 6 | 2 | T |
| Lab. Sum. | Villagedale | Shelburne | 2944822 | 10 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 362 | 26 | 7 | L |

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS

BALSAM TWIG APHID AND BALSAM GALL MIDGE SURVEY

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infest Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J. Bos | | Victoria | | 14 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Baddeck Bay | Victoria | 6795113 | 14 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 441 | 9 | 2 | T |
| Lab. Sum. | Baddeck Depot | Victoria | 6735107 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 474 | 9 | 2 | T |
| Lab. Sum. | Baddeck Forks | Victoria | 6725116 | 14 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 452 | 13 | 3 | T |
| Lab. Sum. | Caines Mtn. | Victoria | 6605092 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 599 | 0 | 0 | T |
| Lab. Sum. | Crowdis Mtn. Ap. | Victoria | 6695120 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 474 | 24 | 5 | T |
| Lab. Sum. | Effies Brook | Victoria | 6925192 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 380 | 0 | 0 | T |
| Lab. Sum. | Fielding Rd. | Victoria | 6665138 | 14 Aug. | 1 | bF | 5 | 100 | 9 | 9 | L | 508 | 13 | 3 | T |
| Lab. Sum. | Fraeny Mtn. Rd. | Victoria | 6975170 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 307 | 2 | 1 | T |
| Lab. Sum. | Gillis Point | Victoria | 6715097 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 539 | 6 | 1 | T |
| Lab. Sum. | Highland Rd. (14) | Victoria | 6675129 | 14 Aug. | 1 | bF | 5 | 100 | 5 | 5 | T | 421 | 34 | 8 | L |
| Lab. Sum. | Highlands Rd. (2) | Victoria | 6635111 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 463 | 10 | 2 | T |
| Lab. Sum. | Indian Brook | Victoria | 6995138 | 14 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 428 | 1 | 0 | T |
| Lab. Sum. | Mariana Airport | Victoria | 6775149 | 14 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 442 | 11 | 2 | T |
| Lab. Sum. | Mary Ann Falls | Victoria | 7015182 | 14 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 329 | 0 | 0 | T |
| Lab. Sum. | Norman Fire Tower | Victoria | 6785144 | 14 Aug. | 1 | bF | 5 | 100 | 3 | 3 | T | 492 | 41 | 8 | L |
| Lab. Sum. | Oregon Rd. | Victoria | 6815132 | 14 Aug. | 1 | bF | 5 | 100 | 4 | 4 | T | 429 | 1 | 0 | T |
| Lab. Sum. | River Bennet | Victoria | 6895138 | 14 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 488 | 1 | 0 | T |
| Lab. Sum. | South Ridge Rd. | Victoria | 6835189 | 14 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 382 | 2 | 1 | T |
| Lab. Sum. | Warren Lake | Victoria | 7025176 | 14 Aug. | 1 | bF | 5 | 100 | 2 | 2 | T | 480 | 1 | 0 | T |

134

| Crew | Location | District | UTM GRID Number | Date 1989 | Plot Code | Tree Sp. | No. | BALSAM TWIG APHID Total No. Shoot | No. Shoot Infest | % | C. | BALSAM GALL MIDGE Laboratory Total No. Need. | No. Infset Need. | % | C. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. Gordon | | Yarmouth | | 16 Aug. | | bF | | | | | | | | | |
| Lab. Sum. | Ardnamurchan Rd. | Yarmouth | 2714848 | 16 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 281 | 8 | 3 | T |
| Lab. Sum. | Brooklyn | Yarmouth | 2524861 | 16 Aug. | 3 | bF | 5 | 100 | 6 | 6 | L | 447 | 0 | 0 | T |
| Lab. Sum. | Chebogue Rd. | Yarmouth | 2514855 | 16 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 371 | 0 | 0 | T |
| Lab. Sum. | Clellan Corner | Yarmouth | 2564881 | 16 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 404 | 0 | 0 | T |
| Lab. Sum. | East Kempt | Yarmouth | 2764882 | 16 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 308 | 0 | 0 | T |
| Lab. Sum. | E. Kempt MA | Yarmouth | 2784881 | 16 Aug. | 2 | bF | 5 | 100 | 9 | 9 | L | 272 | 0 | 0 | T |
| Lab. Sum. | First Bear Lake | Yarmouth | 2874888 | 16 Aug. | 4 | bF | 5 | 100 | 0 | 0 | T | 304 | 0 | 0 | T |
| Lab. Sum. | Gardner Mill | Yarmouth | 2614878 | 16 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 313 | 0 | 0 | T |
| Lab. Sum. | Hamilton Road | Yarmouth | 2634869 | 16 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 208 | 0 | 0 | T |
| Lab. Sum. | Hardscratch Road | Yarmouth | 2554866 | 16 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 463 | 0 | 0 | T |
| Lab. Sum. | Hog Lake | Yarmouth | 2684863 | 16 Aug. | 2 | bF | 5 | 100 | 0 | 0 | T | 391 | 13 | 3 | T |
| Lab. Sum. | Hwy 103 Argyle | Yarmouth | 2714851 | 16 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 369 | 4 | 1 | T |
| Lab. Sum. | Hwy 103 Yarmouth | Yarmouth | 2534858 | 16 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 424 | 4 | 1 | T |
| Lab. Sum. | Lake George | Yarmouth | 2564882 | 16 Aug. | 3 | bF | 5 | 100 | 2 | 2 | T | 481 | 0 | 0 | T |
| Lab. Sum. | Lake George East | Yarmouth | 2564880 | 16 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 503 | 4 | 1 | T |
| Lab. Sum. | Lake George West | Yarmouth | 2544880 | 16 Aug. | 5 | bF | 5 | 100 | 0 | 0 | T | 441 | 0 | 0 | T |
| Lab. Sum. | Overton #1 | Yarmouth | 2484859 | 16 Aug. | 3 | bF | 5 | 97 | 0 | 0 | T | 388 | 0 | 0 | T |
| Lab. Sum. | Overton #2 | Yarmouth | 2484860 | 16 Aug. | 3 | bF | 5 | 100 | 0 | 0 | T | 353 | 0 | 0 | T |
| Lab. Sum. | Teffry Road | Yarmouth | 2694865 | 16 Aug. | 1 | bF | 5 | 100 | 0 | 0 | T | 285 | 3 | 1 | T |
| Lab. Sum. | Whistler Brook | Yarmouth | 2744981 | 16 Aug. | 1 | bF | 5 | 100 | 1 | 1 | T | 395 | 0 | 0 | T |

Doc.: 0413J

# 1989 NEW BRUNSWICK PROTECTION PROGRAM AGAINST SPRUCE BUDWORM

(Annual Forest Pest Control Forum, November 14-16, 1989)

N. Carter

## Spruce Budworm Conditions in 1989

The 1989 aerial survey for defoliation was conducted in the standard manner and revealed an estimated 67 000 ha of light, 129 000 ha of moderate, and 267 000 ha of severe defoliation (Figure 1). Approximately 75.8% of the M-S defoliation was outside the treated areas. Defoliation was detected in largest concentrations throughout the north-central and northern parts of the Province, primarily in Restigouche and Northumberland Counties. Except for occasional small areas of defoliation, the majority of the rest of the Province was undamaged. The 396 000 ha of M-S defoliation is a 20% less than 1988, and is 80% below the 2.03 million ha in 1983.

## 1989 Spray Program

The 1989 Spruce Budworm Spray Program (Figure 2) conducted by Forest Protection Limited, in New Brunswick covered approximately 576 900 hectares. This is 28.6% more than the 448 500 ha treated in 1988. Another 34 000 ha were sprayed by J. D. Irving Ltd. on its own freehold limits (compared to 98 000 ha in 1988).

Of the total area treated by FPL, 80.9% received a double application of the chemical fenitrothion (Sumithion) and 0.9% received a single application as the second was deemed unnecessary by larval counts after the first application. About 18.2% of the area received a single (7.0%) or double (11.3%) treatment of bacterial insecticide, Bacillus thuringiensis var. kurstaki (B.t.) in the form of two products, viz. Futura XLV and Dipel 176 (Table 1).

Spray aircraft included 12 TBMs, 2 four-engine DC-6s, and 11 single-engine agricultural-type small spray planes (SSPs). TBMs were used to treat 47.6% of the total area and the DC-6 treated 39.2% of the area. B.t. was applied undiluted at the normal 30 BIU/ha rate in one or two applications by TBMs, and once or twice at 15 BIU/ha using SSPs with enhanced atomization (i.e. Micronair AU4000s with reduced flow rates/unit). Fenitrothion was applied in water-based formulation at the normal 210 g/1.47 L/ha rate from TBMs and DC-6s, and at 210 g/0.44 L/ha from SSPs.

The first spray blocks were declared biologically ready for chemical spraying the evening of on May 26th and spray operations commenced the morning of May 28th after a few days of unacceptable spray weather. The first B.t. blocks were declared biologically ready on the evening of May 30th and spraying began the next evening. The operational program was completed on the evening of June 17th. Weather during the spray period was regarded to be "normal", although 7 days of the 22-day period were unacceptable for spraying.

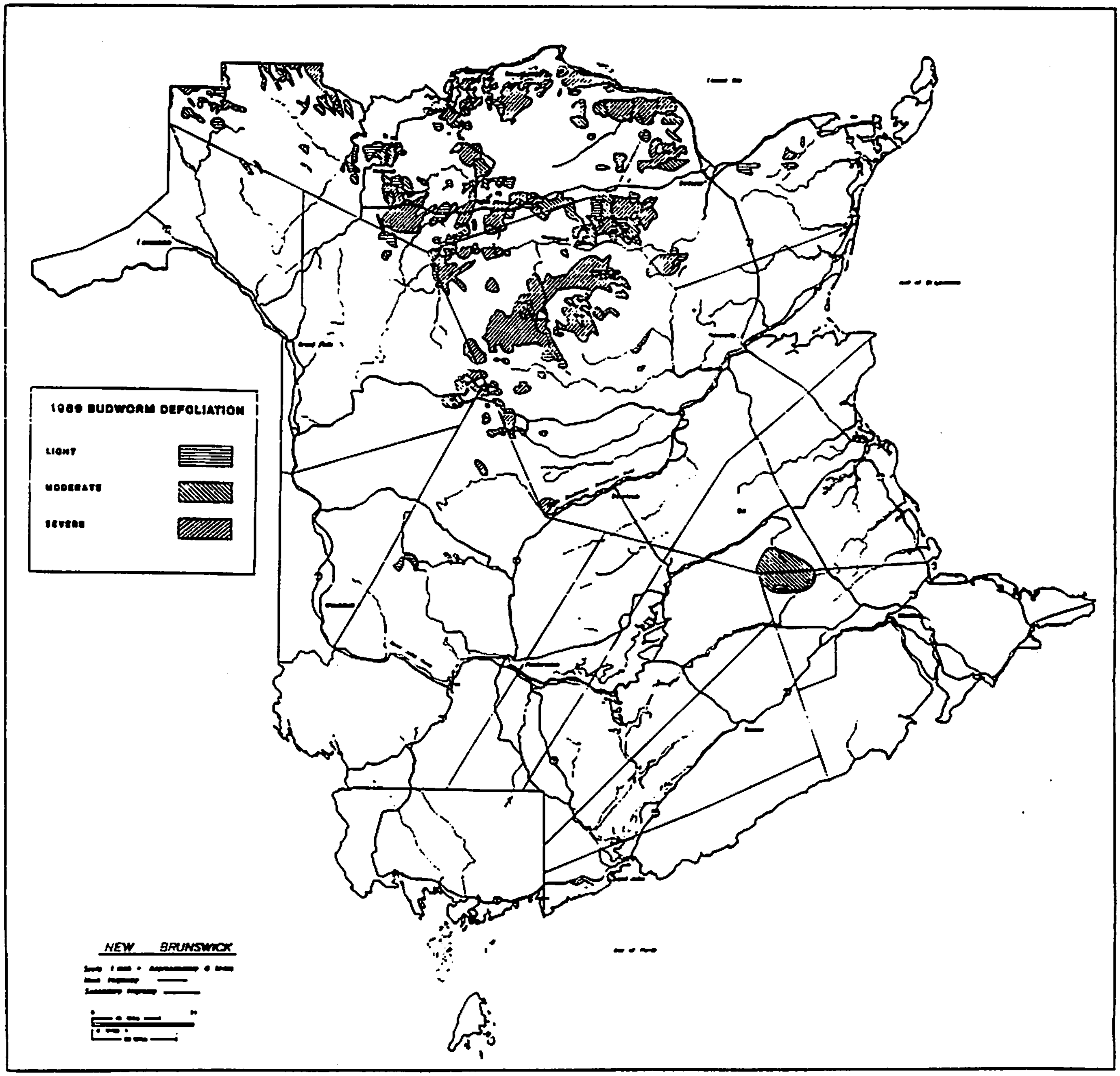



Figure 1. Areas of light, moderate and severe defoliation caused by spruce budworm in New Brunswick in 1989.

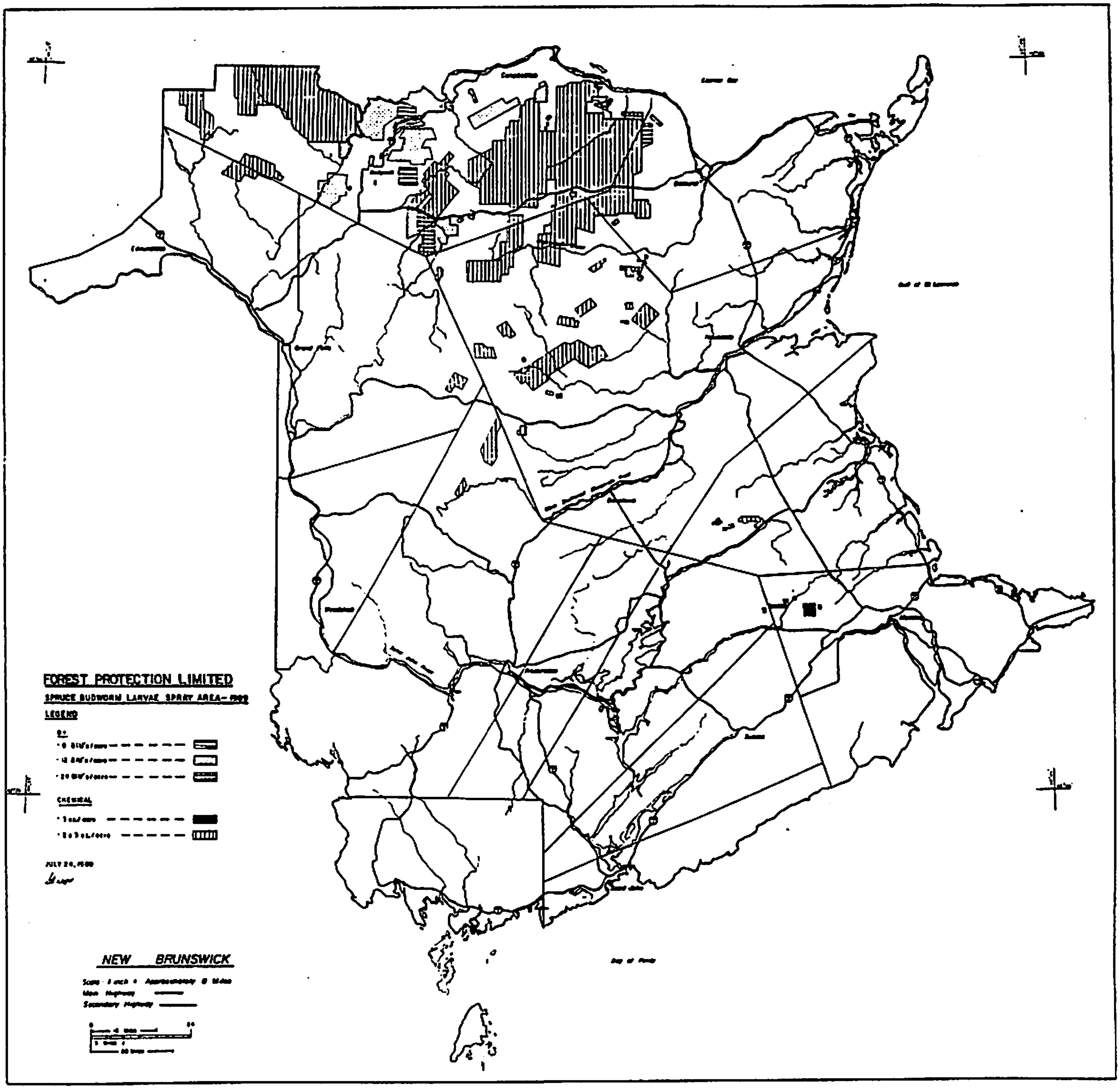



Figure 2. Areas sprayed by FPL for spruce budworm control in New Brunswick in 1989. (Does not include J. D. Irving Ltd. program).

*Table 1. Areas sprayed by Forest Protection Limited for spruce budworm control in 1989 in New Brunswick*. (Does not include J.D. Irving Ltd. program).*

| Treatment** | Hectares Thousands | (%) | Acres Thousands | Aircraft Type |
|---|---|---|---|---|
| ***One Application - Biological*** | | | | |
| 15 BIU-D176/1.18 L/ha | 8.7 | (1.5) | 21.6 | SSP |
| 30 BIU-FXLV/1.01 L/ha | 11.9 | (2.1) | 29.5 | SSP |
| 30 BIU-FXLV/2.02 L/ha | 10.2 | (1.8) | 25.3 | TBM |
| 30 BIU-D176/2.36 L/ha | 9.0 | (1.6) | 22.3 | TBM |
| SUB-TOTAL | 39.8 | (7.0) | 98.7 | |
| ***Two Applications - Biological*** | | | | |
| 15 BIU-D176/1.18 L/ha + 15 BIU-D176/1.18 L/ha | 18.3 | (3.2) | 45.2 | SSP |
| 15 BIU-D176/1.18 L/ha + 15 BIU-FXLV/1.01 L/ha | 31.6 | (5.4) | 78.2 | SSP |
| 30 BIU-FXLV/2.02 L/ha + 30 BIU-FXLV/2.02 L/ha | 4.7 | (0.8) | 11.7 | TBM |
| 30 BIU-D176/2.36 L/ha + 30 BIU-FXLV/2.02 L/ha | 10.3 | (1.8) | 25.5 | TBM |
| SUB-TOTAL BIOLOGICAL | 64.9 | (11.2) | 160.6 | |
| SUB-TOTAL BIOLOGICAL | 104.7 | (18.2) | 259.3 | |
| ***One Application - Chemical*** | | | | |
| 210 g Fen/0.44 L/ha | 5.3 | (0.9) | 13.3 | SSP |
| ***Two Applications - Chemical*** | | | | |
| 210 g Fen/1.46 L/ha + 210 g Fen/1.46 L/ha | 466.7 | (80.9) | 1 153.0 | TBM, DC-6 |
| SUB-TOTAL CHEMICAL | 472.0 | (81.8) | 1 166.3 | |
| GRAND TOTAL | 576.9 | (100.0) | 1 425.6 | |

*Source: Forest Protection Ltd.

**D176 = Dipel 176
FXLV = Futura XLV
Fen = Fenitrothion

## Results of Spray Program

This year spring populations of spruce budworm larvae were generally lower (Figure 3) and the intensity of feeding damage was less than in 1988 (Figure 4). Weather conditions were warmer during this year's spray season due primarily to higher minimum temperatures. Though total rainfall was greater during this year's spray period, rain did not occur on as many consecutive days as last year. Shoot elongation and larval development were also more advanced this year at the time the blocks were deemed ready for treatment.

Compared to 1988, the 1989 spray program contained a greater proportion of area treated with Fenitrothion than B.t. (i.e. 80/20 vs 50/50). Less moderate and severe defoliation was found in treated areas this year compared to last (i.e. 16% vs 38%). In 1989, each total treatment area had about the same proportion of moderate and severe defoliation (i.e. Fenitrothion = 16.4% vs B.t. = 17.6%). Whereas the value for Fenitrothion is similar to 1988 (i.e. 19%), the value for B.t. is greatly improved from the last year's value of 60%. The average for spray programs based mostly on chemicals in the last 13 years is 16% (range 6% to 38%).

Table 2 provides summary data from sample plots in each treatment. When B.t. data were pooled and compared to the pooled Fenitrothion data there were no differences in the overall levels of protection afforded (Figure 5). Mean pre-spray populations in B.t. areas were lower than in Fenitrothion areas (e.g. mean B.t. = 9.4 larvae/branch and 0.104 larvae/bud vs. mean Fenitrothion = 16.2 larvae/branch and 0.186 larvae/bud).

The SSP 2 x 15 BIU/ha treatment gave the best B.t. results followed by the TBM 1 x 30 BIU/ha (Figures 6 and 7). There were few observations above the moderate range for SSP 1 x 15 BIU/ha but results were positive in the low range. Ironically the TBM 2 x 30 BIU/ha did not provide as good protection as the other B.t. rates. It is not known whether higher populations, later application (due to operational queuing), or insufficient deposit (not measured) might account for this.

In Fenitrothion plots treated by TBMs, mean defoliation was generally lower than in DC-6 plots across the population ranges examined (Figures 6 and 7).

Overall, Fenitrothion results this year were on par with traditional expectations. For B.t., the results of 1989 were a qualified success contrasting the qualified failure of 1988. In other words, this year's operation was successful, but did not yeild sufficient data on which to evaluate the performance of B.t. under high population conditions. Present thinking suggests that in 1989, larval populations, shoot development, and weather were more conducive to successful B.t. use than 1988.

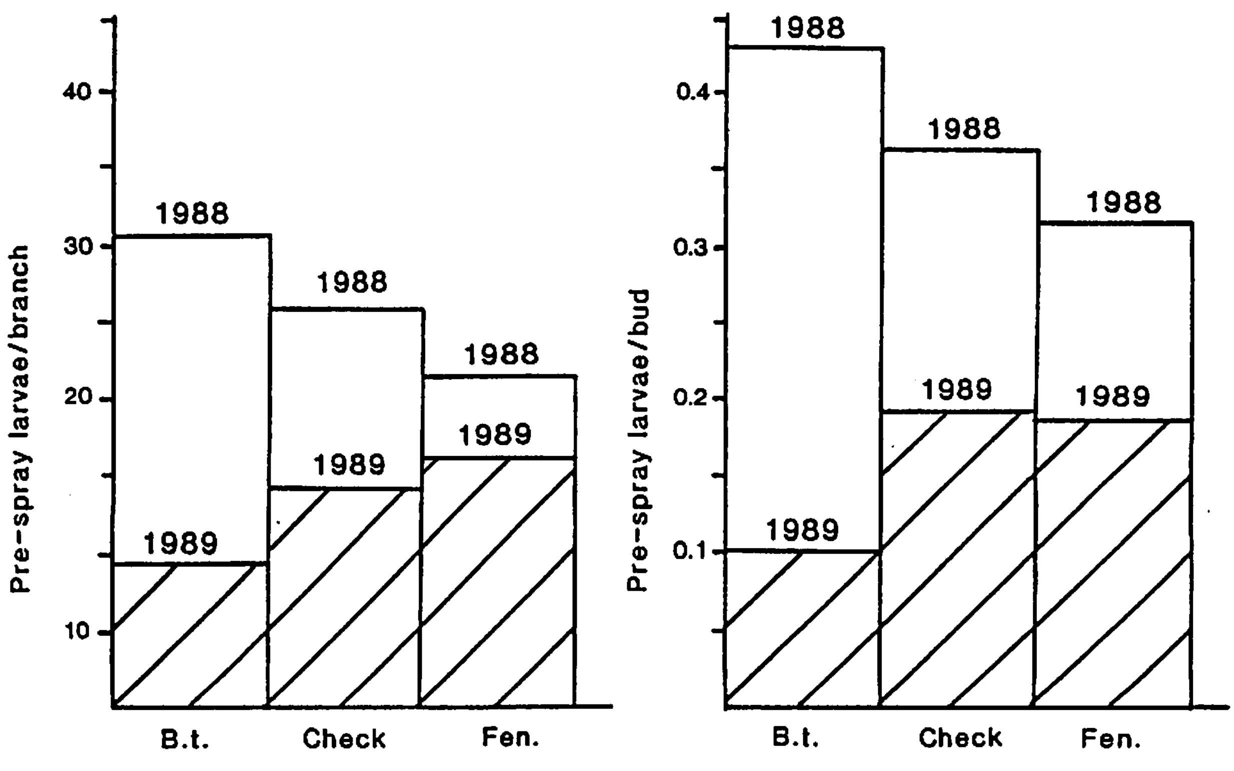
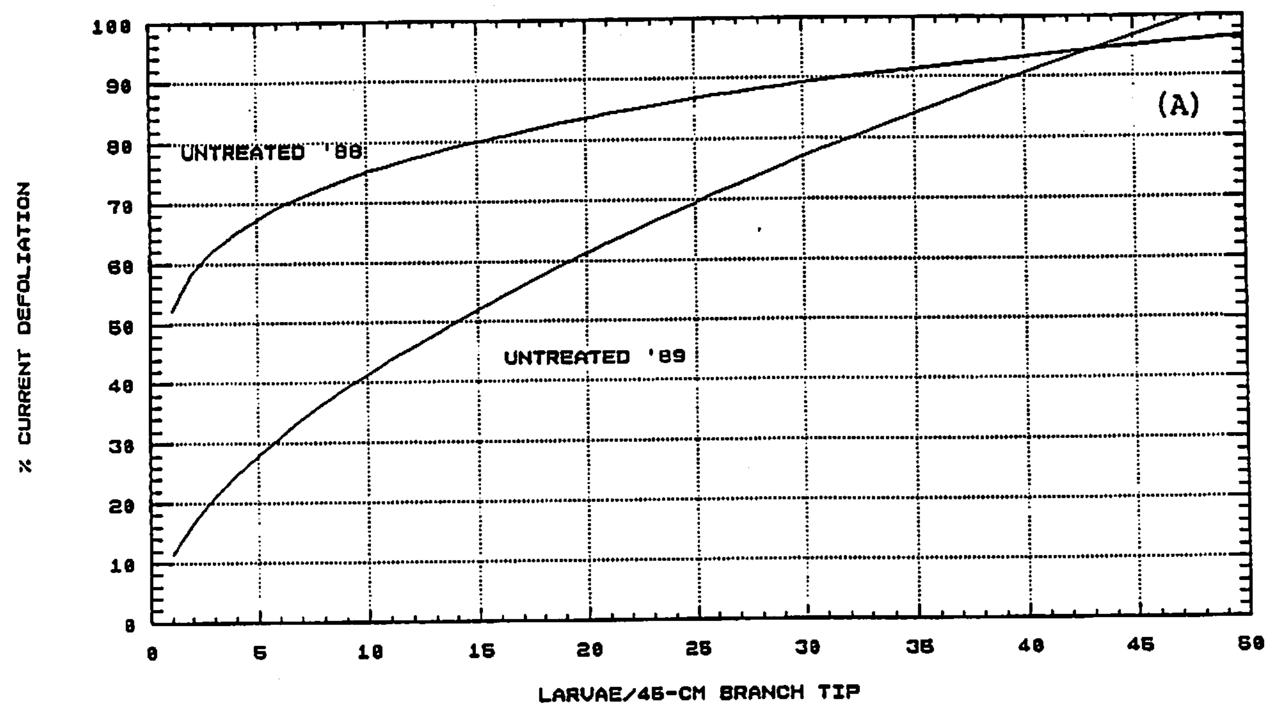



Figure 3. Mean pre-spray larval densities (larvae/branch or larvae/bud) in check plots, combined Fenitrothion, and combined B.t. treatment plots, in 1989 compared to 1988.



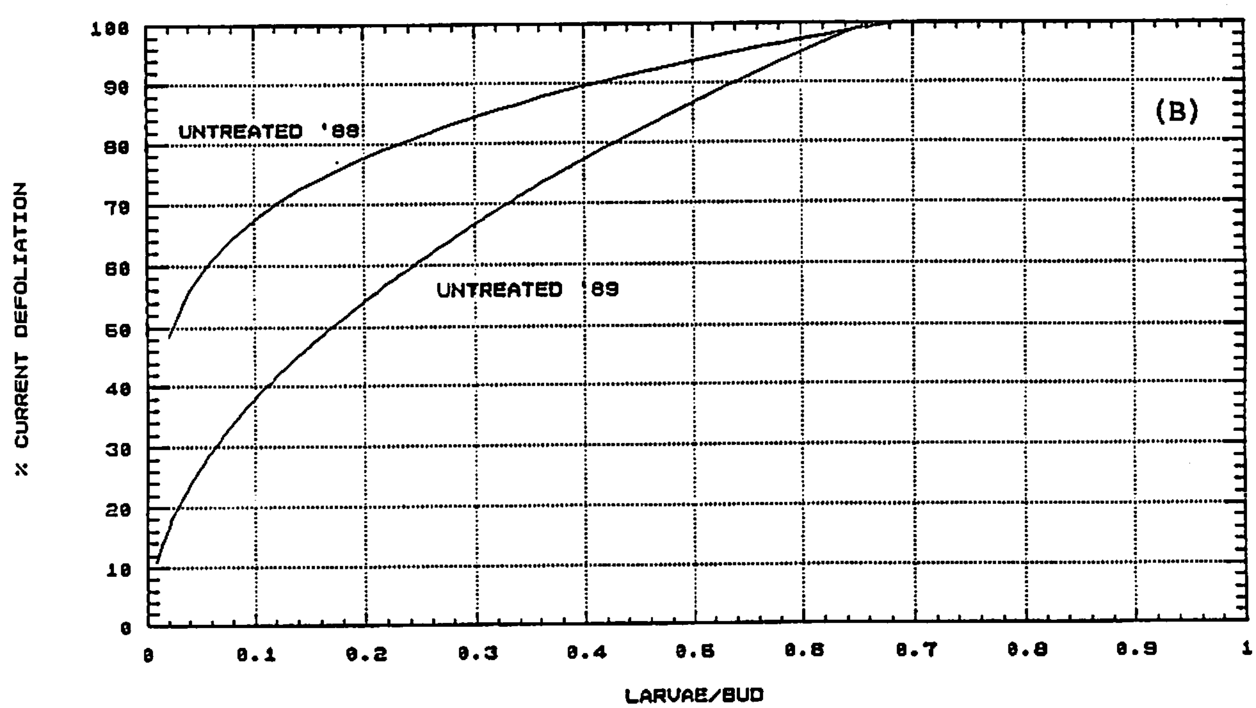




Figure 4. Comparison of relationships between expected defoliation and larvae/branch (A) or larvae/bud (B) from untreated check plots in 1988 and 1989.

Table 2. Summary data for treatments applied in 1989.

| Block | Lines | Aircraft | n | Pre-Spray Larvae Per 45-cm | Pre-Spray Larvae Per Bud | % Mortality Obs. | % Mortality Corr.[a] | Defoliation Obs.% | Defoliation % Red |
|---|---|---|---|---|---|---|---|---|---|
| **Kedgwick** | | | | | | | | | |
| **Fenitrothion - 2 X 210 g/ha** | | | | | | | | | |
| A-1 | 3-28 | TBM | 50 | 15.9 | 0.125 | 89.0 | 66.0 | 18.7 | 67.2 |
| A-3 (A) | 3-20 | TBM | 50 | 10.8 | 0.152 | 97.7 | 91.5 | 15.9 | 68.1 |
| A-3 (B) | 24-80 | TBM | 75 | 18.6 | 0.306 | 96.4 | 85.7 | 30.4 | 57.8 |
| A-4 | 50-110 | TBM | 75 | 16.0 | 0.184 | 98.4 | 90.7 | 16.0 | 71.9 |
| A-9 | 4-30 | TBM | 75(92)[b] | 17.8 | (0.185) | 95.6 | 84.7 | (12.6) | (76.0) |
| A-19 | 21-54 | TBM | 30 | 7.6 | 0.107 | 82.2 | 60.4 | 9.8 | 79.6 |
| **Bacillus thuringiensis - 1 X 15 BIU/ha** | | | | | | | | | |
| A-6 (B) | 156-168 | SSP | 50 | 7.1 | 0.074 | 94.9 | 81.9 | 9.6 | 72.8 |
| A-10 | 0-17 | SSP | 50 | 9.8 | 0.084 | 94.4 | 87.8 | 18.0 | 64.9 |
| **Bacillus thuringiensis - 2 X 15 BIU/ha** | | | | | | | | | |
| A-7 | 14-24 | SSP | 50 | 6.0 | 0.068 | 97.6 | 91.2 | 2.9 | 86.0 |
| A-6 (A) | 121-149 | SSP | 50 | 7.3 | 0.099 | 92.6 | 78.7 | 5.2 | 81.6 |
| A-11(B) | 2-0 | SSP | 50 | 9.8 | 0.082 | 100.0 | 100.0 | 10.2 | 69.0 |
| **Bacillus thuringiensis - 1 X 30 BIU/ha** | | | | | | | | | |
| A-11 (A) | 19-27 | TBM | 50 | 6.5 | 0.069 | 99.6 | 92.7 | 7.0 | 80.8 |
| **Bacillus thuringiensis - 2 X 30 BIU/ha** | | | | | | | | | |
| A-8 | 36-47 | TBM | 50 (70) | 17.6 | (0.208) | 91.3 | 79.1 | (29.9) | (48.4) |
| **Untreated** | | | | | | | | | |
| C-502 | - | - | 50 | 6.8 | 0.073 | 82.5 | - | 19.8 | - |
| C-104 (C) | - | - | 50 | 10.1 | 0.185 | 73.1 | - | 48.1 | - |
| C-508 (D) | - | - | 68 | 24.2 | 0.363 | 80.3 | - | 87.4 | - |
| C-105 (E) | - | - | 50 | 12.3 | 0.156 | 83.6 | - | 25.4 | - |
| **Campbellton** | | | | | | | | | |
| **Fenitrothion - 2 X 210 g/ha** | | | | | | | | | |
| D1 (A) | 0-35 | DC6 | 75 | 14.8 | 0.174 | 89.7 | 74.4 | 24.8 | 55.3 |
| D1 (B) | 50-102 | DC6 | 75 | 12.1 | 0.118 | 99.2 | 95.6 | 7.1 | 79.4 |
| D1 (C) | 44-64 | DC6 | 50 | 10.7 | 0.155 | 94.6 | 83.3 | 14.8 | 69.2 |
| D1 (D) | 85-120 | DC6 | 50 | 21.4 | 0.264 | 95.4 | 78.3 | 19.2 | 66.2 |

[a] based on curve of % natural mortality vs. larvae/45-cm branch tip.
[b] extra samples with larvae/bud and defoliation data.

Table 2. Con't.

| Block | Lines | Aircraft | n | Pre-Spray Larvae Per 45-cm | Per Bud | % Mortality Obs. | Corr.[a] | Defoliation Obs.% | % Red |
|---|---|---|---|---|---|---|---|---|---|
| **Bacillus thuringiensis - 1 X 30 BIU/ha** | | | | | | | | | |
| A-12 | 0-11 | TBM | 50 | 10.9 | 0.105 | 80.5 | 51.0 | 14.9 | 57.8 |
| **Untreated** | | | | | | | | | |
| C-101 (A) | - | - | 50 | 7.1 | 0.087 | 74.2 | - | 25.9 | - |
| **Bathurst** | | | | | | | | | |
| **Fenitrothion - 2 X 210 g/ha** | | | | | | | | | |
| D1 (A) | 151-159 | DC6 | 20 | 33.9 | 0.372 | 87.1 | 41.6 | 76.2 | 13.7 |
| D1 (B) | 94-150 | DC6 | 50 | 23.9 | 0.223 | 98.5 | 89.3 | 34.9 | 44.5 |
| D1 (C) | 135-149 | DC6 | 20 | 23.0 | 0.231 | 82.5 | 51.7 | 48.7 | 22.9 |
| A-16 | 158-164 | TBM | 15 | 11.0 | 0.114 | 95.7 | 82.6 | 45.8 | 22.4 |
| **Untreated** | | | | | | | | | |
| C-17 | - | - | 15 | 39.3 | 0.507 | 83.7 | - | 99.3 | - |
| C-102 | - | - | 50 | 12.1 | 0.200 | 56.5 | - | 57.9 | - |
| **Newcastle** | | | | | | | | | |
| **Fenitrothion - 2 X 210 g/ha** | | | | | | | | | |
| A-21 | 0-15 | TBM | 25 | 4.8 | 0.070 | 98.9 | 84.7 | 2.3 | 88.6 |
| A-24 | 3-22 | TBM | 15 | 22.4 | 0.130 | 92.4 | 45.2 | 34.1 | 45.9 |
| **Untreated** | | | | | | | | | |
| C-220 | - | - | 25 | 26.0 | 0.167 | 68.2 | - | 54.2 | - |
| C-221 | - | - | 25 | 9.6 | 0.103 | 69.6 | - | 23.2 | - |
| **Fredericton** | | | | | | | | | |
| **Fenitrothion - 2 X 210 g/ha** | | | | | | | | | |
| A-25 | 6-15 | TBM | 30 | 19.8 | 0.198 | 89.3 | 56.6 | 23.9 | 52.9 |
| **Untreated** | | | | | | | | | |
| C-225 | - | - | 30 | 16.5 | 0.177 | 68.2 | - | 54.5 | - |

[a] based on curve of % natural mortality vs. larvae/45-cm branch tip.

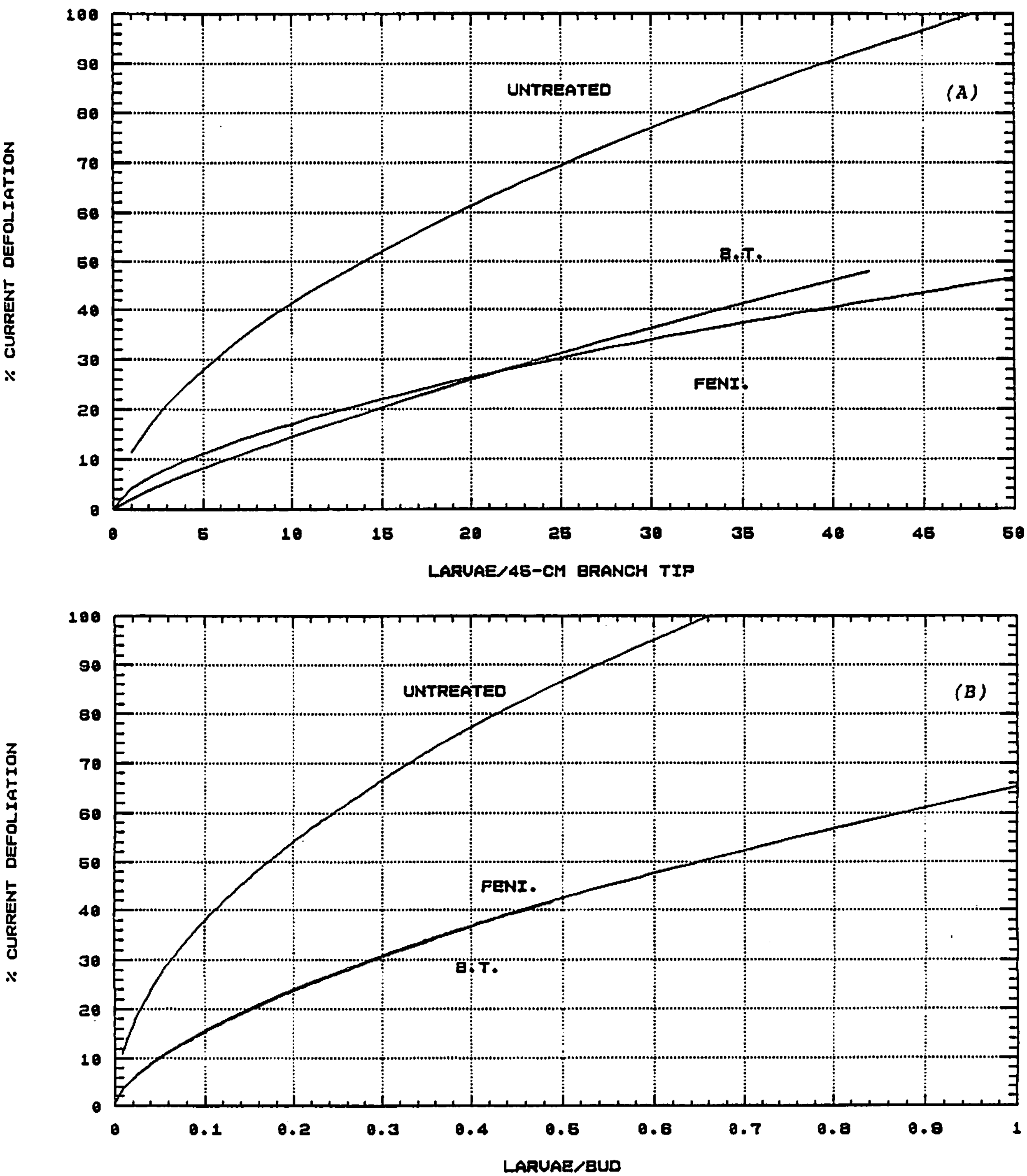



Figure 5. Relationships between defoliation and larvae/branch (A) or larvae/bud (B) from pooled Fenitrothion, pooled B.t., and untreated plots in 1989.

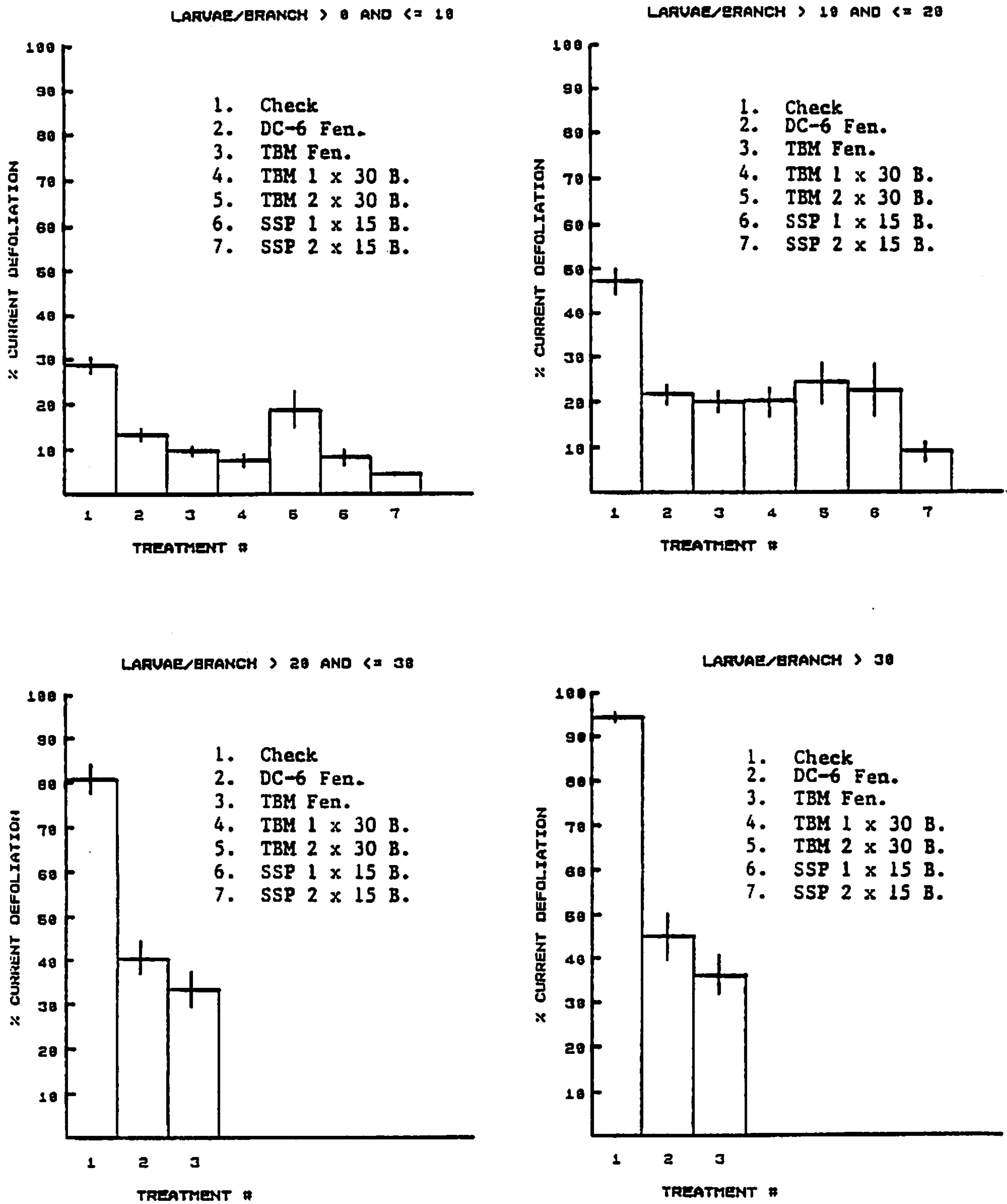



Figure 6. Mean percent defoliation for each treatment in various larvae/branch population ranges in 1989.

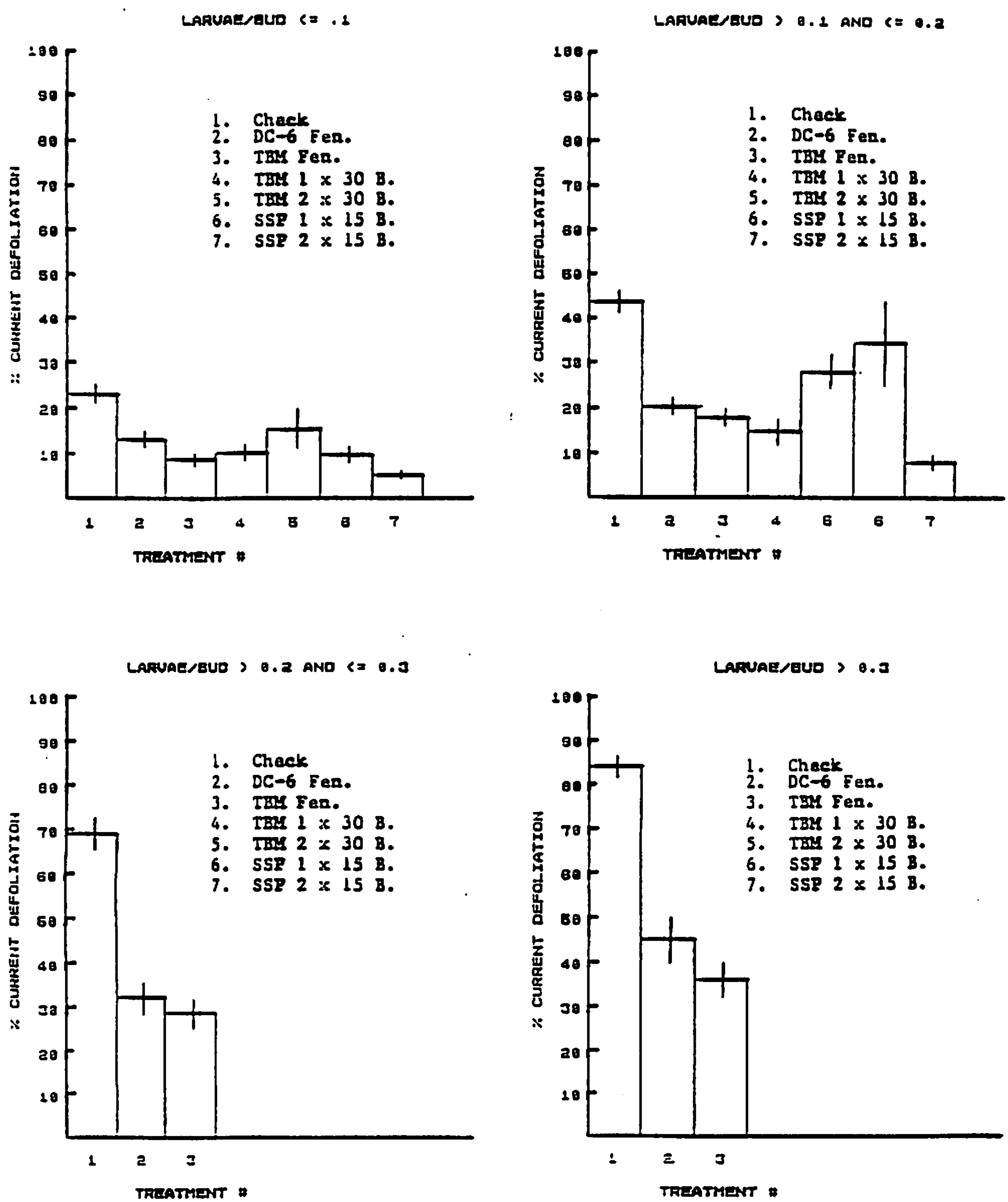



Figure 7. Mean percent defoliation for each treatment in various larvae/bud population ranges in 1989.

## Forecast of Infestation for 1990

The spruce budworm egg mass survey was replaced by the L2 survey in 1985 as the method of forecasting infestation levels in New Brunswick. Table 3 compares the proportion of sample points within each infestation category used in the initial forecasts from 1981 to 1989. Between 1982 and 1986 there was an increasing trend in the percent of points in the Low category with a corresponding decreasing trend for the High category. In 1987, there was a three-fold increase in the proportion of points in the High category in the North-central to North-western parts of the Province, primarily Restigouche County. Most of Restigouche County now contains variable low to moderate populations, whereas moderate to high populations occur in the northwestern part of Northumberland County and adjacent western part of Gloucester County. Except for one large area of variable populations in the west-central area, and one moderate to high pocket northwest of Moncton no significant damage is expected throughout the majority (80%) of the Province.

The forecast for 1990 is for 1.47 million ha (Figure 8) of variable (low to moderate) and moderate to high infestation, which is a 10% decrease from last year's forecast (Table 4). Of most significance is the 65% decrease in the area with moderate to high population levels compared to last year (i.e. 0.5 million ha compared to 1.5 million ha).

## Plans for 1990

Spray plans for 1990 have not been formulated at this time. Nevertheless, it does appear that a protection program will be required in New Brunswick next year. Whether a combination of chemical insecticides and B.t. will again be used is presently not known. Tentative spray plans should be known by mid-December.

N. Carter
Director
Forest Pest Management
Dept. Natural Resources & Energy
P. O. Box 6000
Fredericton, N.B.
E3B 5H1

Table 3. Comparison of Spruce Budworm Forecast Infestation Levels 1981-1989.

| | FORECAST INFESTATION LEVEL | | | |
|---|---|---|---|---|
| YEAR/SURVEY | LOW | MODERATE | HIGH | LOCATIONS[a] |
| 1981/egg-mass | 591 (34%) | 441 (25%) | 708 (41%) | 1740 |
| 1982/egg-mass | 458 (26%) | 512 (29%) | 783 (45%) | 1753 |
| 1983/egg-mass | 636 (48%) | 257 (20%) | 423 (32%) | 1316 |
| 1984/egg-mass | 747 (51%) | 331 (22%) | 398 (27%) | 1476 |
| 1985/L2 | 833 (56%) | 503 (32%) | 185 (12%) | 1521 |
| 1986/L2 | 1216 (77%) | 322 (20%) | 48 ( 3%) | 1586 |
| 1987/L2 | 1198 (76%) | 230 (15%) | 144 ( 9%) | 1572 |
| 1988/L2 | 879 (73%) | 226 (19%) | 99 ( 8%) | 1204[b] |
| 1989/L2 | 1102 (82%) | 180 (13%) | 67 ( 5%) | 1349[b] |

a - Supplementary sampling not included.
b - Fewer samples taken because of collapse in southern part of province.

Table 4. Comparison of forecast area (ha) of Moderate and High infestations 1982-1989, including Variable (low-moderate) infestations in 1988 and 1989.

| YEAR (N) | (N + 1) FORECAST |
|---|---|
| 1982 | 5.30 million ha |
| 1983 | 4.10 million ha |
| 1984 | 3.57 million ha |
| 1985 | 3.15 million ha |
| 1986 | 1.71 million ha |
| 1987 | 1.50 million ha |
| 1988 | 1.65 million ha |
| 1989 | 1.47 million ha |

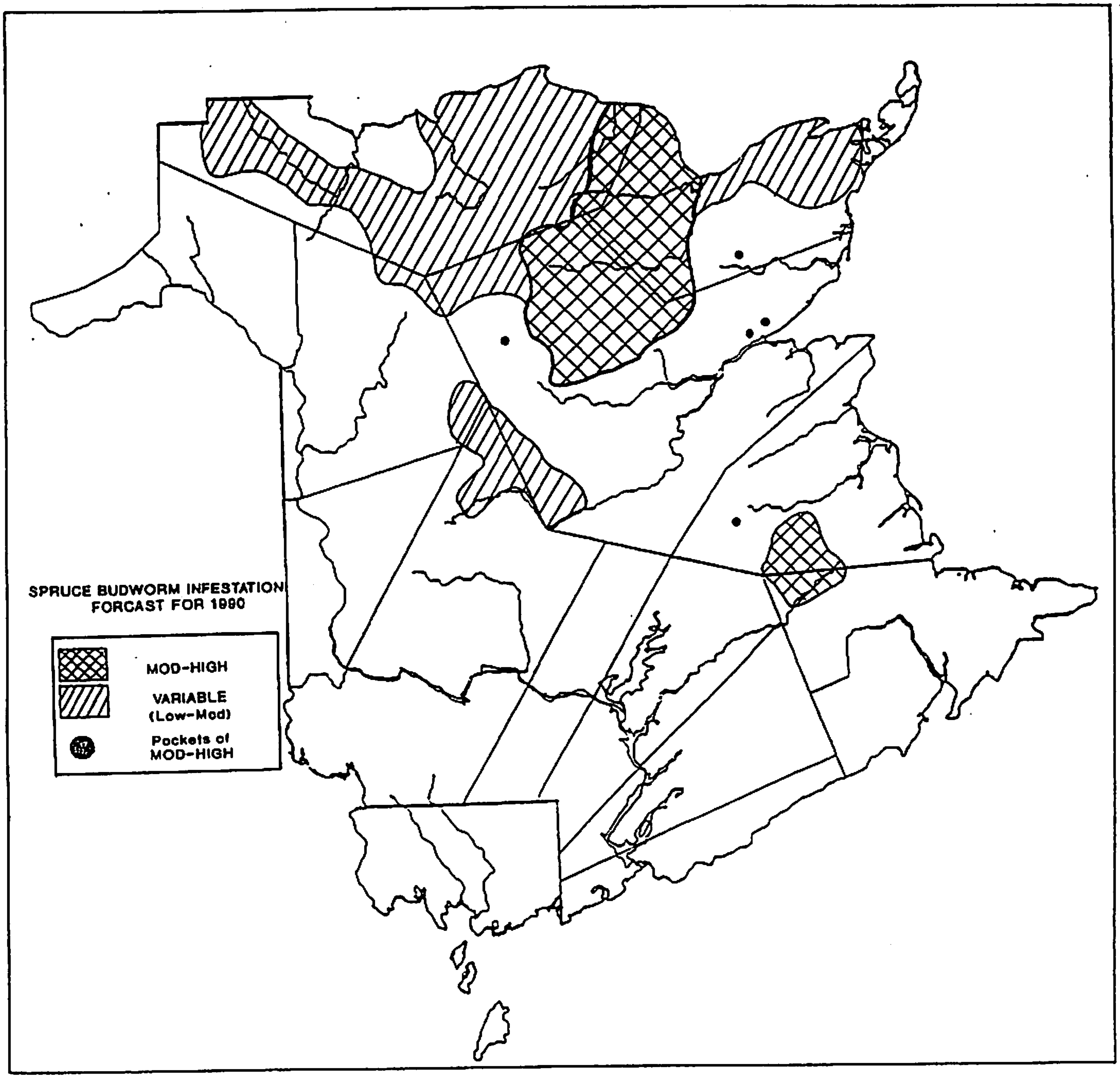



Figure 8. Areas of New Brunswick forecast to have variable (low to moderate), and moderate to high spruce budworm populations in 1990 based on the 1989 L2 survey.

# GYPSY MOTH IN NEW BRUNSWICK IN 1989

(Annual Forest Pest Control Forum, Nov. 14-16, 1989)

N. Carter

## Actions Taken in 1989

The Department of Natural Resouces and Energy entered into a formal cooperative agreement with Agriculture Canada in 1989 to pursue various activities related to Gypsy Moth in New Brunswick. Most significant, was a pre-payment of $17,600 by Agriculture Canada to DNR for out-of-pocket expenses anticipated in 1989.

No aerial spray programs against Gypsy Moth were conducted this year. Instead, efforts were concentrated on (i) detection/delimitation pheromone trap surveys and intensive male moth trapping, and (ii) egg-mass searches.

## Trapping

Overall, DNR placed out 780 traps and collected all but 11 (i.e. 98.6% recovery) (Table 1). For the detection survey along the Trans Canada Highway (one trap every 4-5 km) from the Quebec border to the Nova Scotia border, positive trap catches were only found between Woodstock (90 km NW of Fredericton) and Sussex (120 km E of Fredericton). Moth catches were low (0-9/trap). It is suspected that these catches represent wind-distributed male moths.

Traps within the intensive trapping areas yielded approximately 5 moths/trap. Although trap catches in Old Ridge were 65% less than that found last year, the number of egg-masses found per man-hour of searching only decreased by 15%, hence the benefits of trapping are unclear. In Cedar Mills the number of egg-masses found per man-hour of searching decreased by 90% indicating that the combined effects of the intensive trapping, natural control factors, and cutting (being done by the landowner) significantly decreased populations within the 4 ha area.

In areas where delimitation surveys were carried out in 1988 and 1989 (Moores Mills, St. George) a 200-400% increase in the mean number of moths caught per trap was noted. Meteorological conditions might have been more favourable in 1989 for the spread of moths and is suspected to be primarily responsible for the increase. Highest trap catches where found in the Mohannes area along the Maine-N.B. border. Trap catches were found to decrease with increasing distance from the Mohannes/St. Stephen area.

In Mohannes, an increase in trap catches in 1989 was paralleled by an increase in the number of egg-masses found in the area. Trap catches were uniformly in the 20 to 40 moths/trap range.

Table I. 1989 GM trapping summary.

| Survey Type | Area | Original Agreement # Traps | Minor Adjustments # Traps | Placement Dates[1] | Actual # Traps | Collection Dates[2] | Missing # Traps | # Gypsy Moth Range | # Gypsy Moth x | # Gypsy Moth 1988 x | GM Egg-Masses/Man-Hour 1988 x | GM Egg-Masses/Man-Hour 1989 x |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I) Detection | Trans Canada | 140 | (no change) | 17-27/07 | 140 | 05-10/89 | 2 | 0-9 | 0.3 | - | - | - |
| II) Control | Old Ridge | 50 | 10 | 20/06 | 10 | 06/07 | 0 | 0-10 | 4.5 | 12.8 | 2.7 | 2.3 |
| | Cedar Mills | 0 | 100 | 06,07/07 | 99 | 05,08/07 | 2 | 0-21 | 5.4 | - | 4.6 | 0.5 |
| III) Delimitation | Moores Mills | 200 | (no change) | 17-19/07 | 200 | 05,06/09 | 3 | 0-23 | 4.9 | 2.3 | 0.04 | 0.03 |
| | St. George | 200 | 50 | 28/07 | 50 | 07/07 | 3 | 0-12 | 3.0 | 0.[illegible] | - | - |
| | Cedar Mills | 50 | (no change) | 20-24/07 | 50 | 08-11/07 | 1 | 0-32 | 19.1 | - | - | - |
| | Mohannes | 50 | 40 | 25-28/07 | 56 | 07,08/07 | 0 | 15-41 | 25.5 | - | 0.01 | 1.02 |
| | Forest City | 75 | (no change) | 26,27/07 | 75 | 08/07 | 0 | 0-19 | 2.6 | - | - | - |
| | Oak Hill | 0 | 50 | 24,25/07 | 50 | 06/07 | 0 | 0-25 | 10.2 | - | 1.9 | 3.9 |
| | Old Ridge | 0 | 50 | 20,21/07 | 50 | 06/07 | 0 | 0-32 | 15.3 | - | - | - |
| | TOTALS: | 765 | 765 | | 780 | | 11 | | | | | |

[1] Recommended Placement Period: Detection - July 17 to 28, Control - June 19 to 30, Delimitation - July 17 to 28.

[2] Recommended Retrieval Period: All - Sept. 4 to 15.

Doc. #0851J

TABLE 2. Summary of Gypsy Moth Survey and Positive Finds (1989).

| Location | Corresponding Map Number | Date Sampled | Larvae Skins | Pupae Cases | ♀ Moths | *Egg-masses Remaining New/Old? | Old Egg-masses | New Egg-masses | Total Man/Hours Searched | New Egg-masses Per Man/Hour |
|---|---|---|---|---|---|---|---|---|---|---|
| McAdam | 5 | Sept. 29 | 0 | 1 | 0 | 0 | 0 | 1 | 2.17 | 0.46 |
| St. Andrews | 170 & 222 | Sept. 18&26 | 4 | 8 | 3 | 4 | 5 | 20 | 10.33 | 1.94 |
| Old Ridge | 258 | Sept. 28 | 0 | 1 | 0 | 0 | 1 | 4 | 1.50 | 2.67 |
| Oak Hill | 259 - 261 | Sept. 28&29 | 0 | 2 | 0 | 9 | 1 | 20 | 5.17 | 3.87 |
| Moores Mills | 265 & 299 | Oct. 2 | 0 | 1 | 0 | 0 | 0 | 1 | 29.33 | 0.03 |
| The Ledge | 272 | Oct. 6 | 0 | 0 | 0 | 6 | 1 | 4 | 1.33 | 3.01 |
| Scotch Ridge | 297 | Sept. 21 | 0 | 0 | 0 | 3 | 4 | 12 | 25.00 | 0.48 |
| St. Stephen | 298 | Sept. 22 | 3 | 16 | 0 | 5 | 11 | 48 | 15.67 | 3.06 |
| Mohannes | 300 | Sept. 19 - Oct. 4 | 6 | 7 | 1 | 1 | 5 | 76 | 74.67 | 1.02 |
| All other areas with negative finds. | - | Sept. 18 - Oct. 6 | 0 | 0 | 0 | 0 | 0 | 0 | 73.87 | 0.00 |
| Totals | 300 | Sept. 18 - Oct. 6 | 13 | 36 | 4 | 28 | 28 | 186 | 239.04 | 0.78 |

* Egg-masses remaining are out of reach, but will be collected, identified as to whether new or old and be destroyed.

## Egg-mass Searches

The 1989 Gypsy Moth egg-mass survey was, in part, concentrated in areas that in 1988-89 were treated for Gypsy Moth or that produced positive finds. Additional areas were also sampled to obtain sufficient coverage in Charlotte County. A total of 186 new and 28 old egg-masses were discovered during 239.04 man-hours searching time, or 0.78 new egg-masses per man-hour (Table 2).

The survey revealed nine locations where new Gypsy Moth egg-masses were found. Two other positive locations (Milltown, Fredericton) were found by Forestry Canada. Thus, only 3.6% of the 305 locations searched yielded positive results. Seven areas had repeated finds from 1988. Two areas had repeat finds from 1986 (McAdam) and 1987 (The Ledge). Both the Rockland cemetary in McAdam and the Ledge Church and cemetary had low numbers and are potential candidates for further examination next year. Egg-mass numbers only increased significantly in two areas - Mohannes and Oak Hill. Conversely, egg-mass numbers decreased significantly in Cedar Mills. In the four remaining areas (St. Stephen, St. Andrews, Old Ridge, and Moores Mills) populations were similar to those found in 1988.

Mohannes has a number of years of Gypsy Moth finds and has had two years of treatments. Egg-mass numbers were higher this year despite virtually the same number of man-hours searching as last year (76.5 compared to 74.7 man-hrs.). Only one new egg-mass was found last year as compared to 76 new egg-masses in 1989. Of these, 97% were concentrated in an area southeast of the block sprayed in 1988.

## Actions for 1990

Meetings will be held this winter with Agriculture Canada to discuss actions for 1990.

N. Carter
N.B.D.N.R.

# EASTERN HEMLOCK LOOPER IN NEW BRUNSWICK
(Annual Forest Pest Control Forum, Nov. 14-16, 1989)

N. Carter

## Outbreak Status

For the first time in reported history in New Brunswick defoliation caused by hemlock looper was mapped from an aerial survey in 1989. Defoliation covered a total of 3 824 ha in the following categories: Trace to Light, 1 488 ha; Moderate, 2 184 ha; and Severe, 152 ha. These pockets of defoliation occurred in the northwest central part of the Province in Northumberland County.

In addition field crews had observed looper moth activity in Charlotte County in southwestern New Brunswick and in the Moncton/Sussex area of southeastern New Brunswick. Forestry Canada FIDS data revealed an increase in the occurrence of hemlock looper larvae this summer and one light trap at Mayfield, Charlotte County caught about 1 000 looper adults this fall.

## Biological Survey

Pupal collections were made from a total of 60 trees from 3 locations which yielded 167 pupae and 160 pupal cases. Defoliation of current year's foliage averaged 69%, 64% and 84% at these locations. Total defoliation was rated as 35%, 25%, and 70% respectively. A total of 157 pupae were lab reared and revealed 31% parasitism (identification still pending), 43% death by unknown causes (disease investigations to be done), and 41% emergence. These figures need not reflect actual mortality or survivorship because an accurate estimate of parasitism of emerged pupae was not attempted in the field.

## 1990 Forecast Survey

In order to predict the infestation for 1990, an egg survey using methods developed in Newfoundland has been initiated. A total of 128 plots (5 trees/plot) have been sampled: 93 from northcentral, 25 from southwestern, and 10 from southeastern New Brunswick. Lab processing has only just begun and results are not yet available except to note that looper eggs have been recovered at some sites known to have been severely infested. A collection of eggs will be reared over the winter to estimate viability and egg parasitism.

## Control 1990

The decision regarding the need for control in 1990 depends on the results of the forecast later this winter.

N. Carter
N.B.D.N.R.

# Situation concernant quelques ravageurs forestiers au Québec 1989

Préparé pour le
17e Colloque annuel sur la répression des ravageurs forestiers
Ottawa-Ontario
14-16 novembre 1989

Denis Lachance
CFL
Sainte-Foy

**Situation concernant quelques ravageurs forestiers au Québec 1989**

Introduction

Ce rapport représente une vue sommaire de la situation de quelques ravageurs actuellement importants au Québec. Des détails sur les situations particulières rapportées ici seront disponibles dans le rapport régional "Insectes et maladies des arbres, Québec 1989", qui sera publié au début de 1990.

Au Québec, le relevé général des insectes et des maladies est effectué par le Service de la protection contre les insectes et les maladies (SPIM) du ministère de l'Energie et des Ressources du Québec. L'information présentée ici provient en grande partie des données recueillies par ce service, et en particulier, de leur rapport mi-saison intitulé "Faits saillants au 28 juillet 1989".

**TORDEUSE DES BOURGEONS DE L'EPINETTE**

Choristoneura fumiferana (Clem.)

Cet insecte n'est pas traité dans ce rapport. La description de l'infestation est inclue dans une présentation plus complète sur les activités de lutte contre la TBE au Québec, présentée à un autre moment dans le présent colloque, par les représentants du MER-Québec. Notons ici, cependant, que la TBE a progressé, dans la péninsule gaspésienne en 1989 tant en étendue qu'en intensité. Les populations présentes dans la région de la Côte-Nord en 1988 se sont maintenues à peu près aux mêmes niveaux cette année.

**LIVREE DES FORETS**

Malacosoma disstria Hbn

En général, la régression de l'infestation de cet insecte dans la région de l'Abitibi-Témiscamingue s'est poursuivie en 1989, alors que les populations augmentent partout ailleurs dans la province.

Dans la région de l'Abitibi-Témiscamingue, une infestation a débuté en 1984, a atteint son apogée en 1986 et décline depuis. En 1989, le périmètre de l'infestation est sensiblement le même que l'an dernier. Le lac Simard constitue la limite nord du foyer principal et la localité de Laniel borde l'infestation à l'ouest. Au sud, l'infestation borde la frontière Ontario-Québec. A l'est, non loin de Rapides-des-Joachims, les défoliations s'estompent et se confondent avec celles causées par la spongieuse. Dans ce vaste quadrilatère, les défoliations sont morcelées et évaluées principalement au niveau léger (380 000 ha) et modéré (200 000 ha). Au nord du lac Simard, un foyer résiduel persiste entre Rouyn et Rollet. On y retrouve des défoliations sévères et modérées sur respectivement 7 500 et 20 200 ha.

Le peuplier faux-tremble est la principale essence affectée cette année alors que les érablières subirent très peu de défoliation.

Plus au sud, dans la région administrative de l'Outaouais, la livrée des forêts cohabite avec la spongieuse dans le secteur de Bristol-les-Mines. Ces deux insectes, conjointement, ont réussi à défolier de façon modérée ou élevée environ 2 000 ha de forêt.

Dans la région administrative de Montréal, de nombreux petits foyers de défoliation modérée ou sévère, de 200 à 300 ha chacun, sont observés un peu partout. Dans l'est de la région, les défoliations sont plus fréquentes mais de niveau léger à modéré principalement. La livrée des forêts affecte le peuplier faux-tremble surtout, et à l'occasion, l'érable à sucre.

Dans la région de Trois-Rivières, le secteur de La Tuque est fortement infesté. L'infestation est localisée le long de la rivière Saint-Maurice. On y observe des défoliations modérées et sévères sur respectivement 12 000 et 15 800 ha; total de l'aire affectée: 30 312 ha. Plus au sud, entre Grand-Mère et Cap-de-la-Madeleine, 1 720 ha ont été défoliés dont plus de 900 sévèrement.

Entre le fleuve Saint-Laurent et l'autoroute Jean-Lesage et entre Bécancour et Villeroy, de nombreux foyers de défoliation modérée ont été observés. Au total, 2 000 ha ont été affectés dont 1 650 de façon modérée.

Plus à l'est, la livrée des forêts se retrouve un peu partout et surtout à l'état de trace, sur les deux rives du fleuve Saint-Laurent jusqu'à Rimouski sur la rive sud et jusqu'à Clermont sur la rive nord. Des observations très sporadiques de l'insecte ont été faites plus à l'est, soit à Caplan et au sud de Sainte-Anne-des-Monts en Gaspésie et au lac des Perches sur le Côte-Nord.

Dans la région du Saguenay-Lac-Saint-Jean, la livrée des forêts a défolié le peuplier faux-tremble conjointement avec la tordeuse du tremble, (Choristoneura conflictana (Wlk.)). Les défoliations sont localisées dans la partie ouest du Lac-Saint-Jean, de Chambord jusqu'à Péribonka. Dans le secteur nord, de Saint-Félicien à Péribonka, les défoliations observées sont particulièrement sévères mais réparties en petits îlots. Sur ce territoire, plus de 17 800 ha ont été défoliés dont 7 600 sévèrement. Plusieurs petits foyers de défoliation de niveau léger à sévère, et attribués à la livrée seulement, sont disséminés un peu partout dans le secteur est du Lac-Saint-Jean jusqu'à Chicoutimi. La partie nord-est du Lac-Saint-Jean semble toutefois un peu plus affectée.

## THRIPS DU POIRIER

### Taeniothrips inconsequens (Uzel)

Au Québec, la présence du thrips du poirier fut signalée dans les vergers au début des années 50 et son importance fut, jusqu'à date, négligeable. Suite aux dégâts observés au Vermont en 1988 et à cause des prévisions de montées de populations pour 1989, des relevés spéciaux de cet insecte furent effectués cette année au Québec.

A la fin d'avril 1989, RIMA-CFL a effectué un échantillonnage du sol dans dix érablières sélectionnées au hasard et situées au nord de la frontière Vermont-Québec, entre la baie Missisquoi et le lac Memphrémagog. La méthode utilisée consistait à prendre, dans chaque érablière, cinq échantillonnages de sol organique d'environ 12 x 12 x 12 cm de coté, et distancés d'environ 30 m l'un de l'autre. Ces échantillons furent ensuite introduits dans des contenants hermétiques et placés dans des chambres d'éclosion en laboratoire afin de permettre la sortie du sol et la récupération des adultes présents. Le thrips fut récupéré dans sept des dix érablières visitées, toutes situées dans l'est de la zone échantillonnée.

Le SPIM-MERQ a, pour sa part, effectué un relevé extensif de l'insecte sur une grande partie du Québec. L'échantillonnage s'est fait durant la deuxième semaine de mai et consistait en la dissection et à l'examen sur place d'au moins 10 bourgeons d'érable à sucre, par site visité. Près de 115 points d'échantillonnage furent ainsi réalisés et 71 d'entre eux se sont avérés positifs.

Les relevés effectués indiquent que le thrips du poirier est largement distribué au Québec. Sa présence fut observée sur toute la rive sud du Saint-Laurent, de la frontière avec l'Ontario jusqu'à Saint-Pamphile (L'Islet) à l'est, ainsi qu'entre La Malbaie et Shawville sur la rive nord. Les dégâts causés par l'insecte ont été toutefois négligeables et non significatifs. Pour des raisons d'ordre technique, aucun relevé n'a pu être effectué au Témiscamingue. La vaste distribution de ce thrips au Québec permet de croire qu'il est présent dans les érablières depuis plusieurs années.

## SPONGIEUSE

Lymantria dispar (L.)

Cette année, la spongieuse fut un peu plus active qu'en 1988. Bien qu'on la retrouve encore une fois principalement le long de l'escarpement Eardly qui est la limite méridionale du parc de la Gatineau, elle affecte également plusieurs peuplements à l'intérieur du parc. De nombreux petits foyers sont aussi disséminés vers l'est jusqu'à Montebello. Les peuplements affectés sont composés de chênes blancs et rouges ainsi que de peupliers à grandes dents.

La spongieuse a défolié, de concert avec la livrée des forêts, des peuplements feuillus entre Sheenboro, au nord-ouest de Fort-Coulonge et Deux-Rivières (Ontario) le long de la rivière des Outaouais.

Dans la région de Montréal, la spongieuse se retrouve principalement entre Longueuil et Saint-Jean, mais elle a causé peu de défoliation.

Ces basses populations de la spongieuse sont aussi apparentes par le nombre relativement bas de captures de papillons mâles dans les pièges à phéromones placés par RIMA-CFL au sud du Saint-Laurent. Environ 19 papillons par piège furent captés dans la région de Drummondville, soit une légère augmentation sur 1988, et environ 11 insectes par piège seulement capturés entre Victoriaville et Lotbinière, soit une légère diminution.

## TORDEUSE DU TREMBLE

Choristoneura conflictana (Wlk.)

L'épidémie de la tordeuse du tremble qui sévit depuis maintenant 4 ans au Saguenay-Lac-Saint-Jean continue de régresser. On la retrouve principalement au nord-ouest et nord du Lac-Saint-Jean, de Roberval à Sainte-Jeanne-d'Arc (est de Dolbeau).

Les défoliations sont sporadiques et couvrent des superficies restreintes, alors que les dégâts sont tout de même modérés à sévères.

Dans la région administrative de la Côte-Nord, l'insecte se retrouve principalement entre les rivières Portneuf et Sainte-Marguerite. Les défoliations varient de trace à léger. Une mineuse du genre Lyonetia se retrouve simultanément avec la tordeuse du tremble dans ce secteur.

Dans la région administrative de Québec, près de Clermont, des défoliations modérées et sévères sur environ 2 500 ha respectivement ont été observées. Dans les mêmes aires, on pouvait observer des défoliations de moindre importance de la livrée des forêts.

La tordeuse du tremble a également été retrouvée dans la région administrative du Bas-Saint-Laurent-Gaspésie. Près de Saint-Bruno-de-Kamouraska, une défoliation à plus de 60% a été observée sur une superficie totale d'environ 2 000 ha.

## TENTHREDE A TETE JAUNE DE L'EPINETTE
## Pikonema alaskensis (Roch.)

Des populations très importantes de la tenthrède à tête jaune de l'épinette ont été observées dans quelques plantations d'épinettes noires et blanches près de l'Alverne en Gaspésie. Les dommages sont spectaculaires: plusieurs arbres d'une hauteur de 5 m sont morts récemment et d'autres ont subi des défoliations complètes cette année. On a dénombré jusqu'à 2 400 larves sur un arbre. Une telle pullulation de cet insecte est une première pour le relevé général.

**TORDEUSE DE L'EPINETTE**

*Zeiraphera canadensis* Mut. et Free.

Les populations de cet insecte semblent stables par rapport à l'an passé. On retrouve cet insecte dans les plantations d'épinettes blanches, et les dommages qu'entraîne l'activité de l'insecte sont importants dans la Baie-des-Chaleurs et le long de la vallée de la Matapédia.

**CHANCRE SCLERODERRIEN**

*Gremmeniella abietina* (Lagerb.) Morelet

Le relevé spécifique du chancre scléroderrien, amorcé l'an dernier dans les plantations de pins de l'unité de gestion de Beauce, a été complété à la fin de juin. Un total d'environ 256 plantations ont été visitées. De ce nombre, le chancre scléroderrien a été localisé, puis évalué dans environ 90 plantations. Des mises en culture de l'agent pathogène furent faites à partir d'échantillons prélevés dans ces plantations et des tests pour déterminer la race du champignon sont présentement en cours au Centre de foresterie des Laurentides.

En pépinière, la maladie du chancre scléroderrien a été retrouvée dans des lots de pins gris et de pins rouges produits en récipients et dans un lot de pins rouges produits à racines nues. Dans la majorité des cas, un triage des semis affectés ainsi que des réinspections ont permis le reboisement des plants exempts du pathogène. Deux lots de pins rouges produits en récipients ont cependant dû être détruits à la pépinière de Trécesson (Abitibi).

# *PULVERISATION AERIENNE*
# DE BACILLUS THURINGIENSIS
# EN FOREST PRIVÉE
# DANS L'EST DU QUÉBEC

**Résultats, saison 1989**

**PRÉSENTÉ AU DIX-SEPTIÈME COLLOQUE ANNUEL**

**SUR LA LUTTE CONTRE**

**LES RAVAGEURS FORESTIERS**

Ottawa, les 14-16 novembre 1989


**ANDRÉ JUNEAU**

**FORÊTS CANADA**

**CENTRE DE FORESTERIE DES LAURENTIDES**

**DÉVELOPPEMENT FORESTIER**

**C.P. 3 800, SAINTE.FOY**

**QUEBEC, G1V 4C7**

## INTRODUCTION

Dans le cadre de Plan du développement de l'Est du Québec, Forêts Canada, région du Québec a parrainé financièrement et techniquement un cinquième programme de pulvérisation aérienne de Bacillus thuringiensis en forêt privée pour la saison 1989. Les Syndicats des producteurs de bois du Bas-St-Laurent et de la Gaspésie (SPB) ont pris en charge la mise en oeuvre et l'exécution de ce programme.

Quelques 24 000 hectares de forêt ont été traités en 1989, soit plus de 15 000 ha dans le Bas-St-Laurent et près de 9 000 ha en Gaspésie.

Le présent rapport résume les résultats du programme de pulvérisation aérienne de 1989.

**RESSOURCES EN MATERIEL ET SERVICES**

Afin de réaliser l'opération avec succès et fort des bons résultats répétitifs obtenus et à cause de nos engagements avec le ministère de l'Environnement du Québec on a retenu le matériel et les services suivants:

Insecticide

Les préparations de Bacillus thuringiensis Futura XLV[md] de Chemagro Limited, Mississauga, Ontario et Dipel 48AF des Laboratoires Abbott Ltée, Montréal, Québec.

Le dosage utilisé à l'hectare fut de 2,5 litres, soit:

1,5 litre de B.t.

1,0 litre d'eau

1,56 mL de l'adhésif Chevron[md]

Avions

Cinq AgCat[md], 600 HP, qui ont été fournis par Agric Air Inc, Sainte-Cécile de Milton, Québec.

Plans de mélange

Deux plans de mélange mobiles ont été fournis par les SPB du Bas-St-Laurent et de la Gaspésie.

Système de dispersion

Longerons et 25 buses (Teejet Flat Fan 8004) placés dans un angle de 45° face au vent.

Navigation et balisage

Nous avons utilisé des ballons gonflés à l'hélium dans les secteurs accessibles par route et un hélicoptère Hughes 500-C$^{md}$ avec ou sans ballons guides.

RÉSULTATS

Superficie traitées

Quelque 23 940 ha de forêt ont été traités entre le 5 et le 22 juin 1989 inclusivement. La superficie traitée était morcellée en quinze blocs variant de 285 à 4 000 ha. De ces superficies, 15 225 ha étaient situés dans la région du Bas-St-Laurent et 8 715 ha dans la péninsule gaspésienne. Le programme a touché quelque 700 propriétaires de boisés privés.

Mortalité larvaire

La mortalité larvaire dans les parcelles traitées atteint 97,9% et est de 81,09% dans les témoins. La population résiduelle est de 0,26 larve/45 cm dans les parcelles traitées et de 2,9 larves larves/45 cm dans les témoins soit 11 fois supérieure. Le tableau 1 résume les résultats.

Défoliation de la pousse annuelle

La défoliation de la pousse annuelle (tableau 1) offre une donnée des plus intéressante des résultats obtenus en fonction de notre objectif principal de conserver la forêt vivante. Aussi, la défoliation est limitée à 21,3% dans les parcelles traitées et à 61,3% dans les témoins.

Information sur les coûts du programme

Le coût total du programme est de 982 620 $ soit 41,05 $/ha. La partie principale de la dépense est imputable au coût de l'achat de l'insecticide et du produit, soit 429 729 $ ou 43,7% du coût total. Finalement, le coût imputable directement à Forêts Canada s'élève à 50 000 $ et comprend la partie du salaire du conseiller technique affecté au programme, les frais de déplacement de ce dernier et les frais du programme de communication.

Tableau 1. Programme de pulvérisation aérienne de B.t. en forêt privée dans l'est du Québec
Résultats 1989

| BLOC NO | LOCALITE | PARCELLE | POPULATION PRETRAITEMENT (LARVES/45cm) | MORTALITE INTERMEDIAIRE % | EFFICACITE (Abbott) % | POPULATION RESIDUELLE (LARVES/45cm) | MORTALITE FINALE % | DEFOLIATION % |
|---|---|---|---|---|---|---|---|---|
| 129-1 | L'ASCENSION | traitée | 11.28 | 91.33 | 78.88 | .20 | 97.62 | 18.06 |
| | | témoin | 22.50 | 58.10 | | 3.70 | 83.89 | 57.05 |
| 129-3 | ST-FRANCOIS | traitée | 10.80 | 85.20 | 64.70 | .20 | 97.95 | 18.40 |
| | | témoin | 22.50 | 58.10 | | 3.70 | 83.69 | 57.05 |
| 128-6 | ALBERTVILLE | traitée | 11.18 | 90.52 | 57.43 | .08 | 99.30 | 21.58 |
| | | témoin | 12.40 | 85.40 | | 1.40 | 88.70 | 31.70 |
| 128-2 | STE-MARGUERITE | traitée | 15.67 | 92.08 | 62.30 | .13 | 99.20 | 30.57 |
| | | témoin | 8.65 | 79.00 | | 2.50 | 79.40 | 48.15 |
| 128-7 | STE-IRENE | traitée | 12.40 | 85.00 | 74.03 | .20 | 98.50 | 36.65 |
| | | témoin | 18.80 | 78.10 | | 2.30 | 84.10 | 83.75 |
| 128-8 | LAC HUMQUI | traitée | 11.45 | 96.95 | 86.13 | .00 | 100.00 | 25.20 |
| | | témoin | 18.80 | 79.00 | | 2.30 | 84.10 | 83.75 |
| 115-1 | ST-ELZEAR | traitée | 14.15 | 89.64 | 79.30 | .40 | 94.95 | 23.00 |
| | | témoin | 16.00 | 50.00 | | 2.00 | 87.50 | 64.50 |
| 115-2 | ST-SIMEON | traitée | 15.85 | 97.05 | 82.40 | .00 | 100.00 | 14.90 |
| | | témoin | 10.20 | 84.30 | | 2.40 | 76.50 | 40.10 |
| 115-3 | ROBIDOUX | traitée | 20.00 | 83.63 | 40.35 | .06 | 99.60 | 21.96 |
| | | témoin | 12.40 | 72.50 | | 1.40 | 88.70 | 49.10 |
| 115-7 | NEW-RICHMOND | traitée | 19.55 | 56.05 | | 1.70 | 90.10 | 31.35 |
| | | témoin | 19.00 | | | 5.85 | 71.95 | 89.50 |
| 115-15 | GR CASCAPEDIA | traitée | 14.30 | 74.10 | | .40 | 97.40 | 19.45 |
| | | témoin | 13.60 | | | 3.60 | 72.80 | 79.50 |
| 115-11 | NOUVELLE | traitée | 9.40 | 89.30 | 77.60 | .40 | 95.70 | 18.20 |
| | | témoin | 13.90 | 52.50 | | 5.40 | 61.20 | 60.50 |

Tableau 1. Programme de pulvérisation aérienne de B.t. en forêt privée dans l'est du Québec
Résultats 1989

Tableau 1 (suite)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 115-12 | ESCUMINAC | traitée | 10.03 | 95.78 | 34.05 | .00 | 100.00 | 10.25 |
| | | témoin | 28.20 | 93.60 | | 2.60 | 90.70 | 79.90 |
| 114-4 | NEWPORT | traitée | 5.80 | 57.85 | | .00 | 100.00 | 8.15 |
| | | témoin | 9.00 | | | 1.60 | 82.20 | 35.00 |

# AERIAL SPRAYING WITH *BACILLUS THURINGIENSIS* ON PRIVATE WOODLOTS IN EASTERN QUEBEC

## 1989 SEASON

PRESENTED AT THE SEVENTEENTH ANNUAL INSECT

PEST CONTROL FORUM

Ottawa, November 14-16, 1989

André Juneau

FORESTRY CANADA

LAURENTIAN FORESTRY CENTRE

FOREST DEVELOPMENT

BOX 3 800, SAINTE.FOY

QUEBEC, G1V 4C7

## INTRODUCTION

In 1989, within the framework of the Forestry Program of the Eastern Quebec Development Plan, Forestry Canada, Quebec region, sponsored its fifth program of spraying with Bacillus thuringiensis to control spruce budworm on private woodlots. The program was carried out by the wood producer associations of the Lower St.Lawrence and the Gaspé regions. Some 24 000 ha of forest were treated in 1989, some 15 000 ha in the Lower St. Lawrence region and some 9 000 ha in Gaspe.

The present paper summarizes the results of the 1989 spraying program.

## MATERIAL AND SERVICES

The good and consistent results obtained during the previous years and our commitment with the Quebec Department of the Environment dictated the use of the following material and services.

### Insecticide

*Bacillus thuringiensis* preparation Futura XLV® from Chemagro Limited, Mississauga, Ontario and Dipel 48AF®, Abbott Laboratories Ltd, Montreal, Quebec.

Dosage, 2.5 litres/ha:

1.5 L B.t.
1.0 L water
1.56 mL Chevron sticker

### Aircraft

Five AgCat®, 600 H.P., supplied by Agric Air Ltée, Ste Cécile de Milton, Quebec.

### Mixing facilities

Two mobile units set up by the wood producer associations.

### Spray system

Boom and 25 nozzles (Teejet Flat Fan 8004) at a 45° angle facing the wind.

### Navigation system

Helium-inflated balloons were used where road access was available. Otherwise, a Hughes 500-C® helicopter was used, with or without balloons.

## RESULTS

### Treated area

Between June 5 and 22, 1989, 23 940 ha were treated, which involved some 700 private woodlot owners. Fifteen blocks, ranging from 285 to 4 000 ha in area, were sprayed; with 15 225 ha being in the Lower St.Lawrence region and 8 715 ha in the Gaspé peninsula.

### Larval mortality

Larval Mortality in treated blocks reached 97.9% and was 81.1% in untreated areas. Residual population was 0,26 larva/45 cm in treated blocks and 2.9 larvae/45 cm in untreated areas or 11 times higher. Results are summarize in Table 1.

### Current year growth defoliation

Current year growth defoliation (Table 1) is an interesting value considering that the main purpose of the program is to maintain trees alive. It was limited to 21.3% in treated blocks and was 61.3% in untreated areas.

Information on program costs

The total cost of the 1989 program is $ 982 620 or $ 41.04/ha. The insecticide and aircraft cost is $ 429 729 or 43.7% of the total cost. Forestry Canada contributed some $ 50 000 which include a portion of the salary of the technical advisor attributed to the program, his travelling expenses and the communication program.

Table 1. Treatment Program with B.t. on Private Woodlots in Eastern Quebec
Results - 1989

| BLOCK NO | AREA | SAMPLING POINT | PRETREATMENT POPULATION (LARVAE/45 cm) | INTERMEDIATE MORTALITY % | EFFICIENCY (Abbott) % | RESIDUAL POPULATION (LARVAE/45 cm) | FINAL MORTALITY % | DEFOLIATION % |
|---|---|---|---|---|---|---|---|---|
| 129-1 | L'ASCENSION | treated | 11.28 | 91.33 | 78.88 | .20 | 97.62 | 18.06 |
| | | untreated | 22.50 | 58.10 | | 3.70 | 83.89 | 57.05 |
| 129-3 | ST-FRANCOIS | treated | 10.80 | 85.20 | 64.70 | .20 | 97.95 | 18.40 |
| | | untreated | 22.50 | 58.10 | | 3.70 | 83.69 | 57.05 |
| 128-6 | ALBERTVILLE | treated | 11.18 | 90.52 | 57.43 | .08 | 99.30 | 21.58 |
| | | untreated | 12.40 | 85.40 | | 1.40 | 88.70 | 31.70 |
| 128-2 | STE-MARGUERITE | treated | 15.67 | 92.08 | 62.30 | .13 | 99.20 | 30.57 |
| | | untreated | 8.65 | 79.00 | | 2.50 | 79.40 | 48.15 |
| 128-7 | STE-IRENE | treated | 12.40 | 85.00 | 74.03 | .20 | 98.50 | 36.65 |
| | | untreated | 18.80 | 78.10 | | 2.30 | 84.10 | 83.75 |
| 128-8 | LAC HUMQUI | treated | 11.45 | 96.95 | 86.13 | .00 | 100.00 | 25.20 |
| | | untreated | 18.80 | 79.00 | | 2.30 | 84.10 | 83.75 |
| 115-1 | ST-ELZEAR | treated | 14.15 | 89.64 | 79.30 | .40 | 94.95 | 23.00 |
| | | untreated | 16.00 | 50.00 | | 2.00 | 87.50 | 64.50 |
| 115-2 | ST-SIMEON | treated | 15.85 | 97.05 | 82.40 | .00 | 100.00 | 14.90 |
| | | untreated | 10.20 | 84.30 | | 2.40 | 76.50 | 40.10 |
| 115-3 | ROBIDOUX | treated | 20.00 | 83.63 | 40.35 | .06 | 99.60 | 21.96 |
| | | untreated | 12.40 | 72.50 | | 1.40 | 88.70 | 49.10 |
| 115-7 | NEW-RICHMOND | treated | 19.55 | 56.05 | | 1.70 | 90.10 | 31.35 |
| | | untreated | 19.00 | | | 5.85 | 71.95 | 89.50 |
| 115-15 | GR CASCAPEDIA | treated | 14.30 | 74.10 | | .40 | 97.40 | 19.45 |
| | | untreated | 13.60 | | | 3.60 | 72.80 | 79.50 |
| 115-11 | NOUVELLE | treated | 9.40 | 89.30 | 77.60 | .40 | 95.70 | 18.20 |
| | | untreated | 13.90 | 52.50 | | 5.40 | 61.20 | 60.50 |

Table 1. Treatment Program with B.t. on Private Woodlots in Eastern Quebec
Results - 1989

Table 1. (continued)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 115-12 | ESCUMINAC | treated | 10.03 | 95.78 | 34.05 | .00 | 100.00 | 10.25 |
| | | untreated | 28.20 | 93.60 | NA | 2.60 | 90.70 | 79.90 |
| 114-4 | NEWPORT | treated | 5.80 | 57.85 | | .00 | 100.00 | 8.15 |
| | | untreated | 9.00 | | | 1.60 | 82.20 | 35.00 |

# THE SPRUCE BUDWORM
# IN QUEBEC

## 1989

- The spray operation
- State of the epidemic
- Forecast for 1989

Ministère de l'Energie et des Ressources du Québec
Direction de la Conservation

Service de la protection contre les insectes et les maladies

Louis Dorais, For. Eng.
Service Head

Division de l'Evaluation des programmes et prescriptions

Michel Auger, For. Eng.
Division Head

## I THE 1989 SPRAY OPERATION

### 1. Areas treated

The 1989 spruce budworm spray program was carried out in the Bas-Saint-Laurent -- Gaspésie region. The program covered a total area of 165 034 ha, which represents a slight decrease over 1987 and 1988, when the total areas were 197 992 ha and 192 073, respectively. Of the total area treated in 1989, 38 379 ha (23%) of the most severely infested sectors received a second application of insecticide (Fig. 1).

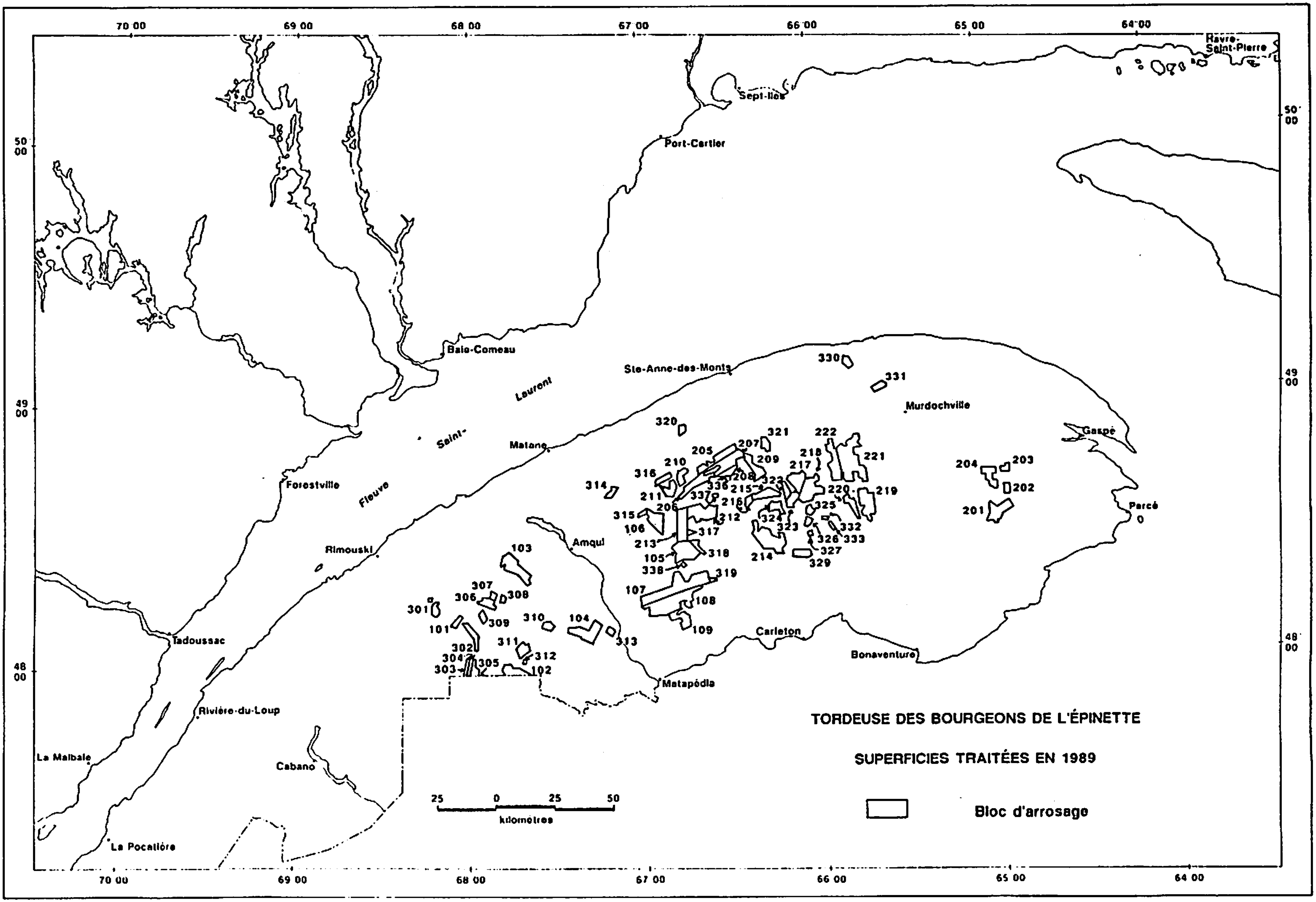
### 2. Insecticides

Dipel 132™ (Abbott Laboratories Ltd.) was sprayed undiluted over an area of 125 170 ha (76%) at a rate of 30 billion international units (Biu) per hectare, for a volume of 2.37 l/ha. The remainder of the program area (24%) was treated with Dipel 176™ applied undiluted at a rate of 30 Biu/ha, for a volume of 1.77 l/ha.

### 3. Insecticide spraying

Treatment began June 2 and continued until July 1. Three four-engine planes (2 DC4s and 1 DC6) and five single-engine craft (3 Bull Thrushes and 2 AG Cats) sprayed 439 711 liters of biological products. The four-engine planes had boom and nozzle equipment, while the single-engine planes were fitted with eight Micronair AU-5000 atomizers.

Fig. 1: Area sprayed for spruce budworm control in Quebec in 1989.



In all, 106 flights were made from the airports at Rimouski, Mont-Joli, Bonaventure, Causapscal, Murdochville, Matane and Nouvelle.

Poor weather conditions interferred considerably with the spray operations. In fact, 60% of the spraying sessions had to be cancelled because of rain, haze or wind, particularly the latter. Bad weather was prevalent between June 1 and 19, when only seven spraying sessions took place, out of a possible 34. A DC6 crashed at the very end of operations, killing the four team members aboard.

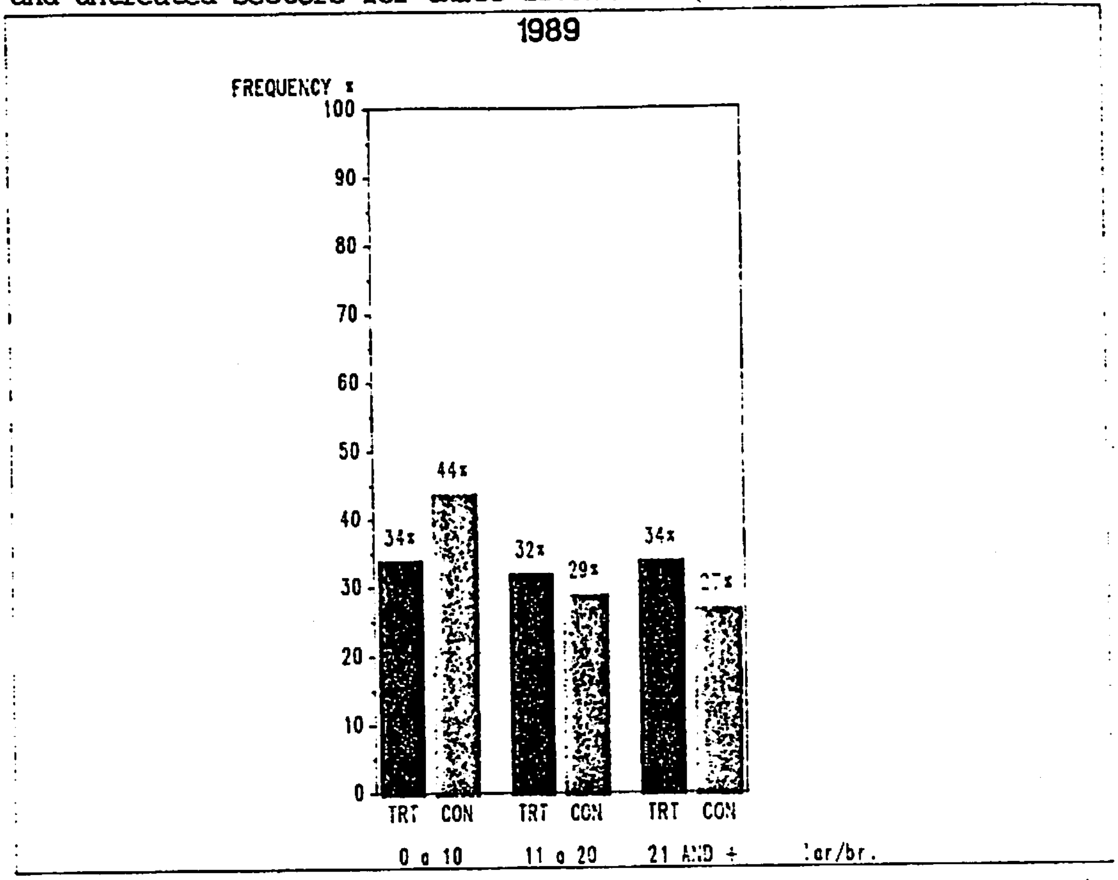
## 4. Insect and shoot development

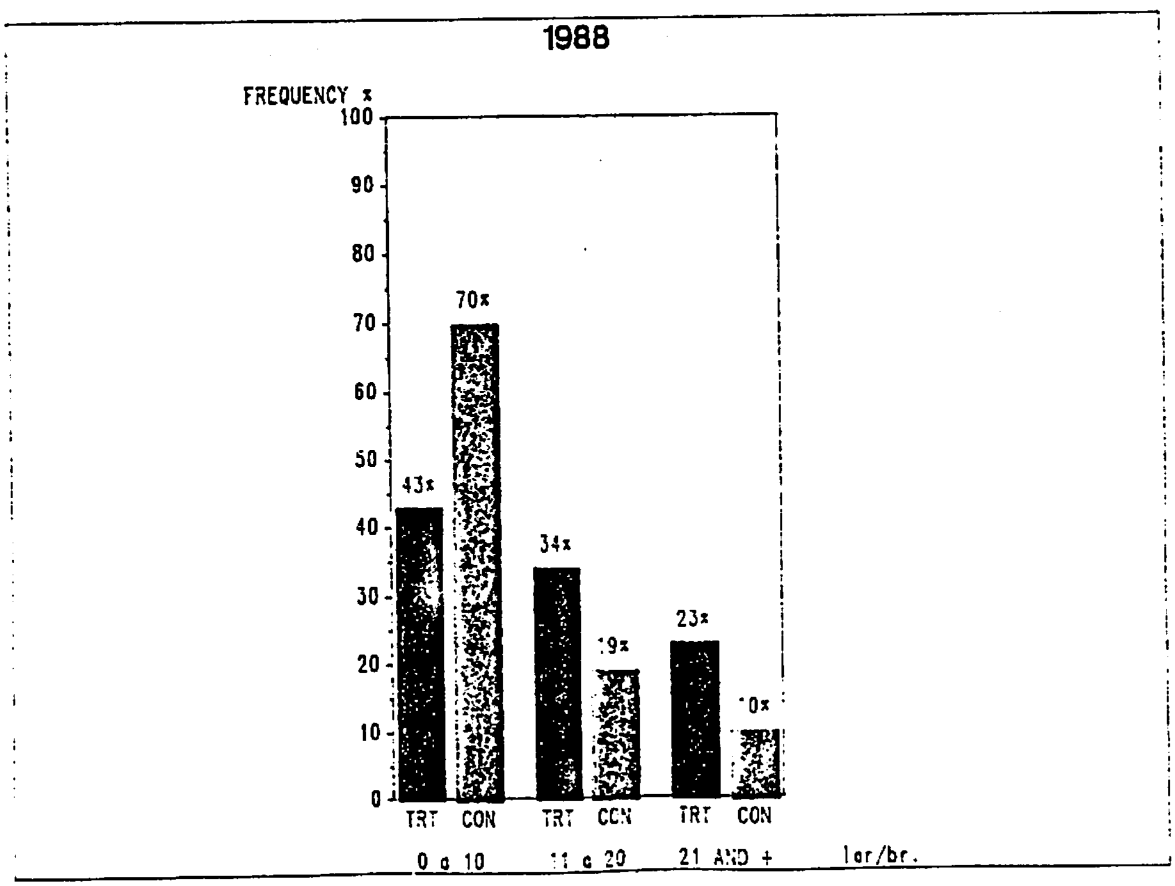
Budworm development in 1989 was basically the same as that recorded in 1988, except for the beginning and end of the larval period, when weather conditions slowed down the insect's activity. Shoot development was enhanced by weather conditions this year, and the shoots opened a week earlier than in 1988.

## 5. Results

The mean larval population in the treated sectors was evaluated at 17.8 larvae per 45-cm branch, compared to 15.0 in 1988. There were more than 10 larvae per branch in almost 66% of the 298 sample points and more than 20 per branch in 34%. In 1988, there were more than 20 larvae per branch in 23% of the sample points (Fig. 2). In the untreated sectors, larval populations were generally slightly lower than in the sprayed areas.

Fig. 2: Distribution of larval populations of the spruce budworm in treated and untreated sectors for three levels of infestation in 1988 and 1989.



## 5.1 Level of infestation

Data analysis was done according to three levels of infestation, for which a corrected mortality rate (treatment induced mortality) and a current foliage protection rate were calculated (Table 1). The corrected mortality rate was comparable across the three levels of infestation, which varied from 56.9 to 59.0%. As predicted, treatment induced foliage protection decreased as larval population densities increased. The difference between the most affected and least affected sectors was only 8%. Defoliation of new shoots was higher than our accepted limit of 50% in the sectors with more than 10 larvae per branch. In the heavily infested areas, only 26% of the sample points had defoliation levels of less than 50%. An aerial survey of current damage revealed that severely defoliated stands exist on 35% of the treated territory, which represents a sharp increase (15%) over the results of the last few years (Table 2). This defoliation level is nonetheless comparable to that of 1975-1976 and 1982-1983 (Fig. 3).

TABLE 1: LARVAL MORTALITY OF THE SPRUCE BUDWORM, CHORISTONEURA FUMIFERANA (CLEM.) AND REDUCTION OF DEFOLIATION IN TREATED SECTORS IN 1989.

| Infestation level | Population Pre | | Post | Total mortality (%) | % defoliation | | Corrected mortality (%) (2) | % reduction of defoliation (3) |
|---|---|---|---|---|---|---|---|---|
| | L/br. | L/Bud. | L/br. | | Pred.(1) | Obs. | | |
| 1 - 10 L/br. | 5,2 | 0,11 | 1,3 | 82,8 | 46,9 | 31,9 | 59,0 | 29,8 |
| 11 - 20 L/br. | 15,8 | 0,26 | 1,6 | 81,9 | 72,8 | 53,9 | 56,9 | 24,2 |
| 21 et + L/br. | 31,6 | 0,43 | 1,9 | 82,1 | 85,8 | 66,9 | 57,3 | 21,6 |

(1). According to a prediction model using initial density of spruce budworm larvae.

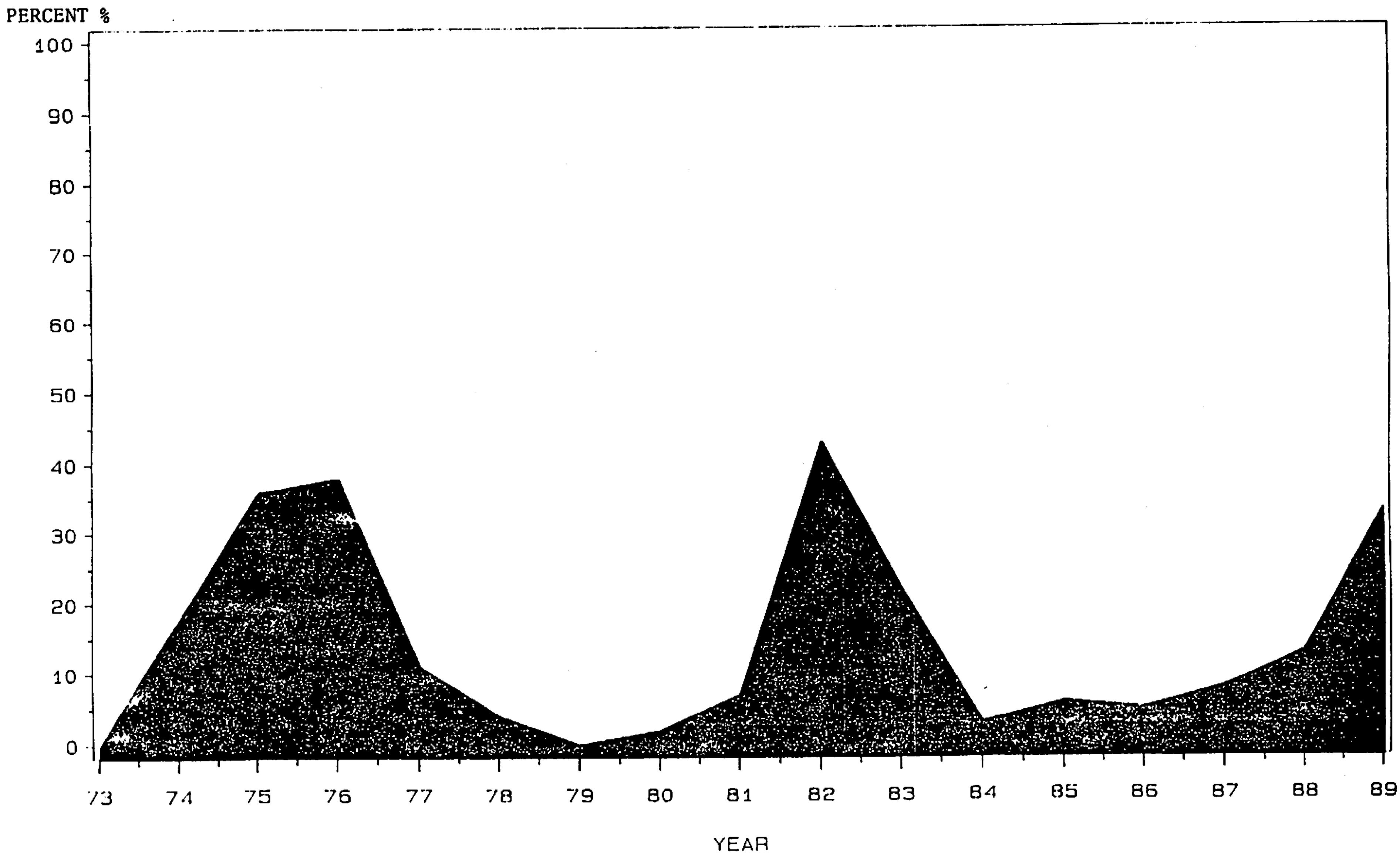
(2). 100 X (mortality treatment - mortality control) / (100 - mortality control).

(3). 100 X (defol. pred. - defol. obs.) / defol. pred.

TABLE 2: FOREST AREA AFFECTED BY THE SPRUCE BUDWORM, CHORISTONEURA FUMIFERANA (CLEM.) FOR EACH LEVEL OF ATTACK IN TREATED SECTORS IN 1989.

| Gestion Unit | Null | Low | Moderated | High | Total |
|---|---|---|---|---|---|
| 12 | 190 | 27 656 | 10 775 | 7 677 | 46 298 |
| 13 | 476 | 18 369 | 26 253 | 31 953 | 77 051 |
| 14 | - | 4 939 | 4 331 | 529 | 9 799 |
| 15 | - | 7 101 | 10 482 | 14 303 | 31 886 |
| Total 1989 | 666 | 58 065 | 51 841 | 54 462 | 165 034 |
| | - | (35%) | (31%) | (34%) | |
| Total 1988 | 1 589 | 124 023 | 41 159 | 25 302 | 192 075 |
| | | (65%) | (21%) | (14%) | |

**FIGURE : 3** Proportion of territory highly defoliated by the spruce budworm in treated areas from 1973 to 1989.



## 5.2 One application vs. two

In heavily infested sectors, it proved more effective to apply two B.t. treatments at a rate of 30 Biu/ha, rather than a single application at the same rate (Fig. 4). Across the three levels of infestation, the corrected mortality rate was higher in the sectors that were trested twice (Table 3). It was twice as high in the sectors with dense larval populations. Foliage protection in the heavily infested sectors was three times as high with the "2 x 30 Biu" treatment than with the "1 x 30 Biu." Where larval populations were lower, the difference in foliage protection between these two treatments was considerably less evident.

## 5.3 Treatment timing

Insecticide application timing has always been one of the major factors influencing the effectiveness of treatment. The analysis of the mortality and protection rates obtained in the sectors which were treated early (between the 3$^{rd}$ and 5$^{th}$ instar) and those which were treated late (beyond the 5$^{th}$ instar) is most convincing (Table 4). Treatment induced mortality was generally comparable among the sectors, whether they received early or late treatment. Foliage protection, on the other hand, was better in the majority of cases when treatment was completed before the 5$^{th}$ instar. Oddly enough, in sectors treated late, protection was better with evening

Fig. 4: Effect of larval density of the spruce budworm on the level of defoliation for three treatments.



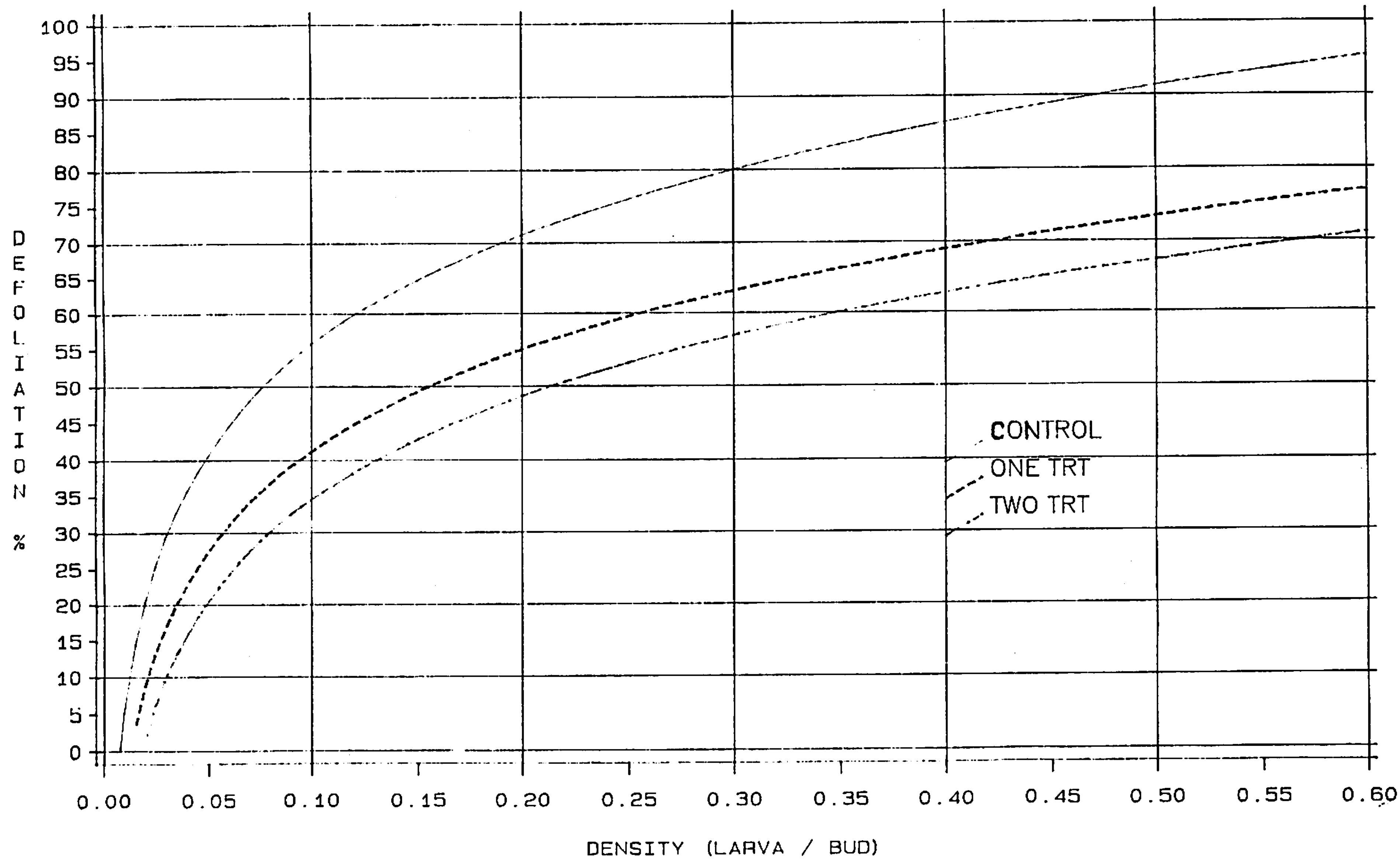


TABLE 3: LARVAL MORTALITY OF THE SPRUCE BUDWORM, <u>CHORISTONEURA</u> <u>FUMIFERANA</u> (CLEM.) AND REDUCTION OF DEFOLIATION FOR EACH TREATMENT IN 1989.

| Treatment | Infestation level | Population (L/br) Pre | Post | Mortality (%) | % defoliation Pred.(1) | Obs. | Corrected mortality (2) | % reduction of defoliation (3) |
|---|---|---|---|---|---|---|---|---|
| 2 X 30 | 0 - 10 L/br. | 5,8 | 1,2 | 90,7 | 45,8 | 36,6 | 77,9 | 20,1 |
| | 11 - 20 L/br. | 15,8 | 1,3 | 89,6 | 73,2 | 50,0 | 75,2 | 31,7 |
| | 21 - + L/br. | 33,1 | 1,3 | 92,5 | 84,9 | 54,2 | 82,2 | 36,2 |
| 1 X 30 | 0 - 10 L/br. | 5,0 | 1,3 | 81,3 | 47,1 | 32,2 | 55,5 | 31,7 |
| | 11 - 20 L/br. | 14,8 | 1,7 | 79,2 | 72,6 | 56,9 | 50,5 | 21,6 |
| | 21 - + L/br. | 31,6 | 2,3 | 75,9 | 86,2 | 75,0 | 42,7 | 13,1 |
| Témoins | 0 - 10 L/br. | 4,9 | 2,0 | 55,5 | 45,8 | 48,6 | -6,2 | -5,9 |
| | 11 - 20 L/br. | 14,8 | 2,7 | 62,8 | 72,4 | 73,9 | 11,2 | -2,1 |
| | 21 - + L/br. | 34,7 | 4,5 | 58,0 | 88,7 | 90,6 | -0,19 | -2,1 |

(1). According to a prediction model using initial density of spruce budworm larvae.

(2). 100 X (mortality treatment - mortality control) / (100 - mortality control).

(3). 100 X (defol. pred. - defol. obs.) / defol. pred.

TABLE 4: EFFECT OF TREATMENT TIMING ON LARVAL MORTALITY OF THE SPRUCE BUDWORM, CHORISTONEURA FUMIFERANA (CLEM.) AND REDUCTION OF DEFOLIATION IN SECTORS TREATED ONLY ONCE

| Timing (1) | | Population L/br. Pre | Post | Mortality (%) | % defoliation Pred.(2) | Obs. | Corrected mortality (%) (3) | % reduction of defoliation(4) |
|---|---|---|---|---|---|---|---|---|
| 0 - 10 L/br. | | | | | | | | |
| early | A.M. | 4,8 | 1,3 | 83,9 | 46,5 | 23,5 | 61,5 | 49,5 |
| | P.M. | 5,2 | 1,3 | 85,8 | 46,1 | 30,6 | 66,2 | 33,7 |
| late | A.M. | 5,5 | 1,8 | 60,6 | 48,6 | 57,9 | 5,9 | -19,3 |
| | P.M. | 4,8 | 1,2 | 91,2 | 49,8 | 26,9 | 79,1 | 45,9 |
| 11 - 20 L/br. | | | | | | | | |
| early | A.M. | 15,3 | 1,6 | 82,8 | 77,1 | 53,3 | 59,0 | 30,9 |
| | P.M. | 14,7 | 1,6 | 82,3 | 70,3 | 53,6 | 57,9 | 23,7 |
| late | A.M. | 14,8 | 2,8 | 61,9 | 68,9 | 70,8 | 9,1 | - 2,69 |
| | P.M. | 14,5 | 1,3 | 89,9 | 73,5 | 51,5 | 76,1 | 29,9 |
| 21 - + L/br. | | | | | | | | |
| early | A.M. | 33,1 | 2,3 | 77,1 | 88,2 | 67,7 | 45,5 | 23,2 |
| | P.M. | 32,5 | 2,4 | 74,9 | 84,1 | 71,5 | 40,2 | 15,0 |
| late | A.M. | 32,0 | 2,2 | 76,4 | 85,7 | 89,2 | 43,7 | - 4,0 |
| | P.M. | 29,2 | 2,3 | 74,5 | 89,2 | 80,6 | 39,1 | 9,6 |

(1). Early= Insect Development index (IDI) < 5,0 ; late= (IDI) > 5,0.
(2). According to a prediction model using initial density of spruce budworm larvae.
(3). 100 X (mortality treatment - mortality control) / (100 - mortality control).
(4). 100 X (defol. pred. - defol. obs.) / defol. pred.

sprays; inversely, when treatment was applied before the 5th instar, the best results were obtained in the morning.

### 5.4 Larval populations in 1990

The B.t. treatment in 1989 will have a marked impact on population levels in the next generation. Despite the wide dispersal of moths this year, the infestation levels in 1990 will be distinctly lower in the sectors treated in 1989 than in the sectors which received no treatment (Table 5).

TABLE 5: EVOLUTION OF SPRUCE BUDWORM POPULATIONS, <u>CHORISTONEURA</u> <u>FUMIFERANA</u> (CLEM.) IN TREATED AND UNTREATED SECTORS IN 1989

| | UNTREATED SECTORS | | | | TREATED SECTORS | | | |
|---|---|---|---|---|---|---|---|---|
| Gestion unit | N | 1988 | 1989 | 89/88 | N | 1988 | 1989 | 89/88 |
| 11 | 19 | 71 | 20 | - 72% | - | -- | -- | -- |
| 12 | 73 | 766 | 927 | + 21% | 70 | 868 | 343 | - 60% |
| 13 | 76 | 1535 | 2746 | + 79% | 79 | 1167 | 1622 | + 39% |
| 14 | 68 | 188 | 752 | + 300% | 15 | 474 | 1197 | + 153% |
| 15 | 32 | 597 | 1555 | + 160% | 38 | 877 | 759 | - 13% |

## 6. Conclusion

The 1989 spray program made it possible to protect 20 to 30% of current foliage. More than 65% of the treated area received a good level of protection despite the very high larval populations found in 26% of the area. The results of the 1989 program were only slightly lower than those obtained with previous programs. They were not sufficient, however, to avoid major defoliation of current shoots over a large proportion of the area. The most heavily infested sectors were not adequately protected despite a second application of insecticide. The double treatment (2 x 30 Biu) was effective when applied at the right time, i.e., before widespread damage was accomplished. The delayed application of B.t. and dense larval populations caused the disappointing results.

The use of additional spray planes should make it possible to treat the target areas earlier next year. High populations have been counted on three quarters of the area to be protected in 1990, which constitutes a sizeable problem. The efficacy of B.t. insecticide must be demonstrated and several strategies must be envisaged. A double application of B.t. provided good results but is difficult to carry out on a large scale, given the very short application period for this product. The alternatives which will be considered and tested over the next few months include increasing the volume of insecticide per hectare and using a higher dosage rate, with one application.

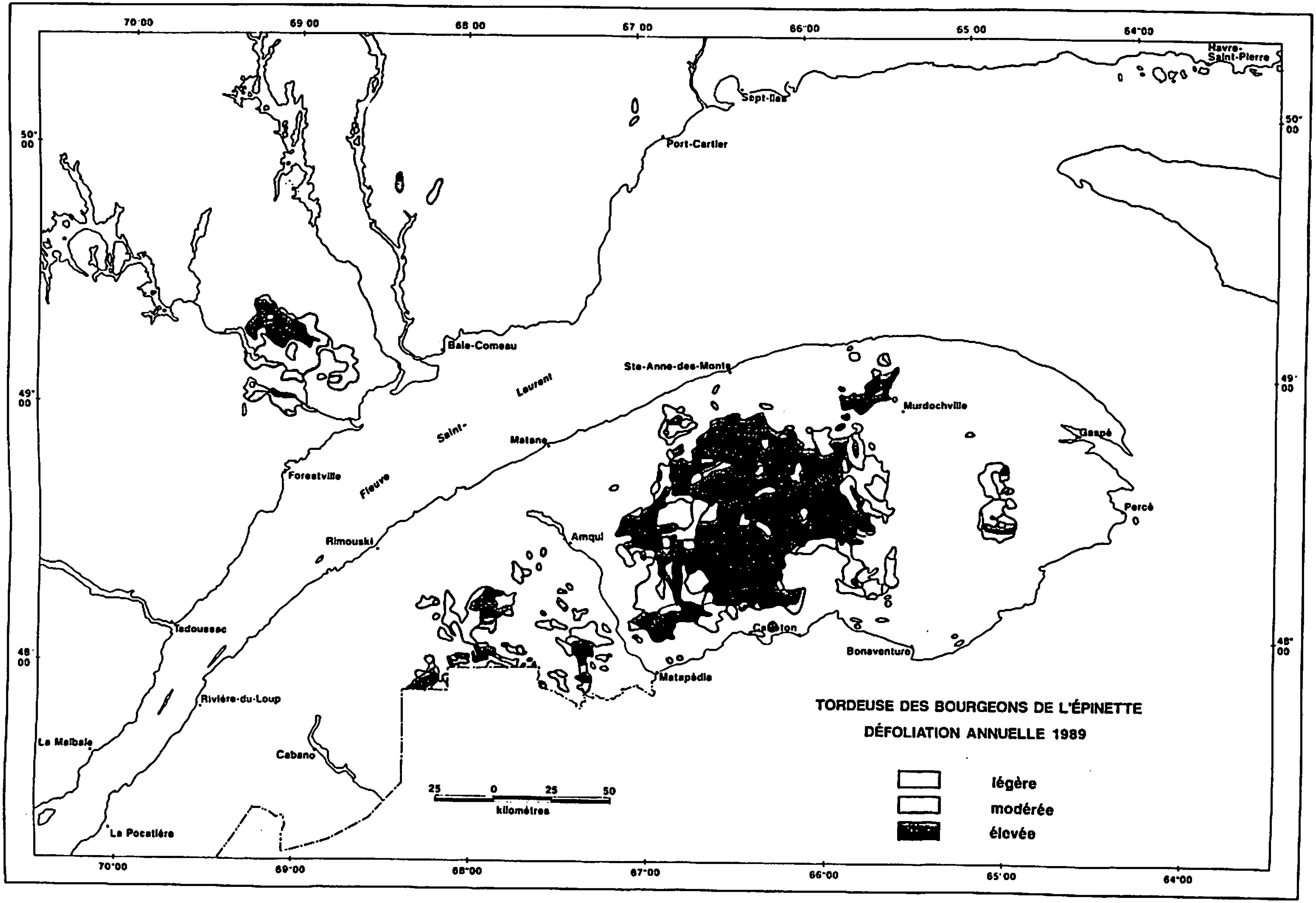
## II SPRUCE BUDWORM INFESTATION IN QUEBEC IN 1989

1989 saw an upsurge in the spruce budworm infestation in the Bas-Saint-Laurent -- Gaspésie region. The insect caused severe damage in the middle of the Gaspé Peninsula, while several sectors in the Chics-Chocs and the Baie des Chaleurs area were once again affected after several years of respite. The budworm population level remained the same in the Côte-Nord region, where the infestation has spread to areas bordering on those infested in 1988. The infestation continued to recede in the Trois-Rivières area, while no damage was detected in the other regions of the province (Fig. 5).

In 1989, budworm infestation covered 924 844 ha in Québec, compared to 708 147 ha in 1988. Damage was moderate to severe in 79% of the total area affected.

The number of infested areas in the Bas-Saint-Laurent region has increased by 36% over 1988, now totalling 816 562 ha. Damage was severe in 59% of the infested areas in this region.

Fig. 5: Area infested by the spruce budworm in Quebec in 1989.



## III FORECAST FOR 1990

A detection network consisting of pheromone traps set up in 250 sample points throughout the province has revealed a sharp increment in spruce budworm populations in western Québec and confirmed the existence of centers in the Trois-Rivières, Côte-Nord and Bas-Saint-Laurent -- Gaspésie regions.

A survey of overwintering larval populations (L2) was undertaken on August 14 and continued until October 27. Samples were taken from a total of 1200 points, mainly in the Bas-Saint-Laurent -- Gaspésie region. Western sectors of the province were visited, as moths had been detected there, along with the Côte-Nord region, where the infestation has persisted for several years now.

The results of the L2 survey confirm that budworm populations are increasing in western Québec.

In addition, the larval populations in the Côte-Nord region have intensified and spread to neighbouring sectors. Larval populations in the Bas-Saint-Laurent region have remained very high and the infested sectors will increase, with the spread of the epidemic to the south, north and east of the Gaspé Peninsula.

Preliminary analysis of the L2 data indicates that an area of approximately 500 000 ha must be covered by the protection program next year, primarily in the Bas-Saint-Laurent region. Adequate treatment must be planned for three quarters of the area, where very high population densities are predicted. At the same time, the Côte-Nord region, deleted from the spray program in 1989, must once again be added in 1990.

# SPRUCE BUDWORM IN ONTARIO, 1989[1]

- Outbreak Status, 1989
- Forecasts, 1990
- Results of Spraying Operations, 1989

by

G.M. Howse[2] and J.J. Churcher[3]

[1] Report prepared for the Seventeenth Annual Forest Pest Control Forum, Ottawa, November 14-15, 1989.

[2] Forestry Canada, Ontario Region, Great Lakes Forestry Centre, Sault Ste. Marie.

[3] Ontario Ministry of Natural Resources, Forest Health and Protection Section, Sault Ste. Marie.

## OUTBREAK STATUS 1989

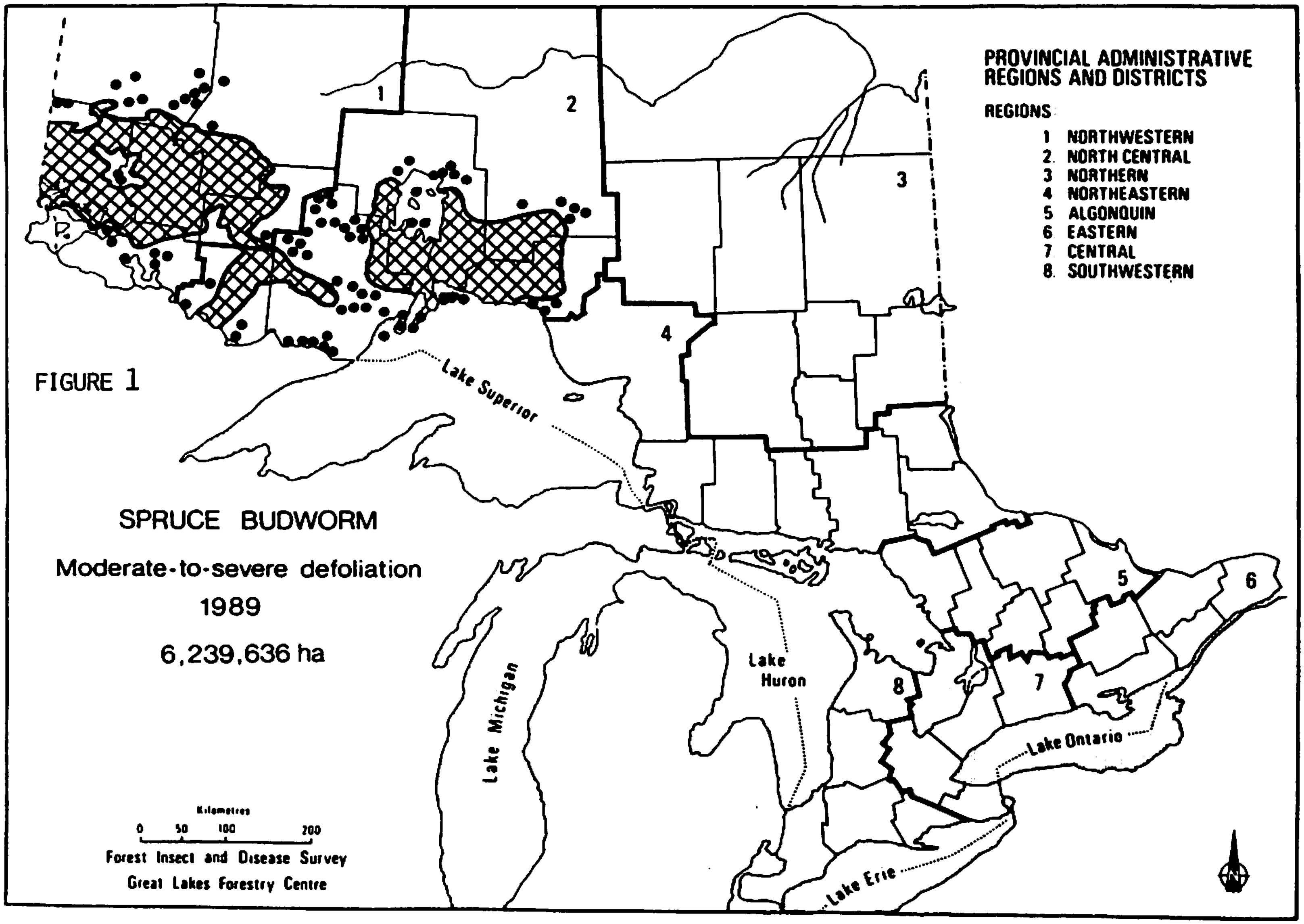
A steady decline in spruce budworm populations has been evident in Ontario for the past several years. This trend reversed itself in 1989 when the overall area of moderate-to-severe defoliation increased by slightly over a million ha to 6,239,636 ha (Table 1). Infestations remain confined to the Northwestern and North Central regions (Fig. 1) and budworm populations developed much as predicted by egg-mass surveys conducted in the fall of 1988. In the Northwestern Region, the area of moderate-to-severe defoliation declined in the Ignace, Dryden, Fort Frances and Red Lake districts, but these declines were largely offset by increases in Sioux Lookout and Kenora districts. In the North Central Region a small decrease in the Atikokan District was rendered insignificant by major increases in the Thunder Bay, Nipigon, Terrace Bay and Geraldton districts. The outbreak occupies much the same area as in 1988 with two large infestations surrounded by a number of smaller pockets. The largest infestation stretched from the Manitoba border eastward to the Golding -Saper-Blackwell townships area of Thunder Bay District. The size of this infestation was approximately 3.7 million ha encompassing parts of Kenora, Fort Frances, Red Lake, Sioux Lookout, Dryden, Ignace, Atikokan and the western Thunder Bay District. The second large infestation occupied some 2.1 million ha from the eastern Thunder Bay District through the Nipigon District to the Caramat-Proctor Lake area of the western Geraldton District and the Grenville Township area of the western Terrace Bay District. A large part of the areas in Geraldton and Terrace Bay districts were free of budworm damage in 1988 but became re-infested this year. A third significant but much smaller infestation of some 62,000 ha occurred along the U.S. border in the southern Thunder Bay District in the Rose Lake-Whitefish Lake-Middle Falls area. Approximately 130 smaller pockets ranging in size from a few to about 36,000 ha were mapped around and between the larger infestations. These included most of the islands in Lake Nipigon along with most of the offshore islands around the northwest coast of Lake Superior.

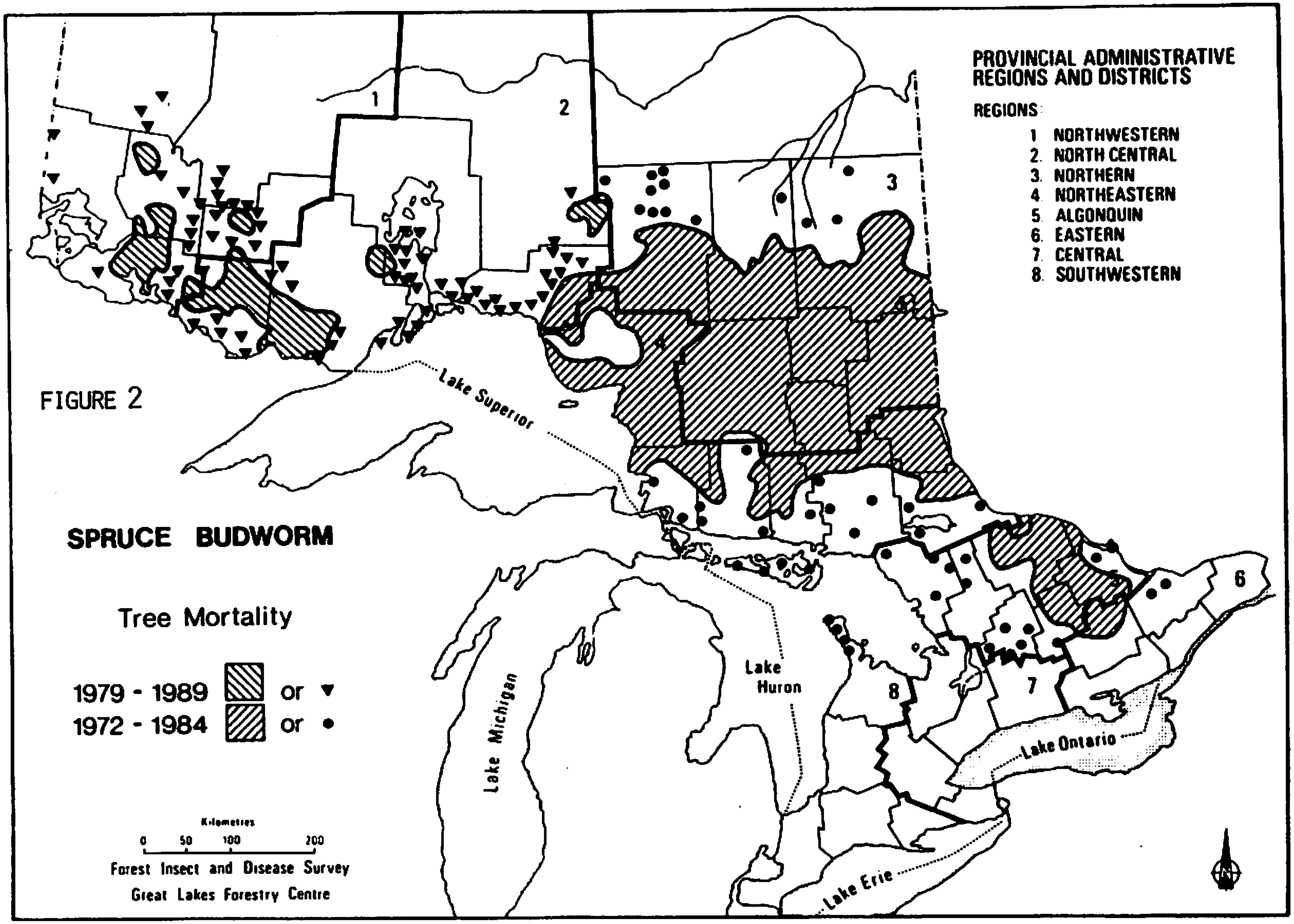
The upward trend in budworm populations was also noted in a number of other areas including the Chapleau, Blind River, Gogama, North Bay, Espanola, Wingham, Lindsay, Cambridge and Huronia districts. In these districts, increased but still low population levels were observed on white spruce and balsam fir. Moderate defoliation was recorded in small white spruce plantations in Adjala Township, Huronia District and Minto Township, Wingham District.

Aerial mapping of spruce budworm-caused tree mortality showed 529,155 ha of new mortality in the North Central and Northwestern regions, bringing the total area to 15,044,874 ha (Fig. 2).

Table 1. Gross area (ha) of current moderate-to-severe defoliation by spruce budworm in Ontario from 1986 to 1989.

| Region | Area of moderate-to-severe defoliation (ha) | | | |
|---|---|---|---|---|
| District | 1986 | 1987 | 1988 | 1989 |
| **Algonquin** | | | | |
| Bracebridge | 436 | 350 | 0 | 0 |
| Algonquin Park | 206 | 0 | 0 | 0 |
| | 642 | 350 | 0 | 0 |
| **North Central** | | | | |
| Atikokan | 890,691 | 808,508 | 578,464 | 482,208 |
| Thunder Bay | 2,005,718 | 1,101,963 | 376,395 | 597,382 |
| Nipigon | 985,961 | 987,526 | 605,741 | 940;513 |
| Terrace Bay | 1,023,773 | 528,555 | 260,393 | 624,724 |
| Geraldton | 400,486 | 211,954 | 13,956 | 389,750 |
| | 5,306,629 | 3,638,506 | 1,834,949 | 3,034,577 |
| **Northwestern** | | | | |
| Ignace | 530,761 | 584,322 | 512,961 | 419,620 |
| Dryden | 891,997 | 835,308 | 907,685 | 902,750 |
| Sioux Lookout | 428,830 | 556,457 | 540,334 | 586,772 |
| Fort Frances | 542,176 | 497,579 | 275,817 | 199,084 |
| Kenora | 906,917 | 821,074 | 886,627 | 897,779 |
| Red Lake | 200,349 | 256,167 | 266,361 | 199,054 |
| | 3,501,030 | 3,550,907 | 3,389,785 | 3,205,059 |
| **Northern** | | | | |
| Chapleau | 70 | 0 | 0 | 0 |
| Cochrane | 0 | 0 | 0 | 0 |
| Gogama | 428 | 0 | 0 | 0 |
| Hearst | 32,384 | 0 | 0 | 0 |
| Kapuskasing | 0 | 0 | 0 | 0 |
| Kirkland Lake | 0 | 0 | 0 | 0 |
| | 32,882 | 0 | 0 | 0 |
| **Northeastern** | | | | |
| Blind River | 0 | 0 | 0 | 0 |
| Espanola | 408 | 0 | 0 | 0 |
| North Bay | 1,802 | 0 | 0 | 0 |
| Sault Ste. Marie | 0 | 0 | 0 | 0 |
| Sudbury | 455 | 0 | 0 | 0 |
| Temagami | 0 | 0 | 0 | 0 |
| Wawa | 11,389 | 0 | 0 | 0 |
| | 14,504 | 0 | 0 | 0 |
| | 8,885,687 | 7,189,763 | 5,224,734 | 6,239,636 |


PROVINCIAL ADMINISTRATIVE REGIONS AND DISTRICTS
REGIONS
1 NORTHWESTERN
2 NORTH CENTRAL
3 NORTHERN
4 NORTHEASTERN
5 ALGONQUIN
6 EASTERN
7 CENTRAL
8 SOUTHWESTERN
FIGURE 1
SPRUCE BUDWORM
Moderate-to-severe defoliation
1989
6,239,636 ha
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
1
2
3
4
5
6
7
8
Kilometres
0 50 100 200
Forest Insect and Disease Survey
Great Lakes Forestry Centre


PROVINCIAL ADMINISTRATIVE REGIONS AND DISTRICTS
REGIONS:
1. NORTHWESTERN
2. NORTH CENTRAL
3. NORTHERN
4. NORTHEASTERN
5. ALGONQUIN
6. EASTERN
7. CENTRAL
8. SOUTHWESTERN
FIGURE 2
SPRUCE BUDWORM
Tree Mortality
1979 - 1989 or ▼
1972 - 1984 or ●
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
Kilometres
0 50 100 200
Forest Insect and Disease Survey
Great Lakes Forestry Centre

## FORECASTS 1990

A spruce budworm egg-mass survey was conducted during August with a total of 434 locations sampled throughout the province. A comparison of 329 locations sampled in 1988 and 1989 showed an overall increase of 73% in egg-mass densities (Table 2). In the Northwestern Region, egg-mass densities declined by only 3% overall with increases of 26% and 58%, respectively, in Dryden and Fort Frances districts and decreases of 6%, 8%, 12% and 29% in Ignace, Kenora, Sioux Lookout and Red Lake districts.

In contrast, large increases were recorded in all districts of the North Central Region with the exception of Atikokan where a decrease of 25% occurred. Increases of 516%, 171%, 701% and 125% occurred in Geraldton, Nipigon, Terrace Bay and Thunder Bay districts, respectively, for an overall regional increase of 179%. There was an increase of 29% in the Northern Region, 55% decrease in the Northeastern Region and 77% increase in southern Ontario.

For the Northwestern Region, it is expected that moderate-to-severe defoliation will persist throughout much of the area infested in 1989 with some expansion along the northern edge of the infestation, particularly in Red Lake District. In the North Central Region, it is expected that infestations will intensify and defoliation will be severe throughout areas in Nipigon, Geraldton, Terrace Bay and the eastern part of Thunder Bay districts that were infested in 1989. There will likely be very little spread or expansion in this section of the outbreak. Decreases in the intensity and extent of defoliation will likely occur in the southwest part of the Thunder Bay District and in Atikokan District. Moderate-to-severe defoliation is not expected elsewhere in Ontario in 1989.

Table 2. Comparison of spruce budworm egg-mass densities in Ontario 1988 and 1989.

| OMNR Region | No. of locations sampled in 1989 | No. of locations common to 1988 and 1989 | Average egg-mass density per 9.29 $m^2$ | | % Change |
|---|---|---|---|---|---|
| | | | 1988 | 1989 | |
| Northwestern | 129 | 116 | 343 | 333 | -3 |
| North Central | 223 | 147 | 197 | 548 | +179 |
| Northern | 40 | 32 | 6 | 7 | +29 |
| Northeastern | 26 | 20 | 6 | 3 | -55 |
| Southern Ontario | 16 | 14 | 12 | 22 | +77 |
| Overall | 434 | 329 | 210 | 364 | +73 |

## RESULTS OF SPRAYING OPERATIONS 1989

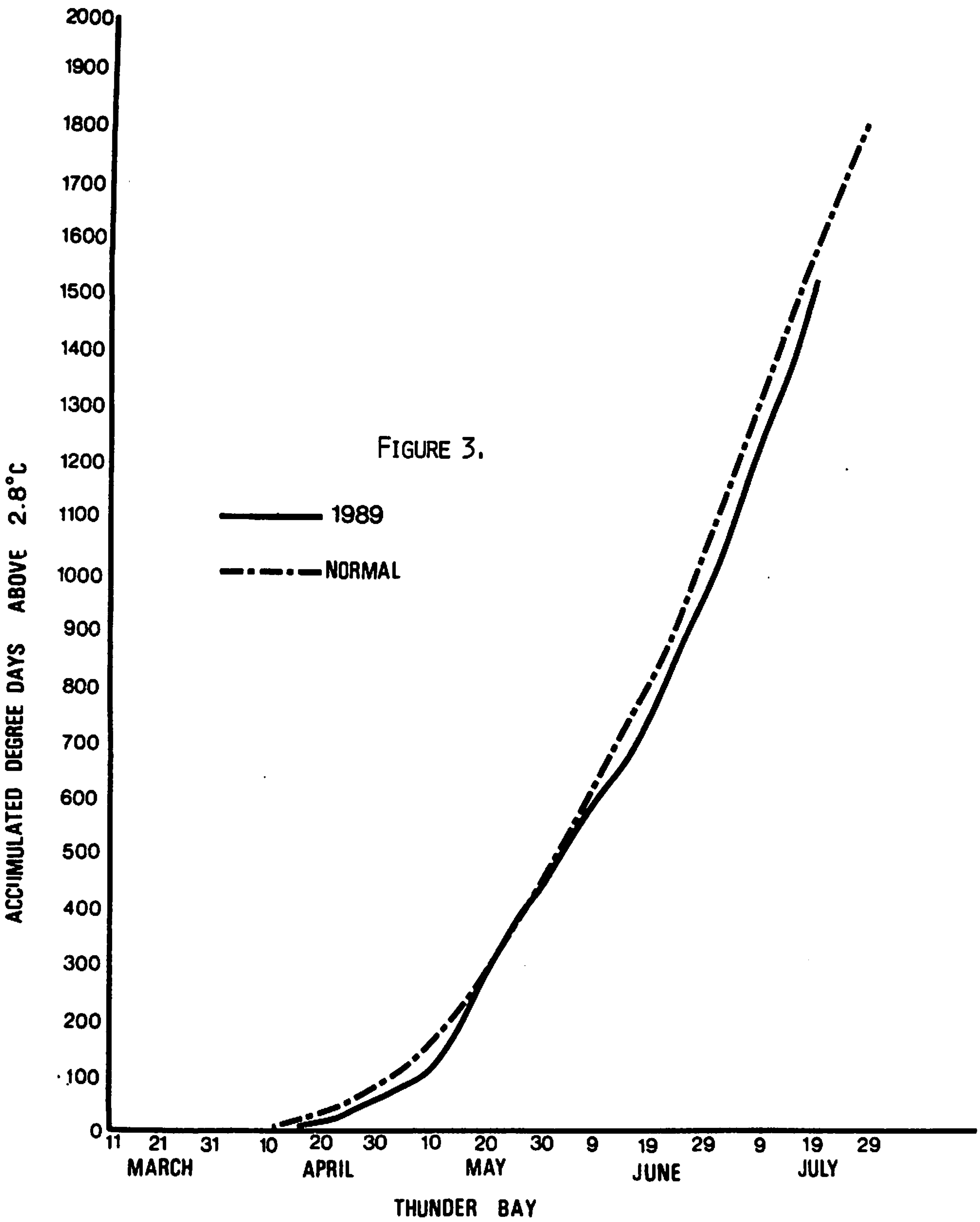
A total of 30,516 ha was aerially sprayed in 1989 in the Nipigon and Thunder Bay districts in the North Central Region (Table 3). A total of 21,769 ha comprised of 17 blocks was treated in the Nipigon District whereas a total of 8,747 ha in one block was sprayed in the Thunder Bay District. The 1989 program included commercial forest, plantations and a provincial park. All areas were treated with a single application of Futura XLV at a rate of 30 BIU/2.03L/ha (neat) except for a double application on Lake Nipigon Provincial Park. Five Ag Trucks equipped with Micronairs were used in this year's program. Spraying took place from June 4 to June 15.

Table 3. Area and date sprayed in Nipigon and Thunder Bay districts in 1989.

| District/location | Area (ha) | Date Sprayed |
|---|---|---|
| Thunder Bay | | |
| Block 18 (Wolfpup, Abigogami) | 8,747 | June 11-15 |
| Nipigon | | |
| Block 1-Lake Nipigon Prov. Park | 195 + 187 | June 4 and 14 |
| Block 2-Limestone Lake plantations | 1,426 | June 15 |
| Block 4-Cameron Falls plantations | 250 | June 4 |
| Blocks 3-9 | 19,769 | June 4-15 |
| | 21,769 | |
| Total | 30,516 | |

In the North Central Region this year, unlike the previous three years, temperatures were cooler than normal in April and the first two weeks of May. Based on temperature data from Thunder Bay airport, heat accumulation lagged about six days behind normal in early May, caught up to normal May 18-19, was ahead of normal by two days from May 20 to June 5 and fell behind normal for the remainder of June. Emergence started May 15 based on field observations. This year's heat accumulation graph for Thunder Bay is presented in Figure 3 and insect development at spray time is presented in Table 4.

Insect development was furthest advanced at Lake Nipigon Provincial Park and Black Sturgeon, i.e. further advanced than intended spray locations to the south such as Limestone Lake, Abigogami Lake and Nonvatin Lake. In most instances, spraying started when the spruce budworm larvae were in fourth instar but, in a few situations, was not completed for up to 10 days later when the




Heat accumulation in degree days for Thunder Bay Ontario. 1989

Table 4. Spruce budworm larval development at spray locations in Thunder Bay and Nipigon districts, 1989.

| Location | Tree species | Date | Stage (%) II | III | IV | V | VI | Remarks |
|---|---|---|---|---|---|---|---|---|
| Thunder Bay District | | | | | | | | |
| Abigogami Lake (Block 18) | bF | June 10 | 2 | 6 | 89 | 3 | | Sprayed June 11-15, 1989 |
| | bF | June 14 | 0 | 0 | 67 | 33 | | |
| Nipigon District | | | | | | | | |
| Lake Nipigon Prov. Pk (Block 1) | bF | June 3 | 0 | 9 | 77 | 14 | | Sprayed June 4 & 14, 1989 |
| | bF | June 14 | 0 | 0 | 44 | 39 | 17 | |
| | wS | June 3 | 0 | 10 | 55 | 35 | | |
| | wS | June 14 | 0 | 3 | 26 | 42 | 29 | |
| Limestone Lake (Block 2) | wS | June 9 | 0 | 5 | 77 | 18 | | Sprayed June 15, 1989 |
| | wS | June 19 | 0 | 0 | 0 | 30 | 70 | |
| Black Sturgeon Lake (Block 9, 10) | bF | June 7 | 0 | 8 | 78 | 14 | | Sprayed June 4 & 6, 1989 |
| | wS | June 7 | 0 | 12 | 70 | 18 | | |
| Nonwatin Lake (Block 13, 14) | bF | June 7 | 0 | 43 | 57 | 0 | | Sprayed June 6, 1989 |
| | wS | June 7 | 2 | 8 | 76 | 14 | | |
| Shillabeer Lake (Block 15, 16, 17) | bF | June 7 | 0 | 43 | 57 | 0 | | Sprayed June 6-11, 1989 |
| | bF | June 10 | 0 | 6 | 79 | 15 | | |
| | wS | June 7 | 2 | 8 | 76 | 14 | | |
| | wS | June 10 | 0 | 0 | 56 | 44 | | |

majority of larvae had reached fifth and sixth instar. In one instance, white spruce plantations at Limestone Lake were not sprayed until June 15 when the insects were probably in fifth and sixth instar.

Approximately 161 plots (balsam fir and white spruce) consisting of 5 to 20 trees per plot for a total of 1,210 trees were sampled to assess the effectiveness of this year's program. In spray blocks, 445 balsam fir and 415 white spruce were sampled whereas 190 balsam and 160 white spruce were sampled in untreated check plots. Results in terms of population reduction and foliage protection due to the treatment are presented by spray blocks in Tables 5, 7 and 9 for Thunder Bay District, Lake Nipigon Prov. Park and the remainder of Nipigon District, respectively. Population reduction and foliage protection on an individual plot basis are presented in Tables 6, 8 and 10 for Thunder Bay District, Lake Nipigon Provincial Park and for the remaining areas sprayed in Nipigon District.

Results this year were quite variable ranging from nil to excellent on a block to block basis which is consistent with past results. Overall, this year's results are better than last year (1988) and not as good as those achieved in 1987. For example, foliage protection was excellent for Block 18 (Abigogami Lake), Tables 5 and 6, but only fair in Block 1 (Lake Nipigon Provincial Park), Tables 7 and 8. Foliage protection for a number of blocks assessed in Nipigon District (Tables 9 & 10) would be characterized as follows: Block 2 - fair, 3 - nil, 4 - poor, 9 - fair, 10 - poor, 13 - fair, 14 - good, 15 - good to excellent, 16 - good to excellent and 17 - good to excellent. Advanced insect development at time of treatment or very high insect densities explain some of the poor results.

Table 5. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray block assessed in Thunder Bay District, North Central Region, 1989.

| Location | Spray date | Host | No. of plots | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|---|---|
| Abigogami Lake | | | | | | |
| Block 18 | June 11-15 | bF | 10 | 30.0 | 89 | 27 |
| Checks | | bF | | 26.8 | | 84 |

Table 6. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Thunder Bay District, North Central Region, 1989.

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Abigogami Lake | | | | |
| Block 18 | | | | |
| P1 | bF | 11.3 | 50 | 30 |
| Checks | bF | 12.4 | | 75 |
| P2 | bF | 18.5 | 78 | 10 |
| Checks | bF | 18.1 | | 81 |
| P3 | bF | 28.5 | 83 | 20 |
| Checks | bF | 27.8 | | 87 |
| P4 | bF | 12.8 | 96 | 25 |
| Checks | bF | 12.4 | | 75 |
| P5 | bF | 38.7 | 93 | 35 |
| Checks | bF | 38.1 | | 92 |
| P6 | bF | 25.5 | 95 | 45 |
| Checks | bF | 27.8 | | 87 |
| P7 | bF | 89.6 | 97 | 24 |
| Checks | bF | 54.2 | | 94 |
| P8 | bF | 23.6 | 90 | 21 |
| Checks | bF | 22.1 | | 83 |
| P9 | bF | 31.0 | 81 | 27 |
| Checks | bF | 32.9 | | 88 |
| P10 | bF | 20.4 | 78 | 30 |
| Checks | bF | 22.1 | | 83 |

Table 7. Spruce Budworm: Population reduction and foliage protection attributable to a double aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray block assessed in Lake Nipigon Provincial Park, Nipigon District, North Central Region, 1989.

| Location | Spray date | Host | No. of plots | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|---|---|
| Lake Nipigon Prov. Pk | | | | | | |
| Block 1 | June 4, 14 | bF | 5 | 28.6 | 87 | 63 |
| Checks | | | 5 | 28.1 | | 84 |
| Block 1 | | wS | 5 | 73.7 | 67 | 83 |
| Checks | | | 5 | 71.9 | | 90 |

Table 8. Spruce Budworm: Population reduction and foliage protection attributable to a double aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Lake Nipigon Provincial Park, Nipigon District, North Central Region, 1989.

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Lake Nipigon Prov. Pk (Block 1) | | | | |
| P1 | bF | 58.9 | 90 | 81 |
| Checks | bF | 54.2 | | 94 |
| P2 | bF | 20.6 | 82 | 32 |
| Checks | bF | 22.1 | | 83 |
| P3 | bF | 26.3 | 88 | 49 |
| Checks | bF | 27.8 | | 83 |
| P4 | bF | 18.9 | 78 | 84 |
| Checks | bF | 18.1 | | 81 |
| P5 | bF | 18.4 | 61 | 68 |
| Checks | bF | 18.1 | | 81 |
| P1 | wS | 114.8 | 84 | 91 |
| Checks | wS | 105.2 | | 95 |
| P2 | wS | 33.8 | 62 | 88 |
| Checks | wS | 33.9 | | 80 |
| P3 | wS | 60.2 | 87 | 78 |
| Checks | wS | 62.6 | | 92 |
| P4 | wS | 107.6 | 39 | 69 |
| Checks | wS | 105.2 | | 95 |
| P5 | wS | 52.2 | 65 | 90 |
| Checks | wS | 52.5 | | 89 |

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray block assessed in Nipigon District, North Central Region, 1989.

| Location | Spray date | Host | No. of plots | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|---|---|
| Limestone Lake | | | | | | |
| Block 2 | June 15 | wS | 9 | 34.2 | 10 | 57 |
| Checks | | wS | | 34.3 | | 77 |
| Purdom Twp | | | | | | |
| Block 3 | June 5 | bF | 2 | 33.2 | 19 | 95 |
| Checks | | bF | 2 | 33.0 | | 88 |
| Block 3 | | wS | 2 | 66.2 | 64 | 95 |
| Checks | | wS | 2 | 65.4 | | 90 |
| Cameron Falls | | | | | | |
| Block 4 | June 4 | bF | 5 | 42.2 | 0 | 78 |
| Checks | | bF | 5 | 42.0 | | 92 |
| Block 4 | | wS | 5 | 70.2 | 0 | 87 |
| Checks | | wS | 5 | 71.0 | | 91 |
| Black Sturgeon | | | | | | |
| Block 9 | June | bF | 5 | 20.6 | 12 | 63 |
| Checks | 4, 6 | bF | 5 | 21.6 | | 79 |
| Block 9 | | wS | 5 | 55.8 | 55 | 71 |
| Checks | | wS | 5 | 56.8 | | 89 |
| Block 10 | June 4 | bF | 1 | 10.2 | 39 | 65 |
| Checks | | bF | 1 | 12.4 | | 75 |
| Block 10 | | wS | 1 | 40.9 | 0 | 83 |
| Checks | | wS | 1 | 43.4 | | 85 |
| Block 13 | June 6 | bF | 5 | 47.0 | 90 | 69 |
| Checks | | bF | 5 | 42.2 | | 91 |
| Block 13 | | wS | 4 | 69.8 | 92 | 71 |
| Checks | | wS | 4 | 64.4 | | 88 |
| Block 14 | June 6 | bF | 5 | 40.0 | 89 | 42 |
| Checks | | bF | 5 | 38.1 | | 90 |

(cont'd)

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray block assessed in Nipigon District, North Central Region, 1989 (concl.).

| Location | Spray date | Host | No. of plots | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|---|---|
| Black Sturgeon (cont'd) | | | | | | |
| Block 14 | | wS | 5 | 85.6 | 42 | 82 |
| Checks | | wS | 5 | 86.0 | | 94 |
| Block 15 | June 6, | bF | 5 | 17.0 | 0 | 27 |
| Checks | 7, 9, 10 | bF | 5 | 16.6 | | 78 |
| Block 15 | | wS | 5 | 41.9 | 77 | 55 |
| Checks | | wS | 5 | 41.2 | | 83 |
| Block 16 | June 6, 7, | bF | 5 | 15.0 | 53 | 26 |
| Checks | 9, 10, 11 | bF | 5 | 14.7 | | 77 |
| Block 16 | | wS | 5 | 39.2 | 69 | 46 |
| Checks | | wS | 5 | 38.6 | | 79 |
| Block 17 | June 10 | bF | 5 | 21.0 | 74 | 24 |
| Checks | | bF | 5 | 20.7 | | 80 |
| Block 17 | | wS | 5 | 29.6 | 92 | 50 |
| Checks | | wS | 5 | 29.7 | | 67 |

Table 1Q. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Nipigon District, North Central Region, 1989.

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Limestone Lake | | | | |
| Block 2 | | | | |
| P1 | wS | 23.6 | 32 | 31 |
| Checks | wS | 23.2 | | 70 |
| P2 | wS | 35.0 | 22 | 49 |
| Checks | wS | 33.9 | | 80 |
| P3 | wS | 44.8 | 0 | 80 |
| Checks | wS | 43.4 | | 85 |
| P4 | wS | 44.3 | 0 | 70 |
| Checks | wS | 43.4 | | 85 |
| P5 | wS | 32.7 | 78 | 41 |
| Checks | wS | 33.9 | | 80 |
| P6 | wS | 41.9 | 32 | 71 |
| Checks | wS | 43.4 | | 85 |
| P7 | wS | 14.6 | 28 | 29 |
| Checks | wS | 12.5 | | 47 |
| P8 | wS | 35.1 | 23 | 64 |
| Checks | wS | 37.5 | | 82 |
| P9 | wS | 36.1 | 0 | 78 |
| Checks | wS | 37.5 | | 82 |
| Purdom Twp | | | | |
| Block 3 | | | | |
| P4 | bF | 29.7 | 0 | 95 |
| Checks | bF | 27.8 | | 87 |
| P5 | bF | 36.7 | 51 | 95 |
| Checks | bF | 38.1 | | 88 |
| P4 | wS | 44.6 | 83 | 95 |
| Checks | wS | 43.4 | | 85 |
| P5 | wS | 87.7 | 17 | 95 |
| Checks | wS | 87.5 | | 95 |

(cont'd)

Table 10. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Nipigon District, North Central Region, 1989 (cont'd).

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Cameron Falls | | | | |
| Block 4 | | | | |
| P1 | bF | 42.6 | 0 | 78 |
| Checks | bF | 42.6 | | 93 |
| P2 | bF | 45.8 | 33 | 82 |
| Checks | bF | 42.6 | | 93 |
| P3 | bF | 53.4 | 36 | 68 |
| Checks | bF | 54.2 | | 94 |
| P4 | bF | 40.6 | 0 | 87 |
| Checks | bF | 42.6 | | 93 |
| P5 | bF | 28.8 | 0 | 74 |
| Checks | bF | 27.8 | | 87 |
| P1 | wS | 37.2 | 0 | 95 |
| Checks | wS | 37.5 | | 82 |
| P2 | wS | 72.2 | 0 | 94 |
| Checks | wS | 72.5 | | 94 |
| P3 | wS | 57.8 | 0 | 68 |
| Checks | wS | 57.5 | | 91 |
| P4 | wS | 81.2 | 0 | 90 |
| Checks | wS | 82.5 | | 95 |
| P5 | wS | 102.8 | 43 | 87 |
| Checks | wS | 105.2 | | 95 |
| Black Sturgeon | | | | |
| Block 9 | | | | |
| P1 | bF | 21.8 | 77 | 87 |
| Checks | bF | 22.1 | | 81 |
| P2 | bF | 16.2 | 0 | 19 |
| Checks | bF | 18.1 | | 75 |
| P3 | bF | 16.7 | 0 | 88 |
| Checks | bF | 18.1 | | 75 |

(cont'd)

Table 10. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Nipigon District, North Central Region, 1989 (cont'd).

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Black Sturgeon (cont'd) | | | | |
| Block 9 | | | | |
| P4 | bF | 27.5 | 47 | 58 |
| Checks | bF | 27.8 | | 83 |
| P5 | bF | 20.9 | 48 | 65 |
| Checks | bF | 22.1 | | 81 |
| P1 | wS | 67.0 | 0 | 88 |
| Checks | wS | 67.5 | | 93 |
| P2 | wS | 30.6 | 69 | 55 |
| Checks | wS | 33.9 | | 80 |
| P3 | wS | 61.0 | 57 | 94 |
| Checks | wS | 62.6 | | 89 |
| P4 | wS | 66.2 | 73 | 36 |
| Checks | wS | 67.5 | | 93 |
| P5 | wS | 54.0 | 91 | 84 |
| Checks | wS | 52.5 | | 89 |
| Black Sturgeon | | | | |
| Block 10 | | | | |
| P1 | bF | 10.2 | 39 | 65 |
| Checks | bF | 12.4 | | 75 |
| P1 | wS | 40.9 | 0 | 83 |
| Checks | wS | 43.4 | | 85 |
| Black Sturgeon | | | | |
| Block 13 | | | | |
| P1 | bF | 44.0 | 85 | 48 |
| Checks | bF | 42.6 | | 93 |
| P2 | bF | 22.6 | 86 | 78 |
| Checks | bF | 22.1 | | 83 |
| P3 | bF | 74.7 | 93 | 93 |
| Checks | bF | 54.2 | | 94 |
| P4 | bF | 35.3 | 75 | 81 |
| Checks | bF | 38.1 | | 92 |

(cont'd)

Table 10. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Nipigon District, North Central Region, 1989 (cont'd).

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Black Sturgeon (cont'd) | | | | |
| Block 13 | | | | |
| P5 | bF | 58.3 | 99 | 43 |
| Checks | bF | 54.2 | | 93 |
| P1 | wS | 125.2 | 71 | 68 |
| Checks | wS | 105.2 | | 95 |
| P2 | wS | 25.8 | 88 | 77 |
| Checks | wS | 27.5 | | 75 |
| P3 | wS | 58.2 | 100 | 88 |
| Checks | wS | 57.5 | | 91 |
| P5 | wS | 69.8 | 100 | 52 |
| Checks | wS | 67.5 | | 93 |
| Black Sturgeon | | | | |
| Block 14 | | | | |
| P1 | bF | 41.9 | 95 | 26 |
| Checks | bF | 42.6 | | 92 |
| P2 | bF | 25.6 | 98 | 49 |
| Checks | bF | 27.8 | | 87 |
| P3 | bF | 35.8 | 95 | 34 |
| Checks | bF | 38.1 | | 92 |
| P4 | bF | 66.6 | 87 | 76 |
| Checks | bF | 54.2 | | 94 |
| P5 | bF | 30.0 | 92 | 26 |
| Checks | bF | 27.8 | | 87 |
| P1 | wS | 103.0 | 86 | 88 |
| Checks | wS | 105.2 | | 95 |
| P2 | wS | 87.8 | 58 | 88 |
| Checks | wS | 87.5 | | 95 |
| P3 | wS | 58.8 | 72 | 77 |
| Checks | wS | 57.5 | | 91 |

(cont'd)

Table 10. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Nipigon District, North Central Region, 1989 (cont'd).

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Black Sturgeon (cont'd) | | | | |
| Block 14 | | | | |
| P4 | wS | 90.4 | 12 | 90 |
| Checks | wS | 92.5 | | 95 |
| P5 | wS | 88.2 | 22 | 65 |
| Checks | wS | 87.5 | | 95 |
| Black Sturgeon | | | | |
| Block 15 | | | | |
| P1 | bF | 19.2 | 0 | 15 |
| Checks | bF | 18.1 | | 81 |
| P2 | bF | 20.6 | 0 | 54 |
| Checks | bF | 22.1 | | 83 |
| P3 | bF | 22.0 | 64 | 11 |
| Checks | bF | 22.1 | | 81 |
| P4 | bF | 8.6 | 100 | 16 |
| Checks | bF | 8.5 | | 69 |
| P5 | bF | 14.6 | 31 | 40 |
| Checks | bF | 12.4 | | 75 |
| P1 | wS | 34.2 | 78 | 27 |
| Checks | wS | 33.9 | | 80 |
| P2 | wS | 30.2 | 85 | 38 |
| Checks | wS | 27.5 | | 75 |
| P3 | wS | 50.0 | 80 | 64 |
| Checks | wS | 48.7 | | 87 |
| P4 | wS | 51.6 | 62 | 72 |
| Checks | wS | 52.5 | | 89 |
| P5 | wS | 43.4 | 77 | 74 |
| Checks | wS | 43.4 | | 85 |
| Black Sturgeon | | | | |
| Block 16 | | | | |
| P1 | bF | 14.0 | 24 | 31 |
| Checks | bF | 12.4 | | 75 |

(cont'd)

Table 10. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Nipigon District, North Central Region, 1989 (cont'd).

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Black Sturgeon (cont'd) | | | | |
| Block 16 | | | | |
| P2 | bF | 19.0 | 84 | 6 |
| Checks | bF | 18.1 | | 81 |
| P3 | bF | 16.9 | 0 | 43 |
| Checks | bF | 18.1 | | 75 |
| P4 | bF | 11.2 | 60 | 34 |
| Checks | bF | 12.4 | | 81 |
| P5 | bF | 13.7 | 71 | 14 |
| Checks | bF | 12.4 | | 75 |
| P1 | wS | 54.4 | 73 | 36 |
| Checks | wS | 52.5 | | 89 |
| P2 | wS | 37.8 | 77 | 45 |
| Checks | wS | 37.5 | | 82 |
| P3 | wS | 29.7 | 53 | 21 |
| Checks | wS | 27.5 | | 75 |
| P4 | wS | 22.0 | 37 | 68 |
| Checks | wS | 23.2 | | 61 |
| P5 | wS | 52.0 | 84 | 58 |
| Checks | wS | 52.5 | | 87 |
| Black Sturgeon | | | | |
| Block 17 | | | | |
| P1 | bF | 17.0 | 70 | 5 |
| Checks | bF | 18.1 | | 81 |
| P2 | bF | 9.6 | 38 | 48 |
| Checks | bF | 8.5 | | 69 |
| P3 | bF | 11.6 | 56 | 5 |
| Checks | bF | 12.4 | | 75 |
| P4 | bF | 42.8 | 94 | 17 |
| Checks | bF | 42.6 | | 92 |

(cont'd)

Table 10. Spruce Budworm: Population reduction and foliage protection attributable to a single aerial application of Futura XLV at 30 BIU/2.0L/ha for each spray plot assessed in Nipigon District, North Central Region, 1989 (concl.)

| Location | Host | Prespray larvae per 46 cm branch tip | Population reduction due to spray (%) | 1989 defoliation (%) |
|---|---|---|---|---|
| Black Sturgeon (cont'd) | | | | |
| Block 17 | | | | |
| P5 | bF | 23.8 | 82 | 46 |
| Checks | bF | 22.1 | | 83 |
| P1 | wS | 23.2 | 88 | 16 |
| Checks | wS | 23.2 | | 70 |
| P2 | wS | 12.8 | 65 | 45 |
| Checks | wS | 12.5 | | 47 |
| P3 | wS | 12.0 | 89 | 37 |
| Checks | wS | 12.5 | | 47 |
| P4 | wS | 63.5 | 98 | 68 |
| Checks | wS | 62.6 | | 91 |
| P5 | wS | 36.4 | 95 | 84 |
| Checks | wS | 37.5 | | 82 |

# JACK PINE BUDWORM IN ONTARIO, 1989[1]

- Outbreak Status, 1989
- Forecasts, 1990
- Results of Spraying Operations, 1989

by

G.M. Howse[2] and J.J. Churcher[3]

[1] Report prepared for the Seventeenth Annual Forest Pest Control Forum, Ottawa, November 14-15, 1989.

[2] Forestry Canada, Ontario Region, Great Lakes Forestry Centre, Sault Ste. Marie.

[3] Ontario Ministry of Natural Resources, Forest Health and Protection Section, Sault Ste. Marie.

## OUTBREAK STATUS, 1989

Jack pine budworm populations declined dramatically in 1989 with the total area of moderate-to-severe defoliation reduced from 734,482 ha to 248,311 ha (Table 1). All of the defoliation this year was confined to areas in the Red Lake and Sioux Lookout districts (Fig. 1). The largest remaining infestation (165,716 ha) was located in the northern Red Lake District between the Berens River and Nungesser Lake. Small extensions of this body of infestation reached as far west as Prideaux and Kirkness lakes and northeast to Madden Lake. Large areas to the north of this infestation which were defoliated in 1988 were completely burned off by uncontrolled fires in the fall of 1988 and spring of 1989. South and east of this large infestation four pockets of defoliation ranging in size from 325 to 12,039 ha were mapped between Coathup Lake and the southwest shoreline of Trout Lake. Two other infestations, 37,682 and 2,448 ha in size, straddled the Red Lake-Sioux Lookout district boundary in the Aerofoil Lake area and the Perrigo-Wakeman lakes area. Three other pockets of infestation were recorded in the Christina Lake (5,584 ha), Brokenmouth Lake (2,700 ha) and Kesaka Creek (6,865 ha) areas of Sioux Lookout District. Throughout much of the areas described above defoliation was moderate rather than severe although scattered, individual trees sometimes supported very high populations.

Table 1. Gross area of current moderate-to-severe defoliation by the jack pine budworm in the Northwestern Region of Ontario from 1987 to 1989.

| | Area of moderate-to-severe defoliation (ha) | | |
|---|---|---|---|
| District | 1987 | 1988 | 1989 |
| Red Lake | 286,949 | 613,096 | 212,265 |
| Fort Frances | 11,237 | 0 | 0 |
| Ignace | 21,194 | 0 | 0 |
| Kenora | 69,344 | 0 | 0 |
| Sioux Lookout | 30,520 | 123,786 | 36,046 |
| Dryden | 85,505 | 0 | 0 |
| Total | 504,749 | 736,882 | 248,311 |

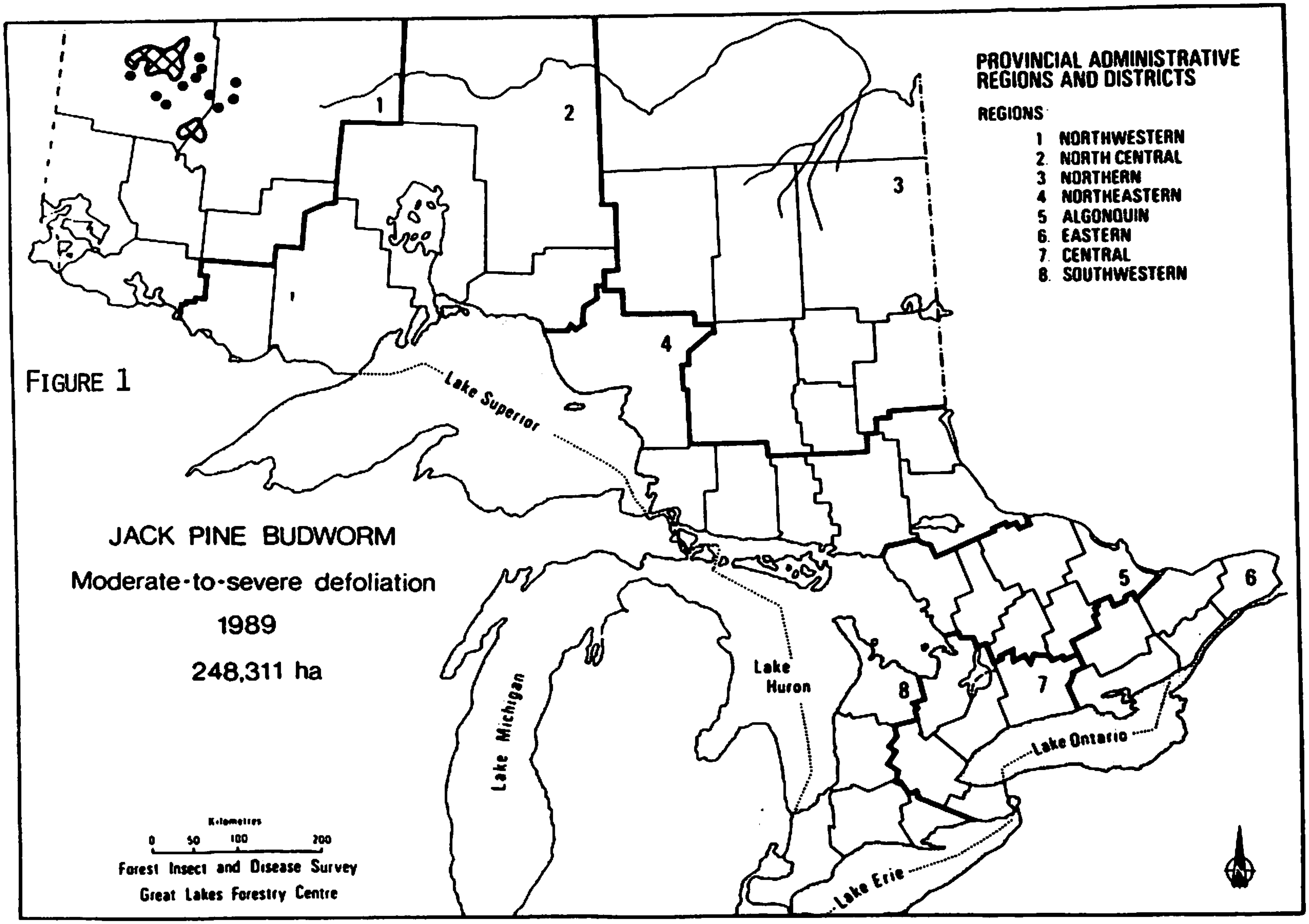


FIGURE 1
JACK PINE BUDWORM
Moderate-to-severe defoliation
1989
248,311 ha
PROVINCIAL ADMINISTRATIVE REGIONS AND DISTRICTS
REGIONS
1 NORTHWESTERN
2 NORTH CENTRAL
3 NORTHERN
4 NORTHEASTERN
5 ALGONQUIN
6 EASTERN
7 CENTRAL
8 SOUTHWESTERN
1
2
3
4
5
6
7
8
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
Kilometres
0 50 100 200
Forest Insect and Disease Survey
Great Lakes Forestry Centre

Aerial surveys in the English River area of Thunder Bay District did not detect defoliation in the area in which some 600 ha of mature jack pine were defoliated in 1988. No infestations were reported elsewhere in the province, although small numbers of larvae were observed at two locations in Dryden District and one location in Wava District.

## FORECASTS, 1990

A total of 108 jack pine budworm egg-mass samples were collected in Ontario in 1989. Based on 69 locations sampled in 1988 and 1989, egg-mass densities declined by 72% (Table 2) to very low levels. A few small, scattered pockets of light or moderate defoliation may occur in 1990 in Red Lake District.

Table 2. Comparison of jack pine budworm egg-mass densities in Ontario 1988 and 1989.

| OMNR Region | No. of locations sampled in 1989 | No. of locations common to 1988 and 1989 | Average no. of egg-masses 1988 | Average no. of egg-masses 1989 | % Change |
|---|---|---|---|---|---|
| Northwestern | 50 | 43 | 7.2 | 2.0 | -72 |
| North Central | 26 | 3 | 5.3 | 1.7 | -69 |
| Northern | 11 | 10 | 0 | 0 | 0 |
| Northeastern | 11 | 7 | 0.4 | 0 | -100 |
| Southern Ontario | 10 | 8 | 0 | 1.0 | +100 |
| Overall | 108 | 68 | 4.8 | 1.3 | -72 |

## RESULTS OF SPRAYING OPERATIONS, 1989

In July 1988, two pockets of moderate defoliation caused by jack pine budworm were detected in commercial jack pine forest near the English River, Thunder Bay District. One pocket of defoliation was 500 ha in size and straddled Hwy 17 about 3 km east of English River (Fig. 2). The other pocket of defoliation was about 100 ha in size and was located about 2 km to the northeast of the first pocket at Rush Creek. The area is under license to Canadian Pacific Forest Products Ltd., Dog River - Mattawin Forest Management Agreement area.

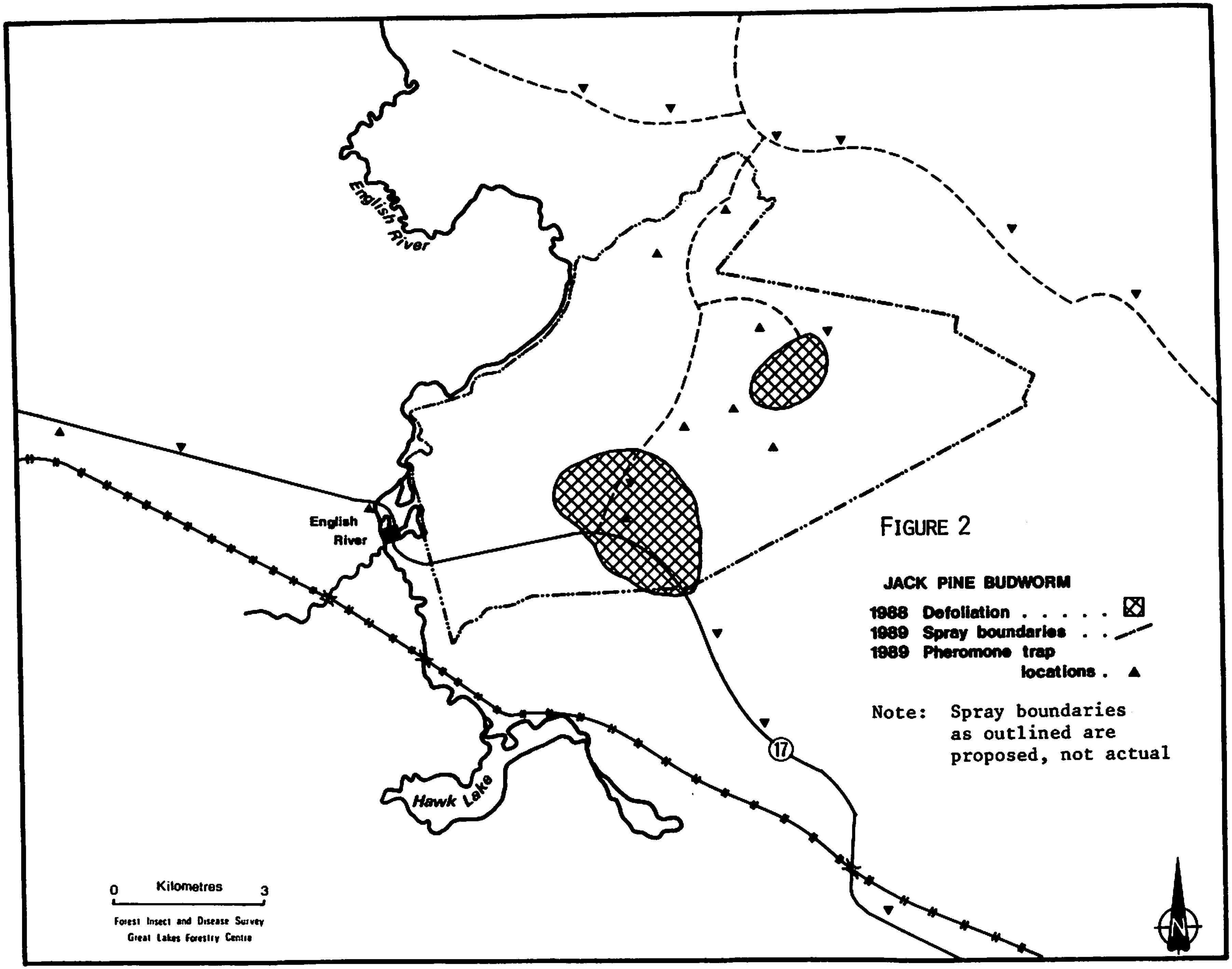

English River
English River
Hawk Lake
17
JACK PINE BUDWORM
1988 Defoliation . . . . .
1989 Spray boundaries . .
1989 Pheromone trap locations .
Note: Spray boundaries as outlined are proposed, not actual
0 Kilometres 3
Forest Insect and Disease Survey
Great Lakes Forestry Centre
N

FIGURE 2

This appeared to be a local, isolated situation in that the nearest known infestations were located some 190 km to the northwest in Sioux Lookout District.

Egg-mass samples and $L_2$ counts indicated a fairly high population although quite variable on a stand by stand basis in and around the pockets of defoliation. The highest populations were associated with the smaller pocket of defoliation. The North Central Region Budworm Planning Committee comprised of OMNR, Forestry Canada-Ontario Region, Ministry of the Environment and forest industry considered this infestation to be a threat to extensive tracts of susceptible mature-immature jack pine stands proposed for harvesting in the near future.

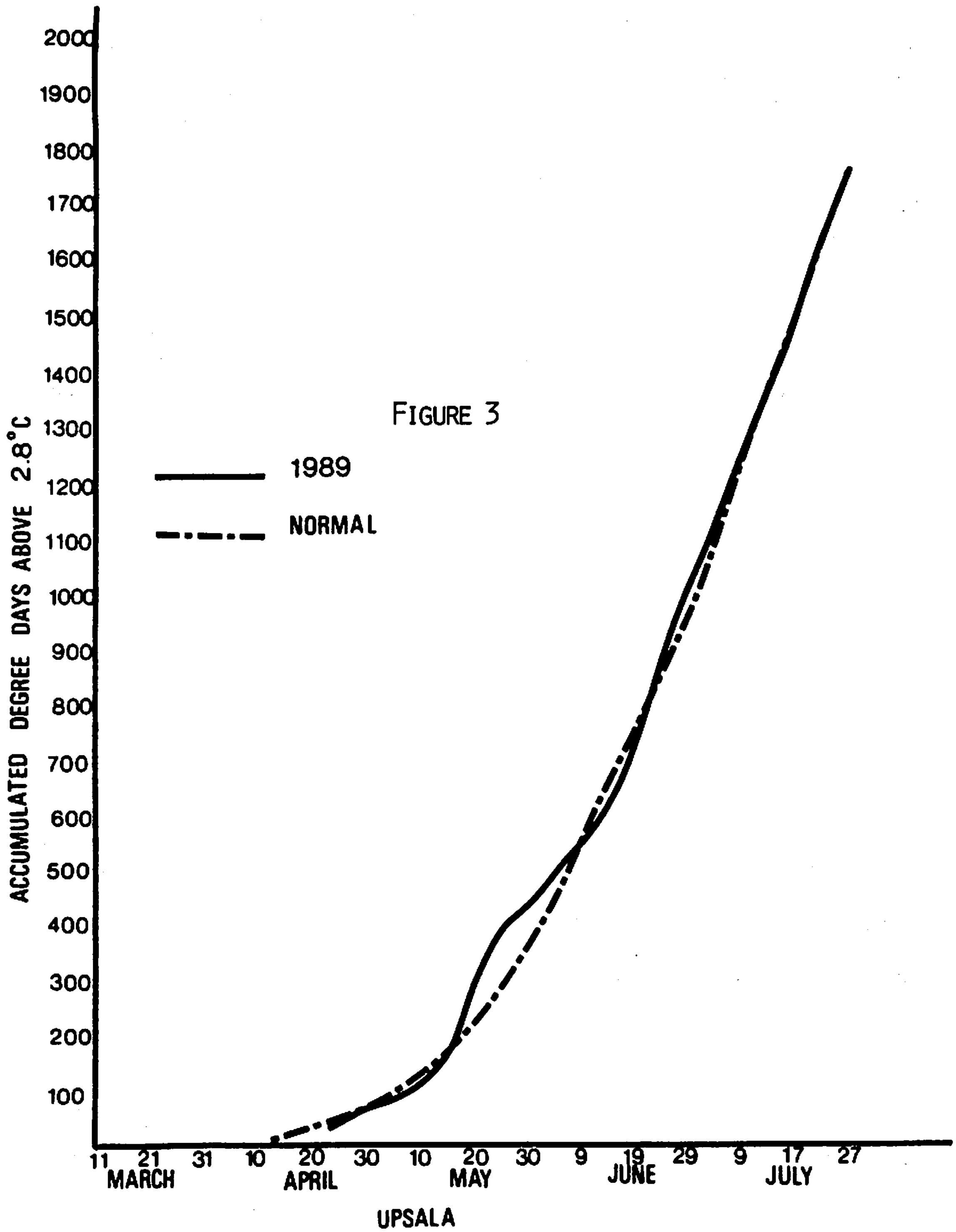
Eventually 44 locations were sampled and $L_2$ densities determined. $L_2$ counts for the 8 locations with the highest densities ranged from 10.4 larvae per branch to 33.0 per branch and averaged 17.6 larvae per branch. Populations of this magnitude have the potential to cause moderate-to-severe defoliation. It was not known whether these numbers represented an increasing, decreasing or stable population since there was no comparable date from 1987. However, these numbers appeared to have potential for increase and spread. OMNR decided to spray the infested area for the purpose of suppressing or reducing populations of jack pine budworm and hopefully preventing further population build up and expansion of the infestation. It was also decided that, in conjunction with the aerial spraying, about 225 ha of the most severely infested area which included the small pocket of defoliation would be harvested by Canadian Pacific Forest Products. The harvesting operation started in April and continued in May until the start of the spraying operation.

A total of 4,763 ha was sprayed in June 1989. The area received three applications of B.t., Futura XLV at a rate of 20 BIU/1.36L/ha (i.e. neat) for each application. Two Ag Trucks equipped with Micronairs were used to apply the B.t.. The first application occurred June 17-19, the second June 22-24 and the third June 28-29. Insect development on these dates is listed in Table 3. The first application was sprayed on third and fourth instars. Heat accumulation based on temperature data from Upsala, about 40 km east of English River lagged behind normal in early May, caught up to normal in mid-May, went ahead of normal by about 6 days by May 24 and fell behind normal by June 7 for the remainder of the month (Fig. 3). Larval emergence started May 23 in the English River area.

A total of 147 plots (jack pine) consisting of 5 trees per plot were sampled to determine pre-spray population densities in areas to be sprayed and untreated (check) area. The pre-spray average larval density in areas to be treated was 1.95 larvae per 61 cm branch sample with highest plot density at 13.8 larvae/61 cm branch tip. For untreated areas, the pre-spray average density was 1.31 larvae per 61 cm branch tip with the highest count being 8.8 larvae per 61 cm branch

Table 3. Jack pine budworm larval development at English River spray block, Thunder Bay District, 1989.

| Spray dates | Development date | Stage (%) II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| 1st Application June 17-19 | June 17 | 4 | 40 | 56 | 0 | 0 |
| | June 19 | 7 | 23 | 65 | 5 | 0 |
| 2nd Application June 22-24 | June 22 | 0 | 3 | 24 | 53 | 20 |
| 3rd Application June 28-29 | June 27 | 0 | 11 | 17 | 39 | 33 |
| | June 29 | 0 | 16 | 31 | 29 | 24 |




Heat accumulation in degree days for Upsala Ontario, 1989 tip. The post-spray sampling intensity was increased but, nevertheless, no living insects were found on 725 branch samples in the treated area compared to two pupae on 362 branch samples from the checks. The two pupae were found on samples from 11 trees in the spray block that were felled and covered with plastic sheeting shortly before the first application to supplement the check plots established outside of the treatment area. Table 4 summarizes the pre- and post-spray data collected to assess the effectiveness of the operation.

Table 4. Jack pine budworm densities (pre-and post-spray), sample size and defoliation in treated and unsprayed areas following a triple application of Futura XLV, each application 20 BIU/1.36L/ha near the English River, Thunder Bay District.

| | Pre | | | Post | | | |
|---|---|---|---|---|---|---|---|
| | n* | Total larvae | $\bar{x}$ | n* | Total pupae | $\bar{x}$ | % Defoliation |
| Spray | 510 | 995 | 1.95 | 725 | 0 | 0 | 5 |
| Check | 225 | 295 | 1.31 | 362 | 2 | .0055 | 4 |

n* = number of 61 cm branch samples

In addition to the pre- and post-spray assessments, several other studies designed to help determine treatment effectiveness were conducted. A bioassay of living larvae picked from foliage in the field, both sprayed and unsprayed, 24-48 hours after the first application had mortality of 32% for sprayed compared to 17% for unsprayed 48 hours after being placed on artificial diet. A similar bioassay following the third application had a mortality of 58% for larvae from sprayed foliage compared to 24% for larvae from unsprayed foliage.

Forty one of the pre-spray assessment plots were sampled (5-61 cm branch tips per plot) between the second and third application on June 25-26 (2-4 days after the 2nd application). A total of 205 branches were examined in the field. Forty-five per cent of the branches had live larvae present with an average density of 1.4 larvae per branch.

Although a huge amount of slash was generated by the harvesting operation, intensive monitoring in late May and June did not detect any living larvae. The slash was extremely dry and larvae either did not emerge or could/did not feed on this material.

In July, pheromone traps were set out at 22 locations, two traps per location. Lures were obtained from New Brunswick Research Productivity Council with the assistance of Dr. C.J. Sanders, GLFC. Eleven of the locations were in the treatment area, 11 were outside. Overall, 7.4 moths were caught per trap, 5.1 per trap in the sprayed area, 9.6 per trap in the unsprayed area. The highest catch was 72 in an unsprayed location, the next highest was 26, also not sprayed. Six traps were empty and moths were not trapped at two locations. Again, because baseline or comparative information is lacking, it is difficult to interpret the significance of this data.

Aerial surveys in mid-July did not detect any defoliation which was substantiated by ground surveys throughout the area which recorded only trace levels of defoliation. Egg-mass surveys in August found 14 egg-masses at 32 locations on a total of 192 branches. The highest count was a total of 4 egg-masses on 6-61 cm branch tips. $L_2$ samples will be collected in November, 1989 to obtain data comparable to fall/winter 1988/89.

Was the objective of the project achieved? It would appear from all of the available evidence, that the B.t. treatments killed jack pine budworm larvae, but it would also seem that B.t. affected larvae were destined to die from other causes in any event. As the numbers indicate, populations of unsprayed larvae virtually collapsed. Nevertheless, the threat of a potential infestation has ceased for whatever reason. The unpredictable nature of jack pine budworm populations is again emphasized by these events.

# GYPSY MOTH IN ONTARIO, 1989[1]

- Outbreak Status, 1989
- Forecasts, 1990
- Results of Spraying Operations, 1989

by

G.M. Howse[2] and J.J. Churcher[3]

[1] Report prepared for the Seventeenth Annual Forest Pest Control Forum, Ottawa, November 14-15, 1989.

[2] Forestry Canada, Ontario Region, Great Lakes Forestry Centre, Sault Ste. Marie.

[3] Ontario Ministry of Natural Resources, Forest Health and Protection Section, Sault Ste. Marie.

## OUTBREAK STATUS, 1989

The area of moderate-to-severe defoliation by this defoliator increased substantially for the second consecutive year in 1989. Altogether, some 81,640 ha of defoliation were mapped in southern Ontario, up from 29,693 ha last year (Fig. 1, Tables 1, 2 and 3).

Much of the increase occurred in the Eastern Region, particularly in Tweed District, where the area affected doubled to about 39,000 ha; in Napanee District, where the area affected more than doubled to about 15,000 ha; and Brockville District, where a six-fold increase brought the area affected to 12,250 ha.

A four-fold increase (to 4,071 ha) occurred in Lindsay District of the Central Region. Increases were also recorded in all other districts affected with the exception of the Carleton Place and Bancroft districts, where small decreases were recorded. The infestation pattern consisted of clusters of small patches of defoliation ranging in size from a few to about 2,000 ha rather than large contiguous areas of damage. This pattern of defoliation occurred across most of southern Tweed District and extended southwest into the western half of Napanee District. Generally smaller pockets of defoliation were recorded in the adjacent southwestern corner of Lindsay District. Here, clusters of pockets of defoliation were centered south of Rice Lake, including a number of islands in the eastern end of Rice Lake; north of the eastern end of Rice Lake, mainly in Asphodel Township; and southwest of Peterborough, centered on the Frazerville area. A sizable pocket of moderate-to-severe defoliation was mapped in the Buckhorn area of Harvey Township on the Lindsay-Minden district boundary. Pockets of defoliation were recorded along the northern shore of the St. Lawrence River in western Brockville District, where the largest single pocket of defoliation (7,127 ha) was mapped in the Ivy Lea-Butternut Bay areas. Hardwoods, mainly oak (*Quercus* spp.) were also damaged on a number of islands in the St. Lawrence River, including Grenadier, Hill and Stove islands. A cluster of pockets of defoliation also occurred in the Jones Falls area of Brockville District. In Carleton Place District, a number of small patches of defoliation were located in the Bennett Lake area of Bathurst Township and several somewhat larger pockets were mapped in the area of Darling and Pakenham townships. In Pembroke District, a sizable pocket of moderate-to-severe defoliation was mapped north of Golden lake in North Algona Township and several small pockets of damage were also mapped in Burns, Richards, Frazer and Wilberforce townships.

In southwestern Ontario, a major increase in population levels was evident in Simcoe District and, to a lesser extent, in Niagara District. In Simcoe District, the area of moderate-to-severe defoliation increased from 240 ha in 1988 to 4,807 ha of which was located in the area northwest of Turkey Point between the towns of Cultus and Simcoe. Infestation in Niagara District increased from 28 to 2,177 ha. Most of the defoliation occurred south of Welland and in Ridgeville, both in Pelham Township. Smaller areas of defoliation were mapped along the Grand River, west of Dunnville, south of Winslow and south of Silverdale.

Elsewhere, a single pocket of heavy infestation straddled Hwy 400 in King Township, Maple District and caused moderate-to-severe defoliation of 370 ha. A small area of defoliation was also observed adjacent to the city of Barrie in Vespra Township, Huronia District. Reports have been received of a general gypsy moth population increase in southern Ontario, with small numbers of larvae and light defoliation in many areas.

Table 1. Gypsy moth infestations in Ontario, 1981-1989.

| Year of infestation | Gross area of moderate-to-severe defoliation (ha) |
|---|---|
| 1981 | 1,450 |
| 1982 | 4,800 |
| 1983 | 40,954 |
| 1984 | 80,624 |
| 1985 | 246,342 |
| 1986 | 167,776 |
| 1987 | 12,678 |
| 1988 | 29,693 |
| 1989 | 81,640 |

## FORECASTS, 1990

Egg-mass surveys were carried out by Forestry Canada as part of a spray evaluation program in southern Ontario (Tables 4 and 5) but are not sufficient to make accurate predictions over a widespread area. However, based on the upsurge of the last two years, the small amount of egg-mass data and other types of information, it is expected that an increase to over 100,000 ha of moderate-to-severe defoliation can be expected in 1990. It should be noted that the Ontario Ministry of Natural Resources conducted an extensive egg-mass survey in southern Ontario this fall but final results are not yet available.

Table 2. Gross area (ha) of moderate-to-severe defoliation by the gypsy moth in Ontario, 1985-1989.

| Region | District | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| Eastern | Tweed | 172,232 | 73,525 | 3,329 | 16,089 | 39,096 |
| | Napanee | 58,326 | 57,780 | 4,781 | 6,198 | 15,001 |
| | Carleton Pace | 4,197 | 13,386 | 1,355 | 3,918 | 2,634 |
| | Brockville | 11,232 | 22,283 | 2,099 | 1,865 | 12,250 |
| Algonquin | Pembroke | 90 | 221 | 0 | 124 | 1,154 |
| | Bancroft | 240 | 164 | 111 | 370 | 15 |
| | Minden | 0 | 0 | 0 | 0 | 65 |
| Central | Lindsay | 25 | 417 | 888 | 861 | 4,071 |
| | Niagara | 0 | 0 | 0 | 28 | 2,177 |
| | Maple | 0 | 0 | 0 | 0 | 370 |
| Southwestern | Simcoe | 0 | 0 | 115 | 240 | 4,807 |
| Total | | 246,342 | 167,776 | 12,678 | 29,693 | 81,640 |

Table 3. Gross area (ha) of moderate-to-severe defoliation by the gypsy moth, 1986-1989.

| County | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|
| York[a] | 0 | 0 | 0 | 370 |
| Northumberland | 1,430 | 2,131 | 5,341 | 8,231 |
| Peterborough | 179 | 167 | 565 | 3,045 |
| Hastings | 11,668 | 4,511 | 5,625 | 22,262 |
| Lennox and Addington | 8,627 | 407 | 10,007 | 12,660 |
| Prince Edward | 540 | 0 | 0 | 340 |
| Frontenac | 109,442 | 1,775 | 1,861 | 11,625 |
| Leeds | 22,283 | 2,099 | 1,865 | 12,250 |
| Lanark | 13,356 | 1,355 | 3,918 | 2,590 |
| Ottawa-Carleton[a] | 221 | 0 | 0 | 44 |
| Durham[a] | 0 | 118 | 51 | 50 |
| Haldimand-Norfolk[a] | 0 | 115 | 240 | 4,937 |
| Victoria | 0 | 0 | 68 | 35 |
| Renfrew | 0 | 0 | 124 | 1,154 |
| Niagara[a] | 0 | 0 | 28 | 2,047 |
| Total | 167,776 | 12,678 | 29,693 | 81,640 |

[a] regional municipality

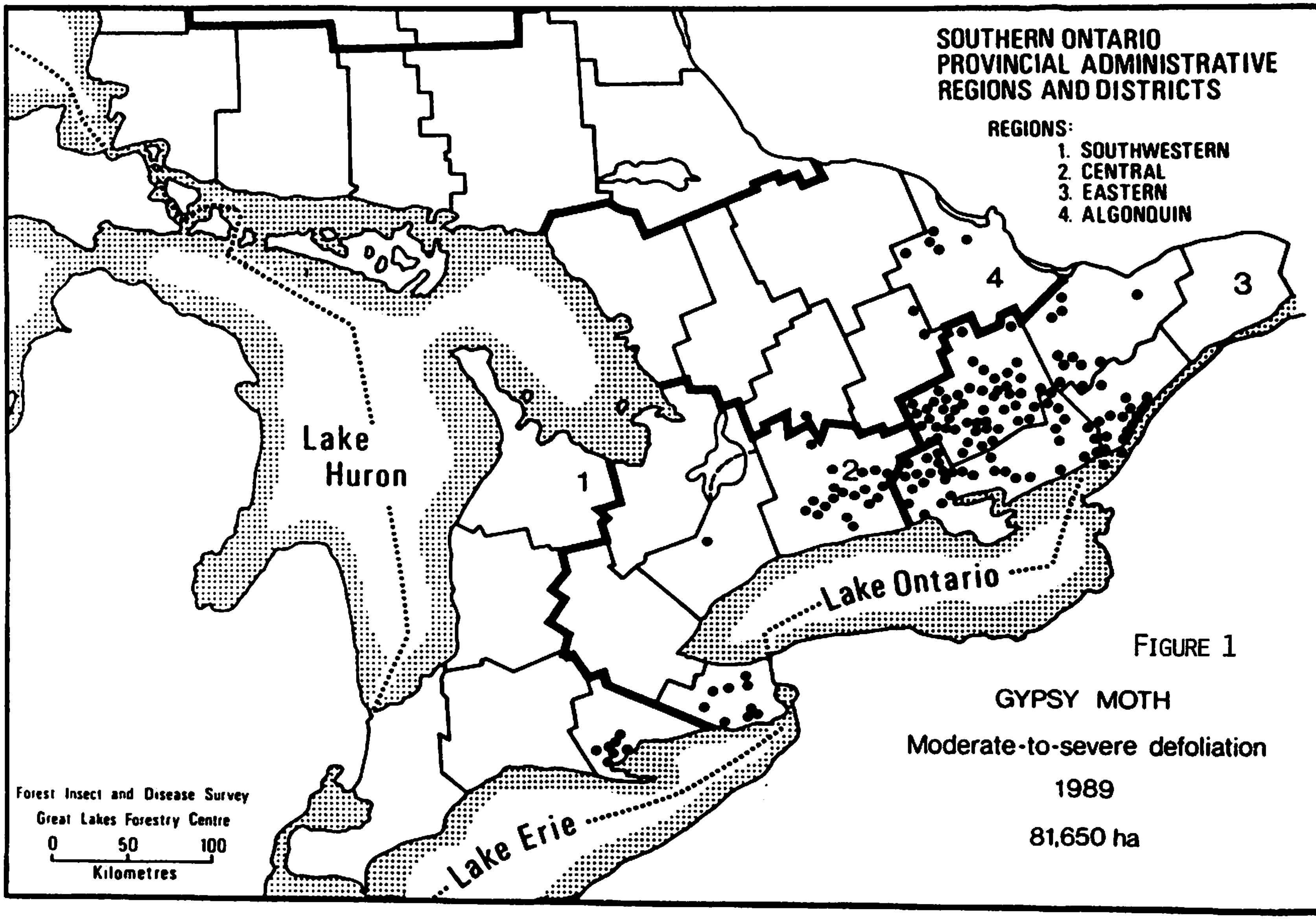



FIGURE 1

GYPSY MOTH

Moderate-to-severe defoliation

1989

81,650 ha

Table 4. Gypsy moth: Comparison of egg-mass densities in 1988 and 1989 in southern Ontario.

| District | No. plots[1] | Average egg-masses per .01 ha 1988 | Average egg-masses per .01 ha 1989 | % Change |
|---|---|---|---|---|
| Bancroft | 12 | 108 | 3 | -97 |
| Brockville | 23 | 133 | 73 | -45 |
| Carleton Place | 36 | 81 | 60 | -25 |
| Lindsay | 10 | 81 | 22 | -73 |
| Napanee | 15 | 33 | 11 | -67 |
| Niagara | 23 | 97 | 292 | +202 |
| Simcoe | 30 | 181 | 355 | +96 |
| Tweed | 22 | 184 | 19 | -89 |
| Overall | 171 | 118 | 129 | +9 |

[1] includes 104 plots sprayed with *B.t.* in 1989.

Table 5. Gypsy moth: Egg-mass counts in sprayed and unsprayed areas in southern Ontario in 1988 and 1989.

| | Sprayed | | | | Unsprayed | | | |
|---|---|---|---|---|---|---|---|---|
| District | No. plots | Average egg-masses per .01 ha 1988 | Average egg-masses per .01 ha 1989 | % Change | No. plots | Average egg-masses per .01 ha 1988 | Average egg-masses per .01 ha 1989 | % Change |
| Bancroft | 5 | 73 | 5 | -93 | 7 | 133 | 2 | -99 |
| Brockville | 12 | 111 | 19 | -83 | 11 | 157 | 131 | -17 |
| Carleton Place | 27 | 85 | 72 | -15 | 9 | 70 | 27 | -62 |
| Lindsay | 5 | 56 | 15 | -73 | 5 | 107 | 30 | -72 |
| Napanee | 10 | 34 | 10 | -69 | 5 | 31 | 12 | -62 |
| Niagara | 20 | 103 | 261 | +154 | 3 | 57 | 501 | +778 |
| Simcoe | 10 | 175 | 94 | -46 | 20 | 183 | 485 | +164 |
| Tweed | 15 | 187 | 25 | -87 | 7 | 176 | 7 | -96 |
| Overall | 104 | 108 | 86 | -21 | 67 | 135 | 196 | +45 |

## RESULTS OF SPRAYING OPERATIONS, 1989

In 1989, the Ontario Ministry of Natural Resources aerially sprayed a total of 12,951 ha comprised of 1,176 ha of Crown land and 11,775 ha of private land. Spraying of Crown land which was primarily provincial but also included a small area of federal land (St. Lawrence Islands National Park and Indian Reserves) was done in the Simcoe, Tweed, Carleton Place and Brockville districts. Private-land spraying occurred in the Niagara, Lindsay, Bancroft, Tweed, Napanee, Carleton Place and Brockville districts. The purpose of spraying was to minimize defoliation as much as possible.

Gypsy moth egg-masses from proposed spray areas are checked each spring to determine overwintering survival. Cold winter temperatures and a lack of snow cover may kill a high proportion of eggs thus changing the necessity for protection. Seven locations were sampled in April 1989. The proportion of egg-masses producing larvae and the average number of larvae hatching at each location is presented in Table 6. Survival of egg-masses laid on the ground was high (i.e. 92%) and the proportion of eggs producing larvae was also high (i.e. 81%). Survival of egg-masses laid above ground level on the boles of trees was generally high except for the Perth and Darling Township sites, Carleton Place District where survival was low. The average size of egg-masses was greatly reduced at Kaladar, both for egg-masses on the ground and on boles. Larvae produced per egg-mass from boles was very low at Darling Township. A comparison of egg-mass hatch from 1983 to 1989 (Table 7) shows that egg-mass hatch in 1989 was relatively normal but egg-mass size and larvae per egg-mass for egg-masses on the ground were reduced 22% and 30%, respectively, compared to the previous year. Larval survival for egg-masses on the ground was the lowest for the seven years of records.

The aerial sprayers worked from six airstrips at Simcoe (Delhi Township), Niagara (Welland-Port Colbourne Airport), Rice Lake, Arnprior, Westport and Gananoque and two mobile units, Rice Lake and Tweed. Three helicopters (Bell 206 B's) and a variety of fixed-wing aircraft including Ag Cats, an Ag Truck and Pawnees were used. The insecticide used was *Bacillus thuringiensis* (*B.t.*), Futura XLV at 30 BIU/2.03L/ha (neat). All spray blocks received at least two treatments and some areas (Table 8, Lindsay, Tweed and Carleton Place districts) received a third application. The date of spray for representative applications and the development of the insect and host at the time of application is presented in Table 8.

Gypsy moth egg-mass hatch was first observed May 8 in the vicinity of Crowe Lake, west of Marmora, at Simcoe, May 10, and Niagara, May 13. Hatch was observed starting May 16 in eastern locations near Perth and California, Carleton Place District, and May 17 at Kaladar, Tweed District. 1989 was one of the latest years on record as far as egg hatch is concerned. A cooler than normal trend prevailed for the last three weeks of April and the first two to three

Table 6. Gypsy moth: Overwintering egg survival in southern Ontario, 1989.

| Location | Egg-mass hatch (%) | | Eggs per mass ($\bar{x}$) | | Larvae per egg-mass ($\bar{x}$) | |
|---|---|---|---|---|---|---|
| | Ground | Bole | Ground | Bole | Ground | Bole |
| Simcoe | 100 | 100 | 258 | 310 | 207 | 225 |
| Belmont Twp | 96 | 100 | 194 | 249 | 173 | 174 |
| Brighton Twp | 96 | 100 | 232 | 254 | 162 | 182 |
| Ivy Lea | 100 | 100 | 228 | 285 | 212 | 247 |
| Kaladar | 84 | 72 | 114 | 150 | 103 | 94 |
| Perth | 84 | 52 | 232 | 298 | 147 | 213 |
| Darling Twp | 84 | 16 | 228 | 178 | 197 | 20 |
| Overall | 92 | 77 | 218 | 247 | 177 | 165 |

Table 7. Gypsy moth: Overwintering egg survival from 1983 to 1989 in southern Ontario.

| Year | Egg-mass hatch (%) | | Eggs per mass (x) | | Larvae per egg-mass (x) | |
|---|---|---|---|---|---|---|
| | Ground | Bole | Ground | Bole | Ground | Bole |
| 1983 | 100 | 100 | 285 | 241 | 274 | 223 |
| 1984 | 96 | 22 | 356 | 354 | 327 | 40 |
| 1985 | 84 | 45 | 375 | 276 | 315 | 125 |
| 1986 | 99 | 89 | 259 | 270 | 247 | 166 |
| 1987 | 98 | 48 | 217 | 285 | 207 | 108 |
| 1988 | 96 | 66 | 280 | 232 | 252 | 161 |
| 1989 | 92 | 77 | 218 | 247 | 177 | 165 |

Table 8. Gypsy moth: Spray application dates and insect and host development at start of spray, 1989.

| Location | Application | Spray dates | % Larval instar I | II | III | IV | V | VI | % Host Development r0 | w0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Simcoe District | | | | | | | | | | |
| Backus Woods | 1 | June 1 | 20 | 79 | 1 | | | | 53 | 51 |
| | 2 | June 6 | 2 | 35 | 63 | | | | 73 | 67 |
| Niagara District | 1 | June 1, 2 | 7 | 84 | 9 | | | | 65 | 71 |
| | 2 | June 7, 8 | | | 33 | 66 | 1 | | 71 | 89 |
| Lindsay District | | | | | | | | | | |
| Northumberland County | 1 | May 27-June 5 | 50 | 50 | | | | | 61 | 57 |
| | 2 | June 5-12 | | 31 | 69 | | | | | |
| | 3 | June 12-13 | | | 33 | 66 | 1 | | | |
| Peterborough County | 1 | June 1-7 | 7 | 63 | 29 | 1 | | | 66 | 59 |
| | 2 | June 7, 12 | | 12 | 80 | 8 | | | | |
| Tweed District | | | | | | | | | | |
| Hastings and Lennox and Addington Counties | 1 | May 28-June 4 | 22 | 73 | 5 | | | | 54 | 53 |
| | 2 | June 5-11 | | 3 | 78 | 18 | 1 | | | |
| | 3 | June 12, 13 | | | 26 | 73 | 1 | | | |
| Brockville District | | | | | | | | | | |
| Frontenac County | 1 | May 29-June 8 | 4 | 79 | 17 | | | | 71 | 81 |
| | 2 | June 8-12 | | 4 | 38 | 57 | 1 | | | |
| Leeds and Grenville County | 1 | May 29-June 8 | 6 | 73 | 21 | | | | 64 | 65 |
| | 2 | June 8-14 | | 6 | 51 | 41 | 2 | | | |
| Carleton Place District | | | | | | | | | | |
| Lanark County | 1 | May 29-June 7 | 43 | 56 | 1 | | | | 61 | 65 |
| | 2 | June 8-18 | 2 | 11 | 51 | 27 | 9 | | | |
| | 3 | June 18, 19 | | 5 | 7 | 83 | 5 | | | |

weeks of May depending on specific location. A warming trend started about mid-May and heat accumulation remained behind but parallel to normal in the case of St. Williams or caught up to normal in the Kingston area by June 20 (Figures 2 and 3).

Spraying started May 27 in Northumberland County, Lindsay District with the insects in first and second instars (50:50) and finished June 19 in Carleton Place District when the insects were primarily in fourth instar.

The effectiveness of the aerial treatments was assessed by comparing changes in egg-mass densities and defoliation rates in plots established in sprayed and unsprayed (check) areas. This year's results, Table 9, are mixed and variable and overall not nearly as good as last year's results which were described as "highly effective". However, the 1988 results were unusual in that they were as good as they were. In previous years, foliage protection was generally quite variable and the 1989 results would seem to fit that pattern. There are no obvious reasons for the difference in results for the two years except perhaps the weather. Good foliage protection occurred in a number of situations but conversely, there was poor or no protection in a number of situations with many locations in between.

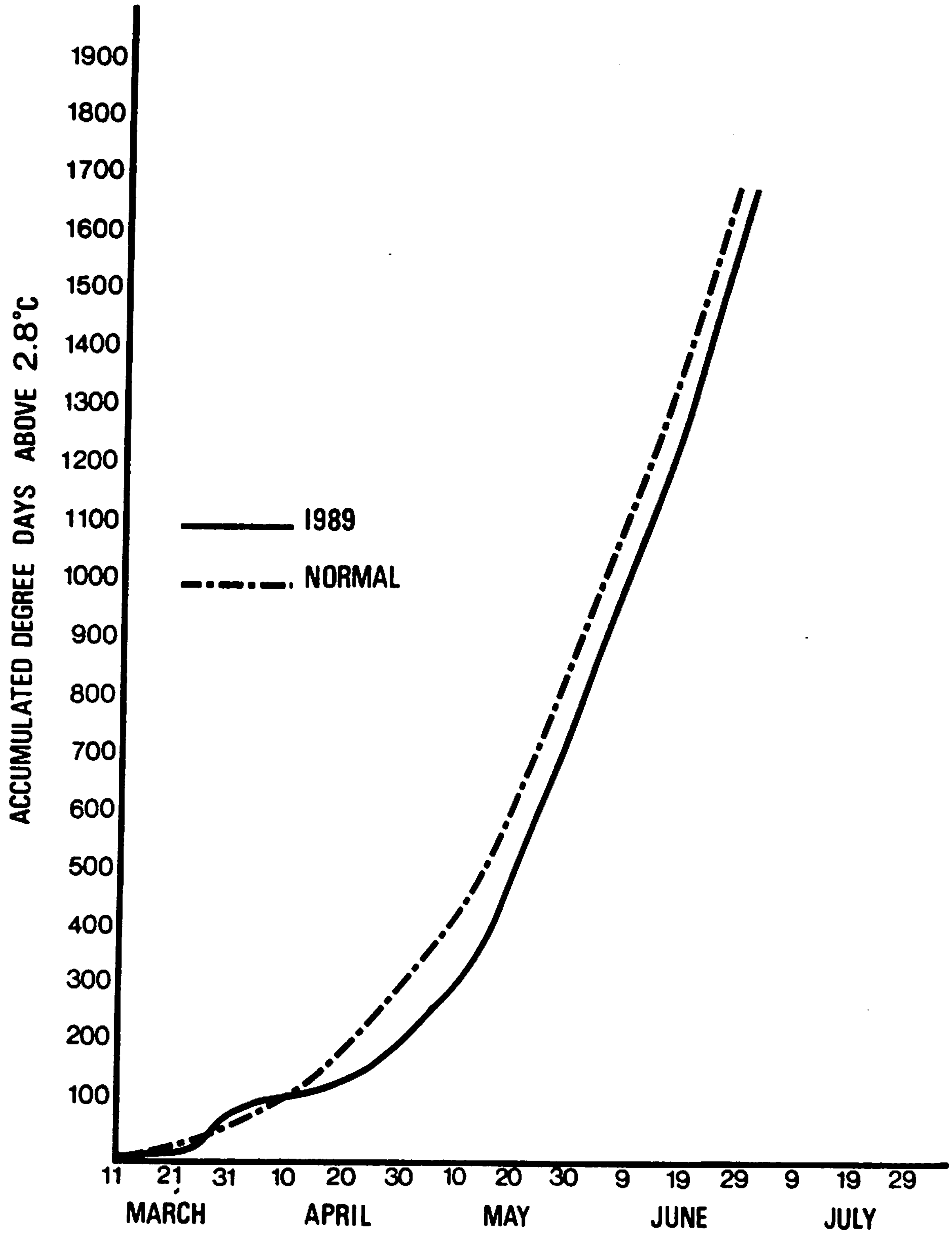



FIGURE 2 ST. WILLIAMS

HEAT ACCUMMULATION IN DEGREE DAYS FOR

ST. WILLIAMS ONTARIO, 1989.

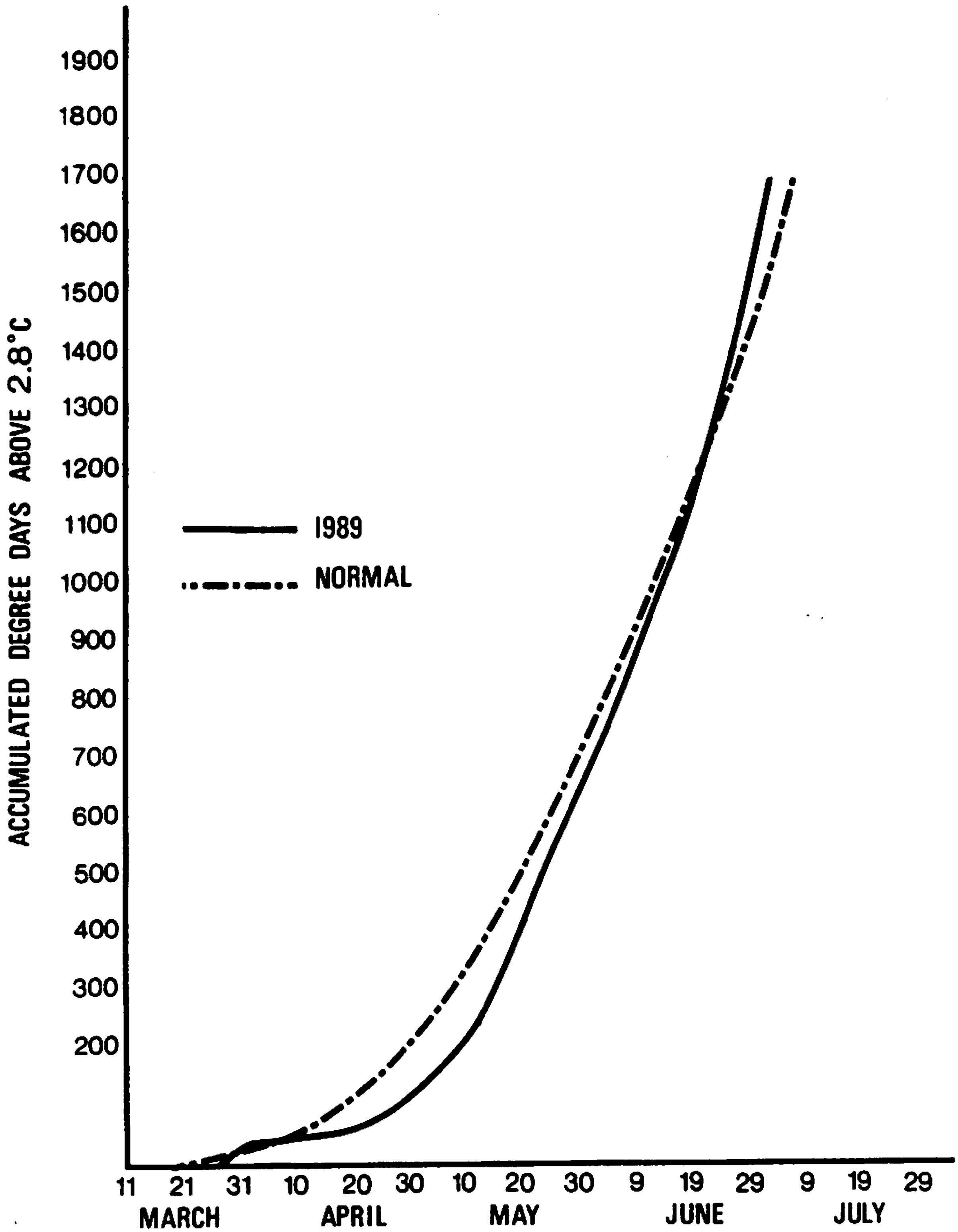



FIGURE 3 KINGSTON

HEAT ACCUMULATION IN DEGREE DAYS FOR KINGSTON ONTARIO, 1989.

Table 9. Gypsy moth: Egg-mass counts and current defoliation in sprayed (2 applications of *B.t.*) and unsprayed plots in southern Ontario, 1989.

| Location | No. of plots | Egg-masses per .01 ha 1988 | Egg-masses per .01 ha 1989 | % Change | % Defoliation rO[a] | % Defoliation wO[b] | % Defoliation sM[c] |
|---|---|---|---|---|---|---|---|
| **Simcoe District** | | | | | | | |
| Backus Woods | 10 | 175.1 | 94.3 | -46 | 62 | 58 | |
| Unsprayed | | | | | | | |
| - Charlotteville Twp | 8 | 102.9 | 817.2 | +694 | 98 | 93 | |
| - Earl Tract | 6 | 116.5 | 205.3 | +76 | 97 | 88 | |
| - Wilson Tract | 6 | 357.3 | 320.7 | -10 | 100 | 96 | |
| **Niagara District** | | | | | | | |
| St. Johns Conservation | 6 | 104.7 | 8.0 | -92 | 39 | 22 | 12 |
| Effingham | 5 | 162.8 | 94.2 | -42 | 82 | 80 | 17 |
| West Lincoln Twp | 5 | 81.4 | 718.0 | +782 | 84 | 51 | |
| West Lincoln Twp | 4 | 51.2 | 277.2 | +441 | 32 | 30 | |
| Unsprayed | | | | | | | |
| - Shorthills Prov. Pk | 3 | 57.0 | 500.7 | +778 | 71 | 62 | 10 |
| **Lindsay District** | | | | | | | |
| Daniels Property | 5 | 55.6 | 14.8 | -73 | 20 | 22 | |
| Unsprayed | | | | | | | |
| - Ganaraska County Forest | 5 | 107.2 | 29.8 | -72 | 23 | 39 | |
| **Tweed District** | | | | | | | |
| Oso Twp | 5 | 83.6 | 23.0 | -72 | 18 | 25 | |
| Sheffield Twp[d] | 5 | 316.4 | 40.6 | -87 | 76 | 71 | |
| Marmora Twp[d] | 5 | 161.6 | 11.6 | -93 | 69 | 38 | |
| Unsprayed | | | | | | | |
| - Oso Twp | 2 | 76.0 | 16.5 | -78 | 22 | 32 | |
| - Kaladar | 5 | 216.4 | 3.4 | -98 | 100 | 100 | |
| **Napanee District** | | | | | | | |
| McIssac Property | 5 | 29.0 | 13.8 | -52 | 45 | 20 | |
| Fox Property | 5 | 38.8 | 7.2 | -81 | 13 | 14 | |
| Unsprayed | | | | | | | |
| - Goodrich Conservation | 5 | 30.8 | 11.8 | -62 | 25 | 19 | |
| **Bancroft District** | | | | | | | |
| Methuen Twp | 5 | 73.0 | 5.2 | -93 | 98 | 97 | 56 |
| Unsprayed | | | | | | | |
| - Methuen Twp | 7 | 133.0 | 1.6 | -99 | 100 | 100 | |

(cont'd)

Table 9. Gypsy moth: Egg-mass counts and current defoliation in sprayed (2 applications of *B.t.*) and unsprayed plots in southern Ontario, 1989 (concl.)

| Location | No. of plots | Egg-masses per .01 ha 1988 | Egg-masses per .01 ha 1989 | % Change | % Defoliation rO[a] | % Defoliation wO[b] | % Defoliation sM[c] |
|---|---|---|---|---|---|---|---|
| **Carleton Place District** | | | | | | | |
| Darling Twp | 8 | 88.8 | 97.1 | +9 | 29 | - | - |
| Darling Twp | 10 | 110.3 | 95.4 | -14 | 58 | 71 | - |
| McGowan Lake | 5 | 32.0 | 17.0 | -47 | 16 | 19 | - |
| Poole Property | 4 | 77.5 | 29.2 | -62 | 22 | 20 | - |
| Unsprayed | | | | | | | |
| - Darling Twp | 7 | 75.7 | 29.3 | -61 | 41 | - | - |
| - Darling Twp | 2 | 48.0 | 17.5 | -64 | 24 | - | - |
| **Brockville District** | | | | | | | |
| Hill Island | 7 | 176.3 | 19.8 | -89 | 18 | 22 | - |
| Charleston | 5 | 20.4 | 18.4 | -10 | 12 | 12 | - |
| Unsprayed | | | | | | | |
| - Lyndhurst | 3 | 150.7 | 63.3 | -58 | 38 | 50 | |
| - Gananoque | 4 | 207.8 | 82.5 | -60 | 78 | 96 | - |
| - Westport Hatchery | 2 | 35.0 | 434.0 | +1140 | - | 64 | - |
| - Hill Island | 2 | 187.5 | 26.5 | -86 | 34 | 42 | - |

[a] rO = red oak except Simcoe District which is black oak

[b] wO = white oak

[c] sM = sugar maple

[d] = received 3 applications.

Report to the Seventeenth Annual
Forest Pest Control Forum

# ONTARIO INSECT CONTROL OPERATIONS, 1989

Geoff Munro & Joe Churcher
Forest Health and Protection Section
Ontario Ministry of Natural Resources

The Ministry of Natural Resources conducted spray operations for the control of three insect species during 1989. The largest was the spruce budworm program, with the gypsy moth and jack pine budworm programs comprising the remaining two. In addition an extensive public information campaign was undertaken to advise on the forest tent caterpillar infestation in Ontario. Details of the control operations are found in the three papers by G.M. Howse and J.J. Churcher found elsewhere in these proceedings (Spruce Budworm in Ontario, 1989; Jack Pine Budworm in Ontario, 1989; and Gypsy Moth in Ontario, 1989).

In 1988 the forest tent caterpillar epidemic covered approximately 3.9 million hectares, mainly along the northern shore of Lake Huron and extending southwards into the Muskokas and cottage-country north of Toronto. A large pocket was also located in the extreme northwest portion of the province. Considerable attention to this pest was expressed by both the public at large and the media, especially in southern Ontario. The Ministry decided not to undertake a spray program for forest tent caterpillar, but instead embark on an effort to make the public aware of the circumstances surrounding this pest.

There were three main messages contained in the information distributed to the public: 1) the anticipated extent of the epidemic for 1989; 2) the biology of the insect, its damage and the effect it will have on the host trees; and 3) effective alternatives should a landowner wish to take action on his or her own property. In conjunction with this, the Ministry instituted a "Good Neighbour Policy" whereby Crown land adjacent to private property being sprayed could also be treated at the expense of the landowner(s). Under this policy any treatment required the use of B.t.

As expected the infestation increased dramatically in 1989 to cover 7.9 million hectares. In spite of this, the majority of calls received at Ministry offices expressed thanks for the information received, requested further information or looked specifically for additional homeowner control options. This was in dramatic contrast to the tone of the calls received in 1988.

As could have been predicted, the Sarcophagid fly population increased significantly towards the end of the caterpillar's life cycle. This common parasite of the tent caterpillar, while harmless, caused some concern to certain members of the public. In retrospect this aspect of the natural rise and fall of forest tent caterpillar infestations could have been stressed in the information campaign.

# NORTHWEST REGION

## STATUS OF IMPORTANT FOREST PESTS AND

## EXPERIMENTAL CONTROL PROJECTS

Prepared for the

Seventeenth Annual Forest Pest Control Forum

November 14 - 16, 1989

Ottawa

Presented by:

H.F. Cerezke
Northern Forestry Centre
Edmonton, Alta.

Contributors:

P. Amirault
J. Emond
H. Gates
M. Grandmaison
H. Ono
B. Pope
G. Still
C. Tidsbury

## STATUS OF IMPORTANT PESTS

This report summarizes information on the current status of major damaging forest pests within the Prairies/NWT region. Mention is also made of several lesser important pest species because of their damage in localized areas or new infestation records. Not included here are major forest disease problems, the status of which is fairly well known and remain relatively stable from year to year. In this category are included pine stem rusts, dwarf mistletoe, Armillaria root rot diseases, and various stem decays and Hypoxylon canker disease of aspen. Some of these disease problems are currently being managed under provincial programs and will be reported on by provincial representatives at this meeting. Additional information on pest conditions in the region can be obtained in the 1989 regional Forest Insect and Disease Survey Report now in preparation.

### Forest Tent Caterpillar

The current outbreak of the forest tent caterpillar continued in all three prairie provinces, covering a composite land area of about 10.2 mil ha, or about 2.3 mil ha of actual aspen forests severely defoliated. This represents an almost 50% decrease in size of outbreak area evident in Alberta and Saskatchewan, but a 6-fold increase in Manitoba. This is the third year of increasing trend in Manitoba, with several new infestations appearing in the Interlake area, north of Lake Winnipeg, and in western Manitoba adjacent to Lake Winnipegosis. Some of the defoliation in the western infestation areas was largely contributed by the large aspen tortrix. An estimated total 325,045 ha was defoliated by the forest tent caterpillar and about 18,650 by the large aspen tortrix.

Several areas defoliated in Alberta and Saskatchewan by the forest tent caterpillar and other lepidopterous feeders produced new foliage by mid-July but were skeletonized by high populations of the aspen leaf beetle, Chrysomela crotchi Brown. The impact of this double injury on aspen trees during the same season is unknown.

Egg band surveys conducted cooperatively with Manitoba Natural Resources suggest a declining trend in northern Manitoba in 1990. Egg band surveys in Saskatchewan and Alberta also indicate some areas of further decline in 1990, but results are still incomplete. Starvation and high incidence of virus disease and parasitism were commonly observed in several infestation areas in Alberta.

Control of the forest tent caterpillar was undertaken in several counties in central Alberta with Bt, to alleviate the nuisance aspect of crawling caterpillars. Due to increasing utilization and management of aspen forests in the Boreal Mixedwood, associated insect and disease pests are being looked at more closely. Alberta is presently considering a project proposal to evaluate existing research information to help define long term management strategies.

## Spruce Budworm

**Spruce budworm** infestations were recorded in all three prairie provinces and in the Northwest Territories, mostly within the same areas as reported in 1988. However, increases over last year occurred in all four jurisdictions, indicating a rising trend over a large geographical area. In the **NWT**, infestations extended along the Liard and Slave Rivers and generally intensified. Some of the increased area of infestation reported this year along the Liard River is due to increased accuracy of mapping, reflecting the increased emphasis now being placed on the forest resource. Almost 99,000 ha of spruce forests are estimated to be affected.

In **Alberta**, one new area of infestation was reported in the Peace River Forest, extending over about 1000 ha, while two other areas (in the Footner Lake and Lac La Biche Forests) showed substantial increases, covering about 83,000 ha. Egg mass surveys have been undertaken by the provincial Forest Service in four of the northern infestations, and results todate in three of the areas generally indicate a continuation of the outbreak trend with moderate to severe defoliation expected in 1990.

An aerial control test was undertaken for the first time by the Alberta Forest Service in an infestation along the Peace River (Grande Prairie Forest District), mainly as an experimental trial to gain experience in procedure and, at the same time test the application of **Bt** as a potential management tool in the northern Mixedwood forests. About 1000 ha was sprayed with Dipel 176 on June 17. The pre- and post-spray assessments were conducted cooperatively by the Alberta Forest Service and Forestry Canada. The control results and foliage protection were considered only partly successful, due mainly to the late date of application. However, the results and technical experience provided valuable training for implementing into other spruce budworm or other pest outbreak areas if the need arises. The Bt aerial spray trial suggested that the window of application in the northern Boreal forest is narrower than in eastern Canada. The approximate cost of the application was $20.00 per ha (included Dipel, application contract and helicopter time for the application and pre- and post-assessment surveys). Additional Bt trials will likely be considered again in 1990. This outbreak has persisted for about five years and considerable top-kill as well as some understory mortality is now evident.

In **Saskatchewan**, a slight increase in area of infestaion over last year was reported, due in part to the discovery of three new small infestations in the west-central part of the province. Other areas of infestation remained essentially unchanged. The total areas of defoliation were estimated as 34,650 ha. No egg mass surveys were undertaken to predict the status for 1990. Some salvage cutting was continued in the older outbreak areas in the east-central part of the province.

In **Manitoba**, the overall areas of infestation increased from 33,670 ha in 1988 to about 58,000 ha this year. Nearly all of the increases occurred in the eastern part of the province adjacent to the Ontario border and in the Interlake area where about 9,600 ha of spruce-fir forests were defoliated. Defoliation predictions for 1990, based on egg mass surveys at 13 locations in the province, indicate similar infestation levels as in 1989. Areas predicted to have severe defoliation include Whiteshell Provincial Park and an area north near Wanipigow Lake. Additionally, of the 14 sites where pheromone-baited traps were placed out this year, highest moth counts per trap were recorded in the Whiteshell Provincial Forest and the Wanipigow site. Spruce budworm pheromone-baited traps have been deployed in essentially the same 14 sites in Manitoba since 1985. Trends in moth captures from 1985 to 1989, when summarized by the four provincial Forest Regions, all follow a similar pattern.

Control applications for spruce budworm were undertaken by Manitoba Natural Resources over some 4900 ha. Details of these operational controls are reported elsewhere.

## Jack Pine Budworm

No infestations were reported this year except a few ha near central Alberta. However, monitoring was continued in Manitoba by the Natural Resources personnel using pheromone baits.

## Mountain Pine Beetle

Infestation areas of concern occurred in Kootenay National Park where an estimated 19,720 (estimated by FIDS at PFC) recent mountain pine beetle-killed lodgepole pine trees were mapped, and at least 600 or more in over 400 sites in southwestern Alberta (mapped by Alberta Forest Service). Several of the recent "beetle-killed" trees in southwestern Alberta were examined from the ground and were apparently attacked in 1987 and 1988 (ie., strip attacks); many of these did not begin fading until late July, 1989. Their mortality does not appear to be adequately explained solely by the mountain pine beetle. Severe frost injury may have been implicated.

The 400+ infestation sites mapped in southwestern Alberta were scattered in the Porcupine Hills, southward to Waterton Lakes National Park and reflect an increase in affected trees compared to the last three years. The increases may be due to immigration of beetles from expanded infestations in adjacent southeastern B.C. (ie., Fernie - Sparwood area).

Semiochemical tree baits were also deployed by the Alberta Forest Service at 13 locations in the southern Bow-Crow Forest and at 12 locations in the Kananaskis Country east of Banff National Park. The baits have been used annually since 1983 as part of the detection and monitoring program. Attacks occurred at 11 of the 13 baiting sites in the southern Bow-Crow Forest and on 9 of the 12 baiting sites in the Kananaskis Country. However, many of the attacks were "pitched out" and unsuccessful and did not necessitate sanitational tree removal. Semiochemical baits deployed in Cypress Hills Provincial Park indicate a continued decline of mountain pine beetle populations in this area of southeastern Alberta.

## Larch Sawfly

Populations causing moderate-severe defoliation of tamarack stands were evident over extensive areas in the Northwest Territories between Liard and Mackenzie Rivers, and extending eastward to the Slave River.

## Large Aspen Tortrix

Extensive defoliation of aspen was noted in association with forest tent caterpillar esspecially in eastern Saskatchewan and western Manitoba (Riding Mountain National Park and Duck Mountain Provincial Park).

## Bruce Spanworm

Extensive defoliation of aspen forests, caused by the Bruce spanworm, occurred in west-central Alberta along the Alberta foothills.

## Leaf Beetles

Two leaf-skeletonizing species, aspen leaf beetle (*Chrysomela crotchi*) and gray willow leaf beetle (*Tricholochmaea decora*) were reported in outbreak population levels throughout much of central and northern Alberta and Saskatchewan. Severe leaf damage was noted on aspen and willow species, caused by the two species respectively.

## Aspen Leaf Diseases

Leaf rust (*Melampsora* sp.) and leaf spot disease (*Marssonina* sp.) incidence occurred commonly throughout central and northern Alberta aspen stands.

## Cankerworms

High populations of fall cankerworm were prevalent in urban centres in the southern parts of the three prairie provinces and caused defoliation to a variety of deciduous species.

## Surveys of Pests and Damage in Genetic and Other High-Value Tree Plantations

Intensive surveys were conducted in several high-value genetic tree plantations in Alberta in which several native and exotic coniferous tree species were planted. Important pests and other damage agents included the following:

- Terminal weevils (*Pissodes strobi*; *P. terminalis*)
- Northern pitch twig moth (*Petrova albicapitana*)
- Yellowheaded spruce sawfly (*Pikonema alaskensis*)
- Warren rootcollar weevil (*Hylobius warreni*)
- Western gall rust (*Endocronartium harknessii*)
- Winter and/or late spring frost damage

## Other Pest Management Programs in Alberta

Dwarf mistletoe: Fifteen permanent sample plots were established in mistletoe-infected lodgepole pine stands to evaluate long term growth impact.

Aerial detection program: Most of the provincial forest staff involved in aerial observations of one kind or another are being trained to observe and report various kinds of forest/tree disturbance, characterized by defoliation, discoloration and mortality.

Staff education & awareness: Awareness of forest insect and disease problems by provincial forest service staff and industry was given a top priority in 1989 through various workshops, seminars and field demonstrations arranged by Forestry Canada. Along with this training, the procedure of processing and identification of insect and disease specimens has been streamlined to provide a faster response to field staff. A monthly newsletter has also been published for field staff to provide timely information. The training demands are likely to increase in 1990.

# FOREST PESTS IN MANITOBA

# 1989

PREPARED FOR THE

17TH ANNUAL FOREST PEST CONTROL

FORUM

NOVEMBER 21-23, 1989

OTTAWA

PRESENTED BY:

A.R. WESTWOOD
FORESTRY BRANCH
MANITOBA NATURAL RESOURCES
WINNIPEG, MANITOBA

CONTRIBUTORS:

Y. BEAUBIEN
T. BOYCE
L. CHRISTIANSON
K. KNOWLES
M. SLIVITSKY
I. PINES

## SPRUCE BUDWORM

The spruce budworm (*Choristeneura fumiferana*) infestation in eastern Manitoba increased in size in 1989. Approximately 58,000 ha of white spruce and balsam fir suffered moderate to severe defoliation within the Abitibi-Price Forest Management License, Nopiming and Whiteshell Provincial Parks. An aerial spray program was implemented over an area of 4,984 ha of which 1,003 ha was high use recreational forest in Whiteshell and Nopiming Parks and 3,981 was commercial forest within the Abitibi-Price F.M.L.

### PRE-SPRAY SURVEY

The pre-spray survey was carried out through the period of May 21-25, 1989. This survey confirmed the necessity for insecticide application. Both larval development and shoot development were assessed in white spruce and balsam fir. Pre-spray populations were as follows:

| Location | Larvae per 45 cm of Branch |
|---|---|
| Nopiming Provincial Park | 10 |
| Falcon-Westhawk Lakes | 5 |
| Dorothy Lake | 12 |
| Abitibi-Price F.M.L. | 17 |

The earliest spray blocks were opened on May 29, coinciding with a larval development index of 3.5 and a shoot development index of 4.0 (Auger's Class).

### Application

*Bacillus thuringiensis* (Dipel 8L) was applied undiluted at 30 B.I.U. per hectare at a rate of 1.77 litres per hectare in a single application. Two Thrush Commanders equipped with six Micronair rotary atomizers were employed for the application. Swath width was 70 meters and a Cessna 172 was employed for navigation. Spray operations were carried out between May 30 to June 4 inclusive.

### Post-Spray Survey

The post-spray survey was carried out June 12 to 16, 1989. Larval reductions due to insecticide (using Abbott's formula) averaged approximately 30% over the spray blocks. Defoliation assessments of spruce and fir indicated foliage protection as follows:

| | % Defoliation | |
|---|---|---|
| Location | Treated Area | Untreated Area |
| Nopiming Park | 25 | 35 |
| Falcon-Westhawk Lake | 5 | 45 |
| Dorothy Lake | 5 | 25 |
| Abitibi-Price F.M.L. | 50 | 70 |

## 1990 Predictions

Egg mass surveys were carried out in white spruce and balsam fir during September 1989 to predict spruce budworm defoliation for 1990 in south eastern Manitoba. Populations are expected to be reduced in Nopiming and Whiteshell Provincial Park areas, with light to moderate defoliation predicted. Severe defoliation is predicted for most of the Abitibi-Price F.M.L.

## JACK PINE BUDWORM PHEROMONE STUDY

Since the 1984-1985 outbreak, jack pine budworm (*Choristeneura pinus pinus*) populations in Manitoba have remained at endemic levels throughout the province. The usual method of monitoring has included branch collection and assessment for egg masses. An alternate technique for detection employing pheromone traps has been field tested since 1985.

Pheromone traps were placed at 12 locations throughout the range of jack pine budworm in Manitoba through the period of 1985 to 1989. During the first four years of the trials, three concentrations of pheromone lure and two trap designs were compared. Based on these test results, the 0.03 microgram concentration of the pheromone lure and two trap types (saturating Pherocon 1C and non-saturating Multipher) were tested in 1989. Branches were collected at each location and are currently being assessed for defoliation, egg masses and staminate buds.

Male moth captures decreased from 1985 through 1987, and have now begun to increase in numbers. The following table shows male moth captures for the 0.03 microgram concentration per location for the Pherocon 1C:

| Location | Total Number of Moths Captured | | | | |
|---|---|---|---|---|---|
| | 1985 | 1986 | 1987 | 1988 | 1989 |
| Sandilands Prov. Forest | 208 | 21 | 5 | 60 | 44 |
| Spruce Woods Prov. Park | 558 | 184 | 184 | 123 | 226 |
| Whiteshell Prov. Park | 50 | 48 | 18 | 28[1] | 19 |
| Belair Prov. Forest | 38 | 43 | 15 | 47 | 13 |
| Nopiming Prov. Park | 133 | 39 | 5 | 44 | 40 |
| St. Martins | 559 | 64 | 2 | 2 | 16 |
| Porcupine Mtn. Prov. Forest | 186 | 7 | 0 | 3 | 7 |
| Moose Lake | 63 | 2 | 0 | 3 | 2 |
| Reed Lake | 46 | 4 | 0 | 1 | 4 |
| Kississing | 76 | 4 | 0 | 5 | 15 |
| Thompson/Wabowden | 31 | 2 | 0 | 7[2] | 5 |
| Lynn Lake | 112 | 1 | 0 | 0 | 0[3] |
| Totals | 2060 | 419 | 229 | 323 | 391 |

1. 50% of traps damaged
2. Plot relocated to Wabowden in 1988
3. Plot destroyed by fire, only 2 traps recovered.

## PINE ROOT COLLAR WEEVIL

Scots pine were planted in 1971 in the Grand Beach area of eastern Manitoba as part of a jack pine mistletoe management program. Initial Scots pine survival was excellent (greater than 80%) and growth was approximately 25 cm per year once trees became established. Beginning in 1981 significant chlorosis and mortality of trees occurred due to root girdling by the pine root collar weevil, *Hylobius radicis*. Permanent sample plots were established in 1983 in four affected plantations to monitor mortality levels due to weevil feeding. Mortality rates in the four plots increased by 37.0%, 9.8%, 25.8% and 27.5% between 1983 and 1989. Total mortality due to weevil feeding in the four plots was 43.3%, 14.9%, 30.9% and 41.8% for the period 1983 to 1989.

The high susceptibility of Scots pine to root collar weevil has made it unsuitable for commercial forestry planting within the range of this insect in Manitoba. Scots pine is a major Christmas tree species grown in Manitoba and should not be planted in the proximity of jack pine forests (the natural habitat of the root collar weevil).

## RENEWED FORESTS - 1989 PEST SURVEY REPORT

Beginning in 1987, 76 renewed forest stands covering 2,686 ha have been surveyed in the Province of Manitoba. In 1989, 7,616 trees were sampled in stands ranging between 6 and 50 years of age (11,662 trees from 1987 to 1989). In 1989, 43 renewed stands totalling 1,694 ha were surveyed in the southeastern and western regions of the province. Five red pine stands (86.8 ha) and 17 jack pine stands (432 ha) were surveyed in the southeast. Six white spruce stands (346.4 ha) and 15 jack pine stands (823.3) were surveyed in the western region. Stands also included naturally regenerated areas.

In the southeastern region red pine has shown significant branch/main stem cankering and tip dieback. Growth loss, mutliple leadering and mortality have resulted in some of the red pine stands. Problems evident on jack pine include western gall rust (*Endocronartium harknessi*), severe j-rooting and main stem cankering, as well as one incidence of chronic pine tortoise scale infestation (*Toumeyella numismaticium*).

The western region has several jack pine plantations with a high proportion of leaning trees. This severe j-rooted condition had resulted from machine planting. High incidence of western gall rust and root collar weevil (*Hylobius warrenii*) in naturally regenerated jack pine stands caused substantial mortality. Other problems included snow, hail, terminal weevil (*Pissodes terminalis*), sapsucker and rabbit damage. White spruce had severe rabbit damage whenever it was overtopped by regeneration, particularly aspen. White pine weevil (*Pissodes terminalis*) damage was significant in some white spruce stands. Trembling aspen showed varying degrees of defoliation by several lepidopterous species and evidence of hypoxylon canker (*Hypoxylon mammatum*).

## DWARF MISTLETOE MANAGEMENT IN MANITOBA

During the winter of 1988-1989, the comprehensive aerial survey for jack pine dwarf mistletoe (*Arceuthobium americanum*) in Manitoba was completed. At present survey results are being used to quantify past volume losses in the province. Operational dwarf mistletoe sanitation projects were carried out in several high-value recreational areas in the winter of 1988-1989. These included sites within Grand Beach Provincial park, Cowan wayside park and Spruce Woods Provincial Park. While no large scale dwarf mistletoe sanitation projects have been initiated since in 1987, clearcut sanitation is performed as a matter of course in most areas.

## ARMILLARIA ROOT ROT

As part of the jack pine dwarf mistletoe management program, red pine, a non-host species was planted on 1,300 ha of jack pine cutovers in the Belair Provincial Forest during the 1970's. The young red pine stands have experienced some mortality due to drought and armillaria root rot (*Armillaria obscura*). In 1983 permanent sample plots were established in five root rot infection centres to monitor armillaria activity. The increase in tree mortality due to armillaria over the past five years in the sample plots has been 17%, 14%, 10%, 3% and 6%. Total tree mortality to date within each plot has been 41%, 35%, 19%, 15% and 19%. Armillaria activity appeared to be at a low level in the infection centres during 1989. Three plots showed no increase in mortality, while two plots had a 1% disease increase.

The presence of armillaria root rot has also been monitored since 1983 in 40 to 50 year old red pine plantations in southeastern Manitoba. Both stumps and standing trees have been included in the assessment. To date armillaria has only been detected in one stump and is absent from standing red pine.

## WESTERN GALL RUST

Western gall rust (*Endocronartium harknessi*) is a disease of jack pine that can lead to serious volume loss, especially when occurring in young plantations. Jack pine currently accounts for 23% of Manitoba Natural Resource's (MNR) planting stock and is projected to increase to 28% by the year 2000. Forestry Canada and MNR have established pedigreed jack pine seed orchards from which jack pine seed requirements for renewal programs in southeastern and eastern Manitoba are to be collected. The western gall rust resistance study was initiated in 1988 to identify jack pine families that where highly susceptible to western gall rust and to exclude them from ongoing jack pine improvement programs.

In 1988 inoculation experiments and a field survey were completed. Seedlings of the selected families from pedigreed seed orchards were inoculated with western gall rust spores and evaluated for symptoms of infection. The original family test replicates were assessed for rust infection at the four test plantations. Through this process techniques for inoculation and rating the degree of disease resistance were established. Data from field surveys strongly indicated the presence of genetic variability in relative resistance to western gall rust amongst the jack pine families.

During 1989 seedlings from selected resistant and susceptible half sibling trees were inoculated along with seedlings from the original family plantings. Western gall rust spores from Alberta, instead of Manitoba, were used in inoculation experiments. Controlled crosses between susceptible and resistant families were postponed until 1990, due to fire restrictions in the Sandilands area. Information gathered on susceptibility to western gall rust will be used to evaluate the families in the current pedigreed seed orchard and to rank families in the province's second generation program.

## DUTCH ELM DISEASE

During the 1989 provincial summer surveillance season, approximately 12,000 elms were examined in and around urban and rural municipalities. A total of 822 were confirmed to have Dutch Elm Disease (DED) and 11,200 were classified as hazards, many of these were dead as a result of DED. Control efforts are primarily concentrated on elms in and around the 43 cost-sharing communities in the DED management program. Trees in wild stands are ignored due to the impracticality of controlling the disease in those areas. Control efforts with cost sharing communities were in the areas of sanitation pruning, basal spraying with chlorpyrifos for control of overwintering elm bark beetles and replacement planting. The province is responsible for all survey and removal of diseased and dead elm trees within cost-sharing communities except those of Brandon and Winnipeg.

Communities with disease included major urban centres e.g. Winnipeg, Brandon, Portage la Prairie, Morden, Dauphin, Selkirk, Steinbach and Winkler. The northwestern disease front is located in Dauphin and around the village of Ste. Rose du Lac (51°N). The disease entered these areas via the Turtle River and Vermillion River tributaries along the eastern escarpment of Riding Mountain National Park. Further west along the Assiniboine River the disease has moved approximately four kilometres northward from St. Lazare.

Although DED continued to increase in wild stands, the incidence of diseased elms in most urban centres with control programs while higher than 1988 still remained comparatively low. Less than two percent of the elms in Winnipeg and Brandon were infected with DED. The severe drought conditions prevailing in southwestern and southcentral Manitoba during 1987 and 1988 have contributed to increased stress on elm trees which has been reflected in higher than anticipated incidence of disease in many areas.

In the City of Winnipeg 1,255 elms were sampled, 3,876 trees were identified and 6875 were marked as hazards in 1989. A total of 10,868 trees are scheduled for removal in the winter months.

Disease levels have increased along southern Manitoba's river systems, especially along the Seine, Red and Assiniboine rivers. Smaller rivers and creeks in southern Manitoba are also experiencing areas of infection and thus endangering shelterbelts in many rural areas. The Souris River in southwestern Manitoba remains extensively infected and DED has spread southward into North

Dakota. DED will most likely be exported into Saskatchewan via the Assiniboine River or by transportation of infected elm firewood.

In western Manitoba the communities of Minnedosa, Virden, Neepawa and Pilot Mound which had been previously infected experienced no disease in 1989. Boissevan, Rivers, Deloraine, Killarney, Reston, Russell and Melita were disease free in 1988 and remain so in 1989. Dauphin experienced its' first disease infection in 1989. Many eastern and central Manitoban communities experienced an increase in disease levels in 1989, while decreases were observed in Stonewall and Ste. Anne.

The most intensive DED sampling was concentrated in July and the first week of August in 1989. From November 1, 1988 to October 31, 1989 the Provincial DED Sanitation crews removed approximately 9,000 trees. In addition, approximately 4,000 decadent elm trees were removed in the Brandon and Souris buffer zones. These removals relied heavily on the use of Corrections and Community Services.

## Status of Forest Insect Pests in

## Saskatchewan - 1989

### Spruce Budworm, Choristoneura fumiferana Clem.

The current outbreak of spruce budworm infestation first appeared in Tall Pines area south of Hudson Bay in 1982. Since then moderate to severe defoliation of scattered white spruce stands still persisted throughout the general area of Porcupine Hills. At present in affected areas are Eldredge and McBride Lakes, Tall Pines, Mann Lake, Usherville and Big Valley. Timber harvesting is in progress in most of the infested areas.

In Red Earth area, northeast of Carrot River, budworm infestation on white spurce was first noticed in 1983. Since then the infestation remained fairly static with moderate to sever defoliation extending northwest towards Carrot River and also extending south of Highway 55 to the Pasqua Hills area. A good portion of the original infestation area north of Highway 55 has been logged, except in the Red Earth Indian Reserve. timber harvesting's still continued in the infested area.

A new outbreak was detected this year in the forest north of Big River around Delaronde, Taggart and Pancake Lake areas. Harvesting operations are already underway in Pancake Lake area. Another infestation was also detected along Monnery River north of Paradise Hill.

### Aspen Defoliators

**Forest Tent Caterpillar, Malacosoma disstria Hbn**
**Large Aspen Tortrix, Choristoneura conflictana (walker)**

The extent of aspen defoliation was similar to that of last year. Forest tent caterpillar was more predominant defoliator. The major outbreak in the west central part of the province extended from Big River and Meadow Lake Provincial Park south towards North Battleford and extended westwards to Saskatchewan - Alberta border. In the east and elsewhere smaller outbreaks were scattered around Smeaton, Nipawin, Green Lake and Duck Lake Provincial Park, Hudson Bay and extended up to Manitoba border.

## Common Tree Insects and Diseases

## in Saskatchewan - 1989

| Insect | Host | Location and Remarks |
|---|---|---|
| Birch leaf miner<br>*Fenusa pusilla* | Birch species | Common throughout forested areas and urban centers. |
| Aspen serpentine miner<br>*Phyllocnistis* sp. | Aspen | Common throughout ~~leaf~~ forested areas and urban centers. |
| Willow leaf miner<br>*Micrurapteryx* sp. | Willow | Common in forest areas. |
| Poplar budgall mite<br>*Aceria parapopuli* | Poplar | In regional parks in southern areas. |
| Poplar vagabond aphid<br>*Mordwilkoja vagabunda* | Poplar | In regional parks in southern areas. |
| Ash plant bug<br>*Tropidosteptes amoenus* | Green Ash | Common throughout. |
| Oak lace bug<br>*Corythucha* sp. | Oak | Welwyn Regional Park. |
| Gray willow leaf beetle<br>*Tricholochmeae decora* | Willow | Common in forest. |
| Aspen leaf roller | Aspen | Common in Southeast. |
| Spruce gall aphid<br>*Adelges cooleyi* | Spruce | Common throughout. |
| Sawflies<br>*Pikonema* sp.<br>*Neodiprion* sp. | Spruce | On planted spruce in parks. |

**Poplar Leaf Beetle**

Poplar leaf skeletonizing was quite sever and widespread in west central part particularly in Glaslyn, Turtleford, Maidstone and St. Walburg area.

**Jack Pine Budworm, Choristoneura pinus Freeman**

The last major outbreak started in 1984, peaked in 1986 and last year (1988) only small patches of defoliation were recorded. This year no incidence of defoliation was noticed.

Madan Pandila
Forestry Branch
Saskatchewan Parks and Renewable Resources
Prince Albert, Saskatchewan

MP/11038902.vmg

# Status of Forest Tree Diseases in Saskatchewan 1989

1. **Needle Rust on Spruce, Chrysomyxa sp.**

   The incidence of needle rust on spurce increased this year throughout the forested area. Moderate to severe infestations were observed in Meadow Lake Provincial park and around Little Fishing Lake in Bronson Forest.

2. **Armillaria root rot, Armillaria sp.**

   Significant tree mortality was observed in old jackpine stands previously heavily infected with jackpine budworm, in Torch River and Fort a la Corne forest east of Prince Albert. Localized but significant mortality in jack pine and white spruce natural regeneration and plantations.

3. **Drought injury**

   Drought injury was not significant in the forest area but in the agriculture zone particularly in the South east, American elm and spurce showed signs of stress from drought.

4. **Western gall rust, Endocronartium haeknessii (J. P. Moore) Y. Hirastsuka**

   Very common at low levels in most of jack pine plantations and natural stands.

5. **Hypoxylon canker, Hypoxylon mammatum (Wahl.) J. H. Miller**

   Very common in natural aspen stands throughout the forest zone.

6. **Chemical injury**

   There were few inquiries regarding mortality or injury to trees and shrubs by agricultural chemicals.

7. **Leaf spot on aspen, Marsonnina sp**

   The leaf spot on aspen was common this year.

8. **Dutch Elm Disease**

   No incidence of DED was reported from Saskatchewan.

Madan Pandila
Forestry Branch
Saskatchewan Parks and Renewable Resources
Prince Albert, Saskatchewan

MP/11028901.vmg

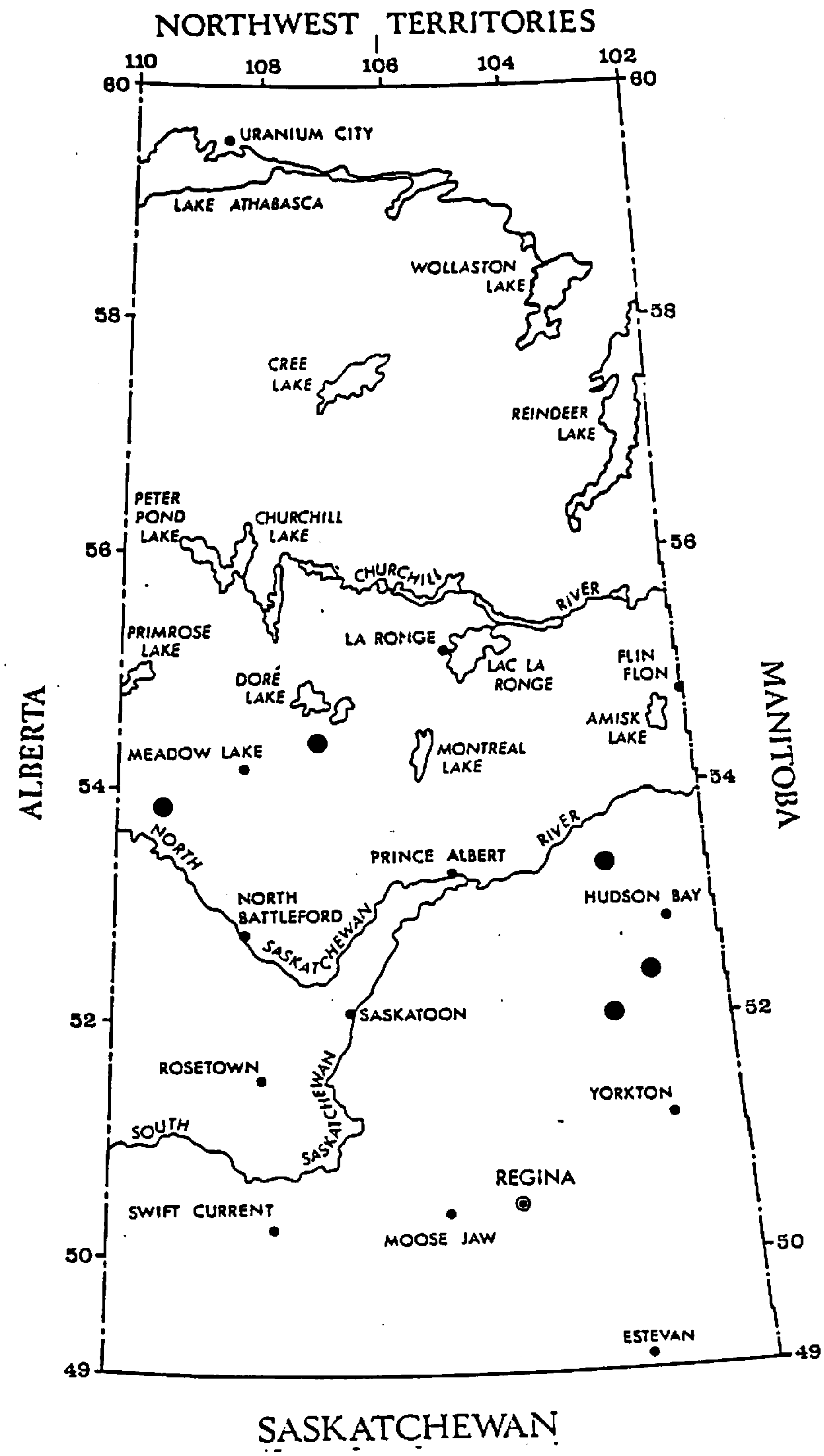
# Common Tree Insects and Diseases

# in Saskatchewan - 1989

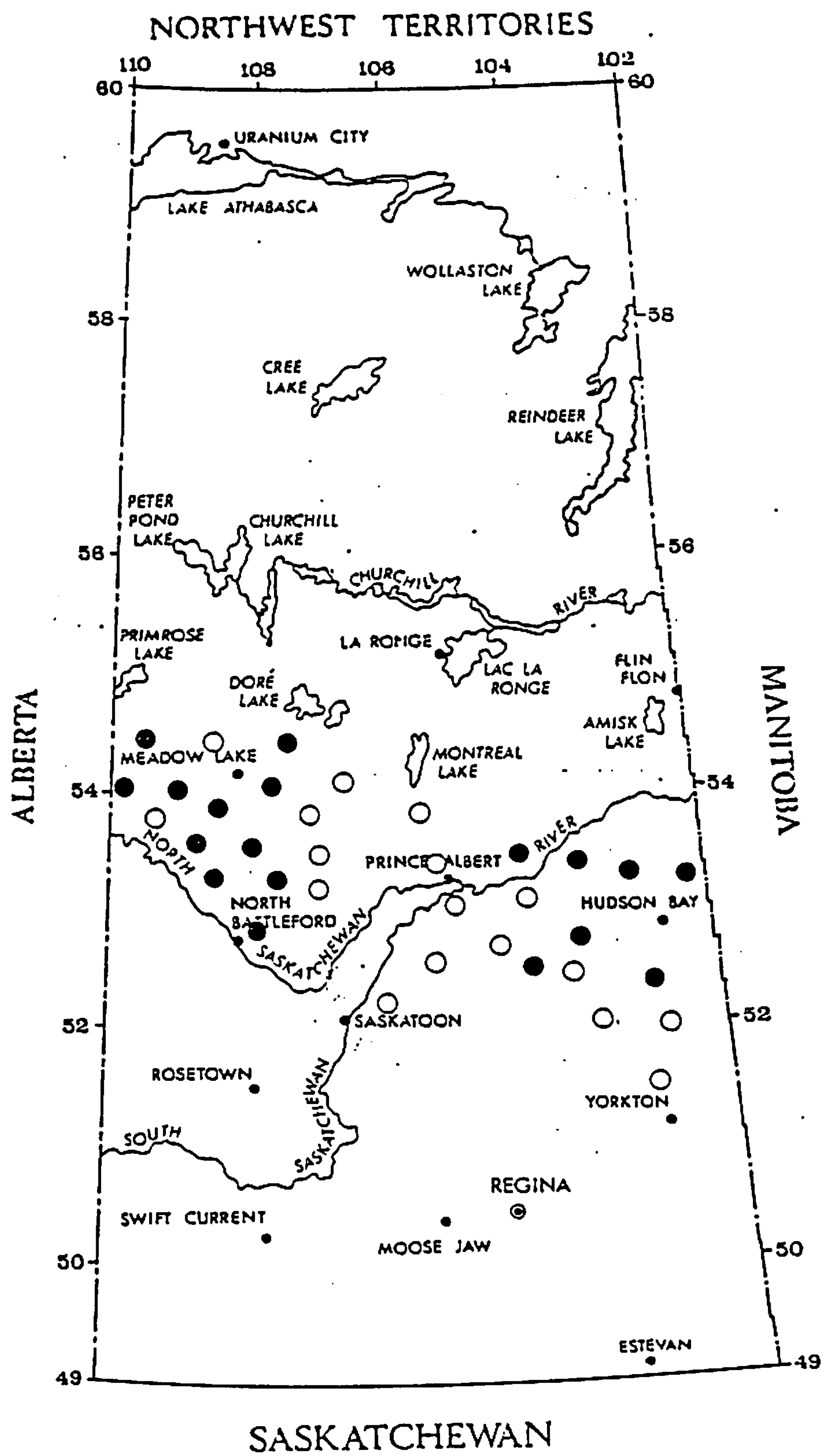
| Insect | Host | Location and Remarks |
|---|---|---|
| Spruce spider mite<br>Oligonychus ununguis | Spruce | On ornamental spruce. |
| Terminal weevils<br>Pissodes sp. | Spruce<br>Jack pine | Common in plantations. |
| Conifer aphids<br>Cinara sp. | Spruce<br>Jack pine | Common in northern forests. |
| Root collar weevil<br>Hylobius sp. | Jack pine | In plantations. |

Madan Pandila
Forestry Branch
Saskatchewan Parks and Renewable Resources
Prince Albert, Saskatchewan

MP/11038903.vmg




1989 ●..... SPRUCE BUDWORM




1989 ..... FOREST TENT CATERPILLAR

● Severe ○ Light

# PACIFIC REGION - 1989

# STATUS OF IMPORTANT FOREST PESTS, EXPERIMENTAL CONTROL PROJECTS AND VEGETATION MANAGEMENT RESEARCH

Prepared for the
Seventeenth Annual Pest Control Forum
November 13 - 15, 1989

Ottawa

Presented by
G.A. Van Sickle
Pacific Forestry Centre
Victoria, B.C.

Contributors:

R. Alfaro
J. Harris
M. Hulme
L. Humble
I. Otvos
L. Safranyik
J. Sutherland
R. Whitehead
C. Wood

## ABSTRACT

The status of more than 18 major forest pests in 1989 is presented with some forecasts for 1990. These include the declining but continuing populations and significant damage by mountain pine beetle and western budworms, the decline in black army cutworm, increasing levels of Rhizina root disease, blackheaded budworm and eastern budworm, and slight increases in Douglas-fir tussock moth and gypsy moth.

Current research progress and control trials of some of these pests include: biological control research directed to spruce weevil, larch casebearer, winter moth and vegetation management; B.t. trials against western budworm and blackheaded budworm; pathogenicity testing with pinewood nematode and hazard rating and model systems for mountain pine beetle.

## SUMMARY OF IMPORTANT PESTS

The following have been selected as the pests most likely to be of interest to participants. Equally significant in terms of losses are several forest diseases such as root rots, dwarf mistletoes, stem decays, rusts and cankers. However, once established, these are perennial and fluctuate little from year to year and annual surveys are neither practical or necessary. Controls for such diseases are most practical as preventative treatments combined with stand management practices during the harvest-regeneration phase or juvenile stand tending. Also not included are impacts such as nursery and regeneration losses; most quarantine matters; aesthetics; increased fire hazards; or earlier losses from white pine blister rust.

For more detailed information of these and other pests active in the Pacific Region in 1989, the reader is referred to "Forest Pest Conditions in British Columbia and Yukon" by Forestry Canada, Forest Insect and Disease Survey and published annually by the Pacific Forestry Centre, Victoria, B.C.

### Mountain Pine Beetle

The beetle continues to be the most damaging forest insect in British Columbia. The area and volume of lodgepole pine and some western white pine killed by the beetle declined to the lowest level since 1975. Yet, more than 7300 active infestations still cover more than 53 350 hectares from the International Border to northeast of Prince Rupert. This is more than double the area burned by forest fires in British Columbia in 1988 (22 350 ha) and the volume lost (3.4 million $m^3$) represents about 16% of the lodgepole pine annually harvested in British Columbia (19.4 million $m^3$ in 1986).

Active infestations continued throughout the six forest regions in British Columbia. An infestation in the Cariboo Region which developed in 1987 in mature pine at Chilko Lake near the Coast Mountain Range declined to 700 ha this year. Elsewhere, areas containing recently killed mature pine as mapped during the 1989 aerial surveys were: Kamloops Region - 12 100 ha, down more than 30% from 1988; Nelson Region - 31 800 ha, up 20%; down 35% in the Vancouver Region to 550 ha; down more than half in the Prince Rupert Region to 5400 ha; and down 30% in the Prince George Region to 2800 ha.

Infestations along the British Columbia-Alberta border and in Glacier and Yoho National Parks were generally stable for the fourth consecutive year. However, increased numbers of small groups of recently-killed pine occurred at Redstreak in Kootenay National Park, and in the Flathead and Elk river valleys. Cooperative aerial and ground surveys in Mt. Robson Provincial Park and west of Jasper National park located 35 mountain pine beetle-killed pine and 234 newly attacked. Cut-and-burn control operations are scheduled for the fifth consecutive year since 1985, when 259 trees were treated.

Overwintering mortality was generally less than 10% providing an increasing population for flight and attack in July 1989 (64% of the ratios of progeny to parents at 50 locations were greater than 4.0 indicating increasing populations). The frequency of new attacks on mature lodgepole pine in 37 previously infested stands cruised in four forest regions ranged from an average of 9% in the Prince George Region to 24% in the Nelson Region with a province-wide average of 16%. Current attacks exceeded the 1988 levels in the Kamloops and Prince Rupert regions but declined in the Nelson and Prince George regions. Cruises in declining infestations in isolated areas of the Cariboo and Vancouver regions were discontinued due to limited host availability and remoteness.

Mountain pine beetle killed increased numbers of mature ponderosa pine in the western part of the Nelson Forest Region. Other bark beetles including western pine beetle, Dendroctonus brevicomis, turpentine beetle, D. valens, and lodgepole pine beetle, Dendroctonus murrayanae were common, some for a third consecutive year, and contributed to pine mortality in parts of the Nelson Region. There was less evidence this year of pine engraver beetle, Ips pini, which had been common for three years. Increased attacks by ambrosia beetles, Trypodendron spp., were widespread in mountain pine beetle infested stands in parts of the Cariboo, Nelson, and Prince George regions.

Salvage of beetle-killed and adjacent susceptible pine continued at high levels in most beetle-infested Timber Supply Areas. Salvage harvesting of economically accessible beetle-killed pine may result in reduced AAC in the near future.

## Spruce Beetle

Overall the area and volume of mature white and Engelmann spruce killed by the beetle in British Columbia declined for the seventh consecutive year, but some local populations are increasing. Host depletion, salvage and sanitation contributed to the decline, mostly in the Nelson Region.

Most of the 1000 ha of infested spruce mapped in aerial surveys were in 118 separate infestations, mainly in the Kamloops and Prince George regions. New attacks in recent windthrow in parts of the Cariboo, Nelson and Prince George regions, however, pose a threat to mature stands in 1990-91.

Along the Haines Road in the far northern part of the Prince Rupert Region, cooperative programs have removed or felled and peeled infested trees and reduced populations in the area to endemic levels.

## Budworms

More than 165 800 ha of mixed age-class Douglas-fir in four forest regions were defoliated by western budworm, about half the area affected in 1988. Defoliation was light on 79% of the area, with 19% moderate and 2% severe, similar to 1988 (83%, 16% and 1%). There were more than 460 separate areas of infestations.

Areas of decrease included the eastern part of the Cariboo Region, and for the second consecutive year, the North Thompson and Adams river drainages in the Kamloops Region. Areas of expansion included the southwestern part of the Nelson Region, the Bridge River drainage west of Lillooet in the Kamloops Region, and near Pemberton in the Vancouver Region. Infestations in the Okanagan Valley were largely unchanged over about 105 000 ha. Parasitism of late-instar larvae occurred at all 13 sites sampled and averaged 10% (range 1 to 22%), down 6% from 1988, and still too low to effectively reduce populations. The cause of the decline in the Kamloops Region has been attributed to larval starvation in chronically infested areas and possibly depletion of nutrient reserves of early instar larvae following emergence during a prolonged warm dry fall in 1987. The population collapse in the eastern part of the Cariboo Region is attributed in part to disease.

The numbers of egg masses collected by FIDS at 37 infested stands in three regions were 10% more numerous than in 1988 indicating a slight overall increase. Defoliation is forecast to be severe at 9 of the sites, mostly in the Nelson Region, moderate at 13, light at 11 and none at 4.

Tree mortality and growth loss is variable. Continued damage appraisal monitoring of long term study plots in open-growing Douglas-fir near Cache Creek indicates that tree mortality averaged 30-40% of the stems/hectare in 1987 one year after collapse of the infestation in these stands. Decline in diameter increment in mature trees occurred one or two years after the first year of defoliation in 1979, and increment has been almost nil since 1982. Monitoring continued in 64 research plots established in young, open-growing Douglas-fir. These plots were established in 1986 in areas which had sustained 0 to 7 years of defoliation. As of 1988, tree mortality averaged 4.9% but varied widely (from 0 to 75%). A trend of increasing mortality with increasing number of years of defoliation is apparent.

A computer model was developed to calculate budworm impacts on uneven-aged Douglas-fir for the interior of British Columbia. This model permits the user to simulate the outcome of infestations of varying duration and severity. The program reads inventory plot data and makes two projections, one without budworms and the second assuming a budworm infestation of a specified duration and severity. The time step in this model is 10 years, with cutting cycles of 20 years.

In cooperative aerial spray trials, Bacillus thuringiensis was applied at ULV to Douglas-fir over 150 ha west of Westbank, in the Kamloops Region.

As part of a study to improve and calibrate detection methods for western budworm, mid- to late-instar budworm larvae and adult males were monitored in four regions at 10 sites still with low populations but a history of budworm outbreaks. Up to 420 larvae/tree were collected per 1 $m^2$ beating (3 branches on

25 trees/plot) and up to 840 male adults were caught in a total of 50 traps. Further analysis and additional sampling is necessary before numbers can be correlated with population potential and damage.

Defoliation of alpine fir and spruce forests by immature 2-year cycle budworm was very light over 11 200 ha in 48 infestations in three forest regions. This was down from more than 102 000 ha defoliated in 1988, a feeding year. The immature 'on-year' cycle budworm larvae defoliated 4 140 ha in the Kamloops Region; 2800 ha in the Cariboo Region; and 4 200 ha in the Prince George Region.

Mature 'off-year' cycle budworm lightly defoliated high elevation fir and spruce over 5850 ha in seven areas in the West Kootenay, and over 50 ha in one area in the East Kootenay, down 50% from 1987. Egg samples in the Nelson Region indicate low numbers of immature budworm larvae in new buds in 1990. A new area of defoliation of fir-spruce over 11 385 ha north of Mackenzie in the Prince George Region was attributed to 2-year cycle budworm; taxonomic studies are in progress to determine the species.

Current foliage of alpine fir and white spruce was defoliated by 1-year cycle eastern spruce budworm over 123 745 ha west and north of Fort Nelson. This is a more than threefold increase over 1988. Defoliation again extended into the Northwest and Yukon territories for a fourth consecutive year. There was no follow-up applications of *B.t* applied aerially in 1988 over three 50-ha seed blocks by the BCFS.

Larvae and adult male budworm populations continued to be monitored in four regions to improve identification and calibrate methods to detect budworm populations in fir-spruce forests. Up to 247 adult males (avg. 117) were collected in 10 non-sticky traps at two locations of 'off-year' populations in the Nelson Region, and up to 15 adult males (avg. 3) in 15 traps at three locations in the Prince Rupert Region. An additional distribution monitoring survey collected up to 4000 adult males (avg. 140) in 96 traps at 16 sites in four regions. Further study, however, is necessary before numbers can be correlated with population damage and potential.

**Blackheaded Budworm and Hemlock Sawfly**

Following four consecutive years of blackheaded budworm and, to a lesser degree, hemlock sawfly feeding, populations on the Queen Charlotte Islands, collapsed, down from 7000 ha of mostly light defoliation in 1988. In the eastern part of the Prince Rupert Region, where budworm populations have been common at fluctuating levels since 1982, new shoots on alpine fir over 65 000 ha were defoliated, up from 58 000 ha in 1988.

Near Holberg on northern Vancouver Island, mature western hemlock over 7400 ha were defoliated, some for the the third year. This is up from 4800 ha in 1988. Mortality was widely scattered and patchy. In each patch up to 94% (avg. 29%) of the 20- to 45-year-old western hemlock were dead after even two years of severe defoliation. On northern Vancouver Island defoliation is expected to continue similar to 1989, based on the number of eggs per 10 $m^2$ of hemlock foliage at 10 sample sites. Parasitism averaged 13% (range 1 to 51%), too low to significantly reduce populations.

## Douglas-fir Tussock Moth

Small numbers of larvae and pupae were present in Douglas-fir trees in urban Kamloops for the second consecutive year since the last outbreak collapsed in 1984, and occurred for the first time at permanent sample sites and near previously defoliated stands in the region.

The number of male adults in pheromone-baited sticky traps placed in Douglas-fir stands selected for the greatest historical frequency of outbreaks increased for the fourth consecutive year. About 1893 adult males were trapped in 77 of 106 traps at 16 of 18 permanent monitoring sites in the Kamloops and Nelson regions. This is 34% more than number trapped in 1988 when 1247 were trapped in 84 of 114 traps at 14 of the sites.

Numbers also increased in the western part of the Nelson Region, where 24 adult males were trapped in 11 of 12 traps at two locations, compared to only one at one location in 1988. An additional 1782 male adults were trapped in 60 of 76 single traps located by FIDS 1 km apart in three areas in the Kamloops Region, up from 478 at 25 of 33 in 1988. At 18 of the 37 sites monitored both years, numbers declined by an average of 8 adults per location; increases of an average of 12 per site occurred at 14 sites. A further 429 male adults were trapped at 52 locations (avg. 8/trap/location) monitored by BCFS, the same as in 1988.

A total of 21 egg masses were found at 8 of 28 trap sites, near Kamloops Lake and Winfield. This was similar to 1988 when an average of three were found at 13 sites. Overall, the forecast is for some possible localized defoliation but populations are not high enough to consider a control program in 1990.

## Larch Casebearer and Sawfly

Larch casebearer populations in western larch stands in southeastern B.C. were at levels similar to 1988. Light defoliation in numerous pockets totalling several hundred hectares were widespread in the West Kootenay and pockets of moderate defoliation were common in the East Kootenay. Defoliation in the western part of the host range in the Kamloops Forest Region was minimal. At most of the 20 long-term parasite release study sites in the Nelson Region defoliation was nil to generally light, and only moderate near Castlegar.

Overall, average parasitism was 20%, varying from 0 to 63% among the sites in 1989. Since the biological control program against larch casebearer was initiated in 1966, more than 15 000 specimens of Chrysocharis laricinellae (Ratzeburg) or Agathis pumila (Ratzeburg) have been released. No releases were made in 1989 and additional releases are not anticipated until the results to date can be further assessed.

Larch sawfly populations remained generally endemic in previously infested western larch in the southeastern part of the Nelson Region, and in tamarack in the Yukon Territory and near the Yukon border in the northern part of the Prince Rupert Region. Populations which moderately defoliated western larch in the West Kootenay, and exotic larch near Haney in the Vancouver Region and at Terrace and Prince George, collapsed in 1989. The decline in the Nelson Region was due to the high incidence of parasitism by a chalcid, Dibrachys saltans in overwintering cocoons.

## European Larch Canker

Formal surveys for the potentially damaging European larch canker in western, alpine, eastern and some exotic larch stands in British Columbia were discontinued in 1989. This followed eight successive years of surveys and no evidence of the disease. A native larch canker continues to be found on immature western larch in the West Kootenay. The distribution of the canker in North America remains limited to New Brunswick and Nova Scotia and several eastern states where small diameter trees have been infected and killed.

## Black Army Cutworm

Cutworm populations declined significantly in previously infested areas in interior British Columbia. Larvae were found only at one 1989 planting in a recently slash-burned site in the eastern part of the Prince Rupert Region, at six previously infested sites in the Nelson Region, and at one site north of Prince George. Seedlings and herbaceous ground cover were very lightly defoliated at two sites in the Prince Rupert Region, and only ground cover was damaged at one site in the Nelson Region.

The decline was attributed to natural climatic factors and some parasitism.

Cutworms could pose a threat to seedlings in 1990 plantings following slash burning in 1989. This is based on the numbers of male adults in sticky traps which exceeded a trial threshold of 10 or more at 31 of 81 sites in parts of four regions, mostly in the Prince Rupert Region. Additionally, non-sticky traps at 7 of 87 sites contained more than a threshold of 500 adult males; five of the sites were in the Prince Rupert Region and two in the East Kootenay. Each sticky trap was baited with an experimental Forestry Canada pheromone and was set out with a commercial non-sticky trap containing a commercially produced pheromone for comparison. Additional years of trapping are required before results can be implemented as a forecasting tool.

A contract to develop a predictive warning system linking moth catches in non-sticky pheromone traps with subsequent defoliation and seedling and vegetation damage, which is building on earlier studies by R. Shepherd in co-operation with FIDS, completed its third and final field year. A report is currently being compiled.

## Rhizina Root Disease

Rhizina root disease infected and killed several hundred newly planted spruce and pine seedlings in 37 of 72 recently burned sites examined in parts of the Nelson and Prince Rupert forest regions. Fruiting bodies were present at an additional 13 sites and over 84 ha west of Clearwater in the Kamloops Region, but seedlings were not affected. It was the second consecutive year of seedling mortality caused by this disease in British Columbia since first being recorded 20 years ago. Up to 74% (average 23%, up from 14% in 1988) of the seedlings were killed in 24 sites in the Prince Rupert Region. Seedling mortality increased in the Nelson Region from an average of 9% in eight plantations to 17% (range 2 to 39%) in 13 of 48 in 1989.

## Pinewood Nematode

Based on more than 1000 samples from trees and potential vectors collected throughout British Columbia since 1983, this nematode remains extremely low in forests in British Columbia and the Yukon Territory with only individual, predisposed trees affected at a few widely distributed locations. More than 75 stem sections from five host species were collected from 20 locations in five forest regions to initiate a study of the potential for various wood boring insects to monitor the nematode.

## Scleroderris Canker

Formal examinations in British Columbia, where only the North American strain of this fungus was previously collected, were discontinued following extensive but negative surveys in 1988. This pathogen, which has caused extensive mortality of young pines in plantations and nurseries in eastern Canada and the United States, was found only rarely as a lower branch saprophyte in British Columbia between 1968 and 1978 near Penticton, Canal Flats, Castlegar and Kimberley.

## Gypsy Moth

About 8000 sticky traps were monitored throughout British Columbia in the fourteenth year of a cooperative program with Agriculture Canada (Plant Health) and B.C. Ministry of Forests and FIDS. Only 25 adult male gypsy moths were trapped this year in British Columbia in 25 pheromone-baited sticky traps in 10 areas. This compares with 12 moths in 12 traps in 7 areas in 1988. Male moths were caught near Parksville (8), and Kelowna (1) for the third consecutive year, and West Vancouver (5) for the second year. New catches were made at Manning Provincial Park (1), near Chilliwack (1), Fort Langley (1), Cultus Lake (1), Jericho Beach in Vancouver (1), on the Saanich Peninsula (5), and near Thetis Lake north of Victoria (1). One new egg mass was found at Parksville.

The captures at Manning and Cypress Provincial Parks were in two of 276 traps set out by FIDS in 237 forested recreation areas in national and provincial parks, commercial campgrounds, or near military bases.

There were no aerial or ground applications of *Bacillus thuringiensis* in 1989, following successful controls with *B.t.* at Kelowna and Colwood, and Parksville in 1988.

## European Pine Shoot Moth

Surveys of native and exotic pines were discontinued following testing of pheromone baits in sticky traps at 5 interior and 6 coastal sites, and determination of the status of shoot moth in 1988 since provincial quarantine regulations lapsed in 1981. Survey results indicated that the shoot moth is established in localized urban areas including Victoria to Courtenay, the lower mainland, and the Okanagan Valley. The areas, however, have not increased in number and there is no evidence of shot moth populations in native pines.

## Balsam Woolly Adelgid

The adelgid killed two small pockets of mature amabalis fir at China Creek, south of Port Alberni on Vancouver Island. Tree mortality had not previously been detected in the drainage, which is within the infestation and quarantine zones. Reforestation plans were revised to include non-susceptible species.

## Forest Tent Caterpillar

Defoliation of trees and shrubs by forest tent caterpillar was more widespread and severe than in 1987 and 1988 in parts of the Cariboo Region, near Prince George, and in the East Kootenay. In these areas defoliation was mapped at more than 300 locations covering 122 500 ha.

Northwest of Prince George increased populations defoliated trembling aspen in 187 infestations over 108 290 ha, a threefold increase from 1988. In the Peace River area defoliation occurred over 4800 ha in 22 separate areas, similar to 1988. In the Cariboo Region there was an eightfold increase over 3215 ha in 26 pockets, and in the East Kootenay a fourfold increase to 9970 ha.

Generally severe defoliation of trembling aspen, cottonwood and other deciduous trees and shrubs is forecast to continue in most recently infested stands near Prince George and Pouce Coupe and in the East Kootenay, based on egg samples from 17 areas.

## Cone and Seed Pests

Assessments of cone and seed insects and diseases in natural forests in the Pacific Region was de-emphasised in 1989. This was due in part to the conclusion of the research study at P.F.C. and some seed orchard pest assessments being done by the B.C. Forest Service.

Twelve coastal and three Interior seed orchards were surveyed. Common pests included Cooley spruce gall adelgid which lightly infested Douglas-fir in six coastal orchards and Sitka spruce in one, and white spruce in two interior seed orchards. In other coastal orchards, Balsam woolly adelgid and balsam twig aphid were common on amabalis fir in four orchards, and severe on Sitka spruce at one. A gall midge infested yellow cedar cones for the third consecutive year in one of two orchards. A foliage and cone mite was more numerous than in 1988, severely infesting all the trees at one orchard. Hemlock woolly adelgids increased, lightly to moderately infesting western hemlock at two of four orchards. In interior orchards, western spruce budworm larvae feeding in lodgepole pine rooted cuttings and seedlings, distorted lateral and terminal shoots on 5% of the trees in one orchard. In another, spruce weevil attacked 40% and frost damaged 20% of the buds on 90% of the white spruce, and most of the lodgepole pine were lightly infected by a needle disease.

Cone crops at 7 of 12 coastal seed orchards surveyed were affected by several pests. Douglas-fir coneworm infested up to 80% of the cones in one of four orchards. Douglas-fir cone midge occurred in up to 100% (avg. 50%) of the cones in four orchards, and Douglas-fir cone scale midge lightly infested cones at two orchards.

## EXPERIMENTAL CONTROL PROJECTS

### Bark Beetles

Highlights are as follows:

a) A preliminary hazard rating system for lodgepole pine against the mountain pine beetle has been developed and field-tested in cooperation with PheroTech Ltd., Vancouver, with encouraging results. The information is currently being analyzed.

b) A mountain pine beetle population biology-spread model is nearing completion which will allow evaluations of the possible effects of various forest management practices and direct control programs on bark beetle populations and damage levels.

c) Cooperative field studies with Dr. S. Lindgren of Phero Tech, Inc., Vancouver, B.C. re effects of verbenone on the dispersal behavior of the mountain pine beetle continued. The results were inconclusive but appear to indicate that verbenone does not significantly affect short range beetle dispersal behavior.

### Spruce Weevil (White pine weevil)

A number of necessary cage studies are being carried out prior to attempted field releases of imported European parasites. The import Embagus semirugosus appeared to mate with our native Allodorus crassigaster in captivity which would confound monitoring of field releases of the former. However, cage studies have shown that the mating did not appear to be successful. Our morphometric analyses will thus allow us to distinguish the two species. Parasitism by Allodorus crassigaster might be decreased by release of the European Coeloides sordidator depending upon the host-seeking behavior of the latter. The behavior of C. sordidator is currently being examined in Europe. A third European parasite, an ichneumonid, has now been reared successfully on P. strobi. However, the polyphagous habits of this parasite are considered poor attributes for successful pest control. Hence, work on this parasite will be given lower priority.

Testing continues on clipping of infested spruce leaders to control spruce weevil. Leaders are clipped in August and left to overwinter in containers covered with a screen of a mesh size that retains the weevils but permits the natural enemies to escape back into the stands. To date, there has been some reduction in the numbers of leaders attacked on some sites. It is recognized that the clipping must be thorough and low enough to include all the brood. It was also demonstrated that previous year's attacks, often ignored during clipping operations, frequently harbor new brood below the old, attacked leaders. Cooperation is being received from the BCFS, Canadian Pacific Forest Products and MacMillan Bloedel Ltd.

A computer simulation model to calculate the impact of the Sitka spruce weevil on Sitka spruce log yield, based on long term records from the Vancouver Region, has now been extended for the Prince Rupert and the Prince George regions of B.C. The program is used by industry and BCMF to calculate the possible impact of the weevil and for technology transfer and teaching.

## Winter Moth

Populations of this accidentally introduced pest of deciduous trees, mainly Garry oak and other shade trees, shrubs and fruit trees continued to be low for the fourth consecutive year. The decline of winter moth populations is mainly due to the introduction of two parasitoids: the parasitic fly, Cyzenis albicans, and the parasitic wasp, Agrypon flaveolatum. Over 30,000 specimens of both species were released between 1979 and 1982. The introduced parasitoids, assisted by other mortality factors such as unfavorable weather, asynchrony between budburst and larval emergence and predators, not only brought the winter moth under control but has kept it under control for the past four years. As a result, defoliation has been minimal (from trace to light) in the Greater Victoria area.

Preliminary results, based on x-raying subsamples of winter moth pupae, show that combined parasitism by Cyzenis albicans and Agrypon flaveolatum was about 45%. Parasitism by C. albicans decreased from that of previous years while parasitism by A. flaveolatum slightly increased.

The winter moth has been reported from the blueberry growing areas of the Lower Fraser Valley where it is causing concern among the growers. This problem and possible solution is being examined by the reactivated winter moth committee. Severe defoliation of birch also occurred near Deas Island Tunnel with scattered defoliation of fruit trees and deciduous ornamentals in Ladner and Tsawwassen.

## Larch casebearer

Casebearer populations remained low in western larch stands in south-eastern B.C. causing only trace to light defoliation in 1989 in most of the affected stands, as predicted from fall samples. Parasite releases were not made in 1988 and 1989 and additional releases are not anticipated until the analysis of the results to date can be completed.

Preliminary results of monitoring larval parasitism at 20 locations showed that the overall average parasitism was 20%, varying from 0 to 67% among the sites. The two most common species of parasites were the introduced Agathis pumilus and Chrysocharis laricinellae; parasitism by A. pumilus was about 13%, an increase from that of 1987.

The overall average parasitism of larch casebearer pupae from 17 locations was 23%, ranging from 1% to 54% between the sites. Chrysocharis laricinellae was the most abundant parasitoid recovered, with overall parasitism averaging 18% (range 0% to 51%). Parasitism by Agathis pumilus in the pupal collections was on average less than 1% (range from 0 to 3%) while parasitism by the native Spilochalcis spp. averaged 2% (range from 0 to 11%).

These data indicate that levels of parasitism by Agathis pumilus are underestimated in standard pupal collections.

Overwintering larval population assessments to predict defoliation in 1990 are in progress.

**Blackheaded Budworm - B.t. trial**

At present we do not have any product registered for the control of the blackheaded budworm in Canada.

In 1989 Dipel 176 (a B.t. product registered both in Canada and the U.S. against the spruce budworm) was field tested in cooperation with the BCFS and WFP Ltd.

Dipel 176 was applied at the dosage recommended for the spruce budworm, 30 BIU/ha at the rate of 1.8 L/ha by a fixed-wing aircraft equipped with micronair atomizers (AU 4000). Three plots (35, 43 and 30 ha) were treated at peak third instar in the Holberg area on northern Vancouver Island where blackheaded budworm population was on the increase. Egg surveys conducted in the spring of 1989 in the plots indicated light to moderate defoliation.

This was the first time in B.C. (and probably in North America) that a treatment was applied at the beginning phase of the outbreak. Previously control measures were applied at the peak or declining phase of blackheaded budworm outbreaks.

The B.t. application was evaluated by:

(a) measuring spray deposit on the needles

(b) rearing larvae for 3 days on foliage collected from the treated plots and for 3 additional days on untreated foliage

(c) by taking population counts before and after treatment and calculating population reduction.

Results are only presented from (a) and (b) as calculations of population reduction due to treatment are still in progress.

| Plot no. | No. needles examined | No. spray droplets per cm (of) needle | Percent larval mortality caused by B.t. after 3 days | 6 days | Total |
|---|---|---|---|---|---|
| 1 | 45 | 1.38 | 63.0 | 52.2 | 59.4 |
| 2 | 45 | 0.58 | 24.4 | 50.0 | 30.5 |
| 3 | 45 | 0.40 | 64.5 | 70.6 | 66.7 |
| Average | | 0.79 | 49.2 | 57.4 | 51.7 |

The number of spray deposit per cm of needle was relatively good, averaging 0.79 droplet/cm (table). However, the mortality among the larvae reared on the foliage collected from the sample trees in the feeding bioassay was disappointing, averaging 51.7 (table). This mortality in the bioassay was considerably less than one would expect from the spray deposit counts. There appeared to be no correlation between density of spray deposit and larval mortality (in fact larval mortality was the highest (66.7%) in the feeding bioassay on foliage with the lowest spray deposit.

Maybe these disappointingly low mortality figures (suggested by the bioassay results) are typical for coastal area of B.C. with unfavorable climatic and terrain conditions and we should not expect much better control under operational control treatments. The same or another *B.t.* formulation may be tested next year against the blackheaded budworm.

**Western Budworm - *B.t.* trial**

In cooperation with the BCFS, Dipel 264 (a more potent strain of *B.t* not yet registered in Canada) was applied at ULV (ultra-low-volume, 1.19 L/ha) at 30 BIU/ha to three 50-ha blocks near Glenrosa, south of Kelowna. The infestation was in its second year and fall egg mass surveys indicated moderate to severe defoliation in the plots for 1989. This forecast was revised to moderate defoliation based on L2 samples taken in the spring.

*B.t.* was applied by a fixed-wing aircraft using micronair atomizers (AU 4000) when most of the larvae were in the 4th and 5th instars. Insect development varied considerably among the plots due to elevation and exposure. The

*B.t.* application was evaluated by:

(a) measuring spray deposit on the needles

(b) using foliage, collected 1-3 hours after the spray, in feeding bioassay in the laboratory, and

(c) taking population counts before and after the spray and calculating population reduction.

| Plot no. | No. needles examined | No. spray droplets per cm of needle | | Percent larval mortality caused by *B.t.* after | | |
|---|---|---|---|---|---|---|
| | | x ± | SD | 3 days | 6 days | total |
| 2 | 45 | 0.25 | 0.32 | 96.0 | 63.2 | 81.8 |
| 3 | 45 | 0.44 | 0.73 | 69.4 | 100.0 | 75.5 |
| 4 | 45 | 0.69 | 0.46 | 86.7 | 100.0 | 92.2 |
| Average | | 0.46 | | 82.4 | 85.7 | 83.6 |

Spray deposit on the needles was good and there was a correspondingly high larval mortality both after 3 days and 6 days in the bioassays.

Results of spray deposit counts and laboratory bioassays are encouraging and the population reduction counts are in progress.

No *B.t.* application against the spruce budworm is contemplated for 1990.

## Pinewood Nematode Research

Pathogenicity studies with Webster and others at SFU using "m" and "r" forms were completed. Offspring are most pathogenic to Scots pine seedlings and offspring with "m" form parents were less pathogenic than "r" form offspring.

## Forest Nursery Disease Research

Modification of styroblocks (seedling growing containers) with up to 60 ventilation holes through the body of each block and under-block air ventilation significantly reduced humidity and improved gray mould (Botyrtis cinerea) control and reduced need for fungicide spraying (DSS-FRDA funded contract with AFS Ltd. of Sidney, B.C.). This research resulted in an Edmonton-based company marketing a new brand of styroblocks called "Ventblocks".

In other cooperative research with AFS Ltd., BCFS and forest companies, numerous materials and techniques have been evaluated for sanitizing styroblocks for seedling root rot control. These pathogens build up on the blocks and carry over to affect seedling roots in the following years. Based on previous results (USFS Techn. Rept. RM-167) and early 1989 results, several materials look promising for root rot control, including 5% bleach, sodium metabisulfite, Safer's Demoss at 75 C, water at 75 C, and steam at about 90 C. All of these treatments will be evaluated for possible carry-over phytotoxicity this coming fall and winter.

## Vegetation Management Research Project (Forest Weeds)

The vegetation management research project at PFC concerns: prevention or avoidance of the development of weed complexes through application of appropriate silvicultural systems; and, identification and development of tools for control of weed complexes that cannot be (or have not been) avoided.

For the first objective, a basic ecosystem approach is taken to investigate effects of harvest season and method and site preparation options on development of vegetation competition through time and relationships with crop performance. Two benchmark studies in the Engelmann Spruce Subalpine Fir biogeoclimatic zone have been established, instrumented with data loggers, and measurements of vegetation invasion and growth are being taken. In 1989, a satellite study was initiated to compare crop species and stock type performance on various site preparation regimes within the same BGC zone.

Studies of conventionally accepted weed control options have focused on registered herbicides and clearing saw applications for brushing on shrub dominated plantations in the Interior Cedar Hemlock zone. A comparison of 4 treatment options was initiated in 1986, and data is under analysis for the 3rd post treatment year. A cost-effectiveness study of clearing saw treatments was initiated in 1987; results of initial treatment costs and damage to crop stems has been published. Follow-up assessments of effectiveness include comparisons of single and multiple treatments.

The Pacific Forestry Centre has been investigating the possibility of deploying native pathogens of weed species as operationally effective weed control agents since 1986. Results to date suggest that several native fungi have potential as complements or alternatives to conventional weed control treatments. Funding for lead development of these fungi, or biorationals developed from these fungi, is now being sought. The intent is to develop, within the next 3 years, a sufficient database on efficacy, mode of action, environmental safety and production technology to attract the interest of commercial collaborators who would undertake final development for marketing.

---

G.A. Van Sickle, Head
Forest Insect and Disease Survey

November 1989

Date: Nov. 3, 1989

File: 235-40

# 1989 PEST CONTROL FORUM

## B. C. Ministry of Forests Report

prepared by

P. M. Hall and J. A. Muir
B. C. Ministry of Forests
Protection Branch
Forest Health Section

Pest management programs continue to address specific pest problems relating to insects, diseases, vertebrate pests and others. The name of the section has been changed from Pest Management to Forest Health. This reflects a change in emphasis from dealing with particular pest species on a reactive basis to a philosophy of dealing with the resource to ensure healthy, vigorous forests which are less susceptible to pest induced losses. A capability to employ direct suppression tactics will be maintained to deal with significant pest occurrences; however, as procedures are implemented, the need for drastic intervention is expected to decline.

Forest Health initiatives other than suppression programs include refinements to the planning process, development of training packages for Protection and Silviculture personnel, completion of Ministry manuals, development of provincial, regional, and district Forest Health plans, and other activities directed at integrating Forest Health concepts into management prescriptions.

### Entomology

Bark beetles, western spruce budworm, tussock moth, gypsy moth and other insects continue to be of concern to the Ministry of Forests.

Bark beetles of concern include the mountain pine beetle, the Douglas-fir beetle, and the spruce beetle.

Mountain pine beetle remains the most important pest in many areas of the province. The total area affected has declined somewhat in 1989, however beetle infestations remain active in regions such as the Nelson and Kamloops Forest Regions. Funding of $3.5 million has been allocated in FY 1989/90 to continue the management program begun in 1984. These funds have been committed to aerial and ground surveys, pheromone bait purchase and placement, and single tree disposal. Access is no longer being funded under this program. Additionally, hazard rating systems have been used on a trial basis in some districts. A beetle spread model developed by Forestry Canada has been used in a number of cases to estimate the effects of control efforts on the infestations. Results of these model runs have shown that the program has been successful in reducing the rate of spread of target infestations and in protecting timber at risk. An independent audit carried out by Price Waterhouse last year stated that the program was effective, efficient, and economical.

Douglas-fir beetle and spruce beetle are of concern in two regions at the present time. However, no control efforts are planned at this time. The situation will be re-evaluated for the next fiscal year.

Western spruce budworm has declined from it's peak in 1987. The spray/assessment project undertaken in 1987 continued in 1989 and approximately 500 ha were sprayed with B.t. at the same rate as in past years. Results have not as yet been compiled.

Tussock moth is expected to return to outbreak status in the interior of the province sometime in the next few years. Forestry Canada (FIDS) continues to use pheromone traps in susceptible areas to detect increasing populations. The B. C. Forest Service has expanded this monitoring by placing additional traps through the area at risk. Once a potential outbreak has been detected, sufficient quantities of the specific NP virus are on hand. This virus supply is made up of 6000 ha equivalents of a U. S. produced product and about 900 ha equivalents (2000 acre/eq) of virus produced by Forestry Canada.

Gypsy moth has appeared in several locations in B. C. this year and treatment to eradicate is being considered. Although this program is the responsibility of Agriculture Canada, Plant Health, the B. C. Forest Service continues to support their efforts. Adequate resources must be made available to Agriculture Canada to continue what has been a most successful program to date. The B. C. situation can serve as an excellent example of what can be achieved with cooperative surveys followed by prompt and effective treatment.

## Pathology

With new legislation that expanded the responsibilities of licensees to reforest areas following harvest, standards and procedures are being developed to ensure that healthy trees are established when young stands are assessed to determine if they are free of competition of undesirable vegetation, and are able to grow to a mature crop of trees.Guidelines have been prepared for major pathogens that can persist on a site after harvest, such as root disease fungi and dwarf mistletoes, and others that can invade or break out in a young stand, such as rhizina root disease and stem rusts. These and other pests must be assessed before harvesting during the silvicultural pre-harvest prescription which must include an assessment of risks of pests during the rotation, and treatments that should be done to ensure that the new trees are free-growing. The draft procedures are being reviewed with regional and district staff, and operational standards possibly with new or amended regulations are expected to be completed in early 1990.

Descriptive and procedural information, including slide-tape shows, were prepared for training courses that certify that a person is qualified to develop pre-harvest silvicultural prescriptions, and to undertake silviculture regeneration surveys.

Another major activity has been an economic analysis of the costs and benefits of treatments for important pests in B.C. The analysis is expacted to be the framework for a new forest health program will address not just bark beetles as has been previously emphasized, but a variety of other significant pests such as dwarf mistletoes, root diseases, vertebrate animals and leader weevils.

The treatments are expected to not only protect mature timber from pests, but also to create new wood volume by enhancing the growth and protecting young trees. Additional benefits include supporting or creating new employment, and increasing other uses or values of forests.

Pest control projects funded by the Canada-British Columbia Forest Resources Development Agreement(FRDA) 1985-1990, have provided considerable benefits, including pest data and information that will facilitate control of several diseases.

In coastal B.C. several surveys and evaluations were made for laminated root rot and blackstain root disease.An assessment is being compiled for tree injury near a sulphite pulp mill. A co-operative study is underway to determine possible effects of atmospheric ozone in the lower mainland region on nursery seedlings.

In the southern interior, projects include surveys of rhizina root disease which recently has become a concern, and assessments of laminated root rot, armillaria root disease,and dwarf mistletoes.The results have indicated the severe effects of diseases in many instances. For example in the Kamloops Forest Region, a stand of Douglas-fir previously had 300 cubic metres of wood volume per hectare at age 75 years, and now at 100 years has 95 cubic metres because of the effects of laminated root rot.

In central interior B.C., dieback and canker disease of Douglas-fir was determined to be mostly associated with frost injury as the result of a co-operative study with the University of B.C. The outlook for growing Douglas-fir appears much better because of these findings.

A task force was formed with representatives of forestry, environment, and highways to investigate and recommend treatments for roadside tree injury. De-icing salt has been implicated in one occurrence of damage in a municipal park, but other complicating factors are apparent in other locations. A study is planned to determine the various effects and the cause(s) for specific occurrences of tree injury.

Work also is continuing in support of a Forestry Canada- B.C. Forest Service project to select white pine resistant to white pine blister rust, and to develop regional programs to manage white pine as a commercial species.

## SPRUCE BUDWORMS CONDITIONS IN THE UNITED STATES 1989

### EASTERN SPRUCE BUDWORM

#### LAKE STATES

Eastern spruce budworm populations continued to decline throughout the Lake States for the fourth consecutive year. A total of 140,000 acres were defoliated in Minnesota, 57,856 acres of which were on the Superio· National Forest and the rest on state and private lands. Defoliation continues in the northeastern part of the state. No defoliation was reported for Michigan and Wisconsin.

#### NORTHEAST

Extremely light spruce budworm populations continued throughout the Northeastern States in 1989 and predictions for 1990 indicate a continued decline. No defoliation was reported in New Hampshire, New York, and Vermont. In Maine, a total of 5,000 acres were reported. This is by far the lowest defoliation reported since the 1950s. Pheromone trap catches confirm the low population levels reported.

No suppression projects were conducted in 1989 and none are planned for 1990.

---

Presented by Daniel R. Kucera, Staff Entomologist, Northeastern Area, State and Private Forestry, USDA Forest Service, Broomall, Pennsylvania, at the Seventeenth Annual Forest Pest Control Forum, Ottawa, Ontario, November 14, 1989.

## WESTERN SPRUCE BUDWORM

### REGION 1 (Northern Region)

Regionwide, western spruce budworm defoliation declined sharply during 1989. Results of an aerial survey show 1,201,273 acres defoliated compared to 2,083,000 acres in 1988. An extreme winter temperature change last January caused a major impact on all conifer species throughout much of central Montana. In late January, temperatures dropped from the mid 50s ($^{o}$F) to sub-zero in less than 24 hours and remained below zero for the next week. During this same period, the wind chill factor fell below -70$^{o}$F in many areas. Within this area, severe vegetative bud damage occurred so that little or no new foliage developed on much of the Helena, Lewis and Clark, Beaverhead, and Deerlodge National Forests. Budworm populations are expected to take several years to recover to their pre-1989 levels in this area.

In Montana where the winter damage occurred (Helena, Lewis and Clark, Beaverhead, and Deerlodge) defoliation declined by just under 1,173,709 acres from 1988. Farther west on the Lolo and Bitteroot National Forests, defoliation increased by almost 331,109 acres; however, winter damage was light on these forests. Where major fires occurred in 1988 (Yellowstone National Park and the Gallatin National Forest) no defoliation was recorded.

In northern Idaho, the infestation on the southern portion of the Nez Perce National Forest was down 2,718 acres from 18,705 acres in 1988. Defoliation has been below 25,000 acres for the last 10 years and is not expected to increase to the 1,334,322 acres level of the early 1970s. No defoliation was detected on the Idaho portion of the Bitterroot National Forest.

In 1989, no control operations were conducted with the exception of acephate implants in two Seed Production Areas on the Gallatin and Helena National Forests.

In 1990, budworm outbreaks are expected to increase in the Northern Region except in the cold-winter damage areas. Levels of defoliation should be well below the 2,083,000 acres recorded in 1988.

REGION 2 (Rocky Mountain Region)

No aerial surveys were conducted this year. Egg mass and pheromone trap surveys were conducted along the Front Range, but the data have not been analyzed.

REGION 3 (Southwestern Region)

Defoliation was detected on 90,363 acres of National Forest, other Federal, and state and private lands in 1989 which is a significant decrease from 483,568 acres in 1988. Moderate defoliation was detected on 20,766 acres and light defoliation on 69,842 acres. Most of the defoliation occurred on the Carson, and Santa Fe National Forests and on state and private lands. No aerial suppression projects were conducted in 1989; however, 13 campgrounds were treated with B.t. on the Carson National Forest in New Mexico. The major objective of the treatment, to maintain visual and scenic quality of the campgrounds, was attained.

**REGION 4 (Intermountain Region)**

Populations continued to decline during 1989 resulting in the lowest levels of defoliation recorded since aerial surveys were initiated in 1952. Approximately 10,588 acres were visibly defoliated in 1989 compared to 42,200 acres in 1988. Defoliation was observed on the Challis, Salmon, and Targhee National Forests. All defoliation was classified as light. No defoliation was recorded on National Forests in Utah, Nevada, or western Wyoming.

Continued low levels of defoliation are predicted for all forests in the Region.

**REGION 5 (Pacific Southwest Region)**

No detectable defoliation was observed in 1989. The infestation has been at endemic levels since 1985.

**REGION 6 (Pacific Northwest Region)**

In 1989, approximately 2,000,000 acres of defoliation was mapped in the Region. Defoliation has increased in portions of northeastern Oregon and northern Washington and decreased in central Oregon. Areas treated with *B.t.* in 1988 exhibited little defoliation in 1989.

A small scale suppression project was conducted on 7,454 acres on the Mt. Hood National Forest in Oregon. Dipel 6L was applied at the rate of 16 BIU in 1/3 gallon per acre. Population reduction targets were not reached on many of the spray blocks.

Foray 48B was pilot tested at the rates of 16 BIU in volumes of 1/3 and 1/2 gallons per acre on the Wallowa-Whitman National Forest in Oregon. Larval populations averaged 24.5 per branch one day before spraying. The 1/2 gallon applications gave better control than the 1/3 gallon applications. Neither rate reduced any of the larval populations below one insect per branch which was the target for a successful treatment. All applications were made with helicopters.

For 1990, plans are being developed for a 65,000 acre operational suppression project on the Yakima Indian Reservation in Washington. The pesticide being considered is B.t. and will be applied undiluted.

REGION 10 (Alaska Region)

Region 10 had no visible defoliation in 1989. Continued low levels are predicted for 1990.

Table 1. Estimated Defoliation by Spruce Budworms in 1988 and 1989

| Region/State | Area Defoliated 1988 (Acres) | Area Defoliated 1989 (Acres) |
|---|---|---|
| Eastern Spruce Budworm | | |
| Lake States | | |
| Michigan | 0 | 0 |
| Minnesota | 200,000 | 140,000 |
| Wisconsin | 0 | 0 |
| Northeast | | |
| New Hampshire | 0 | 0 |
| New York | 0 | 0 |
| Maine | 65,000 | 5,000 |
| Vermont | 0 | 0 |
| Subtotal | 265,000 | 145,000 |
| Western Spruce Budworm | | |
| R-1 | 2,018,779 | 1,201,273 |
| R-2 | 12,000 | 0 |
| R-3 | 483,578 | 90,363 |
| R-4 | 42,300 | 10,588 |
| R-5 | 19,768 | 0 |
| R-6 | 2,762,540 | 2,000,000 |
| R-10 | 0 | 0 |
| Subtotal | 5,338,965 | 3,302,224 |
| Total | 5,603,965 | 3,447,224 |

# FOREST TENT CATERPILLAR
# 1989

## LAKE STATES

Forest tent caterpillar defoliation increased in the Lake States to 4,808,411 acres. Of the total, 526,345 acres were on Federal lands.

A cooperative suppression project was conducted on about 27,496 acres on the Menominee Indian Reservation in Wisconsin in 1989. Dipel 8L was applied to 2,000 acres and Dimilin was applied to 25,500 acres. The project was successful, with scattered low levels of defoliation occurring primarily outside of treatment block areas. Egg mass surveys conducted later this fall will determine suppression needs for 1990.

## NORTHEAST

Forest tent caterpillar defoliation was reported in New York on almost 2,000 acres. No other states reported defoliation in the New England area.

# HEMLOCK WOOLLY ADELGID

The hemlock woolly adelgid has now moved north from Pennsylvania and New Jersey and has been reported in New York, Connecticut, Rhode Island, and Massachusetts as of the spring and summer surveys. Massachusetts is the most recent state to confirm the adelgid's presence. It was first reported in two backyards this spring and then later in a city park where several dozen trees are infested. The adelgid continues to spread to new sites in

Connecticut and New York bringing the total area infested to 2,500 and 4,000 acres, respectively.

There were no control projects in 1989. However, there is a lot of concern about the damage and need for effective registered insectsicides. Both Massachusetts and Rhode Island are considering ground application in 1990 to eradicate new infestations as they are found.

## PEAR THRIPS

The pear thrips damaged far less area in 1989 than in 1988. For example, Vermont reported less than 10,000 acres damaged in 1989 compared to 450,000 acres in 1988. New Hampshire and Massachusetts reported similar damage reductions. These three states were the hardest hit in 1988.

Vermont noted that although there was a sharp decline in damage reduction, there was no corresponding collapse of the pear thrips population. Thrips were abundant in 1989; they simply did not cause the damage observed in 1988. The difference is thought to be the result of a difference in synchrony between host sugar maple trees and the insects.

The Vermont Department of Forests, Parks and Recreation in cooperation with the USDA Forest Service carried out a pilot control project against pear thrips in 1989. Sevin 4 Oil was applied with an Ag Cat on 400 acres (135 acres treated early and 106 ha treated later). Treatment evaluation is underway. However, the lower than expected damage in 1989 even in untreated areas is complicating the analysis.

In Pennsylvania, thrips activity reportedly increased to over 556,310 acres.Although the reported damage occurred in 13 counties, it is a conservative estimate complicated by anthracnose, leaf scorch, and the gypsy moth.

Activity has reportedly increased in Maryland, but no figures are available.

## GYPSY MOTH CONDITIONS IN THE UNITED STATES

In 1989, nearly 3,000,000 acres of hardwood forests were defoliated by the gypsy moth in the eastern United States. This represents a significant increase over the 719,300 acres defoliated in 1988. The gypsy moth front continues to spread in central Michigan, western Pennsylvania, northern Virginia, and West Virginia. This also marks the first year that defoliation has occurred on Federal lands in the Lake States with 2,040 acres of defoliation occurred on the Huron-Manistee National Forest in Michigan.

Cooperative suppression projects were carried out on 694,418 acres in the eastern United States on State and private lands and on 59,677 acres of National Forest or other Federal lands in 1989. About 53 percent of these areas were treated with various formulations of *Bacillus thuringiensis* (*B.t.*); 47 percent with Dimilin, and less than one percent with Gypchek. Numerous delays were encountered during the treatment period due to widespread and frequent spring rains that provided much needed moisture to the eastern hardwood forests.

The Appalachian Integrated Pest Management Project (AIPM), a 13,000,000 acre special project in Virginia and West Virginia, accounted for an additional 37,405 acres of treatment in 1989. Approximately 9,736 acres were treated with *B.t.* and 27,669 acres with Dimilin.

Five eradication projects were conducted on National Forest and private lands in 1989 and totaled 21,151 acres. The projects were conducted in the Coeur d'Alene/Sandpoint area of Idaho (380 acres); Giles County, Virginia (15,312 acres); Hartford-Gates County in North Carolina (4,259 acres), and two areas in Utah (1,200 acres). Of the total areas treated (21,151) 48 percent of the acreage was treated with B.t. and 52 percent with Dimilin.

Residual populations remain in the Coeur d'Alene/Sandpoint, Idaho area, in the Giles County, Virginia and the Utah areas as determined by survey and eradication trapping efforts. Treatment plans for 1990 in these areas have not been finalized.

Preliminary gypsy moth estimates for 1990 indicate that cooperative State and private suppression could involve more than one million acres of treatment in ten eastern States and the District of Columbia; National Forest treatment could amount to 27,000 acres, and other Federal is estimated at 75,000 acres. The AIPM project plans treatment of approximately 200,000 acres in Virginia and West Virginia on State, private, and Federal lands.

USDA FOREST SERVICE GYPSY MOTH AERIAL SUPPRESSION/ERADICATION PROJECTS - 1989

| OWNERSHIP/SITE | STATE/ AGENCY | B.t. | DIMILIN | GYPCHEK | TOTAL |
|---|---|---|---|---|---|
| | | | (A C R E S) | | |
| **NATIONAL FOREST LANDS** | | | | | |
| Allegheny National Forest | PA | 29,684 | 12,441 | 0 | 42,125 |
| George Washington National Forest* | VA | 909 | 2,090 | 300 | 3,299 |
| **OTHER FEDERAL LANDS** | | | | | |
| Agricultural Research Service* | MD | 2,005 | 178 | 0 | 2,183 |
| Catoctin Mountain Park* | MD | 3,045 | 0 | 0 | 3,045 |
| C & O Canal* | MD | 1,266 | 0 | 0 | 1,266 |
| Dulles Airport | VA | 0 | 1,634 | 0 | 1,634 |
| Ft. Belvoir | VA | 0 | 90 | 0 | 90 |
| George Washington Memorial Pkwy. | VA | 1,872 | 0 | 0 | 1,872 |
| Greenbelt & Baltimore Washington PW | MD | 714 | 0 | 0 | 714 |
| Harpers Ferry National Hist. Park | WV | 930 | 0 | 0 | 930 |
| Manassas National Battlefield Park | VA | 230 | 0 | 0 | 230 |
| National Arboretum | DC | 220 | 0 | 0 | 220 |
| National Capital Parks - East | DC | 141 | 0 | 0 | 141 |
| National Zoological Center | VA | 0 | 378 | 0 | 378 |
| Prince William National Park* | VA | 50 | 0 | 100 | 150 |
| Rock Creek Park* | MD | 90 | 0 | 50 | 140 |
| Shenandoah National Park | VA | 0 | 830 | 0 | 830 |
| Wolfe Trap Farm Park | VA | 130 | 0 | 0 | 130 |
| White Oak Naval Warfare Center | MD | 50 | 250 | 0 | 300 |
| Subtotal | | 41,336 | 17,891 | 450 | 59,253 |
| **COOPERATIVE LANDS** | | | | | |
| Delaware | AGR | 14,185 | 25,515 | 0 | 39,700 |
| District of Columbia (no FS funds)* | DC | 3,917 | 0 | 0 | 3,917 |
| Maryland | AGR | 118,494 | 45,410 | 0 | 163.904 |
| Michigan | AGR | 72,600 | 0 | 0 | 72,600 |
| New Jersey Agriculture | AGR | 12,567 | 0 | 0 | 12,567 |
| New Jersey Forestry | FOR | 3,679 | 0 | 0 | 3,679 |
| Pennsylvania | FOR | 92,702 | 103,064 | 0 | 195,766 |
| Virginia | AGR | 38,864 | 112,382 | 0 | 151,246 |
| West Virginia | AGR | 220 | 50,819 | 0 | 51,039 |
| Subtotal | | 357,228 | 337,190 | 0 | 694,418 |
| AIPM | | | | | |
| Virginia | | | | | |
| State and Private* | S&P | 5,578 | 6,400 | 0 | 11,978 |
| George Washington National For. | NF | 50 | 270 | 0 | 320 |
| Shenandoah National Park | NPS | 550 | 830 | 0 | 1,380 |
| West Virginia | | | | | |
| State and Private | S&P | 3,558 | 20,169 | 0 | 23,727 |
| Subtotal | | 9,736 | 27,669 | 0 | 37,405 |

| OWNERSHIP/SITE | STATE/ AGENCY | B.t. | DIMILIN | GYPCHEK | TOTAL |
|---|---|---|---|---|---|
| **ERADICATION PROJECTS** | | | | | |
| Couer d'Alene/Sandpoint* | ID | 380 | 0 | 0 | 380 |
| Giles County | VA | 4.284 | 11,028 | 0 | 15,312 |
| Hartford-Gates County* | NC | 4,259 | 0 | 0 | 4,259 |
| Utah* | UT | 1,100 | 0 | 0 | 1,100 |
| Wasatch-Cache National Forest* | UT | 100 | 0 | 0 | 100 |
| Subtotal | | 10,123 | 11,028 | 0 | 21,151 |
| GRAND TOTAL | | 418,423 | 393,778 | 450 | 812,651 |

* See summary of multiple applications below.

## *SUMMARY OF MULTIPLE APPLICATIONS

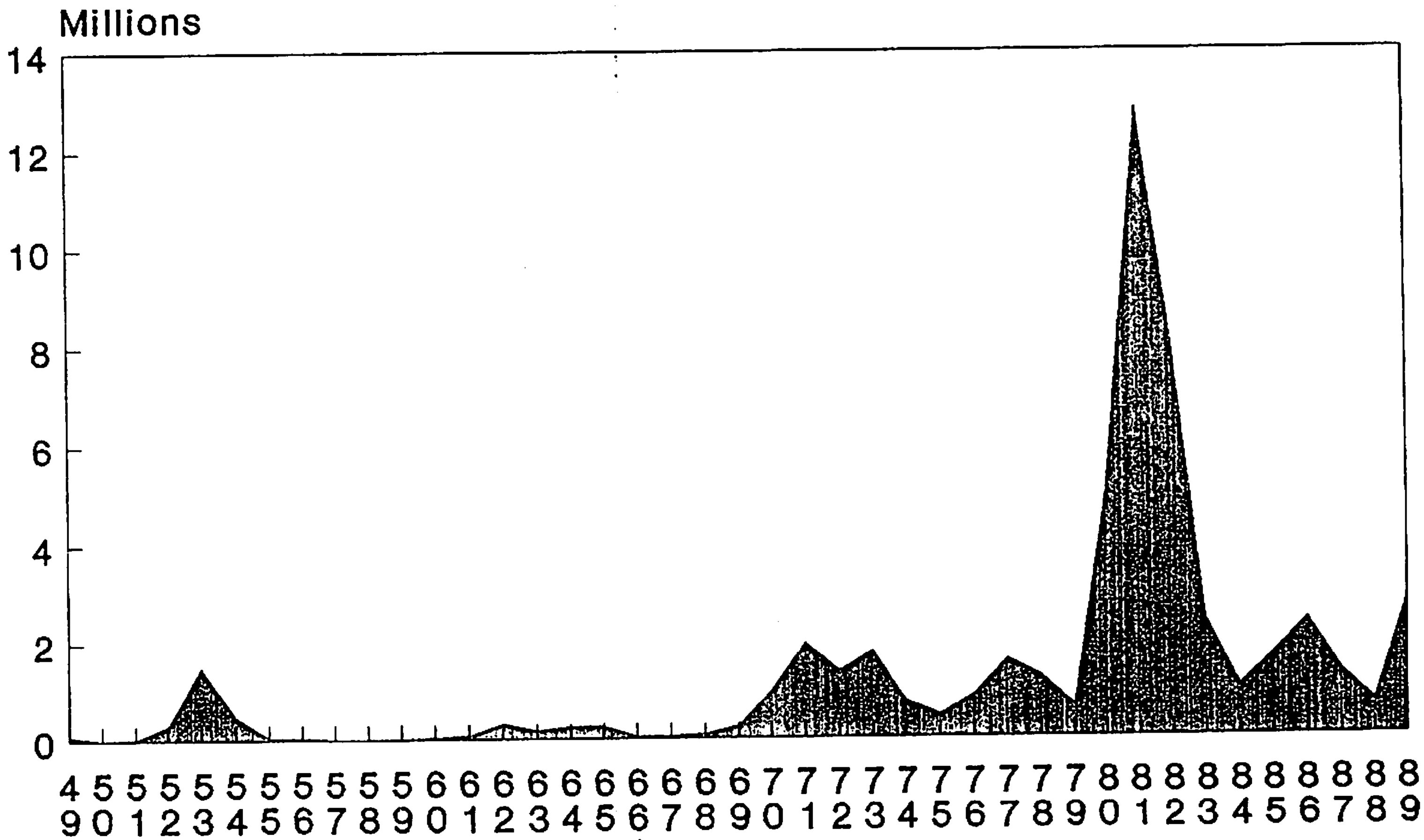
| OWNERSHIP/SITE | ACTUAL ACRES SPRAYED | TOTAL ACRES COUNTING MULTIPLE APPLICATIONS |
|---|---|---|
| **NATIONAL FOREST LANDS** | | |
| George Washington | 2,639 | 3,139 |
| Wasatch-Cache | 100 | 300 |
| **OTHER FEDERAL LANDS** | | |
| Agricultural Research Service | 2,183 | 2,759 |
| Catoctin Mountain Park | 3,045 | 5,736 |
| C & O Canal | 1,266 | 2,532 |
| Harper's Ferry National Hist. Park | 930 | 1,860 |
| Prince William National Park | 150 | 250 |
| Rock Creek Park | 140 | 263 |
| Shenandoah National Park | 830 | 1,660 |
| **AIPM** | | |
| Virginia State and Private | 11,978 | 13,148 |
| **ERADICATION PROJECTS** | | |
| Coeur d'Alene/Sandpoint | 360 | 1,140 |
| Giles County | 15,312 | 30,624 |
| Hartford-Gates County | 4,259 | 8,518 |
| **OTHER** | | |
| District of Columbia | 3,917 | 6,265 |

DEFOLIATION ACRES, 1988-1989

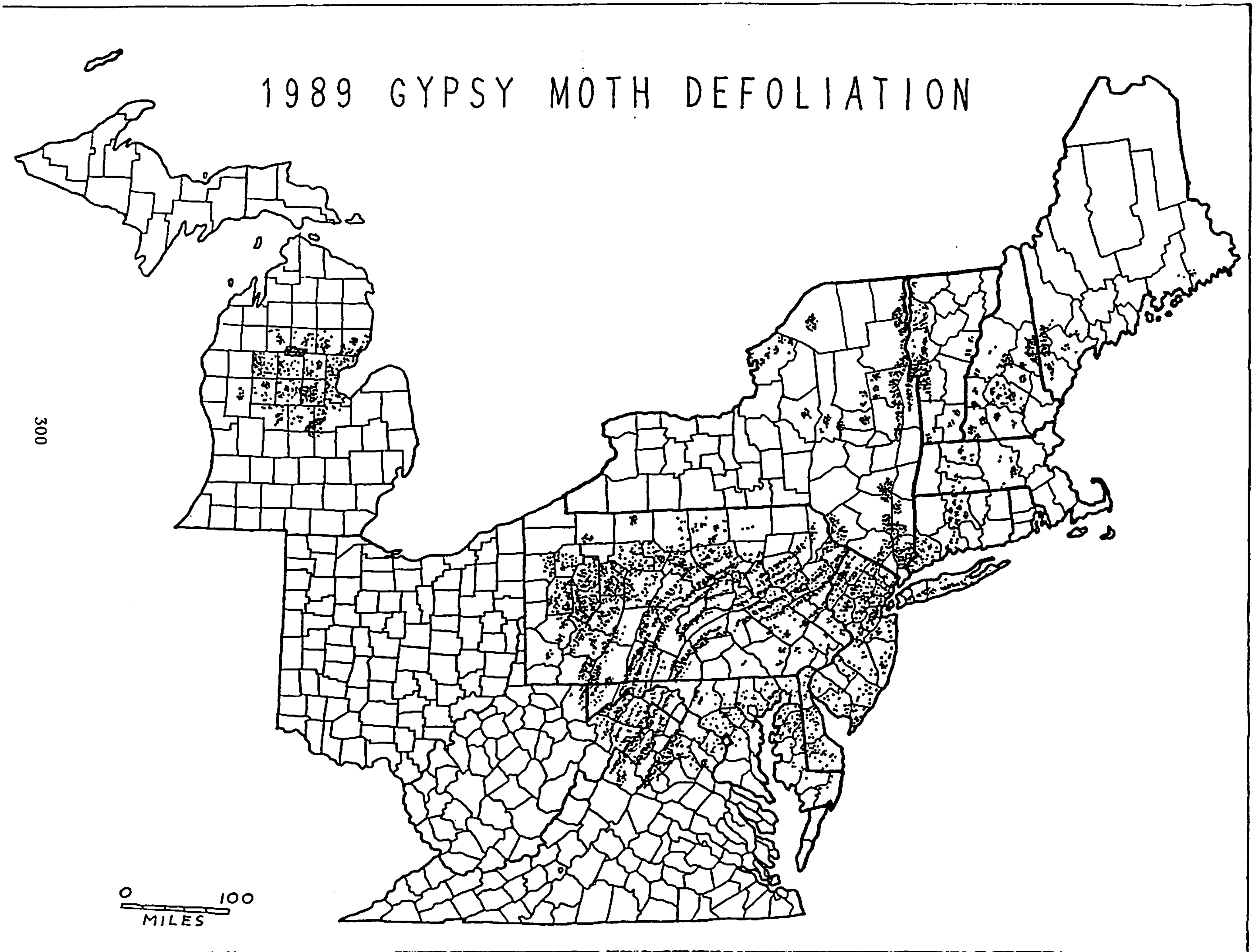
| STATE | 1988 | 1989 |
|---|---|---|
| Connecticut | 1,639 | 78,430 |
| Delaware | 791 | 1,888 |
| Maine | 100 | 35,000 |
| Maryland | 58,507 | 96,591 |
| Massachusetts | 0 | 950 |
| Michigan | 70,350 | 294,344 |
| New Hampshire | 1,015 | 18,395 |
| New Jersey | 7,430 | 137,310 |
| New York | 15,700 | 421,138 |
| Pennsylvania | 312,092 | 1,506,790 1/ |
| Rhode Island | 725 | 0 |
| Virginia | | |
| State | 191,000 | 215,987 |
| AIPM | | 73,345 |
| Vermont | 703 | 27,335 |
| West Virginia | | |
| State | 59,250 | 55,895 |
| GWNF | | 21,319 |
| AIPM | | 9,522 |
| Total | 719,302 | 2,994,239 |

1/ Includes 950 acres on the Allegheny National Forest.

# GYPSY MOTH DEFOLIATION
## 1949 - 1989




Prepared by H.Machesky, USDA FS,
FPM, Morgantown, WV.


1989 GYPSY MOTH DEFOLIATION
0
100
MILES

# SPRUCE BUDWORM IN MAINE - 1989

Prepared by Henry Trial
Maine Forest Service
for the
Seventeenth Annual Forest Pest Control Forum
Ottawa - Nov. 14-16, 1989

The spruce budworm (Choristoneura fumiferana Clem.) infestation which devastated Maine's spruce-fir forests from the early 70's through the mid 80's had nearly disappeared by the summer of 1989. Even a small pocket of population in the southeast coastal area which had persisted through the late 80's was nearly gone by the end of the 1989 season. Because of the potential of the budworm to kill trees and because of reports of population increases in neighboring Canadian provinces, the Maine Forest Service (MFS), Insect and Disease Management Division continued population monitoring efforts in 1989. These efforts included an aerial and ground defoliation survey, operational pheromone trapping, and a test of pheromone trapping efficiency. In 1989, more emphasis was placed on assessing larval populations. The increase in larval sample counts was initiated as a check on pheromone surveys which have given questionable results.

## Larval Population

Larval population counts were made at 13 locations throughout the State. Locations chosen for sampling were, predominantly, traditional development and parasite points. Several 18" branch tips were examined at each site to assess larval population. Larvae were found at only two of the 13 locations; Waltham and Jonesboro. Both locations are in the southeast area. The early larval count at Jonesboro was 3.5 per branch and Waltham had 13.7 larvae per branch. Both locations maintained some population throughout the season and were used to evaluate parasitism and development.

## Microsporidian Evaluation

All larval samples collected from Waltham and Jonesboro were saved for microsporidian disease analysis by Dr. John Dimond of the University of Maine. Analysis of larvae from several collections made at the two development sites showed low rates of infection. Collections made in southeastern Maine have not shown the high infection rates seen in other portions of the State

## Defoliation Survey

A combination of retarded insect development, lush foliage, and light or variable budworm populations made damage detection from the air impossible in 1989. Survey flights were made in the heaviest defoliation areas but only 1300 acres of moderate damage was mapped and even this required ground confirmation. Additional ground checks revealed 3500 acres of light damage (figure 1). Towns in Hancock county that had areas of light or moderate defoliation were Waltham and Gouldsboro. Washington county towns with similar levels of damage were Steuben, Columbia, Columbia Falls, and Jonesboro. Defoliation in 1989 was extremely spotty and even adjacent trees were found to have very different levels of damage.

## Pheromone Survey

Again in 1989, pheromone traps were deployed throughout the previously infested area in order to predict future budworm population trends. Recent experience with this survey method has not been satisfactory mainly because moths have not been trapped in areas of known infestation. Also, inter-trap variability has been high. To increase survey sensitivity, a new lure (Biolure) thought to have a greater ability to attract moths was used in half the traps. Both PVC lure and Biolure were used at each trap location.

In 1989 traps baited with PVC lure consistently caught more moths than traps baited with Biolure. In the southeast, where low to moderate populations persist (figure 2), PVC lures and Biolures both caught moths, however, catch in PVC baited traps was much higher than Biolure. PVC lures produced numbers of moths comparable with catches recorded by other jurisdictions with similar population levels. In areas of low population, PVC lures caught low numbers of moths but in most cases Biolure caught none. For example many PVC traps in the northeast caught one to five moths where Biolure caught none. Due to the great inconsistencies which have occurred between years we do not know if the catch in the northeast represents an increase in moths or an unexplained improvement in trap efficiency.

## Pheromone Tests

Two pheromone tests were conducted in Maine in 1989. In the first test, 20 trap grids of PVC baited traps were established next to 20 trap grids of Biolure baited traps in order to compare trap catch and inter-trap variability. In the second test, three rates of PVC lure plus Biolure were compared in random grids of 20 traps. This test should establish the catch gradient relationship among the four lures.

Results of both tests are currently being analyzed and results will be published as part of a report discussing four years of pheromone use and testing in Maine.

## Light Trap Survey

The MFS has operated a system of light traps since 1943 to monitor budworm and other insects. As budworm populations increased in the 40's this trap system became a supplement to other types of population assessment data and it remains so today. In recent years the MFS has contracted for the operation of 20 traps distributed statewide. Four additional traps began operation in 1989. These traps were located in areas where increased data on low level budworm populations were desirable. A comparison of past light trap data with annual defoliation conducted in 1989 had shown an excellent relationship. Because of this relationship the MFS believes that light trap data may be a good predictor of low level population trends.

Results in 1989 are complicated somewhat by the addition of the four new traps and by a change of the location of another trap. In general, more moths were trapped in 1989 and more of these moths were trapped in traditional infestation areas of the northern and central portions of the State. In 1988 much of the catch occurred in the south and southcentral area. In 1988, nine of 20 traps caught 209 moths with most of the catch coming from one southeastern trap. In 1989, 736 moths were caught in 16 of 24 traps and again most of the catch came from one southern trap. The trap producing the high catch in 1988 was a different trap from the high one in 1989. The high producer in 1988 was moved in 1989 and this move almost certainly reduced catch. If the 1988 and 1989 high producers are excluded, approximately six times as many moths were caught by the remaining traps in 1989 compared to 1988.

Catch numbers are far too low to be considered significant but the catch does indicate a more generally distributed low level population than was seen in 1988. Similar results in 1990 and 1991 would suggest an upward trend.

## 1990 Prediction

Prediction of the budworm population trend in Maine for 1990 is little more than a guess. Pheromone trapping results for 1989 show slight increases in catch from 1988 levels but the change is not significant. Considering the recent inconsistencies with pheromones any change could be due to the method and have no relation to population. Light traps in the northern and central portions of Maine caught more moths than in 1989 but increases for two or three years would be needed to consider the change a trend. It is probably safe to say that any changes in the status of budworm in Maine in 1990 will not be drastic. Population and damage levels are likely to be similar to those seen in 1989.

## MAINE

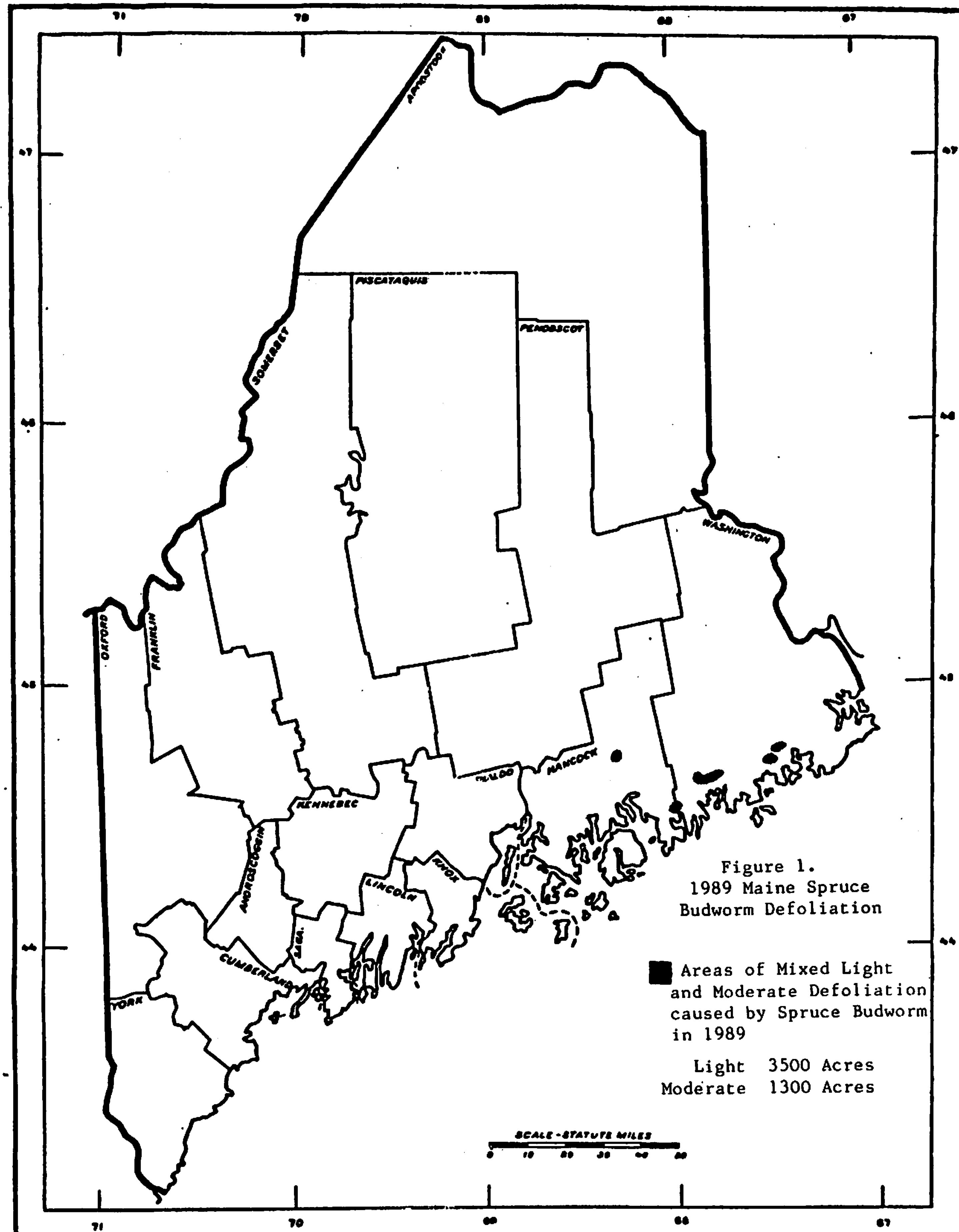



Figure 1.
1989 Maine Spruce
Budworm Defoliation

■ Areas of Mixed Light and Moderate Defoliation caused by Spruce Budworm in 1989

| | |
|---|---|
| Light | 3500 Acres |
| Moderate | 1300 Acres |

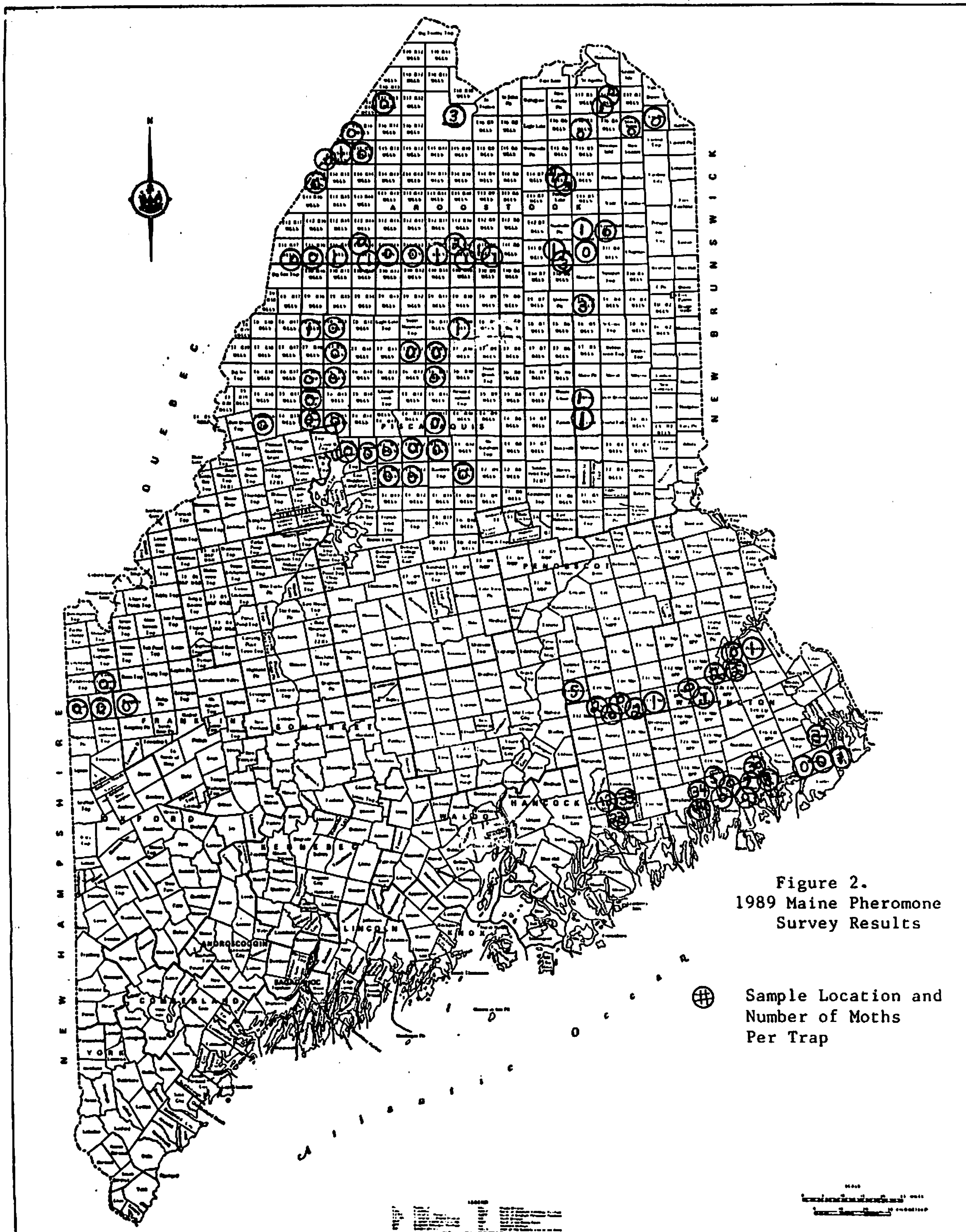



Figure 2.
1989 Maine Pheromone Survey Results

## GYPSY MOTH
## MAINE CONDITIONS - 1989

Dick Bradbury
Maine Forest Service

Gypsy Moth defoliated 34,286 acres in 1989, representing a significant increase from endemic populations of 1988 when only 100 acres were detected. Populations were predominantly located in the southern portion of the State with a small increases in persistent populations in eastern Maine.

Winter temperatures of 1988-1989 were mild and did not result in the usual level of egg mortality. Based on incubation of March-collected egg masses most eggs were viable from both above and below snowline.

Aerial surveys conducted during July to determine the defoliated area revealed 20,020 acres of light (less than 30%) defoliation and 14,266 acres of moderate to heavy (greater than 30%) defoliation.

Pheromone trapping was conducted in an East-West band at the northern edge of the regulated area using 'milk carton' traps baited with "+" disparlure. There was a general increase in moth catches across the State, with the greatest increase in western Maine and very high catches near a known infestation in the Millinocket area. Only 68 of 250 traps along this line had zero catch in 1989. Moth catches within the generally infested area, sampled with 'milk carton' traps baited with racemic disparlure, had a mean of 154.9 moths per trap in 1989, up from a mean of 21 in 1988.

Egg mass sampling is underway; 21 of 75 selected candidate locations have been surveyed with a mean of 1895 egg masses per acre (range: 0 to 13,821). Final results should be available by the end of November.

Gypsy moth populations are apparently now beginning an epidemic phase in Maine. In 1990 acreage and intensity are likely to increase.

The Maine Forest Service plans no gypsy moth suppression project for 1990, but is providing technical advice and assistance to municipalities, forest landowners, the general public, etc. Towns with areas of known defoliation have been contacted and training is being offered.

## II. VEGETATION MANAGEMENT SUMMARIES/RÉSUMÉS PORTANT SUR LA RÉPRÉSSION DE LA VÉGÉTATION

# THE EXPERT COMMITTEE ON WEEDS: ITS RELEVANCE TO FORESTRY HERBICIDE RESEARCH AND REGISTRATION

Report to the 17th Annual Forest Pest Control Forum

Robert A. Campbell

Forest Pest Management Institute
Forestry Canada
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

November 1989

The Expert Committee on Weeds operates under the aegis of Agriculture Canada. Participation is open to anyone interested in weed science as a discipline and in the promotion of safe, effective, efficient methods of weed control suitable for Canada. In practice, the participants are researchers, herbicide manufacturing personnel, extension personnel and regulatory personnel. There is an Eastern Canada and a Western Canada Section, each of which function largely independently although their activities are similar.

The objectives of the Eastern Canada Section are:

1. Report and evaluate, annually, weed science research conducted in Eastern Canada.

2. Develop an information base for herbicide use patterns for Eastern Canada.

3. Make recommendations for herbicide use for Eastern Canada.

4. Hold, on an annual basis, a meeting to serve as a forum for the discussion of problem areas of weed control, new developments in weed control, weed research requirements, various alternatives for weed control, and related concerns for the benefit of weed science.

5. Co-ordinate activities of Agriculture Canada, Universities, Industry and Provincial Departments of Agriculture that pertain to research on weeds and weed control, including surfactants, desiccants, growth regulators, and biological agents as they apply to weed science.

6. Make recommendations to the National Executive of ECW on weed problems, weed research needs, and regulations governing weed control and herbicide use.

7. Remain a scientific working group without the objective of financial gain.

Within each section, there is a Project Summarizer for each crop or group of crops (e.g., corn, forages, fruit trees, silviculture, etc.). Each year all researchers who are carrying out herbicide trials in Canada are invited to submit abstracts of their research results. These are then published in the Annual Research Reports (one for the east and one for the west).

Herbicide treatments are formulated or revised (either by the summarizer or the herbicide manufacturer) based on the reported research results. The Project Summarizers propose which of three categories a particular herbicide treatment should be in. Category "B" consists of treatments that have shown promise in field and/or greenhouse tests and appear to be worthy of further investigation to determine optimum rates and methods of application (i.e., results are positive but data is very limited). After research trials conducted in two or more years have consistently demonstrated weed control and crop tolerance, a treatment will move up to Category "A". Finally, after enough research trials have been conducted that the treatment conditions (rate, soil type, timing, crop stage of development, etc.) can be defined rigidly enough that the treatment will consistently be efficacious, the treatment will move up to the "Accepted" category. All proposed category changes must be defended by the Project Summarizer and approved by the Committee before they are published in the Annual Report of the Research Appraisal and Planning Committee.

It is important to note several points about the ECW review of herbicide research:

1. It is an ongoing process. Through the system of treatment categories, the Committee provides feedback to the researchers and manufacturers about what research is lacking before a treatment can be recommended.

2. The Committee considers only efficacy and crop tolerance in making recommendations. Environmental fate and toxicology are not considered.

3. An "Accepted" rating by the ECW does not have official status with regard to registration. ECW recommendations do, however, form part of the database which the Pesticides Directorate of Agriculture uses to decide whether or not to register a use.

There are two very good reasons why all forestry herbicide trials should be reported in the ECW Research Reports:

1. Because ECW recommendations are based on the research abstracts, the more abstracts are submitted, the sooner a treatment can reach the "Accepted" category. This facilitates registration.

2. Forestry herbicide trials are costly and time consuming. We have too few resources dedicated to this area to be able to afford the waste associated with reinventing the wheel and repeating the mistakes of others.

Both the Eastern and Western Annual meetings have a Forestry Technical Session. At the 1989 Eastern meeting, presentations were made on a variety of topics including: herbicide registration, proposals for non-target plant phytotoxicity registration requirements, glyphosate residues in game animals, effect of glyphosate on wildlife habitat, aerial drift and mechanical weeding.

Anyone wishing to be added to the ECW Silviculture mailing list should contact one of the following:

Newfoundland to Ontario

Dr. Robert A. Campbell
Forest Pest Management Institute
Forestry Canada
P.O. Box 490
Sault Ste. Marie, ON
P6A 5M7
Tel: (705) 949-9461
Fax: (705) 759-5700

Manitoba to BC

Mr. Roger J. Whitehead
Forestry Canada
Pacific and Yukon Region
506 West Burnside Road
Victoria, BC
V8Z 1M5
Tel: (604) 388-0765
Fax: (604) 388-0775

Background Report For

# CANADIAN FOREST NURSERY WEED MANAGEMENT ASSOCIATION

and

# ATLANTIC FOREST NURSERY PEST ADVISORY COMMITTEE

Paper presented at the

SEVENTEENTH ANNUAL

FOREST PEST CONTROL FORUM

by

L.J. Lanteigne

Forestry Canada - Maritimes Region

Government of Canada Conference Centre
2 Rideau Street
Sussex Room, 1st Floor
Ottawa, Ontario
November 14, 15, 16, 1989

## CANADIAN FOREST NURSERY WEED MANAGEMENT ASSOCIATION

The first of the annual workshops on weed control in forest nurseries was held at Indian Head, Saskatchewan in July 1984. Since then, annual meetings have been held in New Brunswick, (1985), British Columbia (1986), Quebec (1987), Manitoba (1988), and Ontario (1989). Participants have included nurserymen, researchers, provincial and federal representatives responsible for controlling the use of pesticides, and representatives from companies manufacturing and/or distributing pesticide products and application equipment. These participants have come from across Canada as well as the United States. The original name of the group was called "The Canadian Tree Nursery Weed Control Committee". In 1987, the official name of this organization became the "Canadian Forest Nursery Weed Management Association".

The orginal objectives of the committee were:

1. to conduct a survey of all tree nurseries in Canada to obtain detailed information about their current weed control programs and to obtain any weed control data which would be suitable for submission to the Expert Committee on Weeds;
2. to set priorities on herbicides for submission for minor use registration;
3. to prepare a release about the workshop and the creation and objectives of the newly formed committee;
4. to contact Forestry Canada headquarters in Ottawa, regional nursery specialists and associations of tree nurserymen, regional directors of the Forestry Canada facilities and the appropriate summarizers of the Expert Committee on Weeds;
5. and to establish a standard testing and reporting procedure for herbicide testing in Canadian tree nurseries.

In 1987, a constitution was finalized defining new objectives:

1. to encourage a wider understanding of the problems of weed control in forest and shelterbelt tree nurseries with particular emphasis on chemical weed control;
2. to promote education in weed science and management practices;
3. to promote public interest and knowledge of sound forest and shelterbelt tree nursery weed control practices;
4. to initiate, design, plan, develop and conduct national research trials on herbicides that are promising for weed control in forest and shelterbelt tree nurseries in order that sufficient data might be collected to allow for registration of these herbicides in Canada; and
5. to provide technical information to nurserymen regarding proper management of weeds in nurseries.

A survey of weed control practices in Canadian forest tree nurseries during 1984 was conducted. The objective of the survey was to obtain detailed information about weed control programs. Forty-seven bareroot production centres with a total production of 285 million seedlings were surveyed (twenty-five returns). The competition level of grass and broadleaf weed species was moderate to severe in over 50 percent of the nurseries. Weed control practices in bareroot nurseries included manual, chemical, mechanical, and mulching. Eighty-three container production centres with a total production of 271 million trees were surveyed (thirty-five returns). The competition level of grass and broadleaf weed species was moderate to severe in 50 percent of the nurseries. Manual and chemical weed control were the primary methods of weed control. The resounding conclusion from this survey was that weeds are a major problem in both bareroot and container forest tree nurseries.

Officials from Agriculture Canada - Pesticide Directorate, Forestry Canada - Forest Pest Management Institute, Expert Committee on Weeds, and regional nursery specialists were contacted to inform them of the activities and purpose of this group (CFNWMA). The opportunity to present a paper at the 17th annual Pest Control Forum and Pesticide Caucus meetings is part of the CFNWMA objectives.

National protocols for testing Goal (oxyfluorfen) were developed for bareroot tree nurseries (1985) and container tree nurseries (1986). The objective of these protocols was to provide a uniform experimental design to test Goal on a national basis in order to provide sufficient data to allow for registration of this product for forest tree nursery use pattern.

A national survey of weed problems and control measures was conducted for forest tree nurseries across Canada during 1988. Preliminary results have been compiled. The total production (container and bareroot) for 1988 was 861 million tree seedlings worth a total value of $123 million. Hand weeding costs were $2.3 million. At the same time though, hand weeding resulted in a decrease in the quantity of seedlings. Also, hand weeding did not provide a complete solution to weed problems in forest tree nurseries. The estimated cost of the weed problems in Canadian forest tree nurseries was about $10 million for 1988. This included cost of handweeding, increased grading cost, and loss of production.

In July 1989, a consulting company - Deloitte, Haskins and Sells had been contracted to write a report - "Economic Benefit Assessment of Weed Control in Nursery Production Using Goal". The first draft was completed on October 11, 1989. The final version of this report should be completed by November 30, 1989. Al McFadden, Rohm & Haas Canada Inc. (manufacturer of Goal), has been closely involved with the national research protocols for testing Goal in forest tree nurseries, the national survey of weed control problems, and the economic benefit assessment study by Deloitte, Haskins $ Sells. Rohm & Haas and the CFNWMA will be jointly submitting all the research results related to the use of

Goal in forest tree nurseries, the economic benefit study, and the revised pesticide label to Agriculture Canada - Pesticide Directorate (late 1989 or early 1990) to seek registration of Goal for tree nursery use pattern.

## ATLANTIC FOREST NURSERY CROP ADVISORY COMMITTEE

On April 12, 1989 several individuals involved with forest nurseries met in Fredericton, N.B. to discuss the use of pesticides in forest tree nurseries and tree seed orchards. Topics discussed included identifying registered pesticides for specific use patterns, interpretation of labels, education, information dissemination, and lack of control measures for pests problems. The final conclusion was that a formal group was required to address these problems.

During the second meeting (May 17, 1989) goals were identified as:

1) interpret pesticide labels and prepare a formal compendium of registered pesticide products for these use patterns;
2) make recommendations for the use of pesticide products;
3) identify pest problems without suitable control methods and enact submissions to Minor Use Program or label extensions for full registration;
4) develop and provide education for the safe and proper use of pesticides;
5) participate in public relations;
6) provide guidelines for the disposal of pesticide products;
7) provide an information base by gathering and disseminating literature on pest control;
8) establish contact with similar groups which have an interest in this subject;
9) conduct an annual survey of pest control practices for forest nurseries and tree seed orchards; and
10) facilitate pesticide residue sampling

Pesticide labels have been reviewed and a compendium of registered pesticide products for forst tree nurseries and seed orchards use patterns has been developed. The list will be sent to Agriculture Canada for final approval. The approved list will be published with the intention of periodic updates. Recommendations for the use of pesticide products in forest nurseries and seed orchards will be developed.

A course on pest control in forest nurseries was conducted on April 11-13, 1989 at the Maritime Forest Ranger School, Fredericton, N.B. An update will be offered on July 10-11, 1990 and the topics to be covered will be "health and safety related to the use of pesticides" and "equipment and application techniques".

Initially, this group was formed to discuss pest management in forest nurseries and tree seed orchards but since then, the scope has been broadened to include all aspects of crop production such as fertilization, irrigation, etc. New goals will have to be identified. It has also been proposed that this type of group be organized on a national level.

**ATTACHMENTS**

1. Proceedings of the Canadian Forest Nursery Weed Management Workshops for 1984, 1985, 1986, 1987, 1988.

2. Draft of "Economic Benefit Assessment of Weed Control in Nursery Production Using Goal" by Deloitte Haskins & Sells.

3. Draft of "Summary of national survey on weed control in forest tree nurseries".

4. Draft of list of pesticides registered for forest tree nursery and seed orchard use pattern.

Table 1. National summary of bareroot and container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Bareroot | 1 736.1 (1 087.8) | 230 176 | 37 305 | 1 294.9 |
| Container | 340.2 (229.6) | 630 575 | 86 211 | 1 001.2 |
| **Total** | **2 076.3 (1 317.4)** | **860 751** | **123 516** | **2 296.1** |

[1] Potential area to be sprayed with Goal

Table 2. National summary of bareroot tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Newfoundland | 50.0 (50.0) | 4 787 | 850 | 23.2 |
| Prince Edward Island | 2.0 (1.0) | 300 | 45 | 1.5 |
| Nova Scotia | 76.7 (76.6) | 4 386 | 725 | 40.8 |
| New Brunswick | 15.5 (15.5) | 2 978 | 403 | 15.4 |
| Quebec | 338.1 (239.9) | 69 183 | 12 143 | 243.9 |
| Ontario | 499.2 (410.5) | 79 892 | 11 565 | 444.3 |
| Manitoba | 42.1 (21.0) | 6 050 | 908 | 13.6 |
| Saskatchewan | 180.0 (65.0) | 12 121 | 1 890 | 235.6 |
| Alberta | 320.0 (50.0) | 7 890 | 990 | 62.5 |
| British Columbia | 212.5 (158.3) | 42 589 | 7 786 | 214.1 |
| **TOTAL** | 1 736.1 (1 087.8) | 230 176 | 37 305 | 1 294.9 |

[1]Potential area to be sprayed with Goal

Table 3. National summary of container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Newfoundland | 2.7 (1.6) | 6 188 | 798 | 1.1 |
| Prince Edward Island | 1.5 (1.0) | 2 600 | 390 | 5.0 |
| Nova Scotia | 14.6 (11.8) | 27 731 | 2 107 | 95.8 |
| New Brunswick | 18.6 (15.6) | 44 391 | 7 033 | 92.4 |
| Quebec | 168.5 (90.3) | 172 717 | 21 901 | 341.0 |
| Ontario | 10.8 (8.1) | 75 000 | 11 880 | |
| Manitoba | 2.8 (0.5) | 8 000 | 960 | 2.4 |
| Saskatchewan | 0.3 ( ) | 1 113 | 82 | 6.4 |
| Alberta | 10.4 (4.0) | 17 835 | 1 714 | 14.5 |
| British Columbia | 110.0 (96.7) | 275 000 | 39 346 | 442.6 |
| Total | 340.2 (229.6) | 630 575 | 86 211 | 1 001.2 |

[1]Potential area to be sprayed with Goal

Table 4. Bareroot tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| **NEWFOUNDLAND** | | | | |
| Wooddale Provincial Nursery | 50.0 (50.0) | 4 787 | 850 | 23.2 |
| **Sub-Total** | **50.0 (50.0)** | **4 787** | **850** | **23.2** |
| **PRINCE EDWARD ISLAND** | | | | |
| J.F. Gaudet Tree Nursery | 2.0 (1.0) | 300 | 45 | 1.5 |
| **Sub-Total** | **2.0 (1.0)** | **300** | **45** | **1.5** |
| **NOVA SCOTIA** | | | | |
| Debert Tree Breeding Center | 0.7 (0.6) | 8 | 200 | 1.5 |
| Lawrencetown Forest Nursery | 40.0 (40.0) | 2 667 | 300 | 25.8 |
| Strathlorne Forest Nursery | 36.0 (36.0) | 1 887 | 225 | 13.5 |
| **Sub-Total** | **76.7 (76.6)** | **4386** | **725** | **40.8** |
| **NEW BRUNSWICK** | | | | |
| Juniper Tree Nursery | | 732 | 88 | |
| Kingsclear Provincial Forest Nursery | 15.5 (15.5) | 2 246 | 315 | 15.4 |
| **Sub-Total** | **15.5 (15.5)** | **2978** | **403** | **15.4** |

Table 4. Bareroot tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| **QUEBEC** | | | | |
| Berthier-M.E.R. | 50.0 (42.5) | 11 700 | 1 900 | 36.0 |
| Duchesnay-M.E.R. | 14.0 (7.0) | 3 500 | 665 | 38.2 |
| Trecesson-M.E.R. | 29.0 (15.0) | 4 100 | 600 | 4.2 |
| Saint-Modeste-M.E.R. | 60.0 (42.0) | 15 300 | 1 836 | 35.5 |
| Sainte-Luce-M.E.R. | 52.0 (35.4) | 12 200 | 3 041 | 46.6 |
| Normandin-M.E.R. | 30.5 (23.0) | 3 710 | 621 | 33.7 |
| Grandes-Piles-M.E.R. | 49.0 (37.0) | 7 700 | 1 554 | 11.0 |
| Adjustment[2] | 53.6 (38.0) | 10973 | 1 926 | 38.7 |
| Sub-Total | 338.1 (239.9) | 69 183 | 1 2143 | 243.9 |
| ONTARIO | | | | |
| O.M.N.R.--Chapleau | 7.1 (7.1) | 3 000 | 525 | 28.0 |
| O.M.N.R.--Dryden | 24.0 (24.0) | 7 795 | 1 169 | 33.2 |
| O.M.N.R.--Gogama | 12.5 (12.5) | 3 500 | 448 | 25.0 |
| O.M.N.R.--Kemptville | 43.0 (42.0) | 7 028 | 609 | 62.5 |
| O.M.N.R.--Midhurst | 58.6 (46.9) | 7 869 | 1 180 | 26.2 |

Table 4. Bareroot tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| O.M.N.R.--Orono | 60.0 (57.0) | 6 000 | 978 | 45.0 |
| O.M.N.R.--St. Williams | 80.0 (32.0) | 8 700 | 1 000 | 28.0 |
| O.M.N.R.--Swastika | 114.0 (114.0) | 18 300 | 2 700 | 100.4 |
| O.M.N.R.--Thunder Bay | 100.0 (75.0) | 17 700 | 2 956 | 96.0 |
| **Sub-Total** | **499.2 (410.5)** | **79 892** | **11 565** | **444.3** |
| **MANITOBA** | | | | |
| Pineland Provincial Forest Nursery | 42.1 (21.0) | 6 050 | 908 | 13.6 |
| **Sub-Total** | **42.1 (21.0)** | **6 050** | **908** | **13.6** |
| **SASKATCHEWAN** | | | | |
| Big River Forest Nursery | 25.0 (25.0) | 5 411 | 545 | 98.5 |
| Prince Albert Forest Nursery | 33.0 (28.0) | 5 870 | 1 115 | 134.1 |
| PFRA Shelterbelt Centre | 122.0 (12.0) | 840 | 230 | 3.0 |
| **Sub-Total** | **180.0 (65.0)** | **12 121** | **1 890** | **235.6** |
| **ALBERTA** | | | | |
| Pine Ridge Forest Nursery | 20.0 (20.0) | 7 000 | 600 | 38.5 |

Table 4. Bareroot tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Alberta Tree Nursery | 300.0 (30.0) | 890 | 390 | 24.0 |
| **Sub-Total** | **320.0 (50.0)** | **7 890** | **990** | **62.5** |
| **BRITISH COLUMBIA** | | | | |
| Ministry of Forest-Skimikin | 16.0 (2.0) | 3 150 | 441 | 11.4 |
| Minstry of Forest-Surrey | 62.0 (31.0) | 11 049 | 2 200 | 35.0 |
| Ness Lake Forest Nursery | 20.0 (20.0) | 4 000 | 600 | 13.0 |
| Yellow Point Propagation | 1.0 (1.0) | 5 | 1 500 | 1.0 |
| Sylvan Vale Nursery | 2.5 (1.3) | 250 | 65 | 1.2 |
| Reid, Collins Nurseries | 5.0 (5.0) | 5 | 100 | 10.0 |
| Grandview Nursery | 24.0 (16.0) | 7 130 | 1 070 | 21.8 |
| Chilliwack River Nursery | 35.0 (35.0) | 6 000 | 480 | 35.0 |
| Campbell River Nursery | 12.0 (12.0) | 3 000 | 420 | 15.7 |
| Red Rock Nursery | 35.0 (35.0) | 8 000 | 1 000 | 70.0 |
| **Sub-Total** | **212.5 (158.3)** | **42 589** | **7 786** | **214.1** |
| **TOTAL** | 1 736.1 (1 087.8) | 230 011 | 37 177 | 1 294.9 |

[1]Potential area to be sprayed with Goal

[2]Adjustment made based on personal communication with Regional representative of Canadian Forest Nursery Weed Management Association.

Table 5. Container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| **NEWFOUNDLAND** | | | | |
| Wooddale Provincial Nursery | 2.1 (1.4) | 5 468 | 700 | 1.0 |
| Mount Pearl Nursery | 0.2 (  ) | 400 | 48 | |
| Goose Bay Tree Nursery | 0.4 (0.2) | 320 | 50 | 0.1 |
| **Sub-Total** | **2.7 (1.6)** | **6 188** | **798** | **1.1** |
| **PRINCE EDWARD ISLAND** | | | | |
| J.F. Gaudet Tree Nursery | 1.5 (1.0) | 2 600 | 390 | 5.0 |
| **Sub-Total** | **1.5 (1.0)** | **2 600** | **390** | **5.0** |
| **NOVA SCOTIA** | | | | |
| Wittenburg Forest Nursery | 1.4 (1.4) | 4 200 | 504 | 3.0 |
| Lawrencetown Forest Nursery | 1.0 (1.0) | 250 | 3 | 0.8 |
| Strathlorne Forest Nursery | 4.5 (4.0) | 11 494 | 225 | 48.6 |
| Westenek Forest Nursery | 0.2 (0.2) | 1 421 | 175 | 1.1 |
| Bowater Forest Nursery | 0.4 (0.4) | 600 | 72 | 0.5 |
| Morrison's Greenhouses | 0.6 (0.1) | 1 916 | 200 | 0.6 |

Table 5. Container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Octa Evergreens Ltd. | 1.0 (0.7) | 2 100 | 300 | 20.0 |
| Scott Tree Nursery | 3.5 (2.0) | 5 600 | 568 | 19.2 |
| Pleasant Vally Nurseries | 2.0 (2.0) | 150 | 60 | 2.0 |
| **Sub-Total** | **14.6 (11.8)** | **27 731** | **2 107** | **95.8** |
| **NEW BRUNSWICK** | | | | |
| Kingsclear Provincial Forest Nursery | 6.0 (6.0) | 10 988 | 1 540 | 54.1 |
| Kent Forest Nursery | 1.6 (1.1) | 5 978 | 715 | 1.0 |
| Madran Forest Nursery | 2.5 (2.0) | 6 144 | 770 | 4.6 |
| Fraser Forest Nursery | 3.0 (2.5) | 6 124 | 1 041 | 24.0 |
| Sussex Tree Nursery | 0.5 (0.3) | 797 | 120 | 1.5 |
| Juniper Tree Nursery | 3.5 (3.5) | 13 240 | 2 648 | 4.5 |
| St. Croix Pulpwood Ltd. | 0.2 (0.2) | 500 | 125 | 2.7 |
| Mann Bros. Nursery | 0.1 ( ) | 200 | 24 | |
| Valley Forest Products | 0.1 ( ) | 60 | 7 | |

Table 5. Container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| MacTavish Equipment Ltd. | 1.1 ( ) | 360 | 43 | |
| **Sub-Total** | **18.6 (15.6)** | **44 391** | **7 033** | **92.4** |
| **QUEBEC** | | | | |
| Berthier-M.E.R. | 2.5 (1.0) | 7 900 | 960 | 24.0 |
| Duchesnay-M.E.R. | 4.7 (0.5) | 5 000 | 750 | 13.6 |
| East Angus-M.E.R. | 7.0 ( ) | 10 000 | 1 200 | 13.6 |
| Trecesson-M.E.R. | 15.0 (15.0) | 6 000 | 800 | 3.2 |
| Saint-Modeste-M.E.R. | 20.0 (10.0) | 15 600 | 1 872 | 9.6 |
| Sainte-Luce-M.E.R. | 10.7 ( ) | 3 000 | 750 | 5.3 |
| Normandin-M.E.R. | 2.0 ( ) | 5 000 | 480 | 32.0 |
| Grandes-Piles-M.E.R. | 3.0 ( ) | 4 394 | 835 | 10.0 |
| Sargim | 4.0 (3.2) | 3 900 | 470 | 46.7 |
| Argenteuil | 11.0 (11.0) | 3 300 | 400 | 0.5 |
| Cooperative Forestiere Laterriere | 3.6 (2.9) | 2 000 | 260 | 6.4 |
| Centre Production de Plants Forestiere du Quebec | 15.0 (9.0) | 8 000 | 1 000 | 17.0 |

Table 5. Container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Somival | 2.2 (1.10 | 4 250 | 550 | 20.0 |
| Serres Coop. de Guyenne | 10.0 (3.0) | 12 000 | 1 700 | 8.0 |
| Centre Sylvicole Forestville | 4.5 (4.5) | 25 000 | 2 600 | 16.0 |
| Reboisement Mauricie Inc. | 4.8 (3.2) | 6 500 | 845 | 7.0 |
| Adjustment[2] | 48.5 (25.9) | 50 873 | 6 429 | 108.1 |
| **Sub-Total** | **168.5 (90.3)** | **172 717** | **21 901** | **341.0** |
| **ONTARIO** | | | | |
| O.M.N.R.--Dryden | 1.8 (1.4) | 13 265 | 1 592 | |
| O.M.N.R.--Kemptville | 0.2 (0.1) | 548 | 596 | |
| Adjustment | 8.8 (6.6) | 61 187 | 9692 | |
| **Sub-Total** | 10.8 (8.1) | 75 000 | 11 880 | |
| **MANITOBA** | | | | |
| Pineland Provincial Forest Nursery | 1.1 (0.5) | 3 000 | 360 | 2.4 |

Table 5. Container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Clearwater Nursery | 0.6 ( ) | 5 000 | 600 | |
| **Sub-Total** | **2.8 (0.5)** | **8 000** | **960** | **2.4** |
| **SASKATCHEWAN** | | | | |
| Prince Albert Forest Nursery | 0.3 ( ) | 1 113 | 82 | 6.4 |
| **Sub-Total** | **0.3 ( )** | **1 113** | **82** | **6.4** |
| **ALBERTA** | | | | |
| Syncrude Canada Ltd. Nursery | 0.3 (0.3) | 120 | 15 | 10.0 |
| Weldwood of Canada Nursery | 4.1 (3.1) | 2 700 | 324 | 1.0 |
| Pineridge Forest Nursery | 4.4 ( ) | 15 000 | 1 300 | 2.0 |
| Alberta Tree Nursery | 1.6 (0.6) | 15 | 75 | 1.5 |
| Blue Ridge Lumber (1981) LTD. | [illegible] | | | |
| **Sub-Total** | **10.4 (4.0)** | **17 835** | **1714** | **14.5** |
| **BRITISH COLUMBIA** | | | | |
| Ministry of Forest-Skimikin | 2.1 (1.0) | 5 875 | 705 | 3.5 |
| Ministry of Forest-Green Timbers | 2.5 (2.3) | 8 400 | 1 428 | 14.4 |
| Minstry of Forest-Surrey | 5.1 (5.1) | 13 444 | 2 689 | 19.5 |

Table 5. Container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Hi-Gro Silva Nursery Limited | 0.8 ( ) | 2 600 | 400 | 2.1 |
| Ness Lake Forest Nursery | 1.0 (0.2) | 10 000 | 1 500 | 4.3 |
| Summit Nursery Limited | 1.2 (1.2) | 6 097 | 1 075 | 9.4 |
| Pacific Regeneration Technologies (Thornhill) | 3.0 (3.0) | 10 000 | 1 400 | 25.6 |
| Yellow Point Propagation | 0.2 (0.1) | 350 | 60 | 1.4 |
| Northwood Forest Center | 0.7 (0.7) | 10 894 | 1 572 | 11.0 |
| Summerland Forest Nursery | 4.0 (3.0) | 6 000 | 800 | 16.0 |
| Sylvan Vale Nursery | 1.1 (1.1) | 3 000 | 450 | 18.0 |
| Pacific Regeneration Technologies (Vernon) | 2.8 (2.8) | 7 300 | 685 | 7.3 |
| Eagle Rock Nursery | 1.5 (0.7) | 4 400 | 572 | 4.6 |
| Reid, Collins Nurseries | 13.0 (13.0) | 15 000 | 1 100 | 10.0 |
| Harrop Nursery | 2.6 (2.0) | 10 000 | 1 500 | 14.0 |
| Chilliwack River Nursery | 4.2 (4.2) | 4 000 | 580 | 27.0 |
| Arbutus Grove | 2.1 (1.8) | 3 000 | 500 | 13.7 |
| Campbell River Nursery | 4.5 (4.0) | 11 000 | 1 800 | 5.7 |

Table 5. Container tree seedling production, value, and hand-weeding cost for 1988.

| NURSERY | AREA (ha)[1] | PRODUCTION ('000) | VALUE ($ '000) | HANDWEEDING COST ($ '000) |
|---|---|---|---|---|
| Red Rock Nursery | 0.4 (0.2) | 675 | 75 | 5.0 |
| Adjustment[2] | 57.2 (50.3) | 142 965 | 20 455 | 230.1 |
| Sub-Total | 110.0 (96.7) | 275 000 | 39 346 | 442.6 |
| **NATIONAL TOTAL** | 340.2 (229.6) | 630 942 | 85 781 | 1 001.2 |

[1] Potential area to be sprayed with Goal

[2] Adjustment made based on personal communication with Regional representative of Canadian Forest Nursery Weed Management Association

## INSECTICIDES REGISTERED FOR USE IN FOREST NURSERIES AND SEED ORCHARDS

| TRADE NAME | COMMON NAME | PCP # | USE PATTERN | | | | |
|---|---|---|---|---|---|---|---|
| | | | GREEN-HOUSE | BARE-ROOT FIELDS | CONTAINER HOLDING | NON-CROP USE | SEED ORCHARD |
| Ambush 500EC | Permethrin | 14882 | * | * | * | | * |
| Ambush 500EC | Permethrin | 10976 | * | * | * | | |
| APM 50W | Azinphos-methyl | 16412 | | * | * | | * |
| Azinphos-methyl 240EC | Azinphos-methyl | 17533 | | | | | * |
| Basudin 500EC | Diazinon | 10979 | | | | | * |
| Basudin 50W | Diazinon | 10975 | | | | | * |
| Cygon 2E | Dimethoate | 10038 | | * | | | |
| Cygon 2E | Dimethoate | 10337 | | * | | | |
| Cygon 2E | Dimethoate | 13526 | | * | | | |
| Cygon 240 | Dimethoate | 8227 | | * | | | * |
| Cygon 4E | Dimethoate | 12864 | | | | | * |
| Cygon 480E | Dimethoate | 10104 | | | | | * |
| Cygon 480E | Dimethoate | 14767 | | * | | | * |
| Diazinon 50W | Diazinon | 10975 | | * | | | |
| Diazinon 500EC | Diazinon | 11934 | | * | | | * |
| Diazinon 500EC | Diazinon | 11530 | | * | | | |
| Diazol 50EC | Diazol | 15921 | | * | | | * |
| Dipel WP | Bt | 11252 | * | * | | | |
| Dipel 88ES | Bt | 16873 | | * | | | * |
| Dipel 132 | Bt | 17954 | | * | | | * |
| Di-Syston 15%G | Disulfoton | 9519 | | * | | | |
| Dormant Oil | Dormant Oil | 9179 | | * | | | * |
| Dormant Oil | Dormant Oil | 10443 | | * | | | |
| Dursban 2E | Chlorpyrifos | 10636 | | * | | | |
| Folithion | Fenitrothion | 10776 | | * | | | |
| Futura | Bt | 17778 | | * | | | * |
| Guthion SC | Azinphos-methyl | 8106 | | * | | | * |
| Guthion 50WP | Azinphos-methyl | 10101 | | * | | | * |
| Guthion 3%D | Azinphos-methyl | 7341 | | * | | | * |
| Imidan 50WP | Phosmet | 9738 | | * | | | * |
| Kelthane EC | Dicofol | 6374 | | * | | | * |
| Kelthane EC | Dicofol | 8165 | | * | | | |
| Kelthane AP-35 | Dicofol | 12871 | * | * | | | * |
| Lannate L | Methomyl | 11725 | | | | | * |
| Lindane 25-WP | Gamma BHC | 4429 | * | * | | | * |
| Lindane 10% EC | Gamma BHC | 6122 | | * | | | * |
| Lindane 20EC | Gamma BHC | 9332 | * | * | | | * |
| Lindane 200E | Gamma BHC | 14795 | | | | | * |
| Lorsban 25% WP | Chlorpyrifos | 11315 | * | * | | | * |
| Malathion 50E | Malathion | 4638 | | * | | | * |
| Malathion 50E | Malathion | 9975 | | * | | | * |
| Malathion 50E | Malathion | 13548 | | * | | | * |
| Malathion 50 | Malathion | 4860 | | * | | | * |
| Malathion 500EC | Malathion | 12590 | | * | | | * |
| Malathion 500 | Malathion | 4709 | | * | | | * |

| | | | | | |
|---|---|---|---|---|---|
| Malathion 500E | Malathion | 14729 | * | * | * |
| Malathion 25-WP | Malathion | 4864 | | * | * |
| Malathion 25W | malathion | 14769 | * | * | |
| Matacil 180-D | Aminocarb | 14186 | | ? | * |
| Metasystox R | Metasystox | 7882 | * | * | * |
| Methoxychlor EC 25% | Methoxychlor | 10690 | | * | * |
| Methoxychlor EC | Methoxychlor | 11590 | | * | * |
| Methoxol 240 EC | Methoxychlor | 14772 | | * | * |
| Ortho | Orthene | 15559 | * | * | * |
| Pentac 50WP | Dienochlor | 17800 | | * | * |
| Pentac 50WP | Dienochlor | 8289 | | * | |
| Sevin 5% | Carbaryl | 11599 | | * | * |
| Sevin 50W | Carbaryl | 6838 | | * | |
| Sevin 80S | Carbaryl | 8151 | | * | * |
| Sevin 50W | Carbaryl | 14798 | | * | * |
| Sevin XLR | Carbaryl | 17027 | | * | * |
| Sumithion | Fenitrothion | 11137 | | * | * |
| System 480EC | Dimethoate | 14338 | | * | * |
| Vendex 50W | Fenbutatin oxide | 17866 | * | * | * |
| Vendex 50W | Fenbutatin oxide | 16309 | * | * | * |
| Vendex 50W | Fenbutatin oxide | 16162 | * | * | * |

## HERBICIDES REGISTERED FOR USE IN FOREST NURSERIES AND SEED ORCHARDS

| TRADE NAME | COMMON NAME | PCP # | USE PATTERN | | | | |
|---|---|---|---|---|---|---|---|
| | | | GREEN-HOUSE | BARE-ROOT FIELDS | CONTAINER HOLDING | NON-CROP USE | SEED ORCHARD |
| Amizine WP | Amitrol | 8655 | | * | | | * |
| Amitrol-T | Amitrol | 16548 | | | | | * |
| Asulox F | Asulam | 11341 | | | | | * |
| BASF Basamid granular | Basamid | 15032 | | * | | | * |
| Casoron | dichlobenil | 2533 | | | | * | |
| Dacthal 75WP | Chlorthal Dimethyl | 8963 | | * | | | * |
| Dacthal | Chlorthal Dimethyl | 13657 | | | | | * |
| Devrinol 50WP | Napropamide | 20123 | | * | * | | * |
| Devrinol 10G | Napropamide | 20124 | | * | * | | * |
| Enide 90W | Diphenamid | 10085 | | * | | | * |
| Eptam | EPTC | 9921 | | * | | | |
| Fusilade 250EC | Fusilade | 18013 | | * | * | | * |
| Gramoxone | Paraquat | 8661 | | | | * | * |
| Kerb 50W | Propyzamide | 11396 | | * | | | * |
| Killex | Mecoprop | 9811 | | | | * | * |
| Linuron 50W | Linuron | 18267 | | | | | * |
| MB-C2 | | 12326 | | * | | | |
| Methyl bromide | | 16495 | | * | | | |
| Paraquat | Diquat | 14179 | | | | * | * |
| Princep 9T | Simazine | 16370 | | * | | | * |
| Princep 4G | Simazine | 11026 | | * | | | * |
| Princep 80W | Simazine | 10904 | | * | | | * |
| Laters Simazine 80W | Simazine | 17697 | | | | | * |
| Rival | Trifluralin | 18612 | | * | | | * |
| Simazine 80W | Simazine | 16049 | | * | | | * |
| Simazine 80W | Simazine | 14274 | | | | | * |
| Simadex | Simazine | 15902 | | * | | | * |
| Simadex Simazine 80W | Simazine | 13561 | | * | | | * |
| Soilkare Mylone | Dazomet | 6853 | * | * | | | * |
| Tenoran 50WP | Chloroxuron | 9509 | | * | | | * |
| Terr-o-Gas 67 | | 13477 | | * | | | |
| CO-OP Treflan EC | trifluralin | 17132 | | * | | | * |
| Elanco Treflan EC | trifluralin | 9257 | | * | | | * |
| Treflan | trifluralin | 16858 | | * | | | |
| Trillion | Trillion | 18963 | | | | * | * |
| Velpar L | Hexazinone | 18197 | | | | * | * |
| Vision | Glyphosate | 19899 | | * | | * | * |
| Vorlex | | 18353 | | * | | | |

## FUNGICIDES REGISTERED FOR USE IN FOREST NURSERIES AND SEED ORCHARDS

| TRADE NAME | COMMON NAME | PCP # | USE PATTERN: GREEN-HOUSE | USE PATTERN: BARE-ROOT FIELDS | USE PATTERN: CONTAINER HOLDING | USE PATTERN: NON-CROP USE | USE PATTERN: SEED ORCHARD |
|---|---|---|---|---|---|---|---|
| Benlate 50WP | Benomyl | 11062 | * | * | * | | * |
| Bravo 500 | Chlorthalonil | 15723 | | * | * | | * |
| Captan 50WP | Captan | 4559 | * | * | * | | * |
| Captan 80WP | Captan | 9582 | | | | | * |
| Vitavix-Captan 30 | Carbathiin/Captan | 13051 | * | * | * | | * |
| Daconil | Chlorthalonil | 15724 | * | * | * | | * |
| Dithane M-45 (80% WP) | Mancozeb | 8556 | | * | * | | * |
| Fixed Copper | Copper Oxychloride | 14741 | | * | * | | * |
| Lesan 5% Granular | Fenaminosulf | 8352 | | * | | | * |
| Lesan 35 WP | Fenaminosulf | 9763 | * | * | * | | * |
| Manzate 200 | Mancozeb | 10526 | | * | * | | * |
| No Damp | Oxine Benzoate | 3794 | * | * | | | * |
| Orthocide 50W | Captan | 3780 | | | | | * |
| Rovral | Iprodione | 15213 | | * | * | | * |
| Terraneb Sp | Chloroneb | 10886 | | | | | * |
| Tersan 1991 | Benomyl | 11061 | | | | | * |

## OTHER PESTICIDES REGISTERED FOR USE IN FOREST NURSERIES AND SEED ORCHARDS

| TRADE NAME | COMMON NAME | PCP # | USE PATTERN: GREEN-HOUSE | USE PATTERN: BARE-ROOT FIELDS | USE PATTERN: CONTAINER HOLDING | USE PATTERN: NON-CROP USE | USE PATTERN: SEED ORCHARD |
|---|---|---|---|---|---|---|---|
| Hinder | ammonium soaps | 16926 | | * | * | | * |
| Agral 90 | polyethoxy ethanol | 11809 | | * | * | | * |
| Bartlett mouse bait | zinc phosphide | 8024 | | * | * | | * |

# Canadian Vegetation Management Alliance (CVMA) Incorporated in 1988

A Report to the 17th Annual Forest Pest Control Forum
(Ottawa, Ontario 14-16 November, 1989)

Phillip E. Reynolds
Vice President, CVMA

Canadian Vegetation Management Alliance
P.O. Box 48861, Bentall
Vancouver, British Columbia
V7X 1A8

**Canadian Vegetation Management Alliance (CVMA) Incorporated in 1988**

Phillip E. Reynolds,
Vice President

The inaugural meeting of the Canadian Vegetation Management Alliance (CVMA) was held in Montreal, Quebec on October 26, 1988. The Alliance has been federally incorporated and membership is comprised of regional vegetation management associations to represent these groups on a national basis.

The objectives of the Canadian Vegetation Management Alliance are to provide a forum for discussion and to encourage a better and more thorough understanding of the vegetation management industry. Promotion of professionalism, establishment and maintenance of a liaison between the industry and all levels of government, as well as representing concerns of the vegetation manager to the government, are of importance to the Alliance.

Presentation of vegetation management to the public is an objective that the Canadian Vegetation Management Alliance will actively pursue. Informed and educated decisions can be made when all available information is presented.j

The founding members of the Canadian Vegetation Management Alliance are:

the **Atlantic Vegetation Management Association,**

the **Ontario Vegetation Management Association,**

the **Industrial Vegetation Management Association of Alberta,**

and the **Integrated Vegetation Management Association of British Columbia.**

Currently, new regional vegetation management associations are being formed in Quebec and in Manitoba. The CVMA is working to encourage regional incorporation of these groups, and will facilitate CVMA membership as soon as possible.

The current officers of the CVMA are:

President: **Ron King,** IVMAA (Asplundh Utility Services, Edmondton),

Vice President: **Phil Reynolds,** OVMA (Forestry Canada, Sault Ste. Marie),

Treasurer: Kim Hughes, AVMA (Dow Chemical Inc., Halifax), and

Secretary: Ken Berry, IVMA of BC (Westcoast Energy Inc., Vancouver).

Other directors of CVMA, elected to a three-year term beginning in October 1988, include: Ray Wellman, OVMA (Chevron Canada Inc., Mississauga); Peter

Romkey, AVMA (Nova Scotia Lands & Forests, Truro); Mel Scott, IVMA of BC (BC Ministry of Forests, Vancouver); and Larry Beaton, IVMAA (TransAlta Utilities Corp., Calgary).

In 1989, the CVMA responded to concerns of its membership concerning the future registration status of the herbicide 2,4-D in Canada. These concerns were expressed through dialogue with a number of government officials. In late 1989, the CVMA was asked to participate as a member of the newly formed Forestry Pesticides Caucus. The Caucus is currently reviewing and formulating recommendations for change to the present federal pesticides registration process.

## Future Activities

Future activities of the CVMA identified by its board of directors at the October 1988 meeting in Montreal include:

1. A Public Relations Campaign: A proactive campaign to show the public the positive aspects of the Alliance and its charter members.

2. Reciprocity of Pesticide Licensing among Provinces.

3. Creation of a National Certification Program for applicators. This would involve the development of a core program plus regional addenda, if determined necessary. The program would encourage uniformity of practice and levels of acceptance across the country.

4. Code of Good Practice or Operating Protocol. A national standard of use, application, testing, acceptance, etc. of vegetation management techniques should be considered.

5. Insurance Liability. Possible need to establish a mechanism whereby individual companies could get a reduction in premiums if they subscribed to the CVMA and adopted a Code of Good Practice.

Communication with the Alliance may be made by contacting any of the directors or through the CVMA Secretary, Mr. Kenneth Berry, P.O. Box 48861, Bentall, Vancouver, B.C. V7KX 1A8.

# OPERATIONAL HERBICIDE RESEARCH CONDUCTED BY FP54-02 IN 1989

**A Report to the 17th Annual Forest Pest Control Forum**

**(Ottawa, Ontario. 14th-15th November 1989)**

**D. Pitt**

**Project FP-54-2 - Operational Use Strategies**

**Forestry Canada**
**Forest Pest Management Institute**
**P.O. Box 490, Sault Ste. Marie,**
**Ontario. P6A 5M7**

# OPERATIONAL HERBICIDE RESEARCH CONDUCTED BY FP54-02 IN 1989

FP-54-2 conducts operational conifer release and site preparation trials that are aimed at the investigation of new and improved uses of herbicide products, new herbicide formulations, and new application technologies. Herbicide efficacy, crop tolerance, and crop growth response data are generated to address operational silvicultural questions. The following paper briefly outlines new and ongoing herbicide research that FP54-2 has been involved with this past year.

## New Operational Herbicide Research

This summer, FPMI worked cooperatively with J.D. Irving Limited, Forestry Canada-Maritimes Region, Chipman, Dow Chemical, and Monsanto Canada to establish a comparative brush-control trial in New Brunswick. The problem addressed is that there are too few weed-control tools available in Canada and those that are available leave serious gaps in our abilities to control certain weed species (i.e. sugar maple). The study attempts to address this problem through demonstration and comparison of GARLON 4, TOUCHDOWN, VISION, MON14420, and manual control as broad-spectrum, brush-control tools in both conifer release and site preparation roles.

A study area was chosen on J.D. Irving freehold land 40 km north of Fredericton, New Brunswick. The area had been full-tree logged during the fall and winter of 1986/87 and was, at the time of treatment, dominated by hardwood saplings and stump sprouts. Sugar maple is the predominant species on the site, accounting for 43% of total hardwood density (40,000 stems/ha) and 35% of total crown area (5,700 $m^2$/ha). Red maple, striped maple, yellow birch, hazel, white ash, mountain maple, and beech comprise the remaining hardwood cover on the site.

In August 1987, the site was divided into sixty-six 40m x 25 m plots with 10-m vegetation buffers between each. Within the center of each plot, twelve subsample locations were established at 2.1-m intervals in a cross pattern, the center of each marking the future planting location of a crop tree and focal point for future weed sampling. In late August 1987, black spruce container stock was planted in 4 of the 12 subsamples in each plot. These trees were allowed to become established prior to treatment and will provide 'release' data for the study. A further 24 trees (of similar stock) were planted in each plot immediately after treatment in order to provide future 'site prep' and growth response data.

Pre-treatment vegetation sampling took place in mid August of 1989. Brush data included measurements of stem density, crown area, crown volume, stem diameter, and basal area, by species. Herbaceous species were evaluated by height and percent cover. Crop data consisted of measurements of seedling height and stem and crown diameter as well as evaluations of health.

Treatments consisted of 5 rates of each chemical, one manual control treatment, and an untreated check plot. Each treatment was replicated 3 times in a randomized complete block design. Specific rates tested for VISION and MON14420 were 0.250, 0,722, 1.193, 1.665, and 2.136 kg ae/ha. For TOUCHDOWN, 0.232, 0.669, 1.106, 1.543, and 1.980 kg ae/ha were tested. Finally, for GARLON 4, 0.400, 1.260, 2.120, 2.980, and 3.840 kg ae/ha were tested.

Chemical treatments were applied during the morning spray sessions of September 4, 5, and 6, 1989. Three backpack $CO_2$ sprayers (R & D Sprayers, Inc., Model 4F), each equipped with a FLOODJET ¼KLC-9 nozzle, were used for the applications. With a release height of 4.5m, these sprayers offered a swath width of 9.5m and a droplet VMD of 1089 µm. Total volume of all applications was 100 l/ha.

A comprehensive evaluation of chemical deposit and environmental fate was conducted by FPMI's Dean Thompson (FP-72). Readers are referred to Mr. Thompson's "Project FP-72 Herbicide Chemical Accountability 1989 Research Summary" in this document for a detailed description of this work.

Manual treatments will be conducted with a Husqvarna brush saw next June, after full leaf expansion. Weed and crop measurements will be repeated in August.

## Ongoing Operational Herbicide Research

Last summer, FPMI worked cooperatively with the New Brunswick Department of Natural Resources and Energy and Forestry Canada-Maritimes Region, to establish a trial designed to develop an improved-use strategy for VISION (glyphosate). The objectives and methodology of this study were reported at the Sixteenth Annual Forest Pest Control Forum (Pitt, 1988). This July, all plots were located and first-season herbicide efficacy, crop tolerance, and crop growth response data were collected. Data analysis will take place this winter and reports will be written as appropriate.

## References

Pitt, D. G. 1988. Operational herbicide research conducted by FPMI in 1988. Proceedings of the 16th Annual Forest Pest Control Forum, Forestry Canada. p 276-280.

# PROJECT FP-72

# HERBICIDE CHEMICAL ACCOUNTABILITY

## 1989 RESEARCH SUMMARY

A REPORT TO
THE 17TH ANNUAL PEST CONTROL FORUM
OTTAWA, ONTARIO NOVEMBER 1989

Dean G. Thompson
Linda MacDonald, Bozena Staznik, Teresa Buscarini & David Thomas

Forest Pest Management Institute - Forestry Canada
P.O. Box 490, Sault Ste. Marie, Ontario.
P6A 5M7

**Project Objective:**

To develop and validate analytical methods for the quantification of herbicide residues in environmental matrices and to implement such methods in laboratory and field research experiments designed to elucidate the environmental fate and persistence of herbicides in Canadian forest ecosystems.

**Progress and Achievements During 1989:**

**a) Methodology Development (FP-72-1)**

Glyphosate

An HPLC-VIS analytical method for quantification of glyphosate and its major metabolite (AMPA) in a variety of environmental matrices has been developed, validated and published (Thompson et al, 1989. J. Assoc. Off. Anal. Chem. 72:355-360).

Triclopyr

Analytical methods provided by DOW CHEMICAL INC. have been modified and validated for quantification of triclopyr (ester, acid and pyridinol metabolite) residues in water and stream sediments, as well as on artificial deposit collectors. Further modifications to the GLC-ECD based method are being made to utilize capillary column chromatographic techniques, thereby enhancing chromatographic resolution and sensitivity. Further validation of the technique for use on soils, foliage and bird seed is continuing. Following validation, the methods will form the basis of a comprehensive report documenting analytical methods for triclopyr in natural matrices typical of Canadian forest environments.

Metsulfuron methyl

A GLC-ECD technique for quantification of metsufluron methyl residues in environmental substrates is currently in the final stages of development. The technique relies upon the conversion of metsulfuron methyl to the hydrolytic product methyl-2(aminosulfonyl)benzoate and is characterized by excellent chromatographic resolution and low limits of detection (ppt). Following final modifications, the technique will be validated for quantification of metsulfuron methyl residues in water, soils and plant matrices.

b) Environmental Fate Research (FP-72-2)

Metsulfuron methyl/Hexazinone - Greenwater Lake, Ont.

A field experiment designed to investigate the aquatic fate and non-target phytotoxicity of metsulfuron methyl (ESCORT) and hexazinone (VELPAR) was successfully initiated as a cooperative venture between the Environmental Impact Project (FP-71) and FP-72 in August, 1989. The completely randomized experimental design utilizes 125 $m^3$ enclosures or mesocosms, with 3 replicates of 4 concentrations of each chemical. Rates of application were established such that impact assessment could be approached using a concentration-response approach. Field sampling will be completed by November 30, 1989. Residue analysis as well as taxonomic identification and enumeration of periphyton, phytoplankton and zooplankton communities will continue throughout 1989-90.

Comparative Brush Control - Dorn Ridge, New Brunswick

A field trial was successfully established in September, 1989 to investigate the efficacy and environmental fate of three formulations of glyphosate (VISION, TOUCHDOWN, MON 14420) and triclopyr butoxyethyl ester (GARLON 4). A description of the experimental design and rates of application have been described by D. Pitt (FP-54-2) in another section of this document entitled "Operational Herbicide Research Conducted by FP-54-2 in 1989". Environmental fate research conducted as a component of this trial included;

i) verification of tank mix concentrations
ii) assessment of the initial on target deposit to foliage of the predominant brush species on site (sugar maple)
iii) determination of dissipation kinetics in foliage, thatch, organic and mineral soils for each chemical
iv) determination chemical residue transport in association with leaf fall

Sampling of sugar maple foliage and leaf litter have recently been completed, while sampling of soils and thatch will be terminated at time of freeze-up and will resume in the spring of 1990, continuing until 1 full year post-application. Analysis of tank mix concentrations and initial deposit on artificial deposit collectors have been completed. Residue analysis in foliage, thatch and soil samples is currently ongoing. Results of this research will provide a comprehensive data base pertaining to the environmental fate of these compounds in the terrestrial compartments of an Acadian forest ecosystem.

## Update on Previous Research Activities

Glyphosate Drift and Off-Target Deposit - Thessalon, Ont.

A field research experiment quantifying the amount of airborne herbicide and off-target deposit resulting from aerial applications of glyphosate (ROUNDUP) using a fixed-wing aircraft and Thru-Valve Boom (TVB) dispersal system has been completed. The degree of off-target drift and deposit as correlated with various meteorological conditions was assessed, details of the study and results have been compiled by Dr. N. Payne (FP-62) and recently submitted for publication in the journal - Atmospheric Environment.

Glyphosate Improved Use - Fredericton, N.B.

An operational research trial designed to investigate strategies for improved-use of glyphosate was conducted in 1987 as a co-operative venture involving FP-54-2, FP-72, New Brunswick Department of Natural Resources and Energy and Forestry Canada - Maritimes Region. On-target deposition of glyphosate resulting from applications using a conventional boom and nozzle system (D10-45/46) and MICRONAIRE (AU5000) atomizers was determined using artificial deposit collectors. Results of on-target deposit analyses will be used in conjunction with first-season herbicide efficacy, crop tolerance and crop-growth response data collected in July 1989, to develop dose-response curves allowing accurate determination of rates required for effective weed control and acceptable growth response in the crop.

Triclopyr Environmental Fate - Dora Creek, Ont.

In August 1987, the environmental fate and impact of triclopyr butoxyethyl ester in a first-order boreal forest stream was investigated by applying the herbicide to 88 ha section of the watershed and involving a direct application to the stream surface for a distance of 3.8 km. Actual application rates measured at two sampling sites within the target zone ranged from 3.35 to 3.99 kg/ha a.e. (i.e. an average of 96% of proposed maximum label rate of 3.84 kg/ha a.e.). Residues of triclopyr as the parent butoxyethyl ester (TBEE), free acid (TRI) and pyridinol metabolite (PYR) were quantified in stream water, sediments, aquatic plants and fish tissues for a period of one year post application. Maximum residues of TBEE (0.35 ppm) and TRI (0.14 ppm) in stream water occurred immediately following overspray and dissipated rapidly, reaching levels below quantification limits within 72 hrs post-application. Aquatic plants taken from the midstream (oversprayed) site were characterized by high total triclopyr residues (128-235 ug/g dry mass) relative to those taken from a site immediately downstream from the target zone (6.7-8.2 ug/g dry mass), residues in aquatic plants dissipated rapidly. No residues of TBEE or PYR occurred in stream sediments and only one sample was positive for TRI. Quantifiable residues (total triclopyr) were found in streamwater in association with the first storm event which occurred 2 days post-application, but not with subsequent storm events. A journal publication detailing the aquatic environmental fate aspects of the study is in preparation and targeted for publication in early 1990. Data generated from this research will allow accurate assessment of the risk to aquatic organisms as related to accidental overspray of a typical boreal forest stream.

<u>Metsulfuron methyl Environmental Fate - Nassau Township, Ont.</u>

Metsulfuron methyl (ESCORT) is the most recent experimental herbicide targeted for use in Canadian forestry. A comprehensive investigation of the environmental behaviour of this compound utilizing both laboratory and field experimental techniques was initiated in 1988 and is continuing. Laboratory experiments dealing with soil persistence and leaching are complete, statistical analysis is ongoing. Field experiments to investigate the environmental fate and impact of metsulfuron methyl in the boreal forest ecosystem were initiated in August 1988, with one year sampling completed in August, 1989. Residue analyses of field samples is pending finalization of the analytical method described above.

# Operational Herbicides Research Conducted by FP-54-1 in 1989

A Report to the 17th Annual Forest Pest Control Forum
(Ottawa, Ontario 14-16 November, 1989)

Phillip E. Reynolds

Project No. FP-54-1 - Weed and Crop Ecology

Forest Pest Management Institute
Forestry Canada
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

## Operational Herbicides Research Conducted by FP-54-1 in 1989

Phillip E. Reynolds

FP-54 (formerly Herbicides Field Efficacy) was reorganized into two new studies (FP-54-1, Weed and Crop Ecology and FP-54-2, Operational Use Strategies) in March 1989. FP-54 is currently designated Management of Competing Vegetation. The future objective of FP-54-1 is:

> **"To conduct and cooperate in operational site preparation and conifer release studies. Canadian silvicultural data relating to operational weed control efficacy, crop tolerance, plant succession, and crop growth response will be generated as a basis for evaluating crop survival and yield in relation to competition between crop and noncommercial forest species. Emphasis will be placed on evaluation of biological and ecological factors affecting operational weed control performance."**

Since the last Pest Forum, FP-54-1 has focused its efforts on publishing previous research relating to the Carnation Creek glyphosate study. Additional eastern Canada crop growth data has been collected, analyzed, and is currently in preparation for journal publication. Research conducted by FP-54-2 in 1989 is described in an accompanying report.

### Western Canada

Carnation Creek publications appearing in 1989 include the following. Additional journal articles have been submitted or are in preparation.

Reynolds, P.E. (Ed.). 1989. Proceedings of the Carnation Creek Herbicide Workshop. Canada/British Columbia Governments, Victoria, British, Columbia. FRDA Report 063, 349 p.(ISSN 0835 0752; ISBN 0-7726-0917-9).

Reynolds, P.E., J.C. Scrivner, L.B. Holtby and P.D. Kingsbury. 1989. An overview of the Carnation Creek herbicide study: historical perspective, experimental protocols and spray operations, p. 15-26. In P.E. Reynolds (Ed.) Proceedings of the Carnation Creek Herbicide Workshop. Canada/British Columbia Governments, Victoria, British Columbia. FRDA Report 063, 349 p.

Feng, J.C., D.G. Thompson and P.E. Reynolds. 1989. Fate of glyphosate in a Canadian forest stream ecosystem, p. 45-64. In P.E. Reynolds (Ed.) Proceedings of the Carnation Creek Herbicide Workshop. Canada/British Columbia Governments, Victoria, British Columbia. FRDA Report 063, 349 p.

Payne, N., J.C. Feng and P.E. Reynolds. 1989. Off-target deposit measurements and buffer zones required around water for various aerial applications of glyphosate, p. 88-109. In P.E. Reynolds (Ed.) Proceedings of the Carnation Creek Herbicide Workshop. Canada/British Columbia Governments, Victoria, British Columbia. FRDA Report 063, 349 p.

Reynolds, P.E., D.G. Pitt, R. Whitehead and K. King. 1989. Three-year herbicide efficacy, crop tolerance and crop growth response results for a 1984 glyphosate conifer release trial at Carnation Creek, British Columbia, p. 141-167. In P.E. Reynolds (Ed.) Proceedings of the Carnation Creek Herbicide Workshop. Canada/British Columbia Governments, Victoria, British Columbia. FRDA Report 063, 349 p.

Reynolds, P.E., J.C. Scrivener, L.B. Holtby and P.D. Kingsbury. 1989. A summary of Carnation Creek herbicide study results, p. 322-334. In P.E. Reynolds (Ed.) Proceedings of the Carnation Creek Herbicide Workshop. Canada/British Columbia Governments, Victoria, British Columbia. FRDA Report 063, 349 p.

## Eastern Canada

FP-54-1 has published a number of articles relating to eastern Canada herbicides site preparation research within 1988 and 1989. Additional articles are scheduled for publication in 1990. A list of these papers relating to hexazinone, sulfometuron, and metsulfuron research in New Brunswick and Ontario follows:

Reynolds, P.E., D.G. Pitt and M.J. Roden. 1989. Herbicide efficacy and crop tolerance after fall soil treatment with liquid and granular hexazinone. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 43: 30-36.

Reynolds, P.E., D.G. Pitt and M.J. Roden. 1989. Crop tolerance after spring soil treatment with hexazinone, sulfometuron-methyl and metsulfuron-methyl. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 43: 51-57.

Reynolds, P.E., D.G. Pitt and M.J. Roden. 1989. Herbicide efficacy and crop tolerance after summer foliar treatment with sulfometuron-methyl and metsulfuron-methyl. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 43: 44-50.

Pitt, D.G., P.E. Reynolds and M.J. Roden. 1989. Crop tolerance and herbicide efficacy after site prep with liquid and dry-flowable hexazinone formulations. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 43: 37-43.

Reynolds, P.E. 1988. Prognosis for future herbicide use in Canada. Canadian Forest Industries Magazine 108(2): 35-42.

Reynolds, P.E., D.G. Pitt and M.J. Roden. 1988. Weed efficacy and crop tolerance after site preparation with liquid and granular hexazinone formulations. Proceedings of the Northeastern Weed Science Society, Supplement 42: 74-78.

Reynolds, P.E., D.G. Pitt and M.J. Roden. 1988. Weed efficacy and crop tolerance after site preparation with sulfometuron-methyl and metsulfuron-methyl. Proceedings of the Northeastern Weed Science Society, Supplement 42: 63-67.

Pitt, D.G., P.E. Reynolds and M.J. Roden. 1988. Weed efficacy after site preparation with liquid and dry-flowable hexazinone formulations. Proceedings of the Northeastern Weed Science Society, Supplement 42: 58-62.

Pitt, D.G., P.E. Reynolds and M.J. Roden. 1988. Growth and tolerance of white spruce after site preparation with liquid hexazinone. Proceedings of the Northeastern Weed Science Society, Supplement 42: 41-47.

Reynolds, P.E. and M.J. Roden. 1990. Black spruce mortality three to four years after site prep with sulfometuron, metsulfuron, and hexazinone. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 44. In Press.

Reynolds, P.E. and M.J. Roden. 1990. Effect of various chemical site prep treatments on free-to-grow status of black spruce. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 44. In Press.

Reynolds, P.E., M.J. Roden and D.G. Pitt. 1990. Growth and health of white spruce after hexazinone site prep and subsequent glyphosate release. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 44. In Press.

Reynolds, P.E., M.J. Roden and D.G. Pitt. 1990. Black spruce health and mortality two years after site prep with liquid and dry-flowable hexazinone formulations. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 44. In Press.

Reynolds, P.E., D.G. Pitt, M.J. Roden, R. Wellman, J.E. Wood and F.W. von Althen. 1990. Performance of liquid and granular hexazinone formulations on silty sand and sandy soils in northern Ontario I. Herbicide efficacy. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 44. In Press.

Wood, J.E., F.W. von Althen, P.E. Reynolds, D.G. Pitt and M.J. Roden. 1990. Performance of liquid and granular hexazinone formulations on silty sand and sandy soils in northern Ontario II. Crop tolerance. Proceedings of the Northeastern Weed Science Society, Supplement, Vol. 44. In Press.

Individuals or organizations having further questions about this research should contact P. Reynolds at FPMI or telephone (705) 949-9461.

**NEWFOUNDLAND**
**AERIAL HERBICIDE SPRAY PROGRAM**

(Prepared by I.N. Downton, Acting Director - Silviculture)

(Presented at Pest Control Forum, Ottawa, Nov. 14-16, 1989)
(by H. Crummey)

The productive forest area of the Island is only thirty-eight percent (38 %) of the land area. The recent outbreak of the Spruce Budworm and the ongoing outbreak of the Hemlock Looper have further reduced our available resource, necessitating more intensive forest management. Silviculture treatment has involved approximately 100,000 hectares since 1975 and includes around 25,000 hectares in plantations and 45,000 hectares in pre-commercial thinning. On-going annual spruce plantings and fir thinnings are expected to involve about 5 000 hectares each, which equates to about two-thirds of the yearly commercial cutting.

Aerial herbicide trials (experimental/semi-operational) have been carried out since 1984 under Forestry Agreements and in conjunction with the pulp and paper industry. A total of 6,807 hectares have been treated up to and including 1989. In 1984, the Provincial Government required an environmental assessment under the Environmental Assessment Act. This assessment had been on-going since that time and was completed in 1988. The components of the assessment included extensive literature review, public consultation, original research in buffer zones and salmonid toxicity, and the development of a herbicide operators manual. The assessment has been accepted by Government and the program has passed from the experimental stage to the operational stage.

The Department of Forestry and Agriculture can now conduct aerial herbicide programs subject to the annual provisions of an operators licence from the Provincial Department of Environment and Lands with the following conditions as per the assessment.

1) maximum area of about 6,000 hectares per year (subject to some flexibility depending on requirements for treatment)

2) only helicopter used with Simplex hardware using boom and nozzle spray gear

3) only glyphosate permitted at 3 to 6 litres per hectare in 39 - 41 litres of water

4) minimum 44 metre buffer zone required around sensitive sites - (eg) fish streams

5) stringent human and environmental safety and security are maintained on mixing and loading sites

The intent is to use aerially applied herbicides in post establishment plantation management and in some special site preparations. It is expected that not more than 3,000 to 4,000 hectares per year will require treatment with glyphosate in the near future. The two paper companies will be given their own licences for the first time in 1990. This means that this treatment is accepted as are other silviculture treatments and there is no strong reliance on the Crown to be the lead agency.

## SUMMARY OF AERIAL HERBICIDE SPRAY - NEWFOUNDLAND 1984-89

| YEAR | AREA(ha) | # SITES | PRODUCT | RATE L/ha | PRESCRIPT* |
|---|---|---|---|---|---|
| 1984 | 259 | 5 | Vision | 3 & 6 | S, P, C |
| 1985 | 475 | 4 | Vision | 4.25 | S, P |
| 1986 | 99 | 1 | 2,4-D D-A | 5.0 | P |
| | 393 | 1 | 2,4-D Est | 5.5 | C |
| | 556 | 2 | Vision | 3 & 4.25 | P, S, C |
| | 1048 | | | | |
| 1987 | 1613 | 6 | Vision | 4 & 6 | P, S, C |
| 1988 | 1010 | 6 | Vision | 4 | P, S, C |
| 1989 | 2302 | 8 | Vision | 4, 5 & 6 | P, S, C |

**TOTAL 1984-89 6807 ha**

* S = Site preparation
P = Plantation release
C = Conifer release

# USE OF HERBICIDES IN COMBINATION WITH OTHER TREATMENTS TO ERADICATE *KALMIA* ON SOFTWOOD CUTOVERS

by Titus, B.D., W.J. Meades and B.A. Roberts

REPORT TO THE 17TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 14-16 NOVEMBER 1989

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
ST. JOHN'S, NEWFOUNDLAND
A1C 5X8

## USE OF HERBICIDES IN COMBINATION WITH OTHER TREATMENTS TO ERADICATE *KALMIA* ON SOFTWOOD CUTOVERS

by

Titus, B.D., W.J. Meades and B.A. Roberts

Sheep laurel (*Kalmia angustifolia*) appears to seriously retard the growth of natural regeneration and planted black spruce on cutovers in central Newfoundland. The Newfoundland and Labrador Region, Forestry Canada in collaboration with the Provincial Department of Forestry and Agriculture have designed an experiment to determine the best silvicultural solution to this problem. The experiment consists of a factorial design using scarification, herbicides and fertilization treatments for three species of planting stock (black spruce, jack pine and European larch).

In July 1989 the herbicides triclopyr and hexazinone were applied to eradicate *Kalmia* in preparation for planting in the spring of 1990. If the eradication is successful and trees show significant response a separate experiment specifically aimed at finding the best herbicide(s) and dosage combination will be initiated. Further particulars are available in a file report upon request.

## III. REGULATORY CONSIDERATIONS/CONSIDÉRATIONS SUR LA RÉGLEMENTATION

UPDATE ON THE REGISTRATION REVIEW PROCESS

G. Leblond

# RATIONALE FOR REVIEW TEAM

- INSISTANCE BY ALL MAJOR STAKEHOLDERS INCLUDING FARMERS, FORESTERS, ENVIRONMENTALISTS, LABOUR, PUBLIC HEALTH, AND CONSUMER GROUPS, FEDERAL AND PROVINCIAL REGULATORS, AND PESTICIDES MANUFACTURERS, OF THE NEED FOR A THOROUGH INDEPENDENT REVIEW OF THE FEDERAL PESTICIDES REGISTRATION PROCESS;

- A NUMBER OF SIGNIFICANT STUDIES/REPORTS RECOMMEND CHANGES TO THE CURRENT SYSTEM, INCLUDING:

  - LAW REFORM COMMISSION REPORT
  - REPORTS BY STANDING COMMITTEES OF THE SENATE AND THE HOUSE OF COMMONS
  - ALACHLOR REVIEW BOARD REPORT
  - AUDITOR GENERAL'S REPORT (1988)

# COMPOSITION OF REVIEW TEAM

## 3 FEDERAL GOVERNMENT REPRESENTATIVES

- ASSISTANT DEPUTY MINISTER, AGRICULTURE CANADA
- ASSISTANT DEPUTY MINISTER, ENVIRONMENT CANADA
- ASSISTANT DEPUTY MINISTER, HEALTH & WELFARE CANADA

## 3 MANUFACTURER / FORMULATOR REPRESENTATIVES

- 2 FROM THE CROP PROTECTION INSTITUTE OF CANADA (CPIC)
- 1 FROM CANADIAN MANUFACTURERS OF CHEMICAL SPECIALTIES (CMCS)

## 3 USER GROUPS REPRESENTATIVES

- 2 FROM THE CROP PROTECTION ADVISORY COMMITTEE (CPAC) TO THE CANADIAN FEDERATION OF AGRICULTURE (CFA) AND THE CANADIAN HORTICULTURAL COUNCIL (CHC)
- 1 REPRESENTATIVE FROM A FORESTRY CAUCUS

## 3 ENVIRONMENTAL REPRESENTATIVES

- 2 FROM THE CANADIAN ENVIRONMENTAL NETWORK (CEN)
- 1 REPRESENTING ALTERNATIVES TO SYNTHETIC PESTICIDES

## 3 PUBLIC SECTOR REPRESENTATIVES

- CANADIAN LABOUR CONGRESS (CLC)
- CONSUMER'S ASSOCIATION OF CANADA (CAC)
- 1 REPRESENTATIVE FROM CANADIAN PUBLIC HEALTH ASSOCIATION (CPHA) AND CANADIAN MEDICAL ASSOCIATION (CMA)

## ISSUES

1. THE LOCUS OF THE FEDERAL DECISION-MAKING AUTHORITY FOR REGULATING PESTICIDES.

2. THE EXTENT AND CAUSE OF BACKLOGS IN REGISTERING NEW PRODUCTS.

3. EFFECTIVENESS OF THE EXISTING MINOR USE OF PESTICIDES PROGRAM.

4. THE ROLE OF RISK MANAGEMENT PRINCIPLES IN MAKING REGULATORY DECISIONS.

5. THE CRITERIA USED TO ASSESS THE HUMAN HEALTH AND ENVIRONMENTAL IMPACTS OF PESTICIDES.

6. THE ROLE OF THE PUBLIC IN THE REGISTRATION PROCESS.

7. A: REGULATION OF ALTERNATIVES TO TRADITIONAL SYNTHETIC PEST CONTROL PRODUCTS.

   B: WITHIN THE REGULATORY PROCESS, INCENTIVES FOR SAFER, MORE EFFECTIVE AND MORE ECONOMICAL ALTERNATIVES TO TRADITIONAL SYNTHETIC PEST CONTROL PRODUCTS.

8. THE INTERIM REGISTRATION POLICY, PRODUCT SPECIFIC REGISTRATION II.

9. A: PRICING.

   B: AVAILABILITY OF PEST CONTROL PRODUCTS

10. A: COORDINATION AND COOPERATION BETWEEN CANADA AND THE UNITED STATES.

    B: SCHEDULE 7 TO THE CANADA - U.S. TRADE AGREEMENT.

11. COORDINATION AND COOPERATION WITH THE PROVINCES.

12. COORDINATION OF PEST CONTROL PRODUCTS REGULATIONS WITH WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM.

13. TEMPORARY REGISTRATIONS.

14. A: APPEAL PROCEDURES.

    B: CANCELLATION AND SUSPENSION PROVISIONS OF THE REGULATIONS.

15. REEVALUATION, INCLUDING THE CLASSIFICATION SCHEME.

16. ENFORCEMENT PROGRAM AND PENALTY PROVISIONS.

17. RESEARCH PERMITS.

18. LABELLING.

19. ONGOING REVIEW MECHANISMS TO ENSURE THAT THE REGULATORY PROCESS CAN ADAPT QUICKLY AND FAIRLY TO CHANGING NEEDS AND CONDITIONS.

20. FEDERAL RECORD KEEPING.

# PESTICIDE REGISTRATION REVIEW
# TERMS OF REFERENCE

## PURPOSE

RECOGNIZING THE PRINCIPLES OF SUSTAINABILITY, THE PURPOSE OF THE REVIEW TEAM IS TO FORMULATE RECOMMENDATIONS FOR THE MINISTER OF AGRICULTURE TO ADAPT THE PESTICIDES REGISTRATION PROCESS TO CHANGING POLICIES AND CONDITIONS WITH A VIEW TO ENSURING THE EFFICIENT FEDERAL REGULATION OF PEST CONTROL PRODUCTS THAT MINIMIZE THE RISK OF HARM TO HUMAN HEALTH AND THE ENVIRONMENT WHILE MEETING THE NEEDS OF THE STAKEHOLDERS.

# WORKPLAN FOR REVIEW TEAM

- 1 TO 3 DAYS OF MEETINGS EACH MONTH BETWEEN JUNE, 1989 AND JUNE, 1990 TO DEAL WITH ISSUES OF CONCERN;
- PRELIMINARY DRAFT REPORT FOR DISTRIBUTION TO GENERAL PUBLIC BY SPRING, 1990;
- PUBLIC MEETINGS IN THE FALL, 1990;
- FINAL REPORT WITH RECOMMENDATION IN DECEMBER, 1990;
- PUBLIC TO HAVE OPPORTUNITY FOR INPUT, INCLUDING ACCESS TO INFORMATION ABOUT THE PROCESS AND SUBSTANTIVE ISSUES, THROUGHOUT THE PROCESS.

# PRINCIPLES FOR IDEAL REGISTRATION SYSTEM

1. OPEN
2. PROTECTION OF HEALTH, SAFETY AND ENVIRONMENT
3. ACCOUNTABLE / RESPONSIBLE / EFFICIENT / FAIR / EQUITABLE
4. RESPONSIVE / ADAPTIVE
5. INCREASE ACCESS TO ALTERNATIVE PEST MANAGEMENT STRATEGIES THAT REDUCE RISK OF HARM TO HEALTH AND ENVIRONMENT
6. SUPPORT THE DEVELOPMENT OF POLICIES THAT ASSIST ECONOMIC VIABILITY/COMPETITIVENESS OF FARM/FORESTRY/FISHERIES

# Report to the Forest Pest Control Forum - Fenitrothion Special Review

R.G. Taylor

In March 1989, Environment Canada published a comprehensive review of the literature titled The Environmental Effects of Fenitrothion Use in Forestry (Environment Canada, Conservation and Protection, Atlantic Region).

The review concluded that the use of fenitrothion under current use patterns and conditions in forest spraying is causing, or has the potential to cause, considerable adverse environmental impact, specifically with respect to ecological processes associated with pollinating insects, song birds and aquatic organisms.

These effects include:

a) population decreases in honeybees and wild bees with a consequent disruption of plant sexual reproductive success;
b) significant mortality among forest songbirds as well as sublethal effects which may impair reproductive success;
c) some effects on aquatic invertebrates and fish populations.

Although information on the impact of fenitrothion on aquatic systems has led to the general conclusion that direct toxicity to fish is unlikely, the accumulated evidence indicates that the use of fenitrothion in forest ecosystems produces reductions in aquatic invertebrate populations and may result in sublethal effects upon fish.

However, fenitrothion has been a valuable insecticide to provincial and private forest pest managers in protection operations designed to reduce defoliation of forest trees caused by insects, particularly the insect damage caused by the Eastern Spruce budworm and Eastern hemlock looper. Although total fenitrothion use has decreased significantly in recent years in favour of the more environmentally acceptable microbial insecticide Bacillus thuringiensis (B.t.), it has remained an important option in control programs partly due to higher costs and inconsistent results of the B.t. alternative.

In response to these concerns, the Pesticides Directorate will be announcing a special review of fenitrothion. The scope of the special review will be consideration of environmental effects and benefits of fenitrothion use in forest management.

An announcement formally beginning the process will likely be issued early in 1990 and the process will follow the consultative discussion/decision document approach.

RT/aw
03561

# CPPA ACTIVITY UPDATE

## Four CPPA Policy Statements

J.P. Martel

## The Pulp and Paper Industry of Canada
# ENVIRONMENTAL STATEMENT

*The Pulp and Paper Industry of Canada shares with all Canadians important responsibilities to the environment in which we live and work. It supports the responsible stewardship of resources, including forests, fish and aquatic habitat, wildlife, air, land and water. Responsible stewardship makes possible sustained economic development. In this spirit, the industry believes that a set of principles should govern its attitude and action in environmental matters. As endorsed by the member companies of the Canadian Pulp and Paper Association, these are as follows:*

- The companies commit themselves to excellence in sustained yield forestry and environmental management, and will conduct their business in a responsible manner designed to protect the environment and the health and safety of employees, customers, and the public.

- The companies will assess, plan, construct, and operate facilities in compliance with all applicable regulations.

- Forest resources will be managed and protected for multiple use and sustained yield.

- Beyond or in the absence of regulatory requirements, the companies will apply sound management practices to advance environmental protection and minimize environmental impact.

- The companies will promote environmental awareness amongst employees and the public, and train employees in their environmental responsibilities.

- The companies will report regularly to their Boards of Directors on their environmental status and performance.

- The industry will work with governments in the development of regulations and standards based on sound, economically achievable technologies, and the analysis of environmental impact.

- The industry will continue to advance the frontiers of knowledge in environmental protection through the support of scientific research and, as appropriate, apply such knowledge at its facilities.

L'industrie canadienne des pâtes et papiers

# ÉNONCÉ SUR L'ENVIRONNEMENT

*L'industrie canadienne des pâtes et papiers partage, avec tous les Canadiens, une responsabilité importante envers le milieu de vie et de travail. Elle encourage une gestion responsable de la ressource: forêt, habitat aquatique et poissons, faune, air, terre et eau. Cette gestion responsable rend possible un développement économique soutenu. Dans cette optique, l'industrie croit qu'un ensemble de principes doit gouverner son attitude et son action dans les questions d'environnement. Ces règles, entérinées par les membres de l'Association canadienne des producteurs de pâtes et papiers, sont les suivantes:*

- Les sociétés s'engagent à l'excellence pour un rendement soutenu de la forêt et pour une saine gestion de l'environnement, et elles dirigeront leurs affaires d'une façon responsable afin de protéger cet environnement ainsi que la santé et la sécurité des travailleurs, des clients et du public.

- Les sociétés verront à l'évaluation, la planification, la construction et l'exploitation d'installations conformes à toutes les règles applicables.

- Les sociétés s'engagent à aménager et à protéger la forêt afin d'en permettre un usage multiple et d'en assurer un rendement soutenu.

- Au-delà, ou en l'absence d'exigences réglementaires, les sociétés s'adonneront à de saines pratiques de gestion afin de faire avancer la protection de l'environnement et de minimiser l'impact sur le milieu.

- Les sociétés verront à sensibiliser les travailleurs et le public aux questions d'environnement, et elles formeront leurs employés à assumer leurs responsabilités à cet égard.

- Les sociétés achemineront régulièrement à leur Conseil d'administration un rapport sur l'état de l'environnement et sur les progrès réalisés.

- L'industrie travaillera, de concert avec les gouvernements, au développement de normes et de règlements basés sur une technologie réalisable économiquement et sur une analyse de l'impact sur l'environnement.

- L'industrie poursuivra, par l'entremise de la recherche scientifique, sa quête de nouvelles connaissances relatives à la protection de l'environnement et, s'il y a lieu, mettra ces connaissances en application dans ses installations.

# A STATEMENT
## BY THE PULP AND PAPER INDUSTRY

FORESTS

# CONTROL OF COMPETING VEGETATION IN FORESTRY

An important aspect of maintaining productive forest resources is the task of establishing a new forest after harvest, fire or insect and disease infestations. When competing vegetation covers the forest floor or overgrows the young trees, depriving them of light and nutrients, they may not be able to reach the free growing stage. This situation is particularly acute in areas with more fertile soils. If the task of maintaining or enhancing the yield of Canada's timber producing forest is to be successful, control of competing vegetation must be a priority.

## COMPETING VEGETATION

Establishing a new forest may require preparation of the site; planting, natural or man-aided seeding; and later release of trees from unwanted competing vegetation. Initial site preparation and control of unwanted vegetation may be done by mechanical means, with fire, or with herbicides. Later, once crop trees are established, the release of the new forest from the retarding influence of competing vegetation is accomplished by manual and mechanical means as well as with herbicides. In the future, research may offer other practical technologies, including biological methods. The method of vegetation control chosen by a forest manager depends on safety, environmental impact, effectiveness and costs.

Often herbicides are the only feasible means of vegetation control. When they are used, they generally are employed only once or twice during the 40- to 90-year growing cycle of a forest. Herbicides are applied in several ways: ground application, involving individual tree treatments and broadcast applications, or aerial spraying with fixed-wing aircraft and helicopters.

## HERBICIDES

In addition to forestry use, herbicides are used in agriculture, range management, horticulture, and in vegetation management on transportation and utility corridors, as well as in homes and gardens. Forest management applications account for less than one percent of all uses.

At this time, only two herbicides — 2,4-D and glyphosate — are approved for aerial application in the forest environment. Several others may be applied from the ground. The number of herbicides available for forestry use is inadequate to deal with the large variety of weed species and environmental conditions in Canada. Additional herbicides are required to ensure forest renewal; their registration should be given high priority. A commitment to support the necessary research and development is needed.

## REGULATING HERBICIDE USE

Concerns about the use of herbicides in the forest have been expressed by the public. The pulp and paper industry believes that strong regulations at the federal and provincial government levels are important safeguards for the public and the environment. The Canadian herbicide registration process involves extensive testing and expert review of new products. Provincial regulations control herbicide use in the forest. Environmental and health impacts

Prepared and issued by:

Canadian Pulp and Paper Association

Sun Life Building, 19th Floor
1155 Metcalfe Street
Montréal, Québec
Canada H3B 4T6
Telephone (514) 866-6621
Telex 055- 60690
Fax (514) 866-3035
or (514) 866-4863

Additional copies of this publication, in English and in French, are available.

continue to be monitored as the herbicide is used. No use is more closely regulated.

The regulatory process of the Canadian government has many safeguards built into its testing and registration procedures. Registered herbicides have been evaluated and determined to be of acceptable risk, and safe when used in the manner prescribed by regulation. All herbicides used in Canada must be registered by Agriculture Canada under the regulations of the Pest Control Products Act. Applications for new registrations are reviewed by the Federal Departments of Health and Welfare for health risks and Fisheries and Oceans regarding impacts on fisheries. Forestry Canada provides advice on the efficacy, impact and application of the herbicide, and Environment Canada reviews effects on wildlife, environmental contamination and disposal aspects. This stringent process involves substantial research, analysis and data submission. It takes many years and is very costly; full registration is not granted until it is completed.

Approved herbicides must be applied by trained, qualified workers supervised by forestry experts in a manner specified by the federal, provincial, and local regulatory authorities. The method selected for any herbicide application is modified to compensate for proximity to settlements or sensitive environments, and for weather and forest conditions.

## RESPONSIBLE MANAGEMENT

Vegetation control is an essential phase of sound forest management and one of several indispensable tools needed to accomplish that control is herbicides. The pulp and paper industry supports the development, testing, regulation and safe field use of herbicides for forest management purposes. Control of competing vegetation will help maintain or enhance the capacity of the forest to yield timber and provide jobs. Forests with impaired productivity are an economic drain on the nation and the region in which they are situated.

Expenditures to regenerate forest lands are rapidly increasing because Canadians recognize the importance of the forest to the nation's future. If these investments in the future are to be successful, competing vegetation should be controlled through the responsible use of available safe technology, including approved herbicides.

October 1989

# ÉNONCÉ
## DE L'INDUSTRIE DES PÂTES ET PAPIERS

FORÊT

# LE CONTRÔLE DE LA VÉGÉTATION COMPÉTITIVE

Un aspect important du maintien de la productivité des ressources forestières est le renouvellement de la forêt après la récolte, l'incendie ou l'infestation par les insectes ou la maladie. Une végétation compétitive qui recouvre le site avant la plantation ou qui envahie les jeunes semis après leur plantation, dérobant lumière et éléments nutritifs, peut empêcher que ces jeunes arbres parviennent au stade où ils pourront croître librement. Cette situation survient surtout dans les zones où les sols sont plus fertiles. La réussite du maintien ou de l'amélioration du rendement de la forêt productive canadienne dépend fortement du contrôle de la végétation envahissante.

## LA VÉGÉTATION COMPÉTITIVE

L'établissement d'une nouvelle forêt requiert la préparation du site; la plantation, l'ensemencement naturel ou artificiel; et le dégagement ultérieur des arbres de la végétation compétitive. Avant la plantation, la préparation du site et le contrôle de la végétation compétitive peuvent être faits par des moyens mécaniques, par le feu ou les phytocides. Une fois les plants mis en terre, le dégagement de la nouvelle forêt de l'effet retardataire de la végétation compétitive est accomplie par des moyens manuels et mécaniques ainsi qu'à l'aide de phytocides. Dans l'avenir, la recherche découvrira peut-être d'autres technologies pratiques, tel les méthodes biologiques. La méthode de contrôle de la végétation sélectionnée par le forestier dépend de la sécurité, de l'impact sur l'environnement, de l'efficacité et des coûts.

Souvent, l'emploi des phytocides est le seul moyen de contrôler la végétation. Dans les cas où ils sont utilisés, ils sont employés qu'une ou deux fois au cours du cycle de 40 à 90 ans de la forêt. Les phytocides peuvent s'appliquer de différentes façons : par voie terrestre, incluant le traitement individuel par arbre ou les traitements en plein ou généralisés par voie aérienne, à l'aide d'avions ou d'hélicoptères.

## LES PHYTOCIDES

En plus de leur utilisation en foresterie, les phytocides sont utilisés en agriculture, en aménagement des pâturages, en horticulture, en aménagement paysager, dans les corridors de transport ainsi que dans les maisons et jardins. Les applications en aménagement forestier comptent pour moins de un pour cent de la totalité des phytocides dont on fait usage au Canada.

Actuellement, seulement deux phytocides, le 2,4-D et le glyphosate, sont homologués pour l'arrosage aérien dans l'environnement forestier. Plusieurs autres peuvent être appliqués par voie terrestre.

Le nombre de phytocides disponibles pour usage forestier ne peut suffire à traiter la grande variété d'espèces de plantes compétitives et toutes les conditions environnementales du Canada. D'autres phytocides sont nécessaires si l'on veut assurer le renouvellement de la forêt. La priorité doit être accordée à l'homologation de ces nouveaux produits. Il faut s'engager dans la recherche et le développement nécessaire à leur mise au point.

Préparé et publié par:

L'Association canadienne des producteurs de pâtes et papiers
Immeuble Sun Life, 19e étage
1155, rue Metcalfe
Montréal (Québec)
Canada H3B 4T6
Téléphone: (514) 866-6621
Télex 055- 60690
Télécopieur: (514) 866-3035
ou (514) 866-4863

Des exemplaires supplémentaires de cet énoncé, en français ou en anglais, sont disponibles sur demande.

## UNE RÉGLEMENTATION DE L'UTILISATION DES PHYTOCIDES

Le public exprime sa préoccupation concernant l'utilisation des phytocides dans la forêt. L'industrie des pâtes et papiers croit qu'une réglementation ferme aux deux paliers de gouvernement fournit une protection essentielle pour le public et l'environnement. Le processus canadien d'homologation des phytocides comprend une période étendue d'essais et l'étude des nouveaux produits par des experts. Les règlements provinciaux contrôlent l'utilisation des phytocides dans la forêt. L'impact sur la santé et l'environnement fait l'objet d'un suivi en tout temps.

Les procédures d'essais et d'homologation faisant partie de la réglementation du gouvernement canadien contiennent plusieurs mesures de protection. Grâce à certains tests, on s'assure que les phytocides homologués représentent un risque acceptable et qu'ils sont sécuritaires lorsqu'ils sont utilisés de la façon prescrite par le règlement. Tous les phytocides utilisés au Canada doivent être homologués par Agriculture Canada selon la Loi sur les produits antiparasitaires. Les demandes pour une première homologation sont étudiées par Santé et Bien-être social Canada quant aux risques pour la santé, et par Pêches et Océans Canada quant à l'impact sur les pêcheries. Forêts Canada apporte ses conseils quant à l'efficacité, l'impact et les applications de ces produits en foresterie. Environnement Canada étudie les effets sur la faune et la contamination de l'environnement, ainsi que les questions relatives à l'élimination. La procédure est longue et coûteuse; la pleine homologation n'est accordée que lorsque toutes les étapes ont été franchies.

Il faut procéder à l'application des phytocides homologués selon les instructions spécifiées sur l'étiquette, ces dernières sont approuvées lors du processus d'homologation fédéral. Les autorités provinciales exigent généralement un permis, et l'application doit être faite par des techniciens qualifiés, formés et supervisés par des experts en application forestière. Les méthodes d'application et la superficie pulvérisée sont modifiées afin de tenir compte de la proximité des régions peuplées, des milieux sensibles et des conditions météorologiques.

## UN AMÉNAGEMENT RESPONSABLE

Le contrôle de la végétation compétitive est une phase essentielle d'un sain aménagement forestier, et l'un des nombreux outils indispensables à la réalisation de ce contrôle est l'utilisation de phytocides. L'industrie des pâtes et papiers appuie la mise au point, l'essai, la réglementation et l'usage sécuritaire en forêt de ces produits. Le contrôle de la végétation compétitive aidera à conserver ou à améliorer le rendement en matière ligneuse de la forêt et les emplois qui s'y rattachent. Les forêts dont la productivité est freinée sont une perte économique pour le pays et la région où elles sont situées.

Les dépenses pour régénérer les territoires forestiers augmentent rapidement car les Canadiens reconnaissent l'importance de la forêt pour l'avenir de la nation. Afin d'assurer la rentabilité de ces investissements, il faut contrôler la végétation en utilisant de façon responsable la technologie sécuritaire disponible, y compris les phytocides homologués.

Octobre 1989

# A STATEMENT
## BY THE PULP AND PAPER INDUSTRY

FORESTS

# PROTECTING THE FOREST FROM INSECT INFESTATION

Canada's forests have frequently been severely damaged by infestations of various insects, resulting in serious timber loss and reduced social, ecological and economic benefits from the forest resource. Long-term reduction of forest losses due to insect infestation can be accomplished through integrated pest management programs. Such programs require a balanced application of forest planning, silvicultural practices, and insect infestation control methods.

## INSECT INFESTATION

Forest insect infestations have a negative impact on aesthetics, wildlife habitat, and recreational and environmental values as well as on timber production. Recent timber losses have averaged approximately 45 million cubic metres per year, or 25 to 30 percent of the timber volume harvested during the same period.

In western Canada, a major disruption in the timber supply has been caused by pine and spruce bark beetles which have killed 10 million cubic metres of timber annually during the recent epidemic. In the East, the spruce budworm has been responsible for annual losses of 48 million cubic metres, roughly equivalent to 80% of the forest's annual harvest of 60 million cubic metres. In Cape Breton alone, 35 million cubic metres of softwood were destroyed in the most recent infestation cycle. This figure represents ten times the annual harvest of Nova Scotia. The pine and spruce bark beetles, the spruce budworm, and other native forest insects, as well as introduced species such as the gypsy moth, are causing significant damage to both newly-regenerated and old forests. Under certain conditions, damaged timber can be salvaged. The integrated pest management approach may afford an opportunity to reduce these losses.

In general, Canada's forests tend to be old; they are being harvested for the first time. Because some forests originated following large uncontrolled fires and insect infestations, they comprise large areas of similar-aged trees of a limited number of species. Forests of this type are highly susceptible to insect attack. The objective of integrated pest management is to lessen the risk of catastrophic damage by insects through the balanced use of all available insect control technology. Creating less susceptible forests is one aspect of integrated pest management. Forest management planning can schedule harvests to reduce risks and ensure a better mix of stand ages in the future. Through proper species selection and stand tending, silviculture will reduce the likelihood of widespread losses. Good monitoring programs will permit timely action. As in fire protection, prevention, early detection and rapid response to infestation are critical. The proper and judicious use of biological and chemical insecticides for control are also indispensable elements of an integrated pest management program.

## INSECTICIDES

Insecticide usage is widespread: it includes home, horticultural, agricultural, forestry, and other industrial applications. In Canada, forest protection use accounts for less than four percent of the total amount of insecticides applied.

Prepared and issued by:

Canadian
Pulp and Paper
Association

Sun Life Building, 19th Floor
1155 Metcalfe Street
Montréal, Québec
Canada H3B 4T6
Telephone (514) 866-6621
Telex 055- 60690
Fax (514) 866-3035
or (514) 866-4863

Additional copies of this publication, in English and in French, are available.

However, the economic value of insecticide use is great, since it substantially reduces tree mortality and prevents growth losses. Both of these factors influence the availability of timber now and in the future.

Most insecticides now in use in the forest are biological (bacteria and viruses) or synthetic. They are generally applied to the forest by spraying from fixed wing aircraft or helicopters. A smaller portion is applied using ground spray methods when these are cost effective. The future will see the development of more biological control methods as well as continuing improvements not only in insecticide application technology but also in pest management techniques to reduce insect population levels.

## REGULATING INSECTICIDE USE

Public concern has been expressed regarding the use of insecticides in the forest. The pulp and paper industry believes that strong regulations at the federal and provincial government levels provide essential safeguards for the public and the environment. The Canadian pesticide registration process involves extensive testing and expert review of new products. Provincial regulations control insecticide use in the forest. Environmental and health impacts continue to be monitored.

The regulatory process of the Canadian government has many safeguards built into its testing and registration procedures. Through careful evaluation, registered insecticides have been determined to be of acceptable risk, and safe when used in the manner prescribed by regulation. All insecticides used in Canada must be registered by Agriculture Canada under the Pest Control Products Act. Applications for new registrations are reviewed by the Federal Departments of Health and Welfare for health risks and Fisheries and Oceans regarding impacts on fisheries. Forestry Canada provides advice on efficacy, impact and applications of forestry insecticides, while Environment Canada reviews effects on wildlife, environmental contamination and disposal matters. This stringent process involves substantial research, analysis and data submission. It takes many years and is very costly; full registration is not granted until the process is completed.

Approved insecticides must be applied in a manner specified on the product label, which is approved under the federal regulatory process. Provincial authorities generally require permits, and application must be carried out by trained, qualified workers supervised by forestry experts. Methods and location of insecticide use are modified to compensate for proximity to settlements and sensitive environments, as well as for weather and forest conditions.

## RESPONSIBLE MANAGEMENT

Substantial losses of present and future timber resources and other forest values will occur if active protection programs are not undertaken. Integrated pest management is the long-term solution to minimize losses. All effective technology, including the use of federally-registered biological and chemical insecticides, should be available to the forest manager. The pulp and paper industry supports forest insecticide research, development, testing for environmental and health risk assessment, a strong regulatory process, and supervised field use for forest management purposes. It also supports research into other practical pest management methods.

The forest industry's objectives are to protect the existing forest and to maintain or enhance the long term productivity of Canada's forests. The use of effective and approved insect control techniques and products is necessary to achieve these goals. It is not reasonable to ask Canadians to invest large sums of money to renew Canada's forests if the new and existing forests are not protected from insect attack. A healthy and productive forest is important to all Canadians, now and in the future.

October 1989

# ÉNONCÉ
## DE L'INDUSTRIE DES PÂTES ET PAPIERS

FORÊT

# PROTÉGEONS LA FORÊT CONTRE LES ÉPIDÉMIES D'INSECTES

Les forêts canadiennes ont souvent été endommagées par divers insectes qui ont détruit de grandes quantités de bois. Ces pertes réduisent les avantages sociaux, écologiques et économiques provenant de la ressource forestière. On peut atténuer à long terme les pertes forestières attribuables aux insectes en appliquant soigneusement les programmes de contrôle intégré des ravageurs. Ces programmes exigent une intégration équilibrée de la planification forestière, de la sylviculture et des méthodes de contrôle des épidémies.

## ÉPIDÉMIES D'INSECTES

Les épidémies d'insectes ont un impact négatif sur l'esthétique de la forêt, l'habitat faunique, les valeurs récréatives et environnementales, ainsi que sur la production de bois. Les pertes récentes de bois ont été en moyenne de 45 millions de mètres cubes par année, soit l'équivalent de 25 à 30 pour cent du volume en bois récolté durant cette période.

Dans l'ouest du Canada, les dendroctones du pin et de l'épinette ont déséquilibré l'approvisionnement en bois. Au cours de la dernière épidémie, ces insectes ont détruit 10 millions de mètres cubes de bois. Dans l'est, la tordeuse des bourgeons de l'épinette est responsable de pertes annuelles de 48 millions de mètres cubes, soit presque l'équivalent de 80 pour cent de la récolte annuelle de 60 millions de mètres cubes. Au Cap-Breton seulement, 35 millions de mètres cubes de résineux ont été détruits lors de la dernière épidémie. Ce volume de bois représente dix fois la récolte annuelle de la Nouvelle-Écosse. Les dendroctones du pin et de l'épinette, la tordeuse des bourgeons de l'épinette, insectes indigènes à nos forêts, ainsi que d'autres espèces exotiques, telle la spongieuse, sont extrêmement nuisibles à la forêt mature et à la jeune forêt régénérée. Sous certaines conditions, on peut récupérer le bois endommagé. Cependant, le contrôle intégré des ravageurs offre la possibilité de réduire ces pertes.

En général, les forêts canadiennes sont âgées; les arbres sont récoltés pour la première fois. Certaines forêts se sont développées à la suite de vastes incendies et d'épidémies d'insectes non contrôlées, elles sont formées de grands peuplements d'arbres équiennes composés de quelques essences seulement. Les forêts de ce type sont hautement susceptibles aux attaques des insectes. L'objectif d'un programme de contrôle intégré des ravageurs est de diminuer les risques de dommages catastrophiques causés par les insectes, au moyen de l'utilisation équilibrée de toute la technologie disponible. La création d'une forêt moins susceptible est un aspect important d'un programme de contrôle intégré des insectes.

L'aménagement forestier permet de planifier le lieu et le temps des récoltes, réduisant ainsi les risques en créant une forêt composée d'un mélange de peuplements d'âges différents. Par une sélection appropriée des essences et par les soins apportés aux peuplements, la sylviculture réduira la possibilité de pertes étendues. De bons programmes de suivi permettront de prendre des mesures opportunes. Comme pour la protection de la forêt contre le feu, la prévention, la détection hâtive et la réponse rapide à l'épidémie sont critiques. L'utilisation appropriée et judicieuse d'insecticides chimiques et biologiques à l'intérieur d'un programme de lutte est aussi un élément indispensable d'un programme de contrôle intégré des ravageurs.

## INSECTICIDES

Les insecticides sont souvent utilisés dans les résidences, en horticulture, en agriculture, en foresterie et pour diverses utilisations industrielles. Au Canada,

Préparé et publié par:

L'Association canadienne des producteurs de pâtes et papiers
Immeuble Sun Life, 19e étage
1155, rue Metcalfe
Montréal (Québec)
Canada H3B 4T6
Téléphone: (514) 866-6621
Télex 055- 60690
Télécopieur: (514) 866-3035
ou (514) 866-4863

Des exemplaires supplémentaires de cet énoncé, en français ou en anglais, sont disponibles sur demande.

les insecticides utilisés pour la protection de la forêt comptent pour moins de quatre pour cent de la totalité des insecticides dont on fait usage au Canada. Toutefois, la valeur économique de l'usage des insecticides est importante, puisque ces produits réduisent substantiellement la mortalité chez les arbres et préviennent les pertes de croissance. Ces deux facteurs influencent l'approvisionnement en bois maintenant et dans l'avenir.

La plupart des insecticides utilisés dans la forêt sont des produits biologiques (bactéries et virus) ou synthétiques. Ils sont habituellement pulvérisés sur la forêt par des avions ou des hélicoptères. Ils sont quelquefois appliqués par pulvérisation terrestre lorsque cette méthode s'avère rentable. Dans l'avenir, nous verrons la mise au point d'autres méthodes de contrôle biologiques de même que l'amélioration non seulement de la technologie d'application des insecticides, mais aussi des techniques de contrôle des ravageurs qui réduisent les populations d'insectes.

## RÉGLEMENTATION DE L'USAGE DES INSECTICIDES

Le public exprime sa préoccupation concernant l'utilisation des insecticides dans la forêt. L'industrie des pâtes et papiers croit qu'une réglementation ferme aux deux paliers de gouvernement fournit une protection essentielle pour le public et l'environnement. Le processus canadien d'homologation des pesticides comprend une période étendue d'essais et l'étude des nouveaux produits par des experts. Les règlements provinciaux contrôlent l'utilisation des insecticides dans la forêt. L'impact sur la santé et l'environnement fait l'objet d'un suivi en tout temps.

Les procédures d'essais et d'homologation faisant partie de la réglementation du gouvernement canadien contiennent plusieurs mesures de protection. Grâce à certains tests, on s'assure que les insecticides homologués représentent un risque acceptable et qu'ils sont sécuritaires lorsqu'ils sont utilisés de la façon prescrite par le règlement. Tous les insecticides utilisés au Canada doivent être homologués par Agriculture Canada selon la Loi sur les produits antiparasitaires. Les demandes pour une première homologation sont étudiées par Santé et Bien-être social Canada quant aux risques pour la santé, et par Pêches et Océans Canada quant à l'impact sur les pêcheries. Forêts Canada apporte ses conseils quant à l'efficacité, l'impact et l'application de ces produits en foresterie. Environnement Canada étudie les effets sur la faune et la contamination de l'environnement, ainsi que les questions relatives à l'élimination. Ce processus strict demande une recherche et une analyse substantielles, ainsi que la soumission de données exhaustives. La procédure est longue et coûteuse; la pleine homologation n'est accordée que lorsque toutes les étapes ont été franchies.

Il faut procéder à l'application des insecticides homologués selon les instructions spécifiées sur l'étiquette, ces dernières sont approuvées lors du processus d'homologation fédéral. Les autorités provinciales exigent généralement un permis, et l'application doit être faite par des techniciens qualifiés, formés et supervisés par des experts en application forestière. Les méthodes d'application et la superficie pulvérisée sont modifiées afin de tenir compte de la proximité des régions peuplées, des milieux sensibles et des conditions météorologiques.

## UN AMÉNAGEMENT RESPONSABLE

Nous subirons des pertes considérables en bois et autres valeurs forestières, maintenant et plus tard, si nous n'entreprenons pas dès maintenant des programmes actifs de protection de la forêt. Le contrôle intégré des ravageurs est une solution à long terme visant à minimiser les pertes. Le forestier doit avoir accès à toute la technologie efficace, y compris l'utilisation d'insecticides chimiques et biologiques homologués par le gouvernement fédéral. L'industrie des pâtes et papiers appuie la recherche, la mise au point d'insecticides forestiers et les essais pour l'évaluation des risques pour la santé et l'environnement, un processus ferme de réglementation et la supervision des travaux en forêt. Elle appuie aussi la recherche sur d'autres méthodes pratiques de contrôle des insectes.

L'objectif de l'industrie forestière est de protéger la forêt actuelle et d'en conserver ou d'en augmenter la productivité à long terme. L'usage de techniques et de produits approuvés et efficaces de contrôle des ravageurs est essentielle à la réalisation de ces objectifs.

Il n'est pas raisonnable de demander aux Canadiens d'investir d'importantes sommes d'argent dans le renouvellement de la forêt, si les forêts actuelles ou nouvelles ne sont pas protégées contre les insectes. Une forêt saine et productive est importante pour tous les Canadiens, maintenant et dans l'avenir.

Octobre 1989

# A STATEMENT
## BY THE PULP AND PAPER INDUSTRY

FORESTS

# PROTECTING THE FOREST FROM FIRE

The Canadian pulp and paper industry believes that increased efforts must be made to protect Canada's forests from losses due to fire. Canada leads the world in the development of fire management technology and there have been significant regional successes in loss control. However, in some regions and during certain years, fire losses have been unacceptably high due to cyclical weather patterns, the stand conditions and species composition of the Canadian forest, or the inability of fire control agencies to cope with the fire load.

## FOREST FIRE LOSSES

Forest fires are caused by lightning strikes, human carelessness, and, in some cases, arson. The combination of high temperature, high winds, and low humidity, conditions favouring catastrophic loss, occur cyclically in different regions. Historically, when these extreme conditions have occurred in an area of Canada, very high levels of losses have been experienced. During a recent period when the annual harvest averaged 160 million cubic metres, timber lost to fire was 80 million cubic metres per year, or the equivalent of 50 percent of the harvest. This situation demands better fire protection in the form of improved prevention, detection, initial suppression, and organization by the provincial forest services and by industry. This must be followed by comprehensive and effective coordination at the provincial, national and international levels to relocate necessary suppression resources expediently. There is also a continuing need for greater public awareness to improve prevention and timely reporting of fires.

## FIRE IN FOREST MANAGEMENT

Fire has played a significant role in the history of the Canadian forest. Many of the highly-valued softwood stands which now form the economic base of the industry owe their origins to fire. As pioneer species, these trees colonize recently burned areas to create productive, even-aged forests. In fact, through the silvicultural practice of controlled or prescribed burning, fire may be used today to help create conditions favourable to the regeneration of these same coniferous species. Controlled fires are also often used to reduce the danger of wildfire in drying harvest residues. Fire, used as a tool, can be beneficial to the forest; uncontrolled, it can cause unacceptable economic, recreational, wildlife, environmental and social losses.

## FIRE PREVENTION AND CONTROL

In general, the primary responsibility for protecting the forest from fire rests with the owners and managers of the forest. For almost 90 percent of our productive forests, the owners are the provincial governments, which have primary responsibility for fire management programs. Industry cooperates both financially and operationally in prevention and suppression programs. The federal government is responsible for protection on federal lands, national parks, Indian reserves and the Territories, and has

Prepared and issued by:

Canadian
Pulp and Paper
Association

Sun Life Building, 19th Floor
1155 Metcalfe Street
Montréal, Québec
Canada H3B 4T6
Telephone (514) 866-6621
Telex 055- 60690
Fax (514) 866-3035
or (514) 866-4863

Additional copies of this publication, in English and in French, are available.

contributed to provincial fire fighting capacity. The pulp and paper industry supports Parks Canada's policy of fighting all fires in national parks. The management of park ecosystems involves the use of controlled burns for forest regeneration.

Through the cooperative Canadian Interagency Forest Fire Centre, the provincial and federal forest services coordinate the allocation of fire fighting resources to areas of greatest need. This system is also integrated with that of the United States. The Canadian Forestry Association and other conservation oriented groups are instrumental in informing the public of the need to prevent fire in the forest. All users of Canada's forests have a role to play in preventing, reporting, and controlling wild fires.

Owing to the nature and scale of its fire prevention problem and the resulting need for effective large scale control capacity, Canada is an international leader in the development of fire-related technology. Forestry Canada, in cooperation with the provinces, is an important contributor in this field. Research programs include the analysis of fire behavior, the development and use of advanced prediction, detection and suppression technology, and the development of prescribed fire techniques. Canada is also a leader in the development of fire management equipment, especially water bombing aircraft, chemicals for forest fire control, and ignition devices for prescribed fire. Certain advanced Canadian fire management systems are exported to the world through the Maniwaki Technology Transfer Centre.

## PROTECTION FOR THE FUTURE

The current effort to prevent, manage and control fires still must be improved. In addition to further advances in technology, a greater and more rapid response capability in periods and locations of high hazard, improved cooperation among provincial and federal control agencies and industry, and increased public awareness of the need to prevent fires must remain important priorities. Research to improve fire management must also be supported.

Forest management in Canada has entered a new era of greatly expanded efforts to ensure regeneration and a productive forest for the future. The first step in guaranteeing that future is better protection now: the result will clearly be worth the effort. Considerable effort is now being made to regenerate and tend a new forest. The risk of losing that new investment, the important older forest and those other social, ecological and economic benefits so much a part of Canada, can be greatly reduced through effective fire protection.

October 1989

# ÉNONCÉ
## DE L'INDUSTRIE DES PÂTES ET PAPIERS

FORÊT

# PROTÉGEONS LA FORÊT CONTRE LE FEU

L'industrie canadienne des pâtes et papiers est d'avis qu'il faut faire encore plus d'efforts afin de protéger les forêts canadiennes contre les pertes causées par le feu. Le Canada est un chef de file mondial dans la mise au point de la technologie de gestion des feux de forêt et il a réalisé de grands progrès dans la prévention des pertes à l'échelle régionale. Toutefois, dans certaines régions et durant certaines périodes, les pertes attribuables au feu ont été beaucoup trop élevées. Les variations cycliques des conditions météorologiques, l'état des peuplements, la composition en essences, et l'incapacité des agences de lutte contre les incendies à répondre aux appels sont les principales raisons de ces pertes.

## PERTES ATTRIBUABLES AUX FEUX DE FORÊT

Les feux de forêt sont causés par la foudre, la négligence humaine et, dans certains cas, par des criminels. Une combinaison de températures élevées, de vents forts et d'un faible degré d'humidité contribuent à provoquer des pertes catastrophiques. Ces conditions reviennent de façon cyclique dans différentes régions. Historiquement, de lourdes pertes ont été subies lorsque ces conditions extrêmes étaient observées dans une région du Canada. Au cours d'une période récente, les pertes en bois attribuables aux feux de forêt ont été de 80 millions de mètres cubes par année soit l'équivalent de la moitié du volume en bois récolté annuellement. Cette situation exige une meilleure protection contre les feux de forêt. Il faut améliorer la prévention, la détection, la suppression initiale rapide, et l'organisation des services forestiers des provinces et de l'industrie. Le suivi doit être assuré par une coordination efficace aux niveaux provincial, national et international, afin d'avoir rapidement accès aux ressources nécessaires au contrôle des sinistres. Il faut aussi continuer à sensibiliser le public à une meilleure prévention et à rapporter plus promptement tous débuts d'incendies.

## FEU ET AMÉNAGEMENT FORESTIER

Le feu a joué un rôle important dans l'histoire de la forêt canadienne. Beaucoup de peuplements résineux de grande valeur qui constituent maintenant la base économique de l'industrie, doivent leur naissance aux feux de forêt. Les essences pionnières colonisent les zones récemment brûlées et créent une forêt équienne productive. En effet, par la pratique sylvicole du brûlage contrôlé, on utilise aujourd'hui le feu pour aider à créer les conditions qui seront favorables à la régénération de ces mêmes essences résineuses.

Le brûlage contrôlé est aussi souvent utilisé pour réduire les risques de feux de brousse lorsque les déchets de coupe sont secs. Le feu, en tant qu'outil de travail, peut être bénéfique pour la forêt, par contre, lorsqu'il est hors de contrôle, il peut causer d'énormes pertes économiques, récréatives, fauniques, environnementales et sociales.

## PRÉVENTION ET LUTTE CONTRE LE FEU

En général, la responsabilité première de la protection de la forêt contre le feu relève des propriétaires et des gestionnaires de la forêt. Près

Préparé et publié par:

L'Association canadienne
des producteurs
de pâtes et papiers
Immeuble Sun Life, 19e étage
1155, rue Metcalfe
Montréal (Québec)
Canada H3B 4T6
Téléphone: (514) 866-6621
Télex 055- 60690
Télécopieur: (514) 866-3035
ou (514) 866-4863

Des exemplaires supplémentaires de cet énoncé, en français ou en anglais, sont disponibles sur demande.

de 90 pour cent de nos forêts productives appartiennent aux gouvernements provinciaux qui sont responsables des programmes de lutte contre les feux de forêt. L'industrie collabore à la fois financièrement et de façon opérationnelle aux programmes de prévention et de lutte contre l'incendie. Le gouvernement fédéral est responsable de la protection des territoires fédéraux, des parcs nationaux, des réserves indiennes et des Territoires, et il contribue au matériel provincial de lutte contre l'incendie. L'industrie des pâtes et papiers appuie la politique de Parcs Canada de lutter contre les feux de forêt qui se déclarent dans les parcs nationaux. L'aménagement des écosystèmes forestiers composant les parcs exigent l'utilisation du brûlage contrôlé pour régénérer la forêt.

Par l'entremise du Centre interservices des feux de forêt du Canada, les services forestiers provinciaux et fédéraux coordonnent la répartition du personnel et du matériel de lutte contre l'incendie aux régions qui en ont le plus besoin. Ce système est aussi intégré à celui des États-Unis. L'Association forestière canadienne et d'autres groupes de conservation informent le public du besoin de prévenir le feu en forêt. Tous les usagers des forêts canadiennes ont un rôle à jouer dans la prévention, la détection et le contrôle des feux.

Étant donné la nature et l'ampleur de son problème de prévention des feux et, par conséquent, du besoin d'un pouvoir de lutte efficace et adéquat, le Canada est devenu un chef de file dans la mise au point de la technologie de lutte contre les feux de forêt. Forêts Canada, en coopération avec les provinces, est un important collaborateur dans ce domaine. Les programmes de recherche comprennent l'analyse du comportement du feu, la mise au point et l'utilisation d'une technologie avancée de prévision, détection et suppression, et aussi le développement de techniques de brûlage contrôlé. Le Canada est un chef de file dans la mise au point du matériel de lutte contre les feux de forêt, surtout des avions-citernes, des produits chimiques aidant au contrôle des feux et d'appareils de mise à feu pour le brûlage contrôlé. Certains systèmes canadiens avancés de gestion des feux sont exportés partout dans le monde par l'entremise du Centre de transfert technologique de Maniwaki.

## PROTECTION POUR L'AVENIR

Le travail actuel visant à prévenir, gérer et contrôler les feux de forêt doit continuer. En plus d'améliorer la technologie, une réponse plus rapide en périodes de risques élevés, une plus grande collaboration entre les organismes provinciaux, fédéraux et l'industrie ainsi qu'un public mieux sensibilisé au besoin de prévenir les incendies, demeurent d'importantes priorités. La recherche visant à améliorer la gestion des incendies doit aussi être poursuivie.

L'aménagement forestier au Canada est entré dans une nouvelle ère qui exige de plus grands efforts de régénération pour assurer une forêt productive pour l'avenir. Le premier geste à poser est une meilleure protection maintenant : la fin en justifiera clairement les moyens. Des efforts considérables sont consacrés actuellement à la régénération et aux soins apportés à la nouvelle forêt. On peut, par une protection efficace contre les feux, réduire de beaucoup le risque de perdre nos investissements dans cette nouvelle forêt en croissance. De plus, il est important de protéger la forêt mature, source d'avantages sociaux, écologiques et économiques.

Octobre 1989

# IV. RESEARCH, MONITORING, AND OTHER REPORTS/RECHERCHE, SURVEILLANCE, ET AUTRES RAPPORTS

17th Annual Pest Control Forum
November 14-15, 1989

Forestry Canada
Forest Pest Management Institute

# Overview of the Biorational Control Agents Program

E. Kondo

Although this report concentrates on FPMI's activities in biological control agents, it must be emphasized that we are researching pest management techniques which translates into attempting to provide forest managers with a broad range of control product options, be they biological or chemical, natural or synthetic, techniques for applying these effectively, efficiently and with minimal impact on non-target components of the forest ecosystem, and a critical knowledge of their persistance and ultimate fate in the environment.

The foregoing perspective must be kept in mind while reading this report.

Each year forest pests destroy on average 90 million cubic metres of commercial timber. Spruce budworm is by far the most important pest in Canada. Other significant pests are Mountain Pine Beetle, Hemlock looper, Tussock Moths, Sawflies, Gypsy Moth, Jack Pine Budworm and Forest Tent Caterpillar. Competing vegetation is another significant forest pest especially in regeneration programs.

The Forest Sector requirement for broad spectrum chemical pesticides to control major forest pests is on a collision course with the concerns of the environmental sector of the nation.

A responsible solution could be the alignment of the forest sector objective "to protect the forest resource from forest pests" with that of the environment sector objective "to protect non-target components of the forest ecosystem from significant impact from pest control agents and strategies".

The ultimate common objective and challenge would be "to develop pest control strategies that are totally benign to non-target components in the forest ecosystem".

Forestry Canada and Environment Canada together can provide the leadership toward development of innovative, new generation environmentally benign biological control agents and strategies.

The broad objectives would be:

1) To accelerate, through biotechnology and bioengineering, research and development of more target-specific biological pesticides/control agents to encourage and maximize the environmental acceptability of pesticides used in the forest environment and become less reliant in broader spectrum pesticides.

2) To foster a climate encouraging the development of Canadian industries in the manufacture of environmentally conscious pest control agents.

3) To provide world leadership in the development of a new generation of environmentally conscious control agents in order to become less reliant on broader spectrum, pesticides, in keeping with Canada's world environmental leadership image.

4) To develop more effective pest control agents and pest management strategies.

Currently FPMI in support of the above broad objectives is expending about 69.4% of its resources towards major programs in Environmental Concerns and Biorational (Biological) Control Agents.

FPMI has already:

1) Pioneered and is continuing research on B.t. which had led to its acceptance as a viable alternative to synthetic insecticides in lepidoptera forest insect control.

2) Registered VIRTUSS & Lecontvirus as first viruses ever registered in Canada for insect control and several more are in the development stream.

3) Built a critical core mass of expertise at FPMI in microbial control agents and related fields that is surpassed in few, if any places in the world.

4) Launched a program to develop next generation biocontrol agents involving national and international collaboration involving other Canadian federal departments and agencies, universities and foreign governmental research departments and agencies.

5) Launched a feasibility study to develop collaboratively with industry a pilot insect virus production plant using FPMI knowhow and research capability to address the need to reduce the cost and increase production of existing highly success target-specific viruses.

In consideration of all of the above, FPMI would work cooperatively with regulatory agencies and other stakeholders (e.g. Environment Canada, Health and Welfare, Fisheries, Agriculture Canada, forest and pesticide industries and forest sector clients) to facilitate the development of a mutual goal to produce a new generation of environmentally conscious pesticides.

In addition, in order to support the registration of these control agents under the Pest Control Products Act, a considerable amount of testing, methodology and protocol development will be required to assess their toxicity to target and non-target species and also determine their environmental fate and behaviour. The technical expertise to undertake these activities lies within the Pest Management Applications and Environmental Research Program at FPMI.

A shift to favour development of more narrow spectrum pesticides will require research on a larger number of options than would be the case for broad spectrum products. This will in turn, increase the cost of developing registration data bases for these products considerably.

In this report I will concentrate on an overview of our activities involving biotechnology, since many of the Biorational Control Agents Program project scientists are making specific more detailed presentations of their work at this year's Pest Forum.

A number of FPMI Projects/Studies are involved in approaches applying biotechnology to the development of enhanced, new generation microbial insecticides. The work, currently, is concentrating on opportunities that exist based on our extensive in-house knowledge and expertise in bacterial and viral pathogens. Because significant advances in this particular field can only be made through cooperative undertakings with researchers with a wide variety of expertise (not all of which exists within FPMI), we have approached this area of endeavour through the formation of research networks which combine in-house expertise with that in outside agencies (e.g. NRC Biotechnology Institute, universities etc.) to provide the critical mass of expertise that is required. Where B.t. is concerned such a research network called BIOCIDE is already making significant advances that will undoubtedly result in much enhanced microbial insecticides based on the B.t. crystal toxin.

Research conducted by Forestry Canada is focussed on resolving remaining constraints. The main obstacle to B.t. efficacy in forestry is its greater dependance on proper timing of application and favourable post-spray weather, which leads to a narrower window of application and less predicatble results than application of chemical insecticides. The development of super-high potency products ( > 30 BIU/L) that also have better residual toxicity is the key to short-term improvement of treatment reliability, because such formulations will allow application of reduced dosages in a split application scheme at reduced costs. Long-term improvement involves the search for wild strains that are more active against a wider spectrum of species, and the use of genetic engineering techniques to develop environmentally-stable strains with high activity tailored against specific forest insects. We are also exploring the future use of B.t. in long-term population suppression strategies, either by direct (modified) application, or by insertion of specific toxin genes into major tree species in collaboration with PNFI scientists.

This foregoing is addressed through extensive collaboration with scientists at FPMI (MICROBIONET: enhancement of baculovirus), at other FORCAN establishments (PNFI: tree engineering; MFC: aerial application techniques), at other government labs (NRC: BIOCIDE), at universities (Univ. of Ottawa: BIOCIDE), and with industry (PGS, ECOGEN, MYCOGEN, ABBOTT, DUPHAR, CIL, NOVO). Fundamental to these collaborations is the development of strong in-house research on B.t.-forest insect interactions at molecular, physiological, and ecological level. To this end, FPMI has (1) sent Ross Milne on educational leave (Univ. of Ottawa, H. Kaplan) to acquire a Ph.D. degree and working knowledge in genetic engineering techniques, (2) approved the creation of a third study within the B.t. project to examine physiological interactions (A base shift), and (3) initiated staffing action at the RES level. FPMI has adopted this approach to ensure a relevant and significant contribution to the rapidly expanding field of B.t. research in a global context and to ensure maximum benefit for the forestry sector.

A framework for industrial collaboration has been established with Plant Genetic Systems (PGS), a Belgian biotechnology company that has pioneered insertion of B.t. toxin genes into plants. PGS has the expertise and resources to isolate and characterize natural B.t. isolates and has an extensive library of characterized cloned toxin genes with lepidopteran or coleopteran activity.

Goals of the collaboration are to:

1. Identify natural isolates of Canadian origin with high activity against forest insects.

   FPMI will provide PGS with soil samples from across the nation; PGS will isolate B.t.s and do primary screening of isolates against agricultural targets; FPMI will screen activity of promising isolates against a range of forestry targets; promising isolates will then be licensed for commercialization as new spray products.

2. Identify toxin genes that can be used for tree transformation and other direct delivery techniques:

   PGS will provide FPMI with library of cloned toxin genes to determine their activity spectra against a range of forest insects. Promising genes can then be licensed for tree engineering programs under auspices of PNFI or for use by MICROBIONET to enhance other microbials.

Another such network called MICROBIONET is just now getting underway which will apply biotechnological techniques to insect viruses both to enhance the virulence and host range of nuclear polyhedrosis viruses and to use them as vectors for the introduction of genes from other pathogens and parasites. Such work at FPMI has not been separated out into a separate program but currently it accounts for a very significant component of projects FP-10, FP-13, FP-20 and FP-22. As these new generation pest control products come closer to fruition, the internal aspects of networking will be expanded to include investigations of environmental impact (FP-70); formulation of these new materials (FP-61); application technologies for them (FP-62) to pave the way for their eventual registration under the Pest Control Products Act and techniques for their effective and environmentally conscious utilization.

Insect viruses, particularly baculoviruses, are generally highly host specific parasites that have been shown not to infect non-target animals or vertebrate tissue culture cells. Several viruses have been registered in Canada and elsewhere as biological control agents. Certain NPVs of the tussock moth, gypsy moth and those of the sawflies, are effective control agents. However, the presently available baculoviruses for the spruce budworm, *Choristoneura fumiferana*, are of limited effectiveness and do not produce the desired level of control. ForCan Laurentian laboratory has indicated that they have isolated a more effective baculovirus recombinant insecticide. Staff from both sister institutes will meet in the near future to discuss collaboration on this matter and others of common interest.

With the advent of genetic engineering and biotechnology, the NPV of the alfalfa looper was engineered to express foreign proteins of medical and veterinary interests as well as proteins deleterious to insect pests. Indeed recently, the *B.t.* delta endotoxin gene has been inserted in the alfalfa looper NPV and this engineered virus demonstrated higher virulence than the normal strain. This accomplishment was the direct result of a strong base of knowledge in the molecular biology of the virus. Similar technology can be applied to engineer the spruce budworm NPV in order to increase its virulence against this serious pest. Our knowledge in the basic molecular biology, gene expression and host-parasite interaction of the budworm NPV is more limited than that of the alfalfa looper NPV because a large number of laboratories work on the later virus. Basic understanding of the nature and structure of the budworm NPV, its homology to other NPV genomes has been developed through molecular cloning, mapping and locating or sequencing some important genes. Through the development and growth of in-house expertise supplemented by a network of national and international investigators, namely, *MicroBioNet*, we plan to improve the effectiveness of the spruce budworm NPV through the engineering of viral insecticides carrying foreign genes deleterious to the spruce budworm. An example of the foreign genes of interest are the *B.t.* gene, insect neurohormone genes and feeding inhibition genese. The general objectives of MicroBioNet are:

i. *To develop more effective biological control agents against the spruce budworm and other forest pests*.

ii. <u>To develop entomopoxviruses as expression vectors and eventually as biological control agents</u>.

In this network, FPMI plays a major role in having a strong in-house research program on the molecular biology and biotechnology of insect viruses in order to maintain a strong influence on the direction of the network. The industrial partner of MicroBioNet is the Canadian Pulp and Paper Association. Several factors will bring MicroBioNet and Biocide in close interaction.

By and large, both networks utilize similar methodologies of biotechnology and genetic engineering that are advancing at a rapid rate. Sharing of newly developed technologies will save considerable amount of time and efforts. Within FPMI, the laboratory of Dr. B.M. Arif will aid the FPMI Biocide group with many of the genetic engineering methodologies. Dr. Arif will also instruct Mr. Ross Milne in molecular biology techniques when Mr. Milne conducts the experimental part of his Ph.D. program. Since Biocide has isolated and characterized a number of B.t. delta endotoxin genes, MicroBioNet will be able to draw from this gene pool for insertion into the baculovirus genome. The Biocide group at FPMI has agreed to assay B.t. gene products cloned in the baculovirus of the spruce budworm.

MicroBioNet will also be investigating the possibility of improving microsporidia as a pest control agents through plasmid engineering and transformation.

The research on the development of the entomopoxvirus as an expression vector is being done and funded at the Biotechnology Research Institute. ForCan headquarters has committed $100,000 to the next generations microbial control agents program at FPMI. This is a long term program that requires long term commitment. By far the bulk of the funds goes to support outside scientists associated with MicroBioNet and the tissue culture networks to create leverage of extra funds for PYs externally.

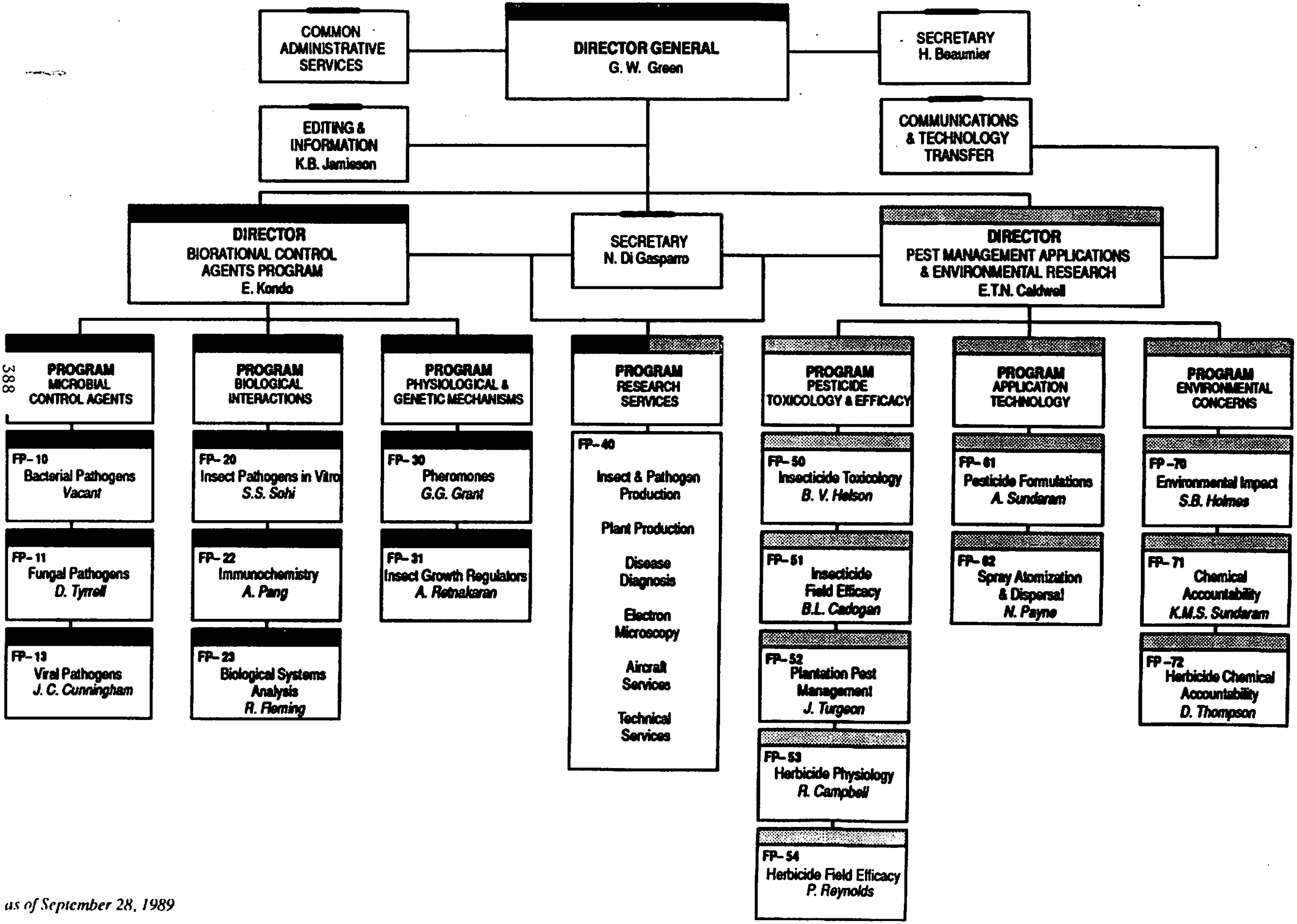
The external funding program at NRC has promised a commmitment of $200,000 to support the research on the isolation and characterization of the synergistic factor, the insertion of the B.t. gene into the budworm NPV and the research on entomopoxvirus expression vectors. The promised funds were contingent on obtaining industrial support to the extent of $50,000 to the program.

The projects on viral biochemistry and on tissue culture also draw from the resources of other programs at FPMI. Insect rearing provides various larvae at different stages of growth along with the required amount of regular or specialized media as requested by the investigators. Collaborative research between Drs. Arif and Sohi provide the viral biochemistry study with cells and media. Frequently, the virology program supply Drs. Sohi and Arif with larvae infected with different virus strains.

Both of the above Networks depend heavily on insect cell lines and tissue culture therefore Dr. S. Sohi is involved in both networks while at the same time undertaking collaborative research in insect tissue culture with Armand Frappier University. Hence, the two networks will again be linked. It must be emphasized that FPMI's insect rearing is critical for live insect bioassay, a very necessary step before field trials. Again FPMI will provide the necessary A-base to support insect rearing for the above networks.

Finally, to address the regulatory and application concerns of the use of genetically-altered microbials, environmental impact research will be developed concomitantly to ensure that the products will be thoroughly safety-tested to satisfy registration protocols and standards. It is anticipated that FPMI will be establishing those registration protocols and standards in-house in collaboration with Depts. of Environment, Health & Welfare, Fisheries & Agriculture.

# FOREST PEST MANAGEMENT INSTITUTE




388

* *as of September 28, 1989*

Overview Statement

## Highlights of 1989/90 Activities of the Pest Management Applications and Environmental Research Program

Forest Pest Management Institute

E.T.N. Caldwell, Director

### Introduction

Emphasis in this FPMI program has shifted significantly over the last several years from research with potential chemical insecticides to research with biorational control agents, herbicides, assessment of environmental impact, development of improved application techniques and regulatory considerations. The majority of changes have come about in response to a general desire for environmentally conscious pest management options, and also in response to a lack of interest in the development of new chemical insecticides for silvicultural uses.

In order to better reflect the research activities and future focus in this Program, it has been retitled to Pest Management Applications and Environmental Research.

The objective of the Program is:

To develop methods of pest management that will reduce forest crop loss from insects and competing vegetation to acceptable levels with minimal effects on the forest environment.

The Program is divided into 4 groupings in order to ensure the fulfillment of the above objective: Pesticide Toxicology and Efficacy, Application Technology, Environmental Concerns, and Communications and Technology Transfer.

The first group, Pesticide Toxicology and Efficacy is devoted primarily to development of efficacy and use strategy data for control of insects and competing vegetation and is composed of the following projects and associated studies:

FP-50 - Insecticide Toxicology and Screening - B. Helson

- 50-1: Factors Affecting Insecticide Toxicity to Spruce Budworm
- 50-2: Insecticide Development for Other Insect Pests of Forests, Plantations and High Value Stands
- 50-3: Pesticide Toxicity to Non-target Invertebrates

FP-51 - Insecticide Field Efficacy - L. Cadogan

51-1: Product Development
51-2: Factors Influencing Insecticide Efficacy in Forests

FP-52 - Plantation Pest Management - J. Turgeon
P. de Groot

52-1: Insect Ecology and Biology
52-2: Protection Strategies and Techniques

FP-53 - Herbicide Physiology - R. Campbell

FP-54 - Vegetation Management - P. Reynolds
D. Pitt

54-1: Weed Ecology
54-2: Operational Use Strategies

The second group, Application Technology is devoted to improving current application practices, formulations, and spray set-backs and includes the following projects and associated studies:

FP-61 - Pesticide Formulations - A. Sundaram

61-1: Physicochemical Properties and Behaviour of Pesticide Formulations
61-2: Methodology Development for Formulation Research

FP-62 - Pesticide Atomization and Dispersal - N. Payne

The third group, Environmental Concerns, is devoted to assessing the biological and chemical impacts of pesticide applications and consists of the following projects and associated studies.

FP-70 - Environmental Impact - S. Holmes
D. Kreutzweiser
R. Millikin
K. Barber

70-1: Environmental Toxicology Assessment
70-2: Aquatic Impact Assessment
70-3: Terrestrial Vertebrate Impact Assessment
70-4: Terrestrial Invertebrate Impact Assessment

FP-71 - Insecticide Chemical Accountability - K.M.S. Sundaram

71-1: Environmental Fate
71-2: Methodology Development

FP-72 - Herbicide Chemical Accountability - D. Thompson

72-1: Environmental Fate
72-2: Methodology Development

In 1989 a new project was initiated to respond to requirements for communications to clients and to implement FPMI's Communications Strategy.

FP-91 - Communications and Technology Transfer - F. Ortiz

## Non-Research Activities

Non-research activities of the program in 1989 have included a number of major regulatory issues. As forestry advisor to the federal registration process under Agriculture Canada, FPMI has been involved in the current review of the federal registration process. Although Forestry Canada does not have a seat on the Review Team, its representative provides input via a Federal Caucus of federal registration advisors as well as via the Forest Pesticides Caucus (a caucus of representing a broad spectrum of forest sector interests). FPMI regulatory activities have included:

(1) participation in the Pesticide Registration Review
(2) member of the Forest Pesticides Caucus
(3) development of forest pesticide economic benefit assessments
(4) participation in the re-evaluation of fenitrothion
(5) advisory input for regulatory guidelines for research permits for both chemical and microbial pesticides; guidelines for registration of naturally-occurring microbials; guidelines for assessment of non-target plant phytotoxicity; development of guidelines for determining pesticide drift
(6) scientific review and advice for B.t., and Dimilin insecticide submissions as well as Garlon and Velpar herbicides
(7) participation on the CORE committee of federal registration advisors
(8) participation as full member of the Canadian Association of Pest Control Officials
(9) coordination for forestry registration submissions under the Minor Use of Pesticides Program

These activities and responsibilities are likely to increase in future. As a result of Forestry Canada's new departmental status and increased workload as a regulatory advisor on forestry pest management, FPMI has been recently allocated several additional PY's to fulfil its advisory mandate. A position in Communications and Technology Transfer has already been staffed and a Regulatory Liaison position is expected to be staffed in the near future. A third support position will hopefully be forthcoming.

## Research Activities

The majority of research activities in the Program have concentrated on assessing the effective application and environmental profiles of pest management strategies. Highlights are summarized below for each of the Program's Research Projects.

### FP-50 - Insecticide Toxicology and Screening - Dr. Blair Helson

- Research with a Rohm and Haas insect growth regulator RH 5992 has shown considerable promise in the control of several forest insect pests. Additional research is in progress.

- research with alpha-terthienyl, an insecticide derived from Asteracae plant species continued to show that this compound has some promise for insect control. This research is being done in cooperation with University of Ottawa and Dr. W. Kaupp.

- cooperative research with Quebec MER on the efficacy of aerial and ground based applications of permethrin for spruce budmoth control showed considerable promise.

- drift studies with permethrin in collaboration with Dr. Nick Payne were successfully completed and demonstrated that at 60m or more downwind from the spray swath less than 10% mortality of sensitive aquatic organisms can be expected in waters of .5m in depth.

- residual toxicity tests with permethrin showed promise for control of white pine weevil.

- Permethrin and chlorpyrifos at 1% and 2.5% solutions respectively showed promise in residual control of *Hylobius congener* on treated seedlings.

- a method for assessing toxicity of surface pesticide deposits to leafcutter bees was successfully tested with E.I. project.

### FP-51 - Insecticide Field Efficacy - Mr. Leo Cadogan

- field trials were successfully completed to assess the effectiveness of a number of *B.t.* formulations against E. Spruce budworm in N. Ontario. Formulations tested included Condor, CIL E2492, high potency Dipel aqueous and oil formulations as well as the highest potency Futura formulation.

### FP-52 - Plantation Pest Management - Dr. Jean Turgeon
Mr. Peter de Groot

- life table studies to help identify mortality factors of black spruce cones were continued.

- with the help of FIDS from each province, a survey was organized across Canada to determine the distribution and relative importance of two species of cone maggots infesting tamarack.

- studies were continued to assess destructive and non-destructive sampling methods for insects affecting cones and seeds.

- studies were continued to assess destructive and non-destructive sampling methods for insects affecting cones and seeds.

- Biosystemaatics research with cone beetles was continued in partial fulfillment for a Ph.D. thesis by P. de Groot.

FP-53 - Herbicide Physiology - Dr. R. Campbell

- Dr. Campbell was hired in 1989 as replacement for Dr. R. Prasad. Dr. Campbell concentrated on fulfilling previous commitments to OMNR with regard to their Class Environmental Assessment hearings. Research activities and future focus of this project will be developed for 1990.

FP-54-1 - Weed Ecology - Dr. P. Reynolds

- following vegetation assessments were continued in New Brunswick on sites previously treated with formulations of Velpar, Pronone, Escort and Oust to assess herbicide efficacy, crop tolerance and growth response as well as plant succession.

FP-54-2 - Operational Use Strategies - Mr. D. Pitt

- first season herbicide efficacy and crop tolerance data were collected from a 1988 cooperative trial to develop an improved use strategy for Vision herbicide in New Brunswick.

- a comparative brush herbicide trial was initiated in New Brunswick to compare the abilities of Garlon 4, Touchdown, 2 Vision formulations and manual control as brush control tools. In parallel with this research FP-72 is assessing the environmental fate of the herbicides tested and a method is being developed to use large scale aerial photography as a means for evaluating herbicide efficacy.

FP-61 - Pesticide Formulations - Dr. A. Sundaram

- small scale field trials were initiated to assess the potential of adjuvants to improve rainfastness and absorption characteristics of Vision herbicide on selected target foliage.

- rainfastness studies with modified B.t. formulations was continued.

FP-62 - Pesticide Atomization and Dispersal - Dr. N. Payne

- an experiment was carried out to quantify meteorological conditions in the atmospheric boundary layer above a forest canopy during periods of dawn and dusk.

- the project cooperated in a collaborative experiment to quantify off-target deposit from various glyphosate applications (with SERG).

- a collaborative permethrin drift study was successfully completed with FP-50.

- on-target deposit from ground-based permethrin applications by Electrodyne and knapsack mistblower sprayers were measured in a cooperative trial with FP-50 and Quebec MER.

FP-70-1 - Environmental Toxicology - S. Holmes

- in cooperation with FP-72, field tests were initiated to evaluate the potential impact of the herbicide hexazinone on lentic plant and animal communities.

- a study was initiated to evaluate chickadee nest boxes as a means of measuring effects of forestry pesticides on reproduction in forest songbirds.

FP-70-2 - Aquatic Impact - D. Kreutzweiser

- brook trout and aquatic invertebrate sampling was continued at the Icewater Creek research area in preparation for a second permethrin application shceduled for June 1990.

- a bioassay procedure was developed and used for testing susceptibility of aquatic invertebrates to pesticides using an artificial stream at Icewater Creek.

- a pilot study of benthos and trout populations was initiated in an Icewater Creek tributary.

FP-70-3 - Terrestrial Vertebrate Impact - R. Millikin

- population censusing of forest songbirds at Icewater Creek continued.

- a field study was conducted in Ontario to assess the effects of B.t. in ground-nesting bird species.

FP-70-4 - Terrestrial Invertebrate Impact - K. Barber

- studies continued in order to assess the potential impact of B.t. applications to non-target species of lepidoptera associated with blueberry.

FP-71 - Insecticide Chemical Accountability - Dr. K.M.S. Sundaram

- project staff participated in the permethrin drift trial with FP-50 and 62 and also investigated the environmental fate of this insecticide in the forest ecosystem.

- the penetration, mobility, persistence and metabolic fate of implanted acephate in black spruce trees was investigated in collaboration with Newfoundland and Labrador region staff.

- degradation and metabolic fate of Dimilin insecticide in clay and sandy loam forest soils was investigated under lab. conditions.

FP-72 - Herbicide Chemical Accountability - D. Thompson

- comparative brush herbicide environmental fate research was initiated in New Brunswick with Garlon 4, Touchdown, and 2 Vision formulations in cooperation with FP-54-2 and Maritimes region staff and cooperators.

- the environmental fate and impact of Escort herbicide and hexazinone were investigated using an aquatic enclosure technique in order to determine the persistence of these herbicides in water and sediments and their impact on phytoplankton and aquatic macrophyte communities.

# Use of Lecontvirus and Sertifervirus in Ontario.

A report to the 17th Annual Forest Pest Control Forum

(Ottawa, Ontario. 14-16 November 1989)

J.C. Cunningham & W.J. Kaupp

Forestry Canada

Forest Pest Management Institute

P.O. Box 490

Sault Ste. Marie, Ontario

P6A 5M7

These data are preliminary and must not be published nor cited without the permission of the Director, FPMI.

Use of Lecontvirus and Sertifervirus in Ontario.

J.C. Cunningham and W.J. Kaupp

Lecontvirus is an emulsifiable oil suspension of a nuclear polyhedrosis virus for control of redheaded pine sawfly, Neodiprion lecontei. It is registered under the Pest Control Products Act (Canada) and is supplied free of charge by FPMI to OMNR staff in districts which have a problem with redheaded pine sawfly in plantations. In 1989, Lecontvirus was supplied to OMNR staff in 6 districts and it was used in 4 of them. A total of 39 plantations with a combined area of 372.6 ha was treated (Table 1). This is a 50% increase from 1988 in the number of plantations treated and an 85% increase in the area treated.

Table 1. Use of Lecontvirus in 1989

| DISTRICT | NO OF PLANTATIONS | AREA (HA) TREATED |
|---|---|---|
| Bancroft | 7 | 40.4 |
| Espanola | 6* | 69.5 |
| Minden | 8 | 18.2 |
| Parry Sound | 18 | 244.5 |
| | 39 | 372.6 |

* Includes 4 plantations (43.5 ha) treated by E.B. Eddy Forest Products Staff

Sertifervirus is a similar product to Lecontvirus and it is for control of European pine sawfly, Neodiprion sertifer. A registration petition for this product is being evaluated and experimental applications have to be made under a Research Permit. In 1989, material was supplied to two collaborators in order to evaluate the opinions of Christmas tree growers who normally use chemical pesticides. A 14 ha Scots pine Christmas tree plantation near Collingwood was successfully treated and complete mortality of flagged sawfly colonies was observed. Material was also supplied to Summerville Nurseries to treat a 28 ha Scots pine plantation near Alliston, but the outbreak of European pine sawfly, which was expected, did not occur and the Sertifervirus was not used.

Lecontvirus will be available to OMNR and forest product company staff in 1990 and requests for material should be made to FPMI around April. Lecontvirus is shipped in early June. A well co-ordinated program directed at the detection of outbreaks of redheaded pine sawfly followed by Lecontvirus treatments should reduce the status of this insect to that of a very minor pest.

# Experimental application of Disparvirus for control of gypsy moth in Ontario: reduced dosage and emitted volume.

A report to the 17th Annual Forest Pest Control Forum

(Ottawa, Ontario. 14-16 November 1989)

J.C. Cunningham, W.J. Kaupp, K.W. Brown, M.B.E. Cunningham and P. Ebling

Forestry Canada

Forest Pest Management Institute

P.O. Box 490

Sault Ste Marie, Ontario

P6A 5M7

These data are preliminary and must not be published nor cited without the permission of the Director, FPMI.

Experimental aerial application of Disparvirus for control of gypsy moth in Ontario: reduced dosage and emitted volume.

J.C. Cunningham, W.J. Kaupp, K.W. Brown, M.B.E. Cunningham and P. Ebling

**Summary**

Following successful Disparvirus trials in 1988 with a double application of $1.25X10^{12}$ PIB/ha (total $2.5X10^{12}$ PIB/ha) in an emitted volume of 10.0 L/ha, a reduced double application of $5X10^{11}$ PIB/ha (total $10^{12}$ PIB/ha) was tested in emitted volumes of 10.0 L/ha and 5.0 L/ha. The 10.0 L/ha application was applied on three 10 ha plots and the 5.0 L/ha application on three 20 ha plots. Total treated area was 90 ha. The tank mix contained 25% v/v molasses, 10% w/v Orzan LS as a UV protectant and 2% v/v Rhoplex B60A spreader-sticker. A Cessna Ag-truck fitted with 4 Micronair AU 4000 rotary atomizers was used for the first application and a Piper Pawnee fitted with 6 Micronair AU 5000 atomizers was used for the second application 3 days later. Larvae were mainly in their first instar at the time of these applications. A further 3 plots were selected as untreated checks. Pre-spray gypsy moth egg mass densities ranged from 2,180/ha to 11,900 in the six treated plots and from 2,000 to 6,380 in the three check plots.

A detailed assessment involved pupal counts in burlap traps, pre-spray and post-spray egg mass counts, weekly records of the incidence of NPV infection in larvae in treated and check plots and estimates of defoliation of oak trees. High levels of virus infection were observed in samples collected 2 weeks post-spray with 71, 81 and 100% of the larvae infected in plots sprayed at 10.0 L/ha and 71, 91 and 97% in plots sprayed at 5.0 L/ha compared to 3, 4 and 5% naturally occurring infection in the check plots.

The number of pupae/m of burlap trap ranged from 13 to 99 in the check plots, 4 to 6 in the plots treated at 10.0 L/ha and 4 to 22 in plots treated at 5.0 L/ha. There were considerable (undefined) numbers of forest tent caterpillars in all the plots which increased the extent of defoliation. However, defoliation of oak was significantly less in all the treated plots compared to check plots with defoliation ranging from 75 to 82% in check plots compared to 28 to 46% in plots treated at 10.0 L/ha and 19 to 38% in plots treated at 5.0 L/ha. There was no significant difference in reduction of egg mass densities between the 10.0 L/ha and 5.0 L/ha treatments, but egg mass densities in both treatments were significantly lower than those in the check plots; population reductions in the 10.0 L/ha treatments, calculated using a modified Abbott's formula, were 79, 79 and 85% and in the 5.0 L/ha treatments were 80, 85 and 98%. Hence, an application volume of 5.0 L/ha is recommended for Disparvirus in preference to 10.0 L/ha. These trials also indicate that a reduction in dosage of Disparvirus from $2.5X10^{12}$ to $10^{12}$ PIB/ha may be feasible, although any further reduction would not be advisable.

## Introduction

Aerial spray trials were conducted in Ontario in 1988 when a double application of $1.25X10^{12}$ PIB/ha (total $2.5X10^{12}$ PIB/ha) was applied to 3 plots in an emitted volume of 10.0 L/ha when larvae were mainly in their first instar. It is necessary to rear, infect, harvest and process about 1,000 gypsy moth larvae to produce a 1 ha dosage of $2.5X10^{12}$ PIB. Foliage protection and reduction in egg mass densities were outstanding following these applications in 1988, far exceeding the parameters regarded as acceptable. These parameters are defined as defoliation of less than 40% in treated blocks and reduction in egg mass densities to below a threshold level of 1,200 egg masses/ha; control measures are advocated above this level.

The dosage used in 1988 is quite high and the application volume of 10.0 L/ha, although widely used for virus applications, is considered unacceptably high for forestry applications in Canada. Hence, in 1989 it was decided to evaluate a lower dosage and a lower emitted volume. The dosage selected was a double application of $5X10^{11}$ PIB/ha (total $10^{12}$ PIB/ha). It requires 400 gypsy moth larvae to produce this dosage which was applied in two different emitted volumes, 10.0 L/ha, the same as used in 1988, and 5.0 L/ha.

## Experimental plots and spray application

Six treatment plots and three check areas were selected in Lindsay District. Two treated plots were on Otonobee Conservation Authority property near Clear Lake, north of Lakefield and one check plot was on private land nearby. The remaining four treated plots and two check areas were on Duro Conservation Authority land and private land near Round Lake, north of Havelock.

Table 1. Meteorological conditions during spray applications.

| Date | Air temp (°C) | Ground temp (°C) | % RH | Wind (km/h) |
|---|---|---|---|---|
| 24 May | 14-15 | 13-14 | 80-85 | 1-2 |
| 27 May | 9 | 8 | 78-84 | 5-8 |

Table 2. Larval development at time of application.

| Plot | Application | %L1 | %L2 | %L3 |
|---|---|---|---|---|
| 1 | 1 | 99.1 | 0.9 | -.- |
| | 2 | 86.3 | 13.7 | -.- |
| 2 | 1 | 100.0 | -.- | -.- |
| | 2 | 94.6 | 5.4 | -.- |
| 3 | 1 | 90.2 | 9.8 | -.- |
| | 2 | 51.1 | 41.1 | 7.8 |
| 4 | 1 | 100.0 | -.- | -.- |
| | 2 | 70.6 | 27.4 | 2.0 |
| 5 | 1 | 91.1 | 7.1 | 1.8 |
| | 2 | 56.0 | 38.0 | 6.0 |
| 6 | 1 | 98.2 | 1.8 | -.- |
| | 2 | 94.5 | 5.5 | -.- |

Table 3. Spray deposit on Kromekote cards.

| Plot | Application number | NMD (µm) | VMD (µm) | Dmax (µm) | #Droplets/ $cm^2$ (± SE) |
|---|---|---|---|---|---|
| 2 | 1 | 48 | 278 | 461 | 3.8 ± 2.5 |
| | 2 | 105 | 241 | 597 | 18.5 ± 16.3 |
| 3 | 1 | 61 | 370 | 938 | 63.6 ± 27.3 |
| | 2 | 109 | 303 | 734 | 43.3 ± 24.3 |
| 4 | 1 | 29 | 158 | 427 | 21.5 ± 8.7 |
| 5 | 1 | 23 | 248 | 392 | 22.6 ± 10.6 |
| | 2 | 101 | 347 | 665 | 10.0 ± 8.0 |
| 6 | 1 | 40 | 283 | 495 | 64.4 ± 37.0 |
| | 2 | 144 | 291 | 631 | 9.8 ± 3.5 |

The same dosage was applied to all 6 plots. It was a double application of $5X10^{11}$ PIB/ha (total $10^{12}$ PIB/ha). Two different emitted volumes were tested, 10.0 L/ha and 5.0 L/ha. Plots treated at 10.0 L/ha (designated 1,2,3) were 10 ha and plots treated at 5.0 L/ha (designated 4,5,6) were 20 ha in area. Hence, a total area of 90 ha was sprayed with Disparvirus in 1989. The tank mix contained 25% v/v molasses, 10% Orzan LS, a lignosulphonate used as a UV protectant, and 2% v/v Rhoplex B60A spreader-sticker. The first spray on May 24th was applied by the FPMI Cessna Ag-truck fitted with 4 Micronair AU 4000 rotary atomizers. The second spray, 3 days later, on May 27th was applied by a Piper Pawnee fitted with 6 Micronair AU 5000 rotary atomizers. Meteorological conditions during the applications are given in Table 1. Gypsy moth larval development is given in Table 2. Oak leaves were about 50% expanded on red oak and 25% expanded on white oak at the time of application. Kromekote cards were placed at 15 m intervals at right angles to flight lines in some of the plots where this was practical. Results of the analysis of these cards is given in Table 3, although there may be anomolies due to masking of some cards by foliage and spray drift away from the card line.

## Assessment

Egg mass counts were made on ten 10 $m^2$ (0.01 ha) sub-plots in each treated and check plot using methods established by Forest Insect and Disease Survey staff. Numbers were converted to egg masses per hectare. Counts were made in early May before hatching commenced and the same plots were re-examined in mid-October. Reduction in egg mass density was calculated using a modified Abbott's formula; treated and check plots with corresponding pre-spray egg mass counts were paired for this calculation.

Incidence of virus infection was estimated pre-spray, between the two spray applications and at weekly intervals post-spray in all the treated and check plots. Random samples of larvae were collected at eye level on understory vegetation (100 to 200 per plot), smeared on microscope slides, stained with naphthalene black 12B and examined at 1,200X magnification for the presence of PIBs. Larvae were not collected in the vicinity of the 0.01 ha sub-plots used for egg mass counts.

Pupal counts were made from burlap traps on three oak (red or white) trees in each of the ten 0.01 ha plots used for egg mass counts in all the treated and check plots. Strips of burlap, 450 cm wide, were folded double and nailed to the trunks of trees. The circumference of sample trees was measured and pupal counts converted to numbers-per-metre of burlap trap. These counts were made on July 11 and 12 at 7 weeks post-spray.

Defoliation estimates were made on 5 red oak or white oak 46-cm branch tips collected at mid-crown from trees in the ten 0.01 ha egg-mass sampling plots. This was done at 7 weeks post-spray when larvae had ceased feeding and were either pupating or dead. A total of 50 branch tips was examined in each treated and each check plot. An estimate of the amount of foliage missing from each branch was made and a mean calculated for each plot.

## Results

Incidence of virus infection in the 6 treated and three corresponding check plots is shown in Fig. 1. Peaks of NPV infection were reached 2 weeks post-spray in the 6 treated plots and ranged from 71% to 100% of the larvae infected in the samples. Only 3 to 5% of larvae in the check plots were infected. Incidence of virus infection then dropped until 6 to 7 weeks post-spray when it again increased. At this time high levels were also recorded in the check plots, ranging from 50 to 94% of larvae infected. As pupation had commenced, figures for incidence of virus infection can become distorted because healthy larvae have pupated and a high percentage of the remaining larval population is infected.

Pupal counts are given in Table 4. Significant differences were recorded in numbers from the treated plots and corresponding check plots. Numbers of pupae/m of burlap trap ranged from 21 to 93 in the check plots and from 4 to 27 in the treated plots.

Egg mass counts in the spring and fall are given in Table 4 along with the population reductions due to treatment calculated using a modified Abbott's formula. Population reductions in the 3 plots sprayed at 10.0 L/ha were 79, 79 and 85% and in the 3 plots sprayed at 5.0 L/ha were 80, 85 and 98%. The results with the 5.0 L/ha treatment were marginally better than the 10.0 L/ha treatment, but this difference is not statistically significant.

Defoliation estimates are also given in Table 4. There was a significant difference in the degree of defoliation between all treated and check plots. However, results were confounded by moderate to high populations of forest tent caterpillar, *Malacosoma disstria*, in all nine plots, although it was impossible to quantify population densities. Defoliation in the three untreated check plots ranged from 75 to 82% and in the six treated plots ranged from 19 to 46%.

## Discussion

The reductions in dosage and emitted volume tested in 1989 are considered effective and both are most desirable achievements if Disparvirus is to become an operational pest management alternative for gypsy moth control. The applications at 5.0 L/ha were marginally better than those at 10.0 L/ha. This is possibly due to better atomization of droplets by Micronair units at the reduced flow rate. Due to the negligible difference between the two application volumes, all six plots treated with the same dosage can be compared as replicates. Of these 6 replicates, three were excellent, two were borderline and one did not meet the criterion of a reduction in egg mass densities to below 1,200/ha. However, in this plot, egg mass density was reduced from 11,900/ha to 2,200/ha which, in itself, was a major accomplishment. Perhaps Disparvirus applications are not so effective on gypsy moth population densities in excess of 8,000 to 10,000 egg masses per hectare. One should possibly consider Disparvirus applications two years in

Fig. 1. Incidence of NPV-infected larvae in plots treated with Disparvirus and in corresponding check plots.

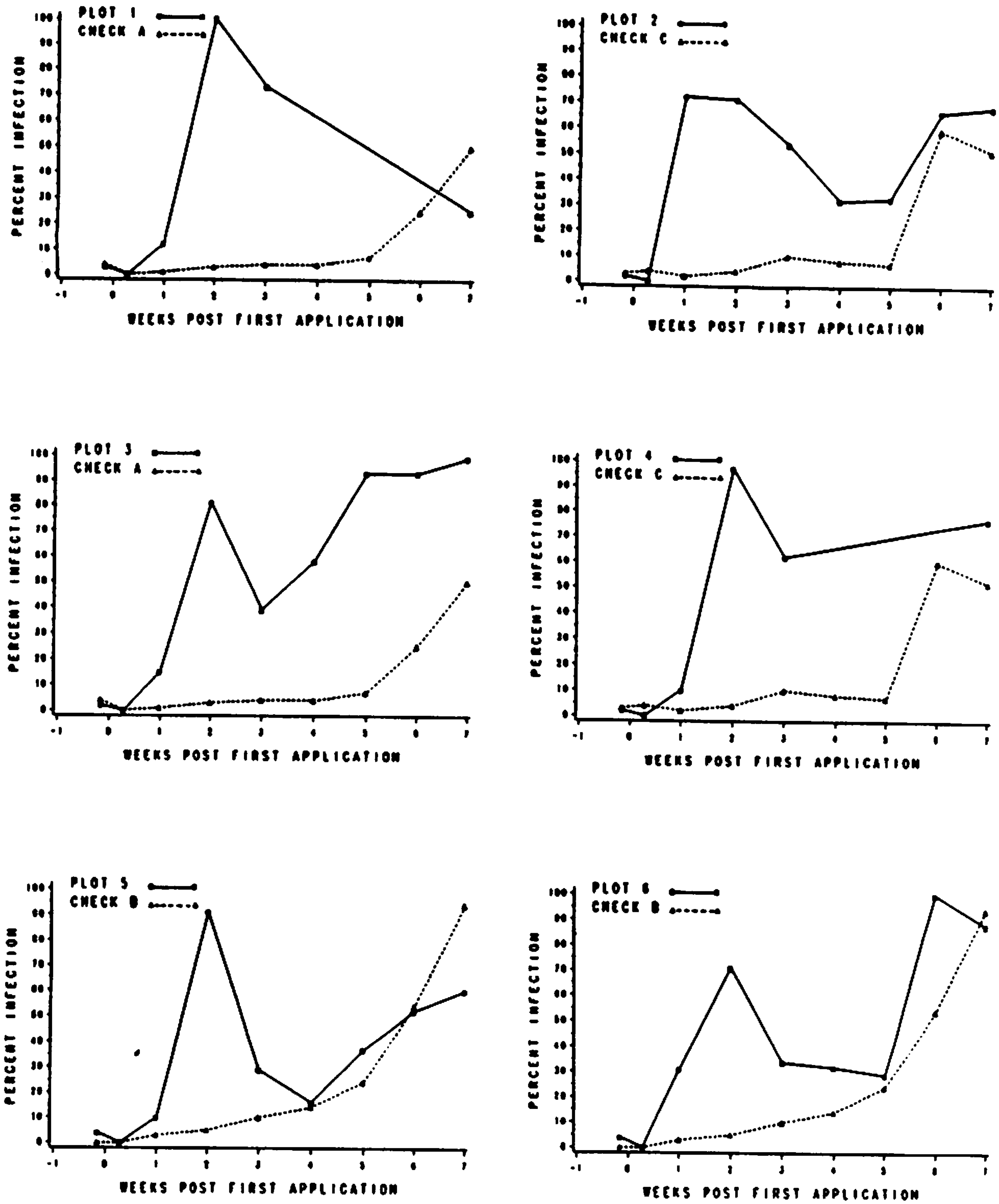


Table 4. Assessment of **Disparvirus** aerial spray trials.

| Plot | Emitted volume (L/ha) | Pupae/m burlap (±S.E.) | Pre-spray E.M./ha (±S.E.) | Post-spray E.M./ha (±S.E.) | % Population reduction due to treatment[1] | % Defoliation of oak |
|---|---|---|---|---|---|---|
| Plot 1 | 10.0 | 27±9 | 2990±326 | 1130±246 | 79 | 46 |
| Check A | - | 93±14 | 2920±407 | 5320±1193 | - | 75 |
| Plot 2 | 10.0 | 9±3 | 2180±199 | 370±106 | 85 | 28 |
| Check C | - | 21±3 | 2000±215 | 2230±414 | - | 82 |
| Plot 3 | 10.0 | 4±1 | 3170±575 | 1230±392 | 79 | 28 |
| Check A | - | 93±14 | 2920±407 | 5320±1193 | - | 75 |
| Plot 4 | 5.0 | 10±2 | 2490±258 | 540±176 | 85 | 38 |
| Check C | - | 21±3 | 2000±215 | 2230±414 | - | 82 |
| Plot 5 | 5.0 | 22±8 | 11900±3778 | 2220±1190 | 80 | 28 |
| Check B | - | 91±13 | 6380±1877 | 5810±888 | - | 81 |
| Plot 6 | 5.0 | 4±1 | 6730±1579 | 150±32 | 98 | 19 |
| Check 5 | - | 91±13 | 6380±1877 | 5810±888 | - | 81 |

[1] Calculated using a modified Abbott's formula.

succession when attempting to control very high density gypsy moth populations.

It is difficult to apply the parameter set for foliage protection in these trials because of undetermined defoliation attributed to forest tent caterpillar in the whole general area. However, defoliation was significantly lower in all the treated plots compared to the check plots and the Disparvirus treatments had an obvious and clearcut impact in saving oak foliage. Only one treated plot did not meet the guideline of under 40% defoliation. This was plot 1 with 46% defoliation; obviously without the intervention of forest tent caterpillar, it too would have been classified as adequately protected.

Some of the very high levels of virus infection recorded two weeks post-spray, followed by moderate pupal and egg mass counts, leads one to doubt the validity of this means of assessment. One would have anticipated virtual eradication of the population and this did not occur. Larvae that were sampled at eye level on understory vegetation were almost all infected with NPV in some samples. This leads one to ask two questions 1) should samples of larvae have been collected from mid-crown or higher in the trees and 2) were the treated plots re-infested by larvae from adjoining, heavily defoliated areas?

## Conclusions and recommendations

From the above results, it is evident that an emitted volume of 5.0 L/ha is as good as, if not better than, 10.0 L/ha, provided it is applied using Micronair rotary atomizers or equipment giving a similar droplet spectrum. A further reduction in emitted volume should be investigated and it is hoped to compare 2.5 L/ha to 5.0 L/ha in 1990.

The double application of $5X10^{11}$ PIB/ha (total $10^{12}$ PIB/ha) applied in 1989 is considered to be the lowest feasible dosage and lower dosages are not recommended. In fact, a higher dosage is desirable, but economic factors come into play. It is necessary to rear, infect, harvest and process 400 gypsy moth larvae to produce $10^{12}$ PIBs. How much will this cost? Is it competitive with *Bacillus thuringiensis*? These questions are academic until Disparvirus (or another viral insecticide for gypsy moth) is commercially available.

FPMI staff is in contact with two companies who are interested in producing a viral insecticide for gypsy moth. The first is Espro, located in Maryland, USA and the second is Calliope, in France. At present, it appears improbable that either company will have a product available for field trials in Canada in 1990. Hence, any field trials conducted next year will use Disparvirus produced at FPMI.

**This research was funded in part by an Ontario Pesticides Advisory Committee grant.**

# White Pine Weevil and Spruce Budmoth Control: Some New Findings

A Report to the 17th Annual Forest Pest Control Forum
(Ottawa, Ontario 14-16 November, 1989)

Arthur Retnakaran
Forestry Canada
Forest Pest Management Institute
Sault Ste. Marie, Ontario
P6A 5M7

and

Luc Jobin
Forestry Canada
Quebec Region
P.O. Box 3800
Ste. Foy, Quebec
G1V 4C7

## White Pine Weevil and Spruce Budmoth Control: Some New Findings

Arthur Retnakaran and Luc Jobin

### Introduction

We previously reported that we had limited success controlling the damage caused by the white pine weevil and spruce budmoth using Dimilin (diflubenzuron). We continued our testing in 1989 in collaboration with the Ontario Ministry of Natural Resources and the Quebec Ministry of Energy and Resources and obtained some new results that are significant. A brief summary of what we discovered is reported herein.

White Pine Weevil: The white pine weevil overwinters in the adult stage in the litter close to the base of the host tree. Upon emergence in early spring, the adults feed on the terminal leader and lay their eggs in the feeding punctures. The larvae that emerge feed in the cambial region girdling and killing the leader which takes on the shpae of a shepherd's crook. The larvae pupate in the pith region and when they reach the adult stage in summer, emerge from the tree. In the fall, the adults overwinter in the litter. The weevil is univoltine and attacks mainly White pine, Jack pine, Scots pine, White spruce and Norway spruce.

Since there are no systemic insecticides available for the weevil, the only time when they can be reached is when they are adults, either in the spring or in the fall. We found that white pine weevil is very sensitive to Dimilin. Adult weevils upon ingestion pass the material to the eggs. Chitin synthesis is inhibited during embryonic development and as a result the structurally weak larva is unable to emerge from the egg. When we sprayed terminal leaders with Dimilin in early spring we obtained excellent protection from weevil damage but there was always a few attacks which we couldn't explain. When we tested weevil activity at low temperatures, we discovered that they were active even at 0.5°C. This meant that the weevil could emerge once the snow melted underneath the host trees and lay eggs even before we sprayed. Therefore, in 1989 we sprayed several plantations when the snow was still on the ground. We got 100% protection, which is exactly what we anticipated (Table 1).

The success of Dimilin was because (i) weevil is very sensitive to this material (ii) the effect is by ingestion (iii) the material persists on the leader for several weeks, even though it breaks down in the soil in a week (iv) use of oil formulation (Dimilin-ODC 45 in 7N oil) in early spring (easier to handle at low temperatures).

Since Dimilin has no effect on adult parasites, predators and pollinators and is perfectly safe to all vertebrates, it is an excellent control agent for weevil. We are planning to conduct tests in 1990 on weevil-infested Jack pine plantations owned by Abitibi-Price in Thunder Bay.

<u>Spruce Budmoth</u>: The spruce budmoth is univoltive and lays its eggs on the inside surface of the scales at the base of the current year's growth of white spruce in late summer. It overwinters in the egg stage and in early spring the emerging larvae rapidly migrate into the bud and lead a cryptic life feeding inside. Upon reaching the 4th instar, the larvae spin down to the ground and pupate in the litter. The adults emerge after about 3 weeks.

We had earlier observed that when Dimilin was sprayed on the trees after the bud scales had fallen off, there was no significant reduction in the larval population or protection from budmoth damage. But in the subsequent year there was significant growth of the terminal leader. For instance, after the helicopter trials in the spring of 1988, there was no effect on larval population or protection of the new growth. However, when we examined the plantations in 1989, especially in the plots sprayed with Dimilin ODC-45 in 7N oil at 70g AI in 5L per ha, x2 there was significant growth. We have hypothesized that Dimilin had a delayed effect on the budmoth and was manifested at the larval-pupal moult in the ground. Since we did not assay the pupae or adult emergence, we probably missed this effect. This effect is similar to what we reported on the spruce budworm (another Tortricid) where the older instars are more sensitive than the earlier ones to Dimilin. The growth of the terminal leader in the year subsequent to spraying was probably because of the delayed effect on the larvae which resulted in a drastic reduction of adults. In 1990 we plan to validate this putative delayed effect.

TABLE 1. Ground application of Dimilin against white pine wevil in jack pine plantations in Hurlburt and Hynes Townships, near Sault Ste. Marie, Ontario in May 1989.

| | Treatment | | | | % leader damage | |
|---|---|---|---|---|---|---|
| Plot number and location | Dosage (g AI/ha) and formulation | Diluent and volume (L) | Area treated (ha) | Number of trees | In 1988 prior to treatment | In 1989 after treatment |
| 1. Hurlburt | Control | - | 0.1 | 300 | 30 | 18 |
| 2. Hurlburt | Control | - | 0.1 | 300 | 30 | 16 |
| 3. Hurlburt | Control | - | 0.1 | 300 | 28 | 22 |
| 4. Hurlburt | 250 (ODC-45) | Oil (10) | 0.2 | 600 | 30 | 0 |
| 5. Hurlburt | 125 (ODC-45) | Oil (10) | 0.16 | 480 | 35 | 2 |
| 6. Hurlburt | 250 (WP-25) | Oil (0.2) + water (9.8) | 0.1 | 300 | 36 | 0 |
| 7. Hurlburt | 125 (WP-25) | Oil (0.2) + water (9.8) | 0.1 | 300 | 12 | 0 |
| 8. Hurlburt | 125 (WP-25) | Water (10) | 0.1 | 300 | 28 | 0 |
| 9. Hynes | Control | - | 0.1 | 300 | 22 | 16 |
| 10. Hynes | Control | - | 0.1 | 300 | 30 | 18 |
| 11. Hynes | Control | - | 0.1 | 300 | 28 | 18 |
| 12. Hynes | Control | - | 0.1 | 300 | 15 | 8 |
| 13. Hynes | 125.00 (WP-25) | Oil (1) + water (9) | 0.1 | 300 | 20 | 0 |
| 14. Hynes | 62.50 (WP-25) | Oil (0.5) + water (4.5) | 0.1 | 300 | 30 | 0 |
| 15. Hynes | 31.25 (WP-25) | Oil (0.5) + water (4.5) | 0.05 | 150 | 26 | 0 |
| 16. Hynes | 125.99 (ODC-45) | Oil (5) | 0.1 | 300 | 26 | 0 |
| 17. Hynes | 62.50 (ODC-45) | Oil (5) | 0.1 | 300 | 26 | 0 |
| 18. Hynes | 31.25 (ODC-45) | Oil (5) | 0.1 | 300 | 30 | 0 |

# WHITE-PINE WEEVIL CONTROL TRIALS IN MAINE, 1989

Richard L. Bradbury, Insect and Disease Management Division,
Maine Forest Service, Augusta ME 04333
and
John B. Dimond, Entomology Department, University of Maine,
Orono ME 04469

The tests described below were a cooperative effort of the Insect and Disease Management Division, Maine Forest Service and the Agricultural Experiment Station, University of Maine. The work was inspired by and assisted by the program of Arthur Retnakaran of FPMI, Forestry Canada; and Larry Smith visited Maine to help with the applications. All of our data have been shared with the Retnakaran program, and we suggest joint publication at the appropriate time. UNIROYAL Chemical Company provided some financial and professional support for the tests.

The object was to evaluate applications of diflubenzeron (Dimilin) in early spring applications to reduce weevil damage. One aerial application and two ground applications of Dimilin were made to white pine plantations in Spring, 1989. The aerial application was made on April 18 to a plantation of about 4 ha of trees of < 1m. The Bell 47 helicopter used conventional boom and nozzles and produced large droplets. This was necessary because of dwellings bordering the plantation and the strict laws in Maine on drift of pesticides. The formulation of Dimilin used was the W-25, and this was diluted with a mix of 3 parts water and 1 part dormant oil. It was applied at a rate of 280g/ha AI, with a spray emission rate of 28 l/ha.

This application gave no indication of success. Within the treated plot, weeviled trees in the year preceeding treatment and in the year of treatment numbered about 26%. About the same attack rate occurred in an adjacent untreated control plantation in the year of treatment. This treatment may have been late since a few weevils were observed already established on leaders. We also were not pleased to have had to use a spray system producing large droplets.

The ground spray trials were effective. Treatments were applied with hydraulic, garden-type sprayers with application to only the leaders and upper whorl. Two concentrations of spray were used, a concentrated or high dose and a dilute or low dose. The high dose was prepared by diluting 28 gms AI of Dimilin W-25 in 3.8 l of water:dormant oil mix. The low dose involved the same quantity of Dimilin diluted in twice as much diluent. These amounts of spray treated about 100 trees with the more concentrated mixture and about 200 trees with the dilute mixture. Two plots of each mixture were applied in a plantation in Lagrange, Maine on April 19. There was no sign of weevil activity in this area. One plot each of the two mixtures was added on May 4. Weevils had become active at this time, but we do not know the proportions that had become active.

Treatments were evaluated in late July when attack is most obvious. Five groups of 20 trees, for a total of 100 trees, were examined in each plot. On four control plots in the plantation, percent weeviling was 38%, 35%, 26%, and 32%, for a average of 33%. The two early high dosages of Dimilin showed 2% and 2% weeviling, average 2%; and the two early low dosages showed 0% and 9%, averaging 4.5%. In the later treatments, the high dose plot showed 10% weeviling and the low dose 1% weeviling. Generally, treatment appeared to reduce weeviling by 90% or more in most cases. We would add that we believe these results to be conservative since trees were tall, some exceeding 4 m, and some of these were not well treated. These also were the trees most likely to be attacked because of the behavioral responses of adult weevils to environmental cues.

# The 1989 Experimental Field Trials to Evaluate the Efficacy of Seven *B.t.* Formulations : A Summary of Preliminary Results

A Report to the 17th Annual Forest Pest Control Forum
(Ottawa, Ontario 14-16 November, 1989)

B.L. Cadogan, B.F. Zylstra, R.D. Scharbach

Project No. FP-51 Insecticide Field Efficacy

Forestry Canada
Forest Pest Management Institute
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

These data are very preliminary and must not be published nor cited without the permission of the Director, F.P.M.I.

# The 1989 Experimental Field Trials to Evaluate the Efficacy of Seven B.t. Formulations: A Summary of Preliminary Results

B.L. Cadogan, B.F. Zylstra, R.D. Scharbach

Since 1985, formulations of Bacillus thuringiensis (Berliner) var. kurstaki have largely replaced synthetic insecticides as the principal management tool to control population outbreaks of lepidopterous forest pests.

Consequently new and/or improved B.t. formulations, all intended to enhance the pest control strategies of forest managers, have continued to be developed and introduced.

However, before these products can be recommended for general use their efficacy must be established against the target pests.

In 1989, we field tested seven(7) formulations (Table I) to determine their respective efficacies against spruce budworm Choristoneura fumiferana Clem.

## Materials and Methods

The trials were conducted in the Cedar Lake area, approximately km north of the town of Vermilion Bay in N.W. Ontario (Fig. 1). Nine 50-ha (1.0 x 0.5 km) blocks were established in 35-55 yr. softwood/hardwood stands, one for each of the B.t. treatments and two as check blocks. Seventy-five balsam fir trees Abies balsamea (L.) Mill were randomly selected as sample trees in each block (3 plots/block).

The formulations were dyed with Erio acid red dye (St. Laurence Analine, Brockville, Ont.) to facilitate droplet assessment and applied undiluted as a single application with a Cessna 188 Ag-truck equipped with 4 Micronair Air 4000 rotary atomizers and a digital flow meter. Details pertinent to the spray application, weather at spray time etc. are presented in Table 2. Methods related to sampling, assessments etc. are detailed on a previous report (Cadogan et al. 1984-FPMI Inf. Rept. FPM-X-64).

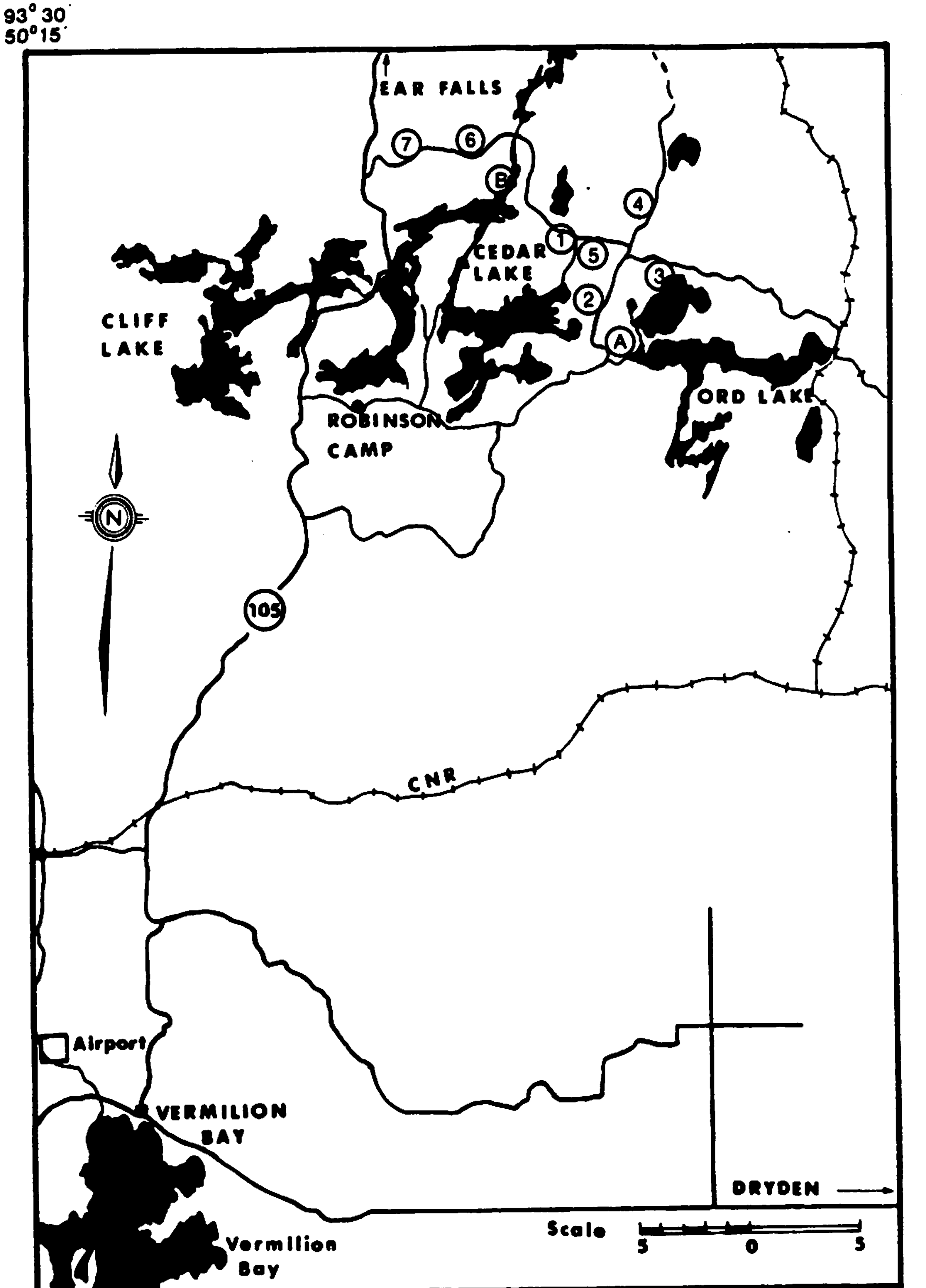
## Results and Discussion

Formulations. Of the seven formulations tested, Condor OF and Futura '0' presented significant problems regarding mixing or/and loading. The former created a gel-like precipitate in the drums; and even after 20 to 25 minutes of stirring with an in-barrel electrical stirrer the precipitate did not return completely to its "flowable" state. Futura '0' was very viscous and could not be easily pumped. It also formed a clay-like precipitate that sedimented soon after circulation or stirring stopped.

Atomization. Only Dipel 352 (ABG 6268) and Futura '0', which incidentally were the most viscous and were sprayed at the lowest volumes (Table 3), deposited at $<3.0$ drops/cm$^2$ at ground level. All the other formulations appeared to atomize efficiently based on ground deposits (Table 3). At time of writing deposit on foliage has not been analysed.

Spruce Budworm Population Reduction. Only Dipel 96 AF (ABS 6278) and to a lesser extent Dipel 352 (ABG 6268) as well as CONDOR OF, recorded budworm population reductions that could be attributed to the *B.t.* The Dipel formulations were the only ones that reduced populations to satisfactory levels. At time of writing we have not ascertained why five *B.t.* formulations performed unsatisfactorily in controlling budworm.

Defoliation. Because *B.t.* requires ingestion by the insect, this implies that some degree of defoliation must incur if the treatment is to be effective and especially when the prespray populations are as high as those experienced in this study (Table 3). Nevertheless, the levels of defoliation shown in Table 3 suggest that the treatments, with a couple of exceptions, were not effectve in protecting balsam foliage. We did observe that the uppermost 1-meter in more than 90% of the sample trees were almost perfectly protected but that the mid and lower crowns were heavily defoliated. This suggests incomplete or inadequate coverage which must be addressed in future trials.




## MAP OF EXPERIMENTAL SITES, 1989

1 = C.I.L. E2492; 2+3 = Condor AF+OF; 4+5 = Futura HP+0; 6+7 = Dipel 96 AF+352 respectively; A+B = Check blocks

**TABLE 1: *B.t.* FORMULATIONS FIELD TESTED IN N.W. ONTARIO, 1989.**

| PRODUCT | FORMULATION TYPE | POTENCY | MANUFACTURER |
|---|---|---|---|
| Dipel 96AF (ABG6278) | Aqueous Flowable | 25.3 BIU/L | Abbott Labs |
| Dipel 352 (ABG6268) | Emulsifiable Sus. | 33.7 BIU/L | Abbott Labs |
| Condor OF | Oil Flowable | 75g(AI)*/L | Ecogen Inc. |
| Condor AF | Aqueous Flowable | 75g(AI)*/L | Ecogen Inc. |
| Futura XLV-HP | Aqueous Suspension | 33 BIU/L | Chemagro Ltd. |
| Futura O | Oil Suspension | 60 BIU/L | Chemagro Ltd. |
| C.I.L. E2492 | Aqueous Suspension | 16.9 BIU/L | C.I.L. Inc. |

* Delta endotoxin

TABLE 2. APPLICATION DATA REGARDING SEVEN B.t. Formulations. N.W. ONTARIO, 1989.

| TREATMENT | | DIPEL 96 AF (AGB 6278) | DIPEL 352 (AGB 6268) | CONDOR OF | CONDOR AF | FUTURA HP | FUTURA O | C.I.L. E2492 |
|---|---|---|---|---|---|---|---|---|
| **AIRCRAFT DATA** | | | | | | | | |
| SPRAY DATE | | 6/6/89 | 5/6/89 | 30/5/89 | 30/5/89 | 31/5/89 | 31/5/89 | 30/5/89 |
| TIME (HRS) | | 0528 | 2053 | 0741 | 0540 | 0603 | 2032 | 2039 |
| APPLICATION RATE | (AI/HA) | 30 BIU | 30 BIU | 126g[1] | 126g[1] | 30 BIU | 30 BIU | 30 BIU |
| | (LITERS/HA) | 1.18 | 0.89 | 1.68 | 1.68 | 0.91 | 0.5 | 1.77 |
| EMISSION RATE | (L/MIN) | 14.2 | 10.7 | 20.1 | 20.1 | 10.9 | 8.0[a] | 21.2 |
| SWATH WIDTH (M) | | 45 | 45 | 45 | 45 | 45 | 60 | 45 |
| ATOMIZER TYPE | | AU-4000 | AU-4000 | AU-4000 | AU-4000 | AU-4000 | AU-4000 | AU-4000 |
| BLADE ANGLE SETTING | | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| **WEATHER DURING SPRAY** | | | | | | | | |
| TEMPERATURE (C) | | 8.0 | 13.6 | 10.9 | 4.8 | 9.2 | 16.4 | 14.7 |
| RELATIVE HUMIDITY (%) | | 88.0 | 71.1 | 76.0 | 95.3 | 59.9 | 42.1 | 56.9 |
| WIND SPEED (Km/h) | | 7.9 | 3.6 | 1.8 | 0.1 | 0.9 | 7.0 | 0.2 |
| WIND DIRECTION (Az) | | 276.8 | 31.1 | 180.0 | 165.5 | 151.6 | 216.4 | 143.6 |
| BLOCK ORIENTATION (Az) | | 22 | 76 | 200 | 25 | 275 | 30 | 314 |
| ATMOSPHERIC STABILITY | | Inversion | Inversion | Inversion | Inversion | Inversion | Inversion | Inversion |

All sprays were applied using a Cessna 188 Agtruck flying at 160 kph and 15 to 20 m above the canopy.
a Lower limit of flowmeter turbine.
1. Delta-endotoxin.

**TABLE 3: SPRAY DEPOSIT, BUDWORM LARVAL REDUCTION AND HOST TREE DEFOLIATION FOLLOWING APPLICATIONS OF UNDILUTED B.t. FORMULATIONS IN N.W. ONTARIO, 1989.**

| Treatment | Application Rate/Ha | | No. of | Spray Deposit | | Population Reduction | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A.I. | L | Samples | Drops/cm$^2$ | Liters/Ha | Larvae / 46 cm Br.($\bar{x} \pm$ SD) | | Corrected | Defoliation |
| | | | | | | Prespray | Final Post | Mortality[a] | (%) |
| Dipel 96AF (ABG 6278) | 30* | 1.18 | 75 | 24.1 ± 15.5 | 0.462 ± 0.167 | 28.3 ± 16.9 | 3.3 ± 3.1 | 72.7 | 42.1 ± 23.3 |
| Dipel 352 | 30* | 0.89 | 75 | 1.1 ± 1.4 | 0.307 ± 0.081 | 26.5 ± 13.6 | 5.2 ± 4.9 | 60.6 | 56.9 ± 25.4 |
| Condor OF | 126** | 1.68 | 75 | 11.7 ± 10.5 | 0.692 ± 0.337 | 31.6 ± 17.5 | 6.9 ± 4.3 | 38.0 | 53.7 ± 24.2 |
| Condor AF | 126** | 1.68 | 75 | 13.5 ± 11.8 | 0.729 ± 0.204 | 24.5 ± 11.8 | 8.3 ± 4.8 | 3.5 | 42.1 ± 21.4 |
| Futura HP | 30* | 0.91 | 75 | 17.8 ± 10.3 | 0.501 ± 0.141 | 25.3 ± 13.3 | 10.8 ± 6.7 | 0.0 | 54.3 ± 19.9 |
| Futura O | 30* | 0.5 | 75 | 2.9 ± 5.9 | 0.360 ± 0.118 | 23.8 ± 10.9 | 10.6 ± 7.0 | 0.0 | 38.8 ± 17.4 |
| C.I.L. E2492 | 30* | 1.77 | 75 | 7.1 ± 3.8 | 0.299 ± 0.113 | 15.4 ± 9.7 | 6.2 ± 3.6 | 0.0 | 47.1 ± 21.7 |
| Check Block A | N/A | N/A | 75 | N/A | N/A | 36.3 ± 15.8 | 8.2 ± 4.7 | N/A | 84.6 ± 11.2 |
| Check Block B | N/A | N/A | 75 | N/A | N/A | 23.7 ± 10.5 | 11.4 ± 5.4 | N/A | 69.9 ± 20.1 |

* BIU ** Grams of Delta-endotoxin.
a Corrected for natural mortality using a modified Abbott's formula for asynchronous sampling.

# RESEARCH STUDIES ON PHYSICOCHEMICAL ASPECTS OF PESTICIDE PERFORMANCE (CONDUCTED IN 1989)

[Project No. FP-61 - Pesticides Formulations]

A Report to The 17th Annual Forest Pest Control Forum

A. Sundaram and J.W. Leung

Forestry Canada
Forest Pest Management Institute
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

November 1989

**Research Studies on Physicochemical Aspects of Pesticide Performance (Conducted in 1989)**

## Introduction

During 1989, the Pesticide Formulations Project at FPMI undertook one field study, and three laboratory studies to examine the potential of certain polymeric adjuvants to provide rainfastness of glyphosate deposits.

### 1. Influence of Two Polymeric Adjuvants On Physical Properties, Droplet Spreading and Drying Rates, and Foliar Uptake and Translocation of Glyphosate in Vision® Formulation.

The effect of Sta-Put® and Silwet® L-7670 on physical properties (viscosity, surface tension and volatility), droplet spreading and drying rates, and foliar uptake and translocation of glyphosate was studied using white birch seedlings and branch tips. Three end-mixtures were prepared using Vision®, one in water alone and the other two with 0.05% of the adjuvants in water. Physical properties were measured to examine their roles on droplet spreading and drying rates. Foliar uptake was investigated to study the effect of droplet spreading and drying rates on foliar retention; and translocation was studied to examine the role of two polymers on bioavailability of glyphosate.

The adjuvants did not contribute to marked differences in the viscosities or volatilities of the three end-use mixtures, although the surface tensions were altered to some extent. Silwet caused a marked increase in the droplet spread areas, along with a simultaneous decrease in the droplet drying time. Sta-Put did not alter any of these parameters. No simple relationship could be found between surface tensions of the mixtures and droplet spreading or drying rates. Both adjuvants contributed to an increase in the foliar uptake of glyphosate, but Silwet caused a much greater increase than Sta-Put, thus suggesting a relationship between droplet spreading and foliar uptake. Nevertheless, there was no significant difference in the amount of glyphosate translocated between the three end-use mixtures, thus indicating no evidence of reduced bioavailability because of the presence of the two polymers at the concentration levels used in the study.

### 2. Influence of Two Polymeric Adjuvants on Bioavailability of Glyphosate: relevance to rainwashing of deposits from foliar surfaces.

Rainfall after treatment is know to reduce efficacy of post-emergence herbicides. The rain-free period after treatment, required to achieve adequate weed control, varied greatly depending upon the type of formulation used. The addition of some polymeric adjuvants has proved to be useful in protecting foliar deposits against washoff and in improving rainfastness of herbicides.

End-use formulations were prepared by adding Sta-Put® and Silwet® Y-6652 adjuvants at levels of 0.05% to 1.5% v/v to diluted Vision® formulation containing $^{14}$C-glyphosate. Two types of studies were carried out, one for investigating the rate of uptake, foliar washoff, translocation and bioavailability of glyphosate; and the other for optimizing adjuvant concentration level to maximize foliar uptake and minimize washoff without causing reduction in translocation and bioavailability. Young trembling aspen seedlings were used for the first study, using end-use formulations containing 0.05% of the adjuvants. However, aspen branch tips were used in the second study for treatment of end-use formulations containing 0.05 to 1.5% of the adjuvants. In the first study, seedlings were harvested at 8, 24, and 48 h post-treatment to examine the distribution of glyphosate in different parts of the plant, whereas in the second study the branch tips were harvested at only one time period, i.e., at 48 h after treatment.

In the first study, the data indicated that foliar uptake of glyphosate is a slow process, since the amount that was washed off from foliage was > 67% at 8 h after treatment, and > 50% at 48 h. Similar to the foliar uptake, translocation process was also slow and only about 2% of the applied amount was translocated in 8 h and about 10% in 48 h. Nevertheless, there was no evidence of reduced bioavailability because of the presence of the adjuvants at the concentration level used. In the second study, the data indicated that both adjuvants contributed to reduced glyphosate washoff even at the low concentration of 0.05%. The amount that was washed off decreased progressively as the adjuvant concentration increased from 0.05 to 1.5%. However, the amount that was translocated into the untreated parts of the branch tip increased initially, passed through a maximum at the concentration range of 0.3 to 0.6%, and decreased gradually at higher concentration levels of 1.0 to 1.5%. The data thus indicated an optimum adjuvant concentration range beyond which reduced translocation and bioavailability would likely occur. Thus the study indicated the need for optimizing adjuvant concentration for every application condition, since the use of different volume rates would alter the concentration of the surfactant which is already present in the commercial formulation concentrate and therefore, the adjuvant concentration would correspondingly require optimization depending upon the volume rate of application used.

### 3. A Method to Study the Effect of A Polymeric Adjuvant on the Bioavailability of Glyphosate in Laboratory Trials.

A method was developed to investigate the effect of a polymeric adjuvant "Nalco-Trol® II" on the bioavailability of glyphosate (in Roundup® formulation), using trembling aspen, Populus tremuloides Michx., seedlings. Absorption and translocation of $^{14}C$-labeled glyphosate was determined with and without Nalco-Trol II, after application at a dosage rate of 0.35 kg of active ingredient (AI) in 25 L $ha^{-1}$ surface area of leaves. At 48 h after treatment, less than 40% of the applied amount was absorbed and translocated into the plants, and more than 60% was still washed away from the treated leaves.

Toxic effects of glyphosate (nonlabeled) were assessed for a period of 48 h after treatment using three parameters, viz., changes in plant height and weight, and chlorophyll content of untreated leaves. The glyphosate-treated plants showed little increase in height, compared to the control plants, but showed significant reduction in weight and in leaf chlorophyll.

No significant differences were noted in absorption and translocation patterns, growth parameters or leaf chlorophyll, in plants treated with Roundup alone or Roundup with Nalco-Trol II, thus indicating no evidence of reduced bioavailability via entrapment of glyphosate into the polymeric chain. Nevertheless, the present method proved useful in detecting small differences in the toxic response of plants to herbicide treatment.

**4. Effect of Ethomeen® and Silwet® Adjuvants on Rainwashing Characteristics of Glyphosate Applied to Trembling Aspen.**

Glyphosate is a water-soluble herbicide and is formulated with water-soluble surfactants to provide the commercial formulation Vision®. Studies reported in the literature indicate that because of high water-solubility, glyphosate deposits on foliage are vulnerable to washing-off by rainfall, resulting in significant reduction in herbicidal activity. Our laboratory studies conducted to date indicate that if rain occurs within 1 h after herbicide application, all the deposited herbicide (100%) was washed off from the treated plant. If rain occurs within 2 h after treatment, about 87% of the deposited amount was washed off from the treated leaf. At 8 h after application, about 76% of the deposited amount was washed off in rain. In all of these studies, the rain intensity was 10 mm/h. However, if a suitable adjuvant can be added to accelerate the rate of uptake and translocation into the active sites, then the foliar deposits would be less vulnerable to washing-off by rainfall. With this objective in mind, we studied six adjuvants and found that surfactant adjuvants, in general, do not enhance the rate of uptake fast enough to provide rain-protection for the foliar deposits. For example, to get an absorption of ca. 75% of the applied amount, a rain-free period of 72 h is needed with Vision alone, and a period of 48 to 55 h is still needed with 0.5 to 1.0% of most surfactants when added to Vision. This means that we probably have to look for a product that will protect foliar deposits from rain, rather than a surfactant adjuvant. Two products have shown promise in the laboratory studies. The first is a surfactant called Ethomeen®. This material has the property of a surfactant plus a rain protectant, since it shows a combined mode of action, involving both enhanced rate of uptake and actual protection of the foliar deposit against rain. The second is a surface active polymer, Silwet®. The mode of action, in our laboratory studies, appears to be more in protecting the foliar deposits rather than in enhancing the rate of uptake, although both types of action is still being demonstrated.

During 1989-90, detailed investigations were undertaken to examine the influence of the two adjuvants on rain-washing characteristics of glyphosate applied to trembling aspen. The investigations consisted of six studies:

a. Compatibility study.

b. Optimizing adjuvant concentration.

c. Droplet spreading and drying rates.

d. Rate of uptake by foliage.

e. Laboratory study on rain-washing of glyphosate using radiolabeled material and under simulated rainfall.

f. Field study on rain-washing of glyphosate using single tree application and under simulated rainfall.

The experimental portion of the six studies have been completed,and analysis of all of the samples are being carried out at present. The results will be ready only during the summer months of 1990.

This comprehensive research study comprises the investigations required for the thesis of the M.Sc. program of Mr. John Leung, to be submitted in 1990, to the University of Manitoba in Winnipeg.

# Research on the Toxicity of Insecticides to Forest Insect Pests and Non-Target Insects in 1989

A Report to the 17th Annual Forest Pest Control Forum
(Ottawa, Ontario 14-16 November, 1989)

B.V. Helson
J.W. McFarlane
D.R. Comba

Project No. FP-50 - Insecticide Toxicology

Forest Pest Management Institute
Forestry Canada
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

Research on the Toxicity of Insecticides to Forest Insect Pests and Non-Target Insects in 1989

B.V. Helson, J.W. McFarlane and D.R. Comba

## Introduction

This report will highlight the major studies on the development of insecticides for forest insect control conducted by the Insecticide Toxicology project in 1988-89. Field trials with permethrin for the control of *Zeiraphera canadensis* are presented in a separate report.

## Alpha-terthienyl

Laboratory evaluation of the toxicity of this naturally-occurring phototoxic plant compound was continued in 1989. As reported last year, some species of forest Lepidoptera pests are highly sensitive to this compound. It is much more toxic to white marked tussock moth than fenitrothion or carbaryl and less toxic than permethrin. Alpha-terthienyl is also toxic to spruce budworm and eastern hemlock looper larvae after a 6h exposure to near UV light. By topical application, it is comparable to fenitrothion on these two species and less toxic than permethrin. Experiments are in progress to determine the role of UV light in the expression of the toxicity of alpha-terthienyl to spruce budworm larvae. To date, we have found that this compound is about 30x less toxic without a UV light exposure. It is also less toxic after only a one hour exposure but toxicity does not increase much when the exposure is increased from 6 to 16h.

## Permethrin

By topical application, permethrin was found to be very toxic to eastern hemlock looper larvae. Further tests in the Potter's tower demonstrated that its contact toxicity to third instar larvae was about 75x that of fenitrothion. The toxicity of permethrin on treated balsam fir foliage was also higher than fenitrothion. On this basis, a minor use proposal has been submitted for the registration of both the Pounce® and Ambush® formulations of permethrin by ground application for the control of eastern hemlock looper larvae at 17.5-35g AI/ha. A similar proposal has been submitted for the control of gypsy moth larvae based on previous laboratory tests which demonstrated that permethrin is extremely toxic to this pest. A proposal has also been submitted for the registration of permethrin by ground application at 70g AI/ha for the control of spruce budmoth larvae based on the field trials reported at the Pest Control Forum last year.

## Zectran metabolites

This cooperative study with K.M.S. Sundaram (FP-71 - Chemical Accountability) to evaluate the involvement of metabolites in the residual toxicity of Zectran was completed in 1989. Two additional major metabolites of Zectran that are present after treatment on white spruce foliage, aminomexacarbate and formamidomexacarbate were tested for their toxicity to spruce budworm larvae by topical application and exposure to treated conifer needles. Aminomexacarbate was as toxic as Zectran by both exposure routes. Formamidomexacarbate was 25x less toxic than Zectran by topical application but only 4x less toxic on treated conifer needles. Another metabolite, dimethylamino xylenol which does not have a carbamate group was not toxic at 3.2 g/larva.

## Hylobius congener

In July 1988, red pine seedlings from Nova Scotia were dipped in or sprayed with aqueous mixtures of 0.5% and 1.0% permethrin, 2.5% chlorpyrifos and 2.5% fenitrothion. No phytotoxicity was observed. On June 13 and June 29, 1989 bioassays with debarking weevils on these trees almost one year after treatment demonstrated that dips and sprays of 1.0% permethrin and 2.5% chlorpyrifos provided high mortality of weevils and very little damage to the seedlings. In June 1989, another set of white spruce seedlings were sprayed with aqueous mixtures of 0.5 and 1.0% permethrin, 2.5% fenitrothion and 2.5% chlorpyrifos for future bioassays with debarking weevil adults. No phytotoxicity was observed.

## White Pine Weevil

Research was continued with white pine weevil adults to assess the potential of permethrin for the control of this pest.

An experiment was conducted to determine the residual toxicity of permethrin to white pine weevil adults. Potted, white pine trees were sprayed with aqueous mixtures of 0.16%, 0.4%, 1.0% or 2.5% permethrin (Ambush 500 EC). Each tree was sprayed with about 15 ml of mixture with a plant misting bottle to thoroughly wet the foliage. The trees were placed outdoors and exposed to natural weathering conditions. Each week for four weeks, five trees treated with each concentration and five control trees were selected at random for bioassays. Twenty, caged adults were exposed to each tree in the laboratory for one week. Mortality and feeding damage were assessed then. Preliminary observations indicate that very little if any feeding damage occurred at any concentration over the 4-week period even though mortality declined to 32% and 70% at the 0.16% and 0.4% concentrations respectively after four weeks.

## Permethrin Buffer Study

In 1989, a study was conducted in a red pine plantation on FPMI land near Thessalon, Ont. to determine the buffer width required to protect aquatic invertebrates from significant impact due to off-target drift of permethrin in cooperation with N.J. Payne, Spray Atomization & Dispersal and K.M.S. Sundaram, Chemical Accountability. Aluminum pans containing 9L of lake water were placed at 30, 60, 120, 180 and 240m from the edge of the spray block along 5 lines, 25m apart on the NE and SE sides of the 16 ha block. Nine pans were also placed inside the block. A set of control pans and pans for treatment with standard permethrin concentrations were placed 2km away. On 24 June beginning at 2035 h., the block was sprayed with an aqueous mixture of permethrin (Pounce® EC) at 70g AI in 4 l/ha using the Institute's Cessna Ag-truck aircraft equipped with four Micronaire AU 3000 atomizers. The aircraft flew at 185 km/h, 18m above ground, perpendicular to the wind direction at 25m intervals. Beginning 30 minutes after completion of the spray, water samples were collected from each pan in Mason jars for bioassays with mosquito larvae as an indicator aquatic insect and in Teflon bottles for permethrin residue analysis. Pans were treated with standard concentrations and samples collected concurrently.

Meteorological conditions during the aerial spray were: wind direction 292° (WNW), wind speed 1.7 m/s at 10m, temperature 20°C, RH 52% and a stable boundary layer. The toxicity of permethrin in the standard pans was similar to previous tests with a final LC50 of 1.35 ppb and a probit mortality-log concentration equation: $y = 4.248 + 5.84x$. Payne et al 1986 (FPMI Inform. Rep. FPM-X-70) developed a model for estimating the width of the buffer from water required for permethrin aerial applications. For this particular 16 ha aerial spray, the model predicted that the buffer required was 58m to limit mosquito mortality to 10% in a water depth of 0.5m. Although data analysis and interpretation are still in progress, the results indicate that, based on observed mosquito mortalities, the concentrations of permethrin in all the pans 60m from the spray block were below that predicted by the model and that this concentration was not exceeded in any pan further than 60m from the block. In other words, mortality of mosquito larvae in water 0.5m in depth would not have exceeded 10% and usually would have been much less at all distances and sites 60m and beyond in the current study.

# CONTROL OF SPRUCE BUDMOTH IN WHITE SPRUCE PLANTATIONS WITH ENTOMOPATHOGENIC NEMATODES

D.C. Eidt
Forestry Canada - Maritimes
Fredericton, N.B.

A preliminary experiment in 1988 with soil treatments against spruce budmoth larvae and pupae indicated that the use of entomopathogenic (=entomophilic) nematodes held promise. The treatments consisted of split tree plots which, because of nematode mobility, obscured treatment effects. The results lacked statistical validity. They were nonetheless encouraging, and a properly designed field test and possibly a foliar spray were anticipated. Thus two experiments were conducted in the J.D. Irving Ltd. white spruce plantations in northern New Brunswick in 1989.

This is basically a bacteriological technique, because it is the bacteria associated with the nematodes that kill. The nematode is the means, with some searching ability, to get the bacteria to the target insect.

Experiment I: Soil treatment.

The area under each tree crown was treated by applying nematodes suspended in water using a plastic watering can. Four replicate trees were used where possible. The mean tree crown diameter was 1.17m and the area under the crown averaged 3.68 sq m.

Steinernema feltiae (courtesy of Biocontrol Products, Willow Hill, Pa) were applied at rates of 30 and 60 million living nematodes in 4L of water per tree. Mortality had been high, 72 to 82%, in the nematodes, because of an accident in storage (the air supply had been interrupted for an undetermined time) and there was no easy way to determine the infectivity of the survivors.

Steinernema bibionis were applied at only 34,375 to each of four trees and 68,750 to one, because fewer of this species were available. Heterorhabditis heliothidis, used last year, was not available.

Treatments were applied under four trees 6 June, when most larvae were in the late 3rd instar (there are four). Air temperature was 13C and soil temperature was 10C at 5 cm depth. The following days saw a warming trend. Temperature is important because the nematodes become less active at lower temperatures and infectivity is said to become negligible at somewhere between 10 and 15C depending on the strain of nematode.

Traps were placed under the trees and four untreated trees to intercept emerging moths. The feeding sites above each trap were counted so that emergence data could be adjusted later to compensate for wide variations in susceptibility of trees to budmoth attack.

Results were as shown in Tables 1 and 2

The results are consistent with those obtained in 1988. Reductions in 1988 using S. feltiae at 20 and 40 million/sq m were 83 and 71%. The reduction in 1989 using 8 million/sq m was 76% based on the actual emergence, or 86% based on emergence adjusted for differences in infestation among trees.

The data show that spruce budmoth numbers can be substantially reduced using the nematode soil treatment. For commercial use of the method, problems to overcome are nematode supply and cost, storage and handling, transportation, accessibility of trees, and labour cost.

Experiment II. Foliar spray.

Three preliminary trials were conducted to determine:

1. if *S. feltiae* in aqueous suspension could seek out budmoth larvae in buds on potted trees in growth cabinets at high humidity. They could not, because the water did not wet the needles, and evaporated quickly.

2. if nematodes could stand the shearing force of being sprayed from a Solo backpack mistblower, and the impact on foliage. They could.

3. if various materials known to be antidesiccants or UV screens were toxic to or inhibited movement of nematodes. No suitable materials were found.

In the field, almost as a last resort, a *B.t.* formulation was used in mixture with a nematode suspension on the assumption that it would contain appropriate, biologically benign adjuvents. Futura XLVC was selected only because enough was on hand for the experiment.

The formulation consisted of:

3.8L *S. feltiae* suspension containing 20,600/mL
1.0L Futura XLVC containing da-glo orange
3.2L water
----
8.0L containing 9785 viable nematodes/L

Less than 7L of this formulation was applied to four trees to runoff at about 1430h, 6 June 1989, when the temperature was >16C, winds were light, humidity was high, the sky was overcast and rain threatened. Four trees were left as controls. There was insufficient Futura to treat with it alone. Trees were the same size as those used in the soil treatment. The deposit stood in small droplets, the dye gave the trees a reddish cast, and there was no obvious evaporation one hour after treatment. No larvae were found in drop trays that had been placed under the trees during the spray.

Three days after treatment, all branch tips with feeding sites were collected and examined. Sick and dead larvae were placed in vials with moist filter paper to allow bacterial and nematode development. Shoot analysis gave the results in Table 3.

Only in the treatment were dead and dying larvae found. There also seemed to be an effect on larval drop, which was less in the treatment whether empty feeding sites was calculated as a percentage of the total larvae or of just the healthy larvae.

Of the 64 dead and dying larvae retained on moist filter paper, only two produced a brood of nematodes. Of the others, 20 were smeared and examined microscopically by Dr. Eldon Eveleigh, FC-M. One contained an adult nematode. All contained masses of bacilli. Eight of 12 other larvae smeared by Dr. Gary Dunphy, Macdonald College, contained primary stage *Xenorhabdus nematophilus*, the bacterium associated with *S. feltiae*. He also confirmed *X. nematophilus* in the 20 slides smeared earlier. The other four larvae either contained secondary stage *X. nematophilus*, *B. thuringiensis*, or both, which were indistinguishable without a biochemical test. Thus 67% infection was an underestimate.

Regardless of whether X. nematophilus or B. thuringiensis killed the larvae, mortality was effectively 40% among larvae remaining on the tree.

The ultimate measure of mortality would be the number of budmoths that reached adulthood in the treatment as a percentage of those that did so in the control. This accounts for infected larvae that dropped, and larvae that became infected by nematodes that fell to the ground. In the treatment, only one moth emerged under each of the treated trees. This represented a reduction of 88% from the treated trees, where an average of 8.5 (range 5 to 11) moths emerged. The difference was statistically highly significant. When these data were adjusted to account for differences in the larval populations on the trees, there was a 93% population reduction. (Table 4)

This experiment indicates that nematode sprays can be highly effective. It is just a matter of time before a formulation is developed (perhaps in combination with B.t.) that will be effective under a range of moisture and temperature conditions that will make X.n. (for Xenorhabdus nematophilus, by analogy with B.t.) an economically effective biological insecticide. Ultimately it should be superior to B.t. because X.n. is carried by a prey-seeking missile, the nematode.

Table 1. Budmoth emergence, soil treatments.

| Replicate | Control | S. feltiae | | S. bibionis | |
|---|---|---|---|---|---|
| | | $30 \times 60^{6}$ | $60 \times 10^{6}$ | 34,350 | 68,750 |
| 1 | 5 | 4 | 4 | 9 | 6 |
| 2 | 11 | 0 | 1 | 5 | |
| 3 | 7 | 6 | 0 | 12 | |
| 4 | 11 | 6 | 3 | 5 | |
| Mean (SD) | 8.5 (3.0) | $4.0^{NS}$(2.8) | $2.0^{*}$(1.8) | $7.8^{NS}$(3.4) | |
| %reduction | | 53 | 76 | 8 | |

*Significant at 0.05% confidence level.

Table 2. Budmoth emergence, soil treatments. Emergence data corrected for differences in infestation among trees.*

| Replicate | Control | S. feltiae | | S. bibionis | |
|---|---|---|---|---|---|
| | | $30 \times 60^{6}$ | $60 \times 10^{6}$ | 34,350 | 68,750 |
| 1 | 8.47 | 5.96 | 2.32 | 7.63 | 2.62 |
| 2 | 7.32 | 0 | 0.73 | 5.03 | |
| 3 | 7.97 | 6.83 | 0 | 10.46 | |
| 4 | 12.82 | 9.81 | 2.25 | 3.03 | |
| Mean (SD) | 9.2 (2.5) | $5.7^{ns}$ (4.1) | $1.3^{**}$(1.2) | $6.5^{ns}$(3.2) | 72 |
| %reduction | | 38 | 86 | 29 | |

*Adjusted emergence = $\frac{\text{no. of feeding sites}}{\text{mean no. of feeding sites}}$ x emergence.

**Significant at 0.01% confidence level.

Table 3. Budmoth larval assessment 3 days postspray

| | Rep. | Empty feeding site | Occupied site living | Occupied site sick | Occupied site dead | Total |
|---|---|---|---|---|---|---|
| Treatment | 1 | 9 | 46 | 5 | 8 | 68 |
| | 2 | 5 | 19 | 8 | 9 | 41 |
| | 3 | 2 | 26 | 8 | 25 | 61 |
| | 4 | 10 | 19 | 3 | 6 | 38 |
| | Mean | 6.5 | 27.5 | 6.0 | 12.0 | 52.0 |
| Control | 1 | 45 | 74 | 0 | 0 | 129 |
| | 2 | 15 | 65 | 0 | 0 | 80 |
| | 3 | 34 | 71 | 0 | 0 | 105 |
| | 4 | 10 | 61 | 0 | 0 | 71 |
| | Mean | 26 | 65.3 | 0 | 0 | 96.3 |

Table 4. Budmoth emergence, sprayed trees

| Replicate | Treatment Emergence | Treatment Feeding sites | Treatment Adjusted Emergence | Control Emergence | Control Feeding sites | Control Adjusted Emergence |
|---|---|---|---|---|---|---|
| 1 | 1 | 64 | 0.86 | 5 | 140 | 9.41 |
| 2 | 1 | 67 | 0.90 | 11 | 55 | 8.13 |
| 3 | 1 | 46 | 0.62 | 7 | 94 | 8.85 |
| 4 | 1 | 38 | 0.51 | 11 | 91 | 13.46 |
| Mean | 1** | | 0.72*** | 8.5 | | 9.96 |
| % reduction | 88 | | 93 | | | |

$$\text{*Adjusted emergence} = \frac{\text{no. of feeding sites}}{\text{mean no. feeding sites}} \times \text{emergence}$$

**Significant at 0.01% confidence level
***Significant at 0.001% confidence level

# STUDIES ON THE ENVIRONMENTAL CHEMISTRY OF FORESTRY INSECTICIDES

[Project No. FP-71 - Insecticide Chemical Accountability]

Report to the 17th Annual Forest Pest Control Forum

K.M.S. Sundaram, R. Nott and J. Broks

Forest Pest Management Institute
Forestry Canada
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

November 1989

## Studies on the Environmental Chemistry of Forestry Insecticides

### Introduction

The Insecticide Chemical Accountability Project has two primary objectives: (1) to study the distribution, persistence, toxicity and fate of forestry insecticides in different components of the forest environment and (2) to develop adequate analytical capabilities to identify and quantify trace levels of the residue moieties present in various forestry matrices. In addition, cooperative interactions with the scientists here and elsewhere, form a viable approach to solve some of the challenging problems facing chemical control methods in forestry and thereby yielding rewarding results. This report summarizes some of the achievements made in the research activities conducted during 1988/89.

### (I) Field Research

#### Penetration, mobility, persistence and metabolic fate of implanted acephate in black spruce trees

A most pressing problem in forestry is the protection of seed producing, high-value stands of black spruce from insect damage. Cooperative research initiated in 1988 is being continued with scientists of NeFC to evaluate the effectiveness of the implanted systemic insecticide, acephate (Acecap ) in the bole of black spruce to control bark beetles, Polygraphus rufipennis (Kirby), which seriously damage the seed producing trees.

Using the method developed previously for this study, bark samples collected from the field during 1989 are currently being extracted and analysed for the residue levels of acephate and its toxic metabolite, methamidophos. Preliminary data show that acephate has excellent penetration and xylem mobility with appreciable degradation to methamidophos. The project will be terminated in 1991 and the methodology and biological evaluation parts will be published separately in the later part of that year.

#### Persistence and drift of permethrin following an aerial application

A cooperative research study was undertaken with FP-62 and FP-50 to study the drift potential and persistence of permethrin following an aerial spray at an application rate of 70 g A.I./ha.

The substrates which were sampled at intervals of time to monitor the persistence of permethrin in the forestry environment are soil, litter, Jack pine, White pine, Aspen and spruce. Individual samples were combined to yield replicate lots for analysis. Sampling of the substrates is still in progress with analysis being performed on a continuous basis.

Deposit samplers (glass plates and aluminum collectors) and water samples were analysed for FP-62 and FP-50 respectively. The analysis has been completed and the results were submitted to the Projects concerned for evaluation.

## (II) Laboratory Research

### Insecticide wash-off from sprayed conifers by simulated rainfall

A major study to determine the foliar retention, persistence and wash-off potential of fenitrothion from foliage and its mobility to soil and groundwater was implemented with the cooperation of FP-61 during the fall of 1988. The fate and stability of the chemical in balsam fir foliage, soil and water is being investigated as it is influenced by: 1) dosage of chemical applied to the tree, 2) formulation type (influence of additives), 3) rain intensity, 4) amount of rainfall and 5) the time period between insecticide application and rainfall. The Institute's spray chamber was used to simulate aerial application of the formulations and then modified to accommodate the simulated rainfall. Four fenitrothion formulations, used in operational sprays, and containing different types of adjuvants, were sprayed on the trees at two dosage levels, viz; 140 and 280 g A.I./ha. The above conditions were varied one at a time, keeping all others constant, to determine their influence on wash-off of the insecticide and accompanying movement to soil and water.

All sprays have been completed and a thorough examination of the data generated is now in progress. Preliminary results indicate that all of the conditions studied, except for the intensity of the rainfall, affect the amount of insecticide dislodged from the foliage. The vertical and horizontal mobility of the insecticide in soil was also determined. This on-going study will in due course be expanded to accommodate other insecticides and other parameters in order to examine critically the wash-off potentials of sprayed materials in forestry.

### Degradation and metabolic fate of diflubenzuron (Dimilin®) in clay and sandy loam forest soils under laboratory conditions

The metabolic fate and rate of degradation of diflubenzuron (DFB) [1-(4-chlorophenyl)-3-(2,6-diflurobenzoyl) urea] is currently being studied in two types of forest soils under controlled laboratory conditions. The soils being investigated are a clay loam and a sandy loam under both natural and sterile conditions. The soils have been fortified in bulk using C-14 radiolabeled DFB, segmented into individual 5 g quantities, placed in an environmental chamber and then sampled in triplicate for each soil type over intervals of time. The 5 g soil aliquots are being extracted by exhaustive homogenization with first acetonitrile and then methanol. The resultant extract is filtered through sodium sulfate, flash evaporated to dryness and reconstituted in 5 mL of acetonitrile for subsequent analysis. The samples are analysed for DFB plus five suspected metabolites by thin-layer chromatography (TLC), liquid scintillation counting (LSC) and high-performance liquid chromatography (HPLC). Un-extractable bound residues are determined by oxidation of the soils and analysis by LSC for total $CO_2$-14 recovery.

Simultaneously, 100 g aliquots of the fortified soils are being monitored for total $CO_2$-14 evolution (from the degradation of DFB in the soils) using a simple flow-through apparatus developed previously. This system involves trapping the CO2-14 gases produced in a medium of Carbosorb and reading the results by LSC. The experimental portion of the study has been completed and analysis and interpretation of the results is currently in progress.

Preliminary methods for the extraction of bound residues from environmental substrates

Recently, new breakthroughs in the extraction and analysis of bound residues has been reported through the use of two different techniques; (1) Super Critical Fluid Extraction (SCFE) and (2) High Temperature Distillation (HTD) methods. Equipment has been purchased and/or modified in order to implement these techniques in our laboratory research. The technique of SCFE involves raising the temperature and pressure of a certain liquid above a specific threshold or "critical value" so that it inherits gas-like properties. The substrate of interest is extracted under these critical conditions which helps to dislodge any bound residues from the sample matrix. The other technique currently under investigation, HTD, consists of extracting the sample under very high temperature conditions (600°C to 800°C) in a stream of inert gas (helium or nitrogen). The effluent is trapped in organic solvents and analysed for the parent material or breakdown products. After cooling, the sample matrix can be extracted to remove any further residues.

Currently, the systems have been set-up and preliminary tests are being conducted. The extraction of bound residues from the diflubenzuron study will be implemented using these techniques and the results will be compared to those obtained by oxidation of the soils. Further investigations using other substrates and insecticides are planned.

Progress Report on Residual Efficacy of Dipel® Formulations Sprayed Aerially Against Spruce Budworm at Bathurst, N.B., During 1988 and 1989

By

P.C. Nigam and S.E. Holmes
Forestry Canada - Maritimes Region
Fredericton, New Brunswick E3B 5P7

## INTRODUCTION

This study was started in 1988 with Dipel® 12L, a concentrated oil formulation of B.t. containing 25.4 BIU/litre. A further concentrated formulation, Dipel® 16L containing 33.8 BIU/litre, was tested in 1989 and effectiveness was compared with Dipel® 12L. Both formulations were developed by Abbott Laboratories. Results of the 1988 study were reported during Sixteenth Annual Forest Pest Control Forum.

Experiments were conducted in cooperation with Mr. E.G. Kettela, Forestry Canada - Maritimes, Forest Protection Limited, Research and Productivity Council and Abbott Laboratories under the auspices of the New Brunswick Spray Efficacy Research Group (NB SERG).

The objectives of this year's study were to determine the (i) residual efficacy of Dipel® 16L, aerially atomized by Micronair AU4000, @ 15 and 30 BIU/ha and to compare the results with Dipel® 12L sprayed similarly in 1988, (ii) effect of post-spray weather parameters on deterioration of residual toxicity of Dipel® 16L and to compare with 1988 weather effects on Dipel® 12L. A brief summary of methods and materials, and results are presented for this report.

## METHODS AND MATERIAL

The experiments were conducted at Bathurst, N.B. Three plots of approximately 200 hectares were selected for two treatment and a control in 1988 and two treatment and two control plots in 1989 of similar size were selected. The treatment plots were sprayed with 15 and 30 BIU/ha of Dipel® 12L and Dipel® 16L using two Cessna 188's equipped with four Micronair AU4000's on each aircraft. The Micronairs were rotated at maximum speed. Dipel® 12L was sprayed @ 0.55 litre/ha and 1.1 litre/ha for 15 and 30 BIU respectively in 1988. Dipel® 16L was sprayed at 0.4 litre/ha and twice at 0.4 litre/ha for 15 and 30 BIU respectively.

The Dipel® formulations were dyed with 1% Day Glo Orange dye by weight for deposit assessment. The deposit assessment was performed on various components of larval microhabitat and artificial surfaces. Only deposit assessments on needles are given for this report. Deposits on new (current) and old needles were measured using three different magnifications (30X, 60X and 100X) during the last two years.

Weather parameters were recorded on a micrologger. Information on canopy level weather was collected using sensors on a 10 meter meteorological tower. Thermocouple (temperature) and leaf wetness sensors were located on host tree branches for collection of data near larval microhabitats.

Foliage samples were collected for (i) bioassay of residues (ii) deposits on needles (iii) droplets on webbings and (iv) budworm behaviour and droplet-interaction.

Pre-spray samples were collected at least 48 hours before spraying and post-spray samples were collected on spray day (0 day), 1 day, 3 day and 5 day after spraying. Residue bioassay samples were kept in paper bags. Twenty-five to fifty current year buds were collected from one branch; if sufficient shoots were not available then a second branch was used. All samples were kept cool and in high humidity in styrofoam coolers in the field and then stored in walk-in-growth-chambers at 0 - 2°C. Bioassay of foliage for residual efficacy of 15 and 30 BIU/ha of Dipel® sprays was carried out using laboratory reared IV instar larval in 10 cm clear plastic dishes. Approximately 10 buds were supplied per dish and 10 larvae per dish were used. In 1988 a total of 120 larvae were used for each observation period, while in 1989 the number of larvae was doubled to 240 for each observation. The mortality counts were taken after 1, 3, 6 and 9 days of releasing the larvae on foliage, at pupation, and at adult emergence. Results of nine day larval mortality counts are presented in this report.

## RESULT AND DISCUSSION

Bioassay results are summarized in Table 1 for 1988 and 1989, along with mean needle deposit data measured at three different magnifications. It is clear from this table that Dipel® 16L in 1989 has given higher residual toxicity as compared to Dipel® 12L in 1988. There is no difference from the practical point of view between the 15 and 30 BIU applications of both formulations. The difference between the 1989 and 1988 results seem to be due to higher mean deposit/needle, and due to the higher concentration of B.t. in Dipel® 16L which is reflected in higher and longer lasting mortality. The effect of high deposit seems to play the dominant role in 1989 mortality;

sufficient residual toxicity has lasted up to 5 days after spraying. Lower volume (0.4 litre/ha) improved the deposit because a higher number of smaller droplets were produced by the Micronairs which emitted the low volume at high rotation speed. This was also noticed in 1988 when 0.55 litre/ha and 1.1 litre/ha were applied; there was better deposit at the lower application rate (Table 1).

Weather elements are given in Fig. 1 to 4 for 1989 and 1988. In 1989 rain started approximately 24 hours after spraying and a total of 9.9 mm fell within the next 12 hours i.e., by 1800 hours on June 16, 1989. The 1 day samples were collected while it was raining. Approximately 10.4 mm rain fell before the 3 day samples were taken for bioassay. It appears rain had no drastic effect on the residual efficacy of Dipel® 16L formulation.

In 1988, there was no rain until the 3 day sampling when it rained from 8 AM to 1800 hours; and 3 day samples were collected from 1440 to 1720 hours, (Table 2). Approximately 6.0 mm rain fell before the 3 day sample collection was completed. The residual toxicity of Dipel® 12L was low on the spray day and 1 day samples, and seems to be more a function of lower deposit than of the effects of weather elements.

Temperature, relative humidity and radiation are also given in Fig 1-4. They do not seem to affect the residual toxicity too much. Initial deposit affects residual toxicity significantly; with higher deposits the residual effect lasts longer. Weather may modify toxicity but has not played a dominant role under these experimental conditions. Dipel® 16L has improved residual efficacy of B.t., and further development and registration of this formulation is recommended.

Table 1. PRELIMINARY SUMMARY OF RESIDUAL TOXICITY OF DIPEL® FORMULATIONS ON BALSAM FIR AFTER AERIAL APPLICATION AT BATHURST DURING 1989 & 1988 CORRECTED % MORTALITY AFTER 9 DAYS OF RELEASING IV INSTAR LARVAE@

| FOLIAGE SAMPLES COLLECTED AT FOLLOWING WEATHERING PERIODS AFTER SPRAYING | DIPEL®16L (1989) | | DIPEL®12L (1988) | |
|---|---|---|---|---|
| | 15 BIU @ 0.4L/ha. | 30 BIU @ 2x0.4L/ha. | 15 BIU @ 0.55L/ha. | 30 BIU @ 1.1L/ha. |
| Spray Day | 80.4 | 85.4 | 36.2 | 42.2 |
| 1 Day | 81.6 | 88.0 | 38.8 | 40.0 |
| 3 Day | 46.8 | 62.7 | 16.9 | 8.7 |
| 5 Day | 38.2 | 36.8 | | |
| MEAN DEPOSIT/NEEDLE | | | | |
| CURRENT NEEDLE | 7.62 (100X) | 8.88 (100X) | 0.82 (31X) | 0.33 (31X) |
| OLD NEEDLES | 9.01 (100X) | 6.48 (100X) | 0.49 (31X) | 0.57 (31X) |
| OLD & NEW NEEDLE | 3.01*(60X) | 3.60*(60X) | 1.06*(60X) | 0.6* (60X) |

AIRCRAFT AND AUTOMIZATION — Two Cessna 188's equipped with 4 micronair per aircraft rotating at maximum speed.

*RPC deposit evaluation for Ed Kettela
Compound Microscope (100X)
Stereo-Microscope (31X or 60X)

@No. of larvae used for each observation were 120 in 1988 and 240 in 1989.

Figure 1 HOURLY WEATHER ELEMENTS
PLOTS 53 A, B AND CONTROL(C)
JUNE 14 – JUNE 21, 1989

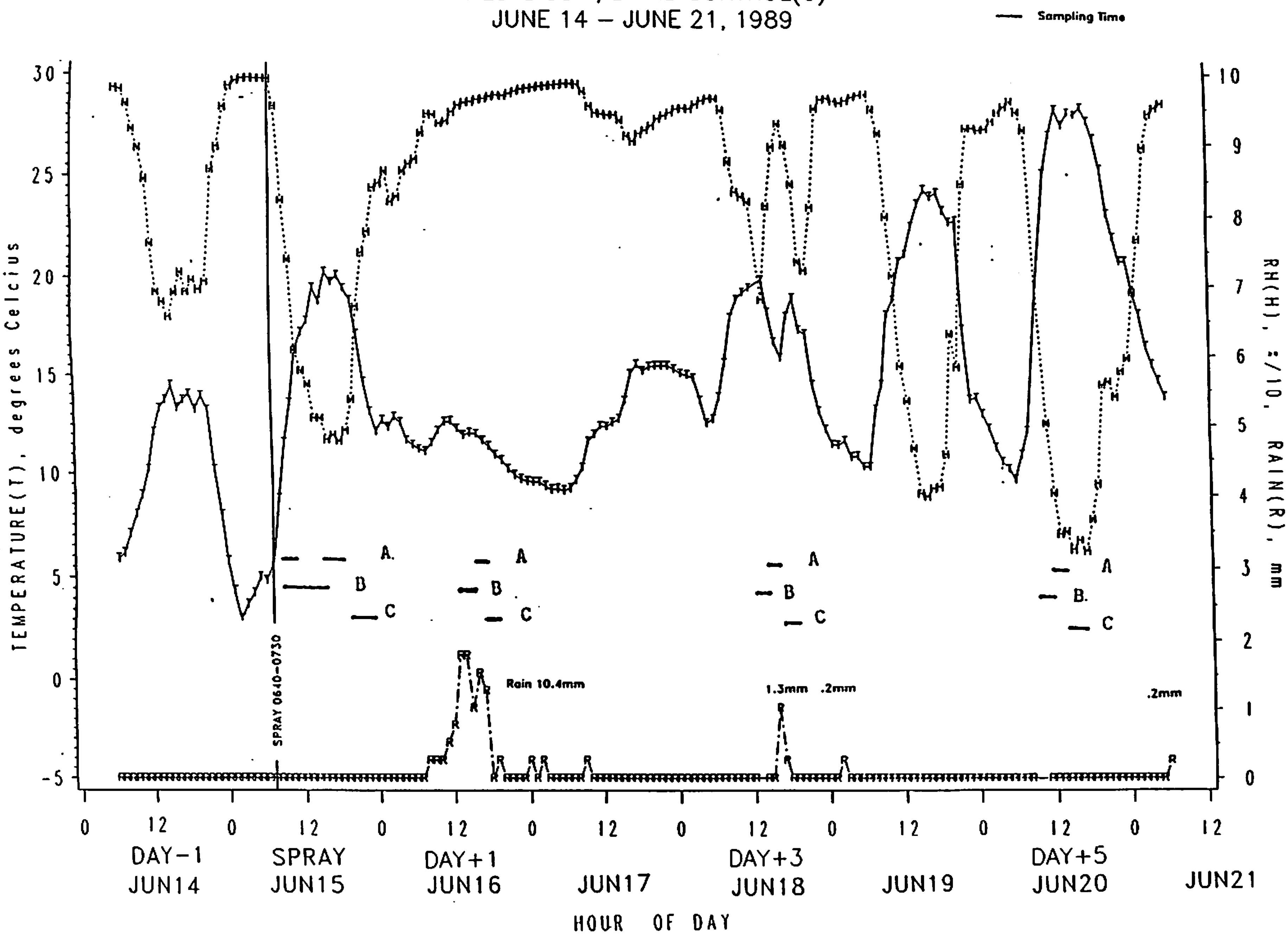


Figure 2 HOURLY WEATHER ELEMENTS
PLOTS 53 A, B AND CONTROL(C)
JUNE 14 – JUNE 21, 1989

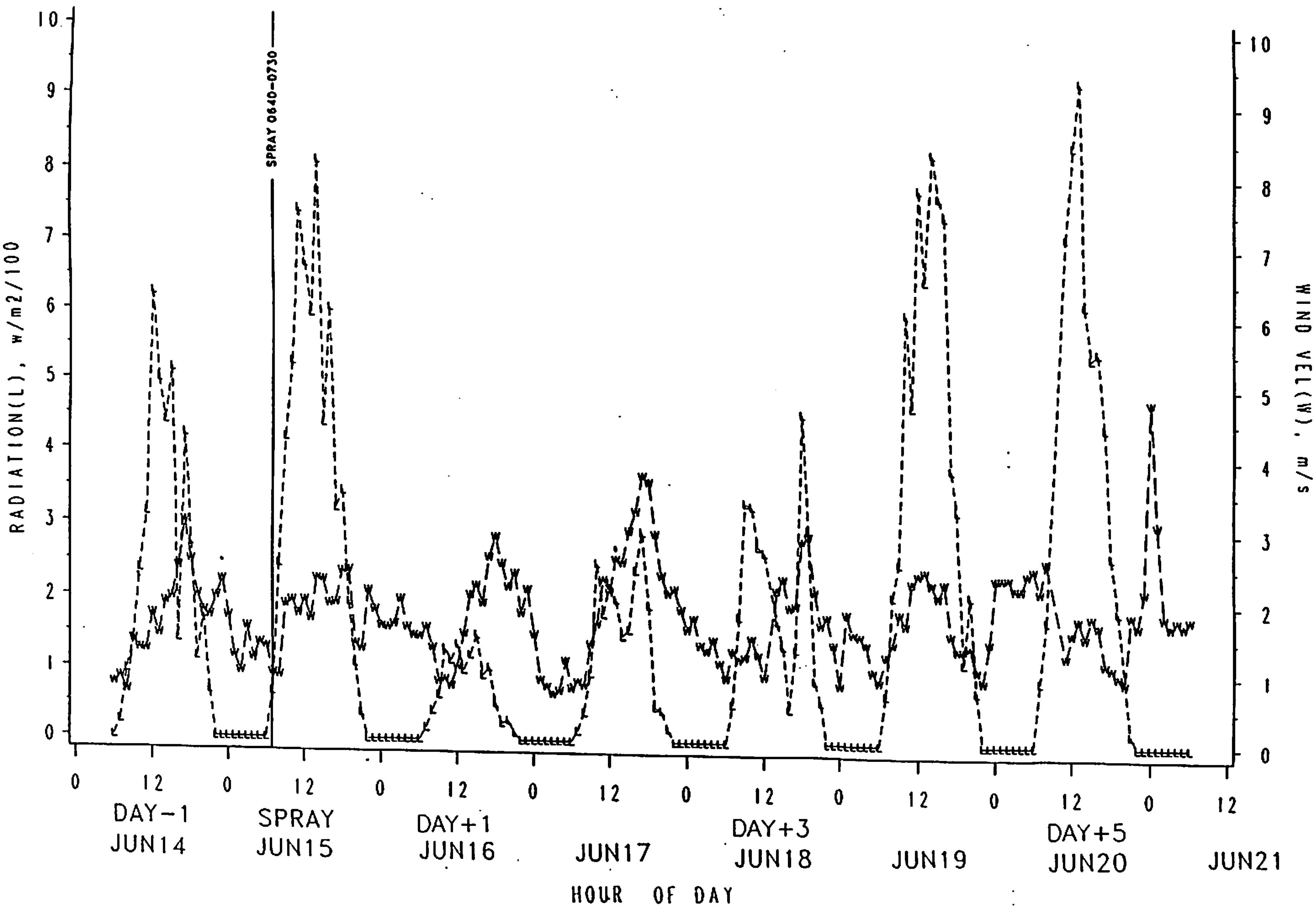


Figure 3 HOURLY WEATHER ELEMENTS
FOR PLOTS D1, D2 AND CONTROL(DC)
JUNE 8 – JUNE 15, 1988

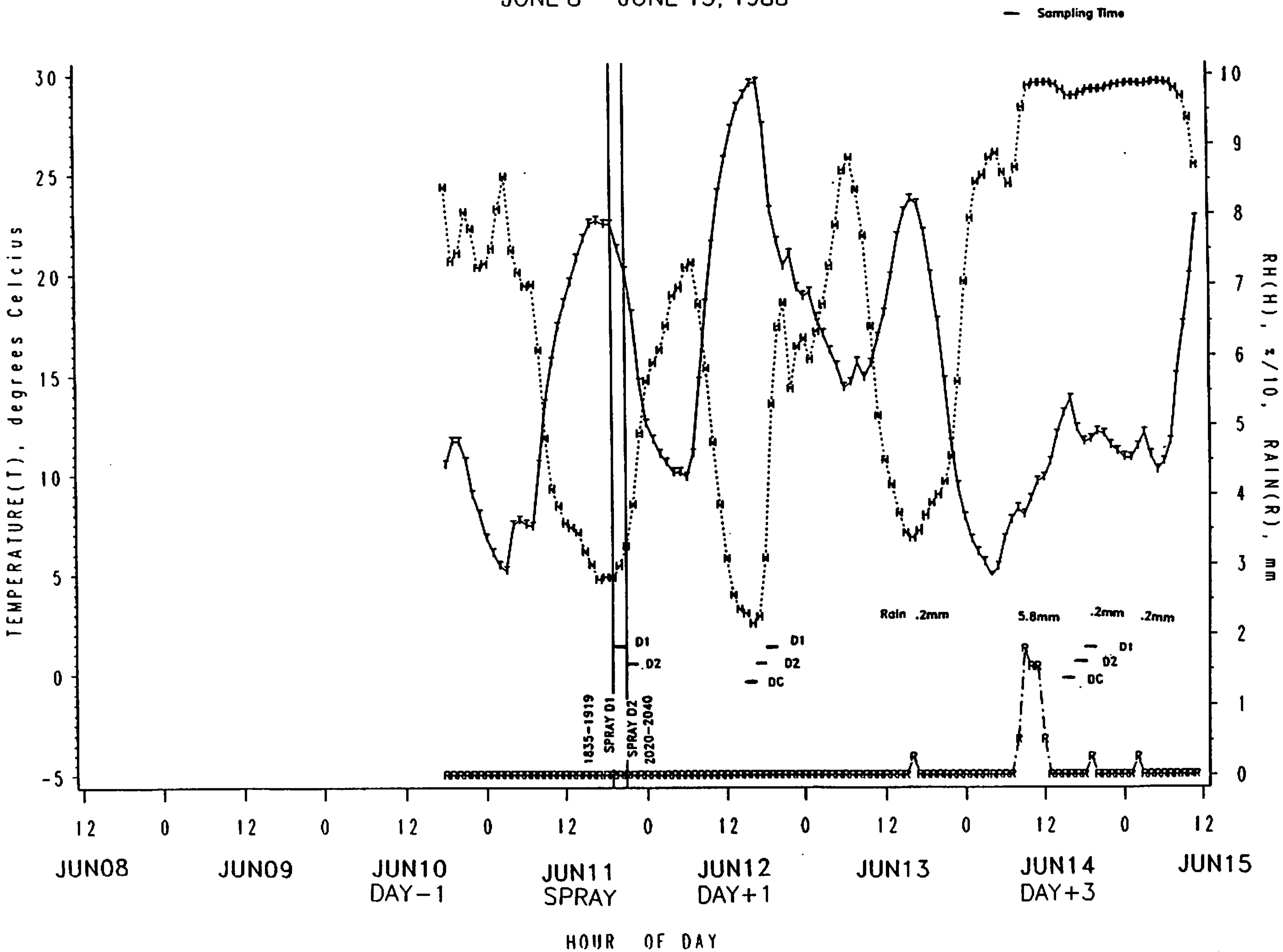
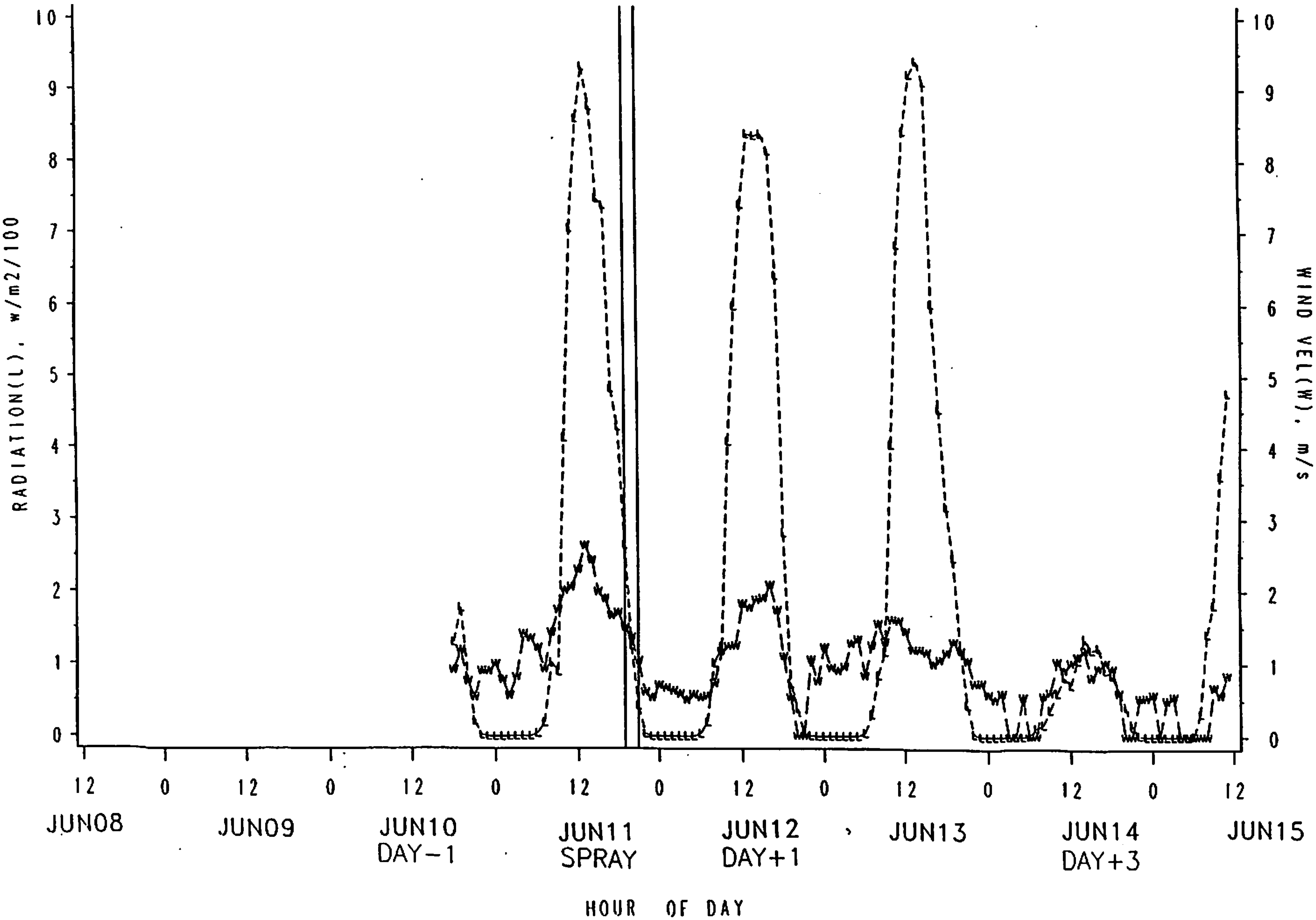


Figure 4 HOURLY WEATHER ELEMENTS
FOR PLOTS D1, D2 AND CONTROL(DC)
JUNE 8 – JUNE 15, 1988




446

Table 2. Field sample collection times on Dipel® plots in 1988 and 1989 at Bathurst, N.B.

1988

| Sample | D1 | | D2 | | DC | |
|---|---|---|---|---|---|---|
| | Date | Time | Date | Time | Date | Time |
| Pre-spray | June 7 | 1030-1230 | June 7 | 1330-1500 | June 7 | 1530-1715 |
| Spray Day | June 11 | 1930-2030 | June 11 | 2045-2145 | June 12 | 1500-1600 |
| 1 Day | June 12 | 1700-1750 | June 12 | 1630-1700 | June 12 | 1500-1600 |
| 3 Day | June 14 | 1620-1720 | June 14 | 1515-1600 | June 14 | 1440-1500 |

1989

| Sample | 53A | | 53B | | 53B East | | 53C West | |
|---|---|---|---|---|---|---|---|---|
| | Date | Time | Date | Time | Date | Time | Date | Time |
| Pre-spray | June 7 | 1000-1240 | June 7 | 1515-1715 | June 8 | 1045-1215 | June 8 | 1430-1505 |
| Spray Day | June 15 | * | June 15 | 0800-1430 | June 15 | 1900-1930 | June 16 | 1545-1630 |
| 1 Day | June 16 | 1345-1515 | June 16 | 1130-1230 | June 16 | 1545-1630 | June 16 | 1650 1735 |
| 3 Day | June 18 | 1215-1330 | June 18 | 1015-1130 | June 18 | 1545-1700 | June 18 | 1415-1515 |
| 5 Day | June 20 | 1140-1415 | June 20 | 1010-1120 | June 20 | 1600-1655 | June 20 | 1450-1540 |

*Two sampling periods: 0800-0915, 1500-1815.

# Permethrin Spray Trials Against the Spruce Budmoth, *Zeiraphera canadensis* in Matapedia, Quebec, 1989

A Report to the 17th Annual Forest Pest Control Forum
(Ottawa, Ontario 14-16 November, 1989)

Blair Helson[1] and Michel Auger[2]

Project No. FP-50 Insecticide Toxicology

[1]Forestry Canada
Forest Pest Management Institute
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

[2]Ministere de l'Energie et des Ressources
Service de la Protection contre les Insectes et les Maladies
1297, boul. Charest Ouest
Québec, (Quebec)
G1N 2C9

Permethrin Spray Trials Against the Spruce Budmoth, <u>Zeiraphera canadensis</u> in Matapedia, Quebec, 1989

Blair Helson and Michel Auger

**Summary**

Trials were conducted to determine the period of time available for spraying with permethrin before and after the beginning of egg hatch. Effective control of larvae and protection of white spruce leaders were obtained with mistblower treatments of individual trees at 70g AI/ha during an 8-day period preceding egg hatch. A simple technique for predicting the time of egg hatch was also tested in 1989. Branch samples in Mason jars in a warm room where checked regularly for hatched larvae to determine the number of degree-days required for first hatch. Egg hatch was then predicted by following the degree-day accumulation in the field until this requirement was reached. The time of egg hatch predicted by this method corresponded closely with direct observations. Three methods of ground applications of permethrin at 70g AI/ha were also evaluated. Treatment of three rows of trees with one swath from a mistblower gave promising results. Treatment with an Electrodyne sprayer provided effective control and protection of leaders. Spraying only the leaders of white spruce trees provided very good protection of the leaders from spruce budmoth damage.

## Introduction

Previous trials have demonstrated that a single treatment of permethrin at 70g AI/ha by mistblower, helicopter or fixed-wing aircraft is effective in controlling spruce budmoth larvae and reducing leader damage. All of these experimental treatments have been timed precisely to the beginning of egg hatch because, based on the known behaviour of this pest, the larvae were expected to be exposed to foliar insecticide deposits only for a short period of time after they hatch while crawling to the flushing buds. However, such precise timing could be difficult in operational sprays if large areas need to be treated and poor spraying weather occurs. This study was designed to determine the period of time available for spraying before and after the beginning of egg hatch to achieve effective control of Z. canadensis larvae with permethrin.

In addition, the following three different ground application methods using permethrin were tested to determine their effectiveness in reducing damage to white spruce leaders caused by this pest. 1. Individual trees were treated with an Electrodyne sprayer in cooperation with Dr. N. Payne, Spray Atomization & Dispersal, FPMI. This device produces electrically-charged spray drops which are attracted to the tree providing efficient coverage. 2. Just the terminal leaders of white spruce trees were sprayed with permethrin. Although Z. canadensis infests buds on the entire tree, only the damage done to the terminal bud of the leader is of major importance because this can result in poorly formed trees. A spray applied selectively to the leader might reduce or prevent this damage even though larvae may still be present on the rest of the tree. 3. Three rows of trees spaced 2m apart were sprayed with one upwind swath of permethrin from a mistblower to determine the level of control obtainable on trees at increasing downwind distances.

A simple technique to predict the beginning of egg hatch was also tested in 1989.

## Materials and Methods

Spray Timing: The trials were conducted in one site containing naturally-regenerating white spruce near Matapedia, Quebec. Twelve groups of 30 trees, 1.5-2.5m in height which had been damaged by spruce budmoth were selected for the trials. Eight groups were used for treatments and four were used as untreated checks. Beginning on 11 May, 1989, one group of trees was randomly selected for treatment every 2 days. The actual period ranged from 1 to 3 days depending on weather conditions and rate of egg hatch. Permethrin (Pounce EC in water) was applied to each tree with a Solo Port motorized mistblower fitted with a ULV nozzle. Each tree was completely sprayed with a 0.35% concentration for 15-17 sec. depending on the flow rate which varied from 28-32 ml/min. to give an equivalent of 70g in 20 L/ha based on 2500 trees/ha. Weather conditions were monitored continuously with a Campbell Scientific CR20X portable weather station. One 15-cm branch from each tree for population assessments and bud damage was collected before treatment from all groups on 11 May, 1989. Another set of branch samples was collected from each treatment group and a check immediately before spraying. Branch samples were collected again from all groups after treatment on 12 June, 1989. Damage to leaders and leader lengths were measured on 22 August, 1989.

Ground Application Methods: These trials were conducted in another white spruce plantation near Matapedia, Quebec on 20 May, 1989 which was the predicted date of hatch in this plantation.

A stock solution of 6% permethrin, specially formulated for use with the Electrodyne sprayer from ICI was sprayed on three consecutive rows of 10 white spruce trees, 1.5-2.0 m in height. The applicator walked at a steady pace of 0.50 m/sec. with the nozzle held directly above the leaders of the trees. Each row of trees was sprayed twice. With a flow rate of 3 ml/min., this provided a dosage of 70g AI in 1.2 L/ha.

For spraying leaders, a Solo, hand-operated, backpack, compressed air sprayer fitted with a flat fan nozzle was used to apply a Pounce solution to each leader at a pressure of 0.5 $kg/cm^2$ providing a flow rate of 660 ml/min. Ca. 20 ml of a 0.14% concentration was applied to each tree by spraying one side of the leader from top to bottom for about 1 sec and then repeating the procedure for 1 sec on the other side. An equivalent of 70g AI in 50 L/ha was applied in the leader spray based on 2500 trees/ha.

To treat three consecutive rows of trees, a 5.25% concentration of permethrin (Ambush 500 EC) was applied with the Solo Port mistblower along one swath at a pace of 1m/sec. With the ULV nozzle, the flow rate was calibrated at 48 ml/min. providing a dosage of 70g AI in 1.33 L/ha assuming a 6m. swath width.

Sampling and damage assessments were performed as above.

Predicting Egg Hatch: At two-day intervals beginning on 9 May, 1989, branches from white spruce trees in the above two sites were collected and the buds were removed. Each branch was placed in a 500 ml, Mason jar containing a piece of moist sponge and capped with a 7-cm, white filter paper circle in the screw band. These jars were placed in a motel room where the inside surface of the filter papers were checked several times a day for newly-hatched Z. canadensis larvae. A thermograph was used to record temperatures in the room and calculate degree-day accumulations using a threshold temperature of 4.5°C. Mean hourly temperatures from the screened thermometer of the CR21X weather station were used to calculate degree-days in the field.

The degree-days required for first hatch in the warm room was determined and the number of degree-days accumulated in the field since the collection date was followed until the required number was reached. Eggs on branch samples were examined daily to determine the time of first hatch.

## Results and Discussion

Spray Timing: The greatest reductions in larval populations and numbers of damaged buds were obtained with treatments between 14-22 May (Table 1) corresponding to the 8-day period immediately preceeding the beginning of egg hatch (Table 2). The earlier treatment and the 2 later treatments were not as effective. In the early treatment, permethrin residues probably did not persist at high enough levels to provide consistent control during the hatching period 11-14 days later. The later treatments were conducted after most eggs had hatched and many larvae had probably already entered buds before these sprays. All treatments except the early one reduced leader damage to an index close to one (Table 3). Leaders were also longer in all the treated groups compared to the checks. These results show that spraying with permethrin can be done over about a one-week period immediately preceeding the beginning of egg hatch. The actual period available will likely depend on the application method and the quantity of permethrin reaching the trees, the prevailing weather conditions which affect the longevity of permethrin residues and the length of time for egg hatch.

Ground Application Methods: The results of the various ground application methods are presented in Table 4. Treatment of three downwind rows of trees with a mistblower provided promising results even though population levels were very high before treatment, particularly on the third row of trees with a mean of 34.5 larvae/branch. Larval population reductions were similar on each row of trees but damage was higher on the second and third rows, presumably because of the higher larval populations on these rows.

The Electrodyne sprayer provided good control and protection.

Leader sprays provided the best protection of leaders of any method tested to date. As expected, considerable numbers of larvae were still present after treatment on these trees because the area of the trees where branch samples were collected was not sprayed intentionally.

Spruce budworm larvae were also present at low population levels on the trees in these trials as well as the spray timing trials (Table 5). Populations in many of the treatments were less than in the checks, particularly in the treatments done between 11 to 18 May. This probably corresponds to the period preceeding or during emergence of second instar larvae from hibernaculae.

Predicting Egg Hatch: The technique was successful in predicting the date of first hatch in the field (Table 6). Collections from different dates predicted the initiation of egg hatch occurring between 21 and 23 May. Egg hatch began on the 22 to 23 May in this site (Table 2). This technique is simple to use and provides lead time for treatments before hatching begins.

Table 1. Effectiveness of Permethrin Mistblower Applications at Different Times Against the Spruce Budmoth, *Zeiraphera canadensis* in Matapedia, P.Q., 1989

| Application Time (May) | Mean No. Larvae/Branch Pre 1 | Pre 2 | Post | % Population[1] Reduction | % Buds Damaged | % Reduction[2] in Bud Damage |
|---|---|---|---|---|---|---|
| 11 | 10.9 | - | 5.1 | 58 | 9.5 | 63 |
| 14 | 19.5 | 10.2 | 2.8 | 87 | 5.9 | 77 |
| 16 | 18.7 | 13.5 | 1.9 | 91 | 4.6 | 82 |
| 18 | 14.5 | 9.9 | 1.4 | 91 | 2.3 | 91 |
| 20 | 16.6 | 22.7 | 1.7 | 91 | 6.3 | 75 |
| 22 | 14.5 | 14.4 | 1.0 | 94 | 2.8 | 89 |
| 25 | 21.8 | 13.4 | 5.1 | 79 | 12.3 | 52 |
| 26 | 16.7 | 11.7 | 4.7 | 74 | 9.7 | 62 |
| Combined Checks | 9.7 | 7.8 | 10.7 | | 25.5 | |

1 Compared to Pre 1 levels and corrected for population changes in the checks
2 Compared to checks

Table 2. Time of Hatch of Spruce Budmoth in 1989

| Date (May) Collected | Date (May) Examined | # Unparasitized Eggs Examined | Percent Egg Hatch |
|---|---|---|---|
| 18 | 19 | 82 | 0 |
| 19 | 20 | 64 | 0 |
| 20 | 21 | 105 | 1.0 |
| 21 | 22 | 39 | 0 |
| 22 | 23 | 79 | 1.3 |
| 23 | 24 | 107 | 18.7 |
| 24 | 25 | 49 | 65.3 |
| 25 | 26 | 61 | 98.3 |

Table 3. White Spruce Leader Damage Following Permethrin Mistblower Applications at Different Times, Matapedia, P.Q., 1989

| Application Time (May) | % Damage | | | | Damage Index | Leader Length(cm) |
|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | | |
| 11 | 10 | 37 | 37 | 16 | 1.60 | 43.7 |
| 14 | 30 | 37 | 33 | 0 | 1.03 | 45.0 |
| 16 | 40 | 37 | 20 | 3 | 0.87 | 43.6 |
| 18 | 43 | 27 | 30 | 0 | 0.87 | 41.9 |
| 20 | 30 | 30 | 37 | 3 | 1.13 | 44.4 |
| 22 | 30 | 40 | 30 | 0 | 1.00 | 48.9 |
| 25 | 33 | 23 | 37 | 7 | 1.17 | 41.4 |
| 26 | 37 | 43 | 20 | 0 | 0.83 | 47.6 |
| Combined Checks | 4 | 17 | 66 | 13 | 1.88 | 31.5 |

Damage Categories 0 = no. SBM damage, 1 = SBM scar

on leader further than 5cm from apical bud, 2 = SBM scar within 5cm of apical bud, 3 = leader broken or apical bud destroyed

Damage Index (Turgeon) = $\frac{(0xt_0)+(1xt_1)+(2xt_2)+(3xt_3)}{t_0+t_1+t_2+t_3}$

where $t_0$ .... $t_4$ are numbers of trees in each category

Table 4. Efficacy of Different Ground Application Methods with Permethrin against the Spruce Budmoth, *Zeiraphera canadensis*, Matapedia, P.Q., 1989

| Method | Mean No. Larvae/Branch | | % Population[1] | Mean % Bud | %[2] | Leader Damage(%) | | | | Damage | Leader Length |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Reduction | Damage | Reduction | 0 | 1 | 2 | 3 | Index | (cm) |
| Row Mistblower | 24.9 | 4.1 | 80 | 13.4 | 63 | 37 | 17 | 40 | 6 | 1.17 | 36.9 |
| Electrodyne | 13.1 | 1.9 | 82 | 6.6 | 82 | 70 | 10 | 20 | 0 | 0.50 | 45.0 |
| Leader Spray | 13.5 | 7.3 | 34 | 13.1 | 64 | 83 | 17 | 0 | 0 | 0.17 | 47.6 |
| Combined Checks | 17.4 | 14.3 | - | 36.4 | - | 3 | 23 | 52 | 22 | 1.92 | 30.6 |

1 Corrected for population changes in the checks
2 Compared to checks

Table 5. Spruce Budworm (<u>Choristoneura fumiferana</u>) Population Levels on White Spruce After Treatment with Permethrin at 70g AI/ha, Matapedia, P.Q., 1989

| Treatment Method | Application Date (May) | Mean No. Larvae Per Branch | %[1] Reduction |
|---|---|---|---|
| Individual Trees Mistblower | 11 | 0.10 | 92 |
| " | 14 | 0.23 | 80 |
| " | 16 | 0.07 | 94 |
| " | 18 | 0.17 | 86 |
| " | 20 | 0.50 | 58 |
| " | 22 | 0.43 | 63 |
| " | 25 | 0.47 | 60 |
| " | 26 | 0.50 | 58 |
| Checks | - | 1.18 | - |
| Tree Rows Mistblower | 20 | 0.50 | 50 |
| Electrodyne Sprayer | 20 | 0.27 | 73 |
| Leader Spray | 20 | 0.70 | 30 |
| Checks | - | 1.00 | - |

1 Compared to checks

Table 6. Technique to Predict Hatching Date of Spruce Budmoth Larvae.

| | Sample Collection Date | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9.05 | 11.05 | 13.05 | 15.05 | 17.05 | 19.05 | 21.05 |
| Time of 1st Hatch in Room | 0700 14.05 | 1300 16.05 | 0900 17.05 | 1100 19.05 | 1400 20.05 | 1400 20.05 | 1800 21.05 |
| Degree Days in Room Required for Hatch | 78 | 83 | 63 | 63 | 52 | 14 | 3 |
| Degree Days Accumulated in Field since Collection Date | 17* | 22 | 18 | 34 | 37 | 11 | 1 |
| Degree Days Remaining for Hatch in Field | 61 | 61 | 45 | 29 | 15 | 3 | 2 |
| No. of Days Required to Accumulate Remaining Degree Days in Field | 7 | 7.5 | 5 | 3 | 3 | <1 | <1 |
| Predicted Date of Hatch | 21.05 | 23.05 | 22.05 | 22.05 | 23.05 | 21.05 | 22.05 |

*Estimated

# SUMMARY REPORT ON STUDIES CONDUCTED BY THE FOREST PEST MANAGEMENT INSTITUTE'S ENVIRONMENTAL IMPACT PROJECT IN 1989

Report to the 17th Annual Forest Pest Control Forum

S.B. Holmes, K.N. Barber, D.P. Kreutzweiser and R.L. Millikin

Forest Pest Management Institute
Forestry Canada
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

November 1989

## Summary Report on Studies Conducted by the Forest Pest Management Institute's Environmental Impact Project in 1989

### Aquatic Studies in the Icewater Creek Research Area

#### Benthos and Brook Trout Populations Assessment

A project to determine secondary effects on brook trout of an insecticide treatment in Icewater Creek was continued. This project was designed to measure the effects on the resident brook trout population of an insecticide-induced reduction of stream benthos. The initial treatment in 1987 resulted in a significant impact on the invertebrate community. Significant post-treatment reductions in growth of young trout were documented, although several other trout population parameters were unaffected. Results from the trout study are in press in the Canadian Journal of Fisheries and Aquatic Sciences and those from the benthos assessment are submitted to Environmental Pollution. Data collected from an untreated reference stream indicated that temperature stress from unusually warm water temperatures in 1987 were at least partially responsible for the post-treatment growth reductions of trout. To determine the secondary effects on brook trout of an insecticide treatment in the absence of temperature stress, a treatment duplication in Icewater Creek is scheduled for 1990. Sampling activities in 1989 contributed to the pre-treatment data base for the treatment duplication. The population density and age structure, movement of individuals, growth rates and production of brook trout were measured three times during the season, while the benthos abundance and composition in both natural and artificial substrates were measured at five week intervals from May to October.

#### Development of a Stream-side Bioassay System

A bioassay facility was constructed and tested at Icewater Creek. The objective was to develop a bioassay system that will predict the response of benthic invertebrates or larval fish to pesticide contamination in forest streams, by exposing test organisms to treated water in simulated stream channels. This approach will allow toxicity testing under more natural conditions than conventional laboratory static or flow-through bioassays. In this system, creek water is diverted through artificial stream channels containing natural stream substrate from Icewater Creek. The channels are constructed of PVC rectangular conduit open on top, and are 10 m long and 30 cm wide. Discharge of stream water into the channels is controlled by gate valves. The pesticide is injected 1.5 m below the intake in each channel. The pesticide is dripped into the channel at this point from a Mariott bottle calibrated for 1 h continuous dosing. A series of Plexiglas baffles immediately below the injection point ensures complete mixing. The contaminated water exits the baffles and flows over natural substrate to the end of the channel.

Test organisms are placed in two locations in each channel: above the injection point (these serve as untreated controls) and at the downstream end of the channel (about 7 m below the injection point). These organisms are held in Plexiglas observation boxes that contain natural substrate and are designed to monitor drift response (downstream transport of affected individuals in the water column), avoidance (downstream movement by crawling), and lethal effects (mortality of individuals). These boxes are 70 cm long, 30 cm wide, screened on either end, open on top, and longitudinally divided into three equal sections. The three sections provide treatment replication. The present facility includes two channels and allows for concurrent testing of two concentrations and two controls.

Several trials with permethrin were conducted to test the operation and efficiency of the system, to determine the effectiveness of the observation box design, and to standardize invertebrate collecting, holding, and handling procedures. Data from these trials are preliminary and do not provide dose-response information for permethrin. The preliminary trials were successful and a systematic operation of the facility was established. The system is prepared for full-scale use in the 1990 season.

### Headwater Stream Pilot Study

A biological survey was conducted in a small first-order tributary of Icewater Creek. This is a heavily-shaded headwater stream that is essentially invisible from the air and therefore represents the type of stream that may be at risk of contamination from aerial applications of pesticides. Pesticide impact assessments in this stream may be forthcoming. The survey included sampling of fish, benthos, and periphyton to determine the density and growth of fish, the abundance and composition of aquatic invertebrates, and production of periphyton. The stream contains a resident population of brook trout (approximately 150 individuals). Seasonal growth of trout was slow and few individuals exceeded 120 mm. There was no movement of trout through a fish weir into or out of Icewater Creek. The invertebrate community is largely dominated by the "shredder" functional class, particularily several species of Trichoptera. Periphyton biomass is limited in summer by the heavy canopy, but increases in fall after defoliation.

### Herbicide Studies in Greenwater Lake

FPMI's Environmental Impact Project and Herbicide Chemical Accountability Project cooperated in an experiment to investigate the environmental fate and biological effects of hexazinone and metsulfuron applications to replicated treatment enclosures in Greenwater Lake. Details of the experiment are provided in the report of the Herbicide Chemical Accountability Project.

## Terrestrial Vertebrate and Invertebrate Studies

Research into the potential effects of B.t. on non-target caterpillars feeding on low vegetation (blueberry) was continued. Field research has been conducted near Gogama, Ontario in jack pine plantations of approximately 20 years of age in cooperation with researchers from the University of Toronto, Faculty of Forestry. The emphasis of the research is to determine the relative toxicity of B.t. to the most important (abundant) species of caterpillars. This research is partially supported by the Ontario Pesticides

Advisory Committee.

## Laboratory Bioassays

Laboratory bioassays with caterpillars and B.t. have been delayed due to slow progress in establishing cultures of two principal species, both of which are known to occur in the crops of spruce grouse chicks and/or songbirds on these research sites. Itame brunneata (Thunb.) (Geometridae) was the most abundant, externally feeding caterpillar on blueberry for at least the first half of June in both 1988 and 1989. Orthosia revicta (Morr.) was the most common of the noctuid species on blueberry and was at least equally abundant to I.brunneata towards the middle (1988) or end (1989) of June as the latter species began to pupate. Adults of both species are readily maintained in the laboratory where they successfully mate and oviposit. Despite very good fertility, overwintering, and hatch of the eggs, the first-instars of I.brunneata are not able to feed successfully on mid-season blueberry foliage but will have to be provided early-season foliage produced in the greenhouse. The larvae of O.revicta are readily reared on artificial diet and our diapausing pupae will probably provide caterpillars for experimentation by the new year.

## B.t. Field trial

Besides direct impacts on non-target caterpillars, B.t. has the potential to affect vertebrate predators of these caterpillars, particularly birds, through a reduction in their food supply. An experimental application of B.t. was conducted in cooperation with U of T personnel to investigate this possibility. The primary investigations by the Environmental Impact Project were 1) a field bioassay trial using clipped blueberry foliage and I.brunneata and 2) studies of behaviour and reproductive success of selected, ground-nesting songbirds.

B.t. was experimentally applied (Dipel 8L at 30 BIU in 1.8 litres/ha) in the Gogama research area on June 11 using the FPMI spray plane. Two forest blocks of 80 hectares each (400 x 2000m) were studied. Spray was applied to the eastern 40 hectares (400 x 1000m) of the northern forest and the eastern 44 hectares (400 x 1100m) of the southern forest. The remaining 40 and 36 hectares directly to the west of and contiguous with the treated areas served as controls for the northern and southern treated blocks, respectively. The northern treated block received 29.0 BIU/ha actual emission and the southern treated block received 31.2 BIU/ha. Deposit cards on 12 sites of the southern forest (described below) all received some spray deposition including two control sites about 700m upwind of the spray boundary. However, there was a highly significant difference between the control and treatment area in terms of number of droplet-stains (0.3 vs. 14.8 stains/cm$^2$). The stains on the control sites were $<100\mu$ diameter compared to a maximum of $400\mu$ on the treated sites (spread factors not yet available).

**1) Bioassay:** Itame brunneata was the only species sufficiently abundant in the field to run the bioassay. These caterpillars were collected off-site on June 7 and June 12 and maintained on clipped blueberry foliage until recruited into the trial. Blueberry foliage was clipped from within 1/2 metre of a deposit sampler situated within or on the edge of each of 12 clearings on the southern forest (6 control, 6 treated). Five caterpillars were placed in a petri plate with a moistened filter paper and sufficient foliage for 24 hours of feeding. Six such plates (30 caterpillars) were prepared for each of 12 sites. This regimen of 72 plates was set up on the day of spray (Day-0), another 72 plates the day following the spray (Day-1), and another 72 plates 48 hours after the spray (Day-2). Foliage was obtained from the sample sites daily and presented to the caterpillars up until June 18 at which time only "clean" foliage was provided. Thus, one series was fed for 7 days, one for 6 days, and one for 5 days. Mortality was recorded daily until all larvae had died or pupated (31 days post-spray). The bioassay was conducted and maintained indoors at the Gogama Tree Nursery (OMNR) until June 17 when it was transported to FPMI.

Mortality responses of the caterpillars are summarized in Table 1. There was a significant treatment effect for all three series in terms of "total mortality" and "dead larvae" (ie. sufficient deposit/residue for at least 2 days after the spray and 5-7 days continuous feeding on contaminated foliage). This is not reflected in any discernible differences in the number of successful parasites (all solitary) nor those larvae "lost" (mishandled) by the experimenters. The treatment effect on mortality rates of prepupae was not consistent. Using Abbott's formula, total corrected mortality was 41.1% (Day-0), 27.8% (Day-1), and 33.8% (Day-2) due to treatment but these were not significantly different from each other.

These data represent the fatal response rates of *I.brunneata* fed foliage from sites likely to have received near maximum deposits of *B.t.* for the range of deposit yet to be determined. *Itame brunneata* is susceptible to the deposits obtained in these relatively open areas during this particular field study but further interpretations cannot be made at this point.

**2) Ground-nesting songbirds:** The aim of this project was to determine if *B.t.* spraying had an indirect effect on the reproductive success of selected songbird species, due to their dependence on larval Lepidoptera as food for their young. Species included in this study were the hermit thrush, *Hylocichla guttata*, dark-eyed junco, *Junco hyemalis*, white-throated sparrow, *Zonotrichia albicollis*, and chipping sparrow, *Spizella passerina*.

Treatment and control areas were compared for differences in reproductive success (number of young hatched and number of young surviving to independence), growth of young, and quality of parental care at the nest. Survival was calculated over the incubation and nestling periods according to the method described by Mayfield. Food samples were collected from nestlings to look for differences in the type of prey brought to the young.

There was little difference in the total number of food items brought to the hermit thrush young (4.8±1.2 food items per food sample in treated areas versus 6.8±1.7 in control areas). However, Lepidoptera comprised a significantly lower proportion of their food in the treated areas compared to the control areas (0.069±0.045 [mean±SE] versus 0.58±0.14, respectively; $p<.005$, G-test). This difference in the Lepidoptera component of food samples had no significant effect on the growth of hermit thrush young (tarsal length or weight; $p>0.1$, ANOVA, df=1, F=1.26 for tarsus, F=1.94 for weight). There was also no effect of treatment on the probability of survival of young (0.41 for hermit thrush nestlings from treated areas versus 0.23 for nestlings from control areas). A separate analysis for other ground-nesting species is not available at this time.

Preliminary analysis of mist netting data suggests that fewer young of ground-nesting species (previous 4 plus the nashville warbler, Vermivora ruficapilla) as a group fledged from treated areas compared to control areas (5.4 young per net hour in treated areas versus 9.2 in control areas). However, there was no significant difference in the proportion of young caught (young comprised 20.5% of the total catch of ground-nesting birds in treated areas versus 24.6% in control areas) or the ratio of young to adult females in treated versus control areas (p>.05, G-test).

Table 1. Mortality prior to pupation of I.brunneata larvae feeding on blueberry foliage contaminated with B.t.

| Treatment Series | Mortality Components - Mean (95% C.L.) | | | | |
|---|---|---|---|---|---|
| | Total[1] | Dead Larvae[1] | Parasites | Lost Larvae | Dead Prepupae |
| Control | | | | | |
| Day-0 | 11.1 a**[2] (5.0, 20.2) | 3.0 a* (0.3, 9.8) | 5.6 a* (0.0, 11.3) | 0.6 a* (0.0, 2.0) | 1.7 a* (0.0, 4.6) |
| Day-1 | 8.9 a (3.7, 16.9) | 0.8 a (0.0, 5.3) | 4.4 a (0.8, 8.1) | 1.7 a (0.0, 3.6) | 1.7 a (0.0, 3.6) |
| Day-2 | 16.8 a,c (9.5, 26.6) | 5.6 a,c (0.5, 18.5) | 6.7 a (3.5, 9.8) | 0.0 a | 2.8 a,b (0.0, 6.9) |
| Treated | | | | | |
| Day-0 | 46.9 b (31.5, 66.1) | 37.0 b (23.8, 53.8) | 3.3 a (1.1, 5.5) | 2.2 a (0.4, 4.0) | 4.4 a,b (0.0, 10.6) |
| Day-1 | 33.7 b,c (21.6, 49.2) | 22.8 b,c (9.5, 43.5) | 1.7 a (0.0, 4.6) | 3.3 a (0.2, 6.5) | 4.4 a,b (0.2, 8.7) |
| Day-2 | 44.4 b (31.0, 60.8) | 29.1 b (19.5, 41.1) | 5.6 a (1.3, 9.8) | 1.1 a (0.0, 2.9) | 8.9 b (6.0, 11.7) |

[1] back-transformed means and confidence limits (0.4-power transform)
[2] means followed by different letters within columns are significantly different based on Tukey's multiple comparisons test with equal sample sizes except for "lost" where a G-test was used (* - p<0.05, ** - p<0.01) while those followed by the same letter are not differenct (p>0.05)

# SURVEILLANCE ENVIRONNEMENTALE DES PULVÉRISATIONS DE PESTICIDES SUR LES FORÊTS PUBLIQUES DU QUÉBEC EN 1989

Rapport préparé pour le dix-septième colloque annuel
sur la lutte contre les ravageurs forestiers
à Ottawa du 14 au 16 novembre 1989

Sylvie Delisle
Jean Legris
Jean Cabana
Pierre-M. Marotte

GOUVERNEMENT DU QUÉBEC
MINISTÈRE DE L'ÉNERGIE ET DES RESSOURCES
SERVICE DES ÉTUDES ENVIRONNEMENTALES

# INTRODUCTION

Le Service des études environnementales (S.E.E.) a le mandat d'évaluer les impacts des pulvérisations de pesticides en forêt. Il doit aussi s'assurer de l'utilisation sécuritaire des produits en ce qui a trait à la santé humaine et à l'environnement.

Chaque année, le Service effectue un contrôle de qualité ainsi qu'un suivi environnemental des insecticides utilisés par le ministère de l'Énergie et des Ressources (M.E.R.) pour lutter contre les ravageurs forestiers. Il réalise également le suivi des phytocides servant à l'entretien des plantations et à la préparation de terrain. Pour ce faire, il procède à l'échantillonnage de différents substrats ou organismes exposés aux pulvérisations.

Le texte suivant résume les différents projets menés en 1989. On y présente également des résultats préliminaires dont l'analyse finale fera l'objet de rapports ultérieurs.

## A. PULVÉRISATIONS D'INSECTICIDES CONTRE LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE

Depuis trois ans le M.E.R. n'utilise que des insecticides biologiques à base de Bacillus thuringiensis var. kurstaki (B.t.k.) contre la tordeuse des bourgeons de l'épinette (Choristoneura fumiferana Clem). Plusieurs études révèlent l'innocuité de cette bactérie pour l'homme, la faune et l'environnement en général. Cependant, les produits utilisés contiennent des spores pouvant persister, s'accumuler et éventuellement se reproduire en présence de conditions favorables. Le S.E.E. juge donc nécessaire de faire le suivi des pulvérisations afin d'évaluer la persistance à court et à long termes des spores de B.t. En ce sens, il réalise chaque année un programme d'échantillonnage dans différents milieux. Le Service effectue également le contrôle de la qualité des préparations de B.t.

En 1989, le Ministère a réalisé des pulvérisations opérationnelles couvrant 164 216 hectares de forêt. Le Dipel MD 132 a été utilisé sur 76 % de cette superficie et le Dipel MD 176 sur le reste. La dose émise sur la majorité du territoire était de 30 M.U.I./ha. Toutefois, 34 579 hectares ont reçu deux applications de B.t. totalisant 60 M.U.I./ha.

Les détails concernant les traitements expérimentaux sont donnés plus loin dans le texte.

### 1. Suivi des produits opérationnels

#### a) Persistance du Thuricide 48 LV dans le sol

En 1985, le M.E.R. entreprenait une étude sur la persistance à long terme du B.t. dans le sol forestier de secteurs traités au Thuricide MD 48 LV. Initialement, 29 stations avaient été établies et échantillonnées pour réaliser cette étude. Depuis ce temps plusieurs stations ont dû être abandonnées pour diverses raisons. En 1989, 12 stations ont pu être échantillonnées afin d'y évaluer la présence des spores de B.t. après quatre années, et plus particulièrement l'augmentation des concentrations dans la partie minérale du sol. Vingt-quatre échantillons ont été analysées pour ce projet.

b) Persistance du Dipel 132 dans le sol

En 1987, le M.E.R. a entrepris une étude sur le comportement à court et à long terme du Dipel MD 132 dans le sol forestier. Ce produit à base d'huile était alors utilisé de façon opérationnelle pour la première fois au Québec. Le but de cette édude était d'évaluer la présence des spores de B.t. quelques jours après une pulvérisation ainsi que leur persistance après un an. Des échantillons ont été prélevés à la suite de traitements réalisés en 1987 et en 1988.

Au printemps de 1989, douze stations ont été échantillonnées dans le but de connaître les concentrations après un an dans le sol de secteurs traités au cours des deux années précédentes. Vingt-quatre échantillons de sols organique et minéral y ont été prélevées.

c) Persistance du Dipel 132 dans les lacs

Faisant suite à l'étude sur le comportement du Dipel MD 132 dans les lacs entreprise il y a deux ans, le S.E.E. a de nouveau récolté des échantillons d'eau et de sédiments en 1989. Cette année, quatre lacs situés dans des secteurs traités en 1987 ont été échantillonnés afin d'y évaluer la persistance du B.t. après deux ans. Des prélèvements ont aussi été faits dans quatre autres lacs exposés aux pulvérisations de 1987 et de 1988. Cet échantillonnage visait à évaluer les concentrations et l'accumulation possible du B.t. un an après une seconde année consécutive de traitements. Ce projet a nécessité l'analyse de 40 échantillons de sédiments et de 24 échantillons d'eau.

d) Évaluation des concentrations de B.t. dans le sol à la suite d'une double application

En 1989, certains secteurs de forêt à population larvaire élevée ont reçu deux applications de Dipel MD 132 ou 176. Le même insecticide était pulvérisé à quelques jours d'intervalle à raison de 30 M.U.I./ha par application. Afin d'évaluer les concentrations de spores viables de B.t. à la suite de ces traitements, 20 stations de sol ont été établies puis échantillonnées. Des prélèvements ont été faits avant le début des opérations et après chacune des applications dans des délais variant d'un à trois jours. Les derniers échantillons ont été prélevés après une période de trois mois. Cette récolte ainsi que celle faite avant les traitements incluaient l'échantillonnage de sol organique et minéral. Dans les jours suivant les pulvérisations seule la portion organique du sol était prélevée. Au total, ce projet a nécessité l'analyse de 80 échantillons de sol organique et de 40 échantillons de sol minéral.

## 2. Suivi des produits expérimentaux

Les traitements expérimentaux en forêt sont nécessaires dans le processus d'homologation des nouveaux insecticides. Le M.E.R. participe à certains projets en vérifiant l'efficacité des produits et le comportement des spores dans l'environnement. En 1988, deux produits ont fait l'objet d'un suivi environnemental soit le E 492 de C.I.L. et le Condor MD AF d'Ecogen. Cette étude s'est terminée en 1989 par un échantillonnage visant à connaître leur persistance à long terme.

Les pulvérisations de 1989 ont permis d'expérimenter sept nouveaux produits biologiques sur une superficie totale de 504 hectares. Cette année seul l'insecticide Foray MD 48 B de la compagnie Novo a fait l'objet d'un suivi par le S.E.E.

a) E 492 (C.I.L.)

Ce produit a été épandu par voie aérienne en 1988 à une dose de 30 M.U.I./ha. Un programme d'échantillonnage élaboré conjointement avec la compagnie C.I.L. a permis au S.E.E. d'étudier son évolution dans les jours et les mois suivant la pulvérisation. Des échantillons ont alors été prélevés dans un ruisseau et à 16 stations de sol forestier. En 1989, le Service a fait des prélèvements *aux* mêmes stations afin d'y vérifier la présence de B.t. après un an. Trente-deux échantillons de sol organique et minéral ainsi qu'un échantillon d'eau ont été récoltés pour ce projet.

b) Condor AF (Ecogen)

En septembre 1988, le Ministère a réalisé une étude sur le comportement du Condor $^{MD}$ AF dans le sol forestier à la suite d'une pulvérisation manuelle. Huit stations de sol ont ainsi été exposées à cet insecticide au moyen d'un pulvérisateur à air comprimé. Huit autres stations ont été traitées simultanément au Dipel $^{MD}$ 132 dans le but de comparer l'évolution des deux produits dans des conditions similaires. Des prélèvements ont été faits immédiatement avant et après les traitements ainsi que deux mois plus tard. En 1989, des échantillons ont été pris aux 16 stations afin de vérifier la persistance du B.t. après une période de neuf mois. Trente-deux échantillons de sol organique et minéral ont été récoltés pour ce projet.

c) Foray 48 B (Novo)

Ce produit à base d'eau a été épandu en 1989 par un monomoteur Piper Pawnee sur deux secteurs de 36 hectares. Chaque secteur a reçu une seule application de 30 M.U.I./ha dans un volume de 2,37 l/ha. Par suite de ces traitements des prélèvements de sol ont été faits dans les deux aires traitées afin d'y vérifier les concentrations. Huit stations ont ainsi été échantillonnées dans chaque secteur avant le début des opérations, d'un à trois jours après celles-ci et trois mois plus tard. Quarante-huit échantillons de sol organique et 32 de sol minéral ont été récoltés pour ce projet. Les concentrations de B.t. seront de nouveau évaluées au printemps de 1990 soit après un délai de 12 mois.

## 3. Contrôle de la qualité

Avant le début des pulvérisations opérationnelles, le laboratoire de microbiologie du S.E.E. a échantillonné tous les lots de B.t. Il a aussi vérifié leur potentialité insecticide ainsi que la présence d'espèces pathogènes.

Tous les lots ont démontré une potentialité insecticide acceptable selon l'étiquette. Par ailleurs, plus de vingt-sept espèces différentes de micro-organismes autres que le *Bacillus thuringiensis* ont été identifiées. On a détecté la présence d'entérocoques dans les trois lots de Dipel MD 132 provenant des surplus de 1988. Ces microorganismes ont aussi été retrouvés dans douze des dix-neuf lots de Dipel MD 132 et dans les huit lots de Dipel MD 176 reçus en 1989.

L'espèce *Enterococcus faecalis* était absente des lots de Dipel 132 de 1988, mais présente dans cinq lots de Dipel MD 132 et dans quatre lots de Dipel MD 176 reçus en 1989. L'espèce *Enterococcus faecium* était présente dans les trois lots de Dipel MD 132 de 1988, dans douze lots de Dipel MD 132 et dans tous les lots de Dipel MD 176 reçus en 1989. Rappelons qu'en 1988, l'*E. faecalis* se retrouvait dans huit des 22 lots de Dipel MD 132 et l'*E. faecium* dans tous les lots du même produit.

Les résultats du dénombrement des entérocoques révèlent des concentrations inférieures à la limite de détection (30 U.F.C./ml) et s'échelonnant jusqu'à un maximum de 267 U.F.C/ml. En 1988, les concentrations étaient inférieures à 100 U.F.C./ml dans 12 des 25 lots. Elles variaient de 274 à 6700 U.F.C./ml dans les 13 autres lots.

Étant donné les faibles concentrations d'entérocoques détectées, le laboratoire n'a pas procédé à un dénombrement hebdomadaire, contrairement à l'an dernier. Il a plutôt préféré effectuer un échantillonnage en août et un autre en novembre sur le produit non utilisé en 1989. Les résultats du premier dénombrement n'indiquent aucune croissance de ces bactéries.

D'autre part, l'espèce Enterobacter cloacae a été isolée dans quatre lots de Dipel 132. L'espèce Pseudomonas aeruginosa n'a été observée que dans un seul lot de Dipel 132 et dans un lot de Dipel 176 reçus en 1989. Comme ces deux espèces font partie des microorganismes choisis comme indicateurs de contamination par Agriculture Canada en 1988, le laboratoire a donc procédé à leur dénombrement. Dans tous les cas, la concentration de ces deux espèces est apparue comme inférieure à la limite de détection.

A l'exception des entérocoques, de l'Enterobacter cloacae et du Pseudomonas aeruginosa, aucune autre espèce indicatrice désignée par Agriculture Canada n'a été détectée. Ainsi, tous les lots de B.t. ont été approuvés et ont pu être utilisés sécuritairement en 1989.

## B. PULVÉRISATIONS DE PHYTOCIDES SUR LES TERRES PUBLIQUES

Afin de valider et de compléter nos connaissances sur le comportement des phytocides utilisés en milieu forestier par le Ministère, le S.E.E. a poursuivi, en 1989, son suivi environnemental du glyphosate (Vision $^{MD}$) et de l'hexazinone (Velpar L $^{MD}$). Au total, 5 948 ha ont été traités par voie terrestre afin de préparer le terrain ou de dégager les plantations. La plupart des travaux (4 376 ha) visaient toutefois le dégagement des plantations de résineux de la végétation compétitive à l'aide du glyphosate.

### 1. Glyphosate

Neuf prélèvements d'eau en milieu lotique ont été récoltés cette année afin de valider les données déjà obtenues lors de suivis antérieurs et de vérifier la qualité des traitements. Ces échantillons ont généralement été récoltés près des superficies traitées dans les 2 jours suivant la première pluie à survenir dans la zone traitée. En conservant une approche semblable, 14 échantillons de sédiments ont été récoltés à l'intérieur d'un délai d'un mois suivant le traitement. Vingt-quatre autres prélèvements de sédiments ont permis de compléter certains suivis débutés en 1987 et 1988.

Dans le sol, une dizaine d'échantillons ont été recueillis afin de de finaliser les suivis amorcés à des sites de déversements accidentels.

Un suivi des résidus de glyphosate dans les framboises a été réalisé à deux stations. Des échantillons ont été prélevés avant les opérations ainsi que 3 heures, 1, 2, 3, 4, 5, 6, 7 et 14 jours après le traitement. En tenant compte des précipitations affectant le site, ces données permettront de vérifier le comportement du produit dans ces fruits. Quinze prélèvements de fruits (framboises et bleuets) ont aussi été recueillis dans la première semaine suivant le traitement. Ces données permettront de préciser le niveau maximum de résidus dans cette composante végétale. Les mêmes échantillons serviront à vérifier l'influence des pluies sur le lessivage du produit présent sur les fruits. Lors de l'analyse, une portion de chaque échantillon sera lavée avec un volume d'eau connu.

L'évaluation de la dérive lors des opérations terrestres effectuées avec des pulvérisateurs de type Boomjet MD (buse OC 20) a été réalisée dans quatre secteurs différents à l'aide de feuilles d'aluminium (analyse chromatographique). En tout, 12 lignes d'échantillonnage, perpendiculaires au passage du transporteur, ont servi à la détermination de la dérive à 0, 5, 25, 50 et 100 mètres de la zone traitée. Mentionnons que les trois dernières distances correspondent actuellement aux bandes de protection exigées par le Ministère selon les zones sensibles rencontrées.

## 2. Hexazinone

Le suivi de ce produit a été moins important compte tenu de son utilisation limitée dans la province et des diverses méthodes d'application encore à l'essai. Néanmoins, trois prélèvements d'eau et sept de sédiments ont été recueillis en milieu lotique.

Un suivi des résidus dans le sol a été réalisé dans un secteur de préparation de terrain traité avec des pulvérisateurs de type Boomjet MD. Cette méthode permet une application plus uniforme sur toute la surface à traiter. Des échantillons dans les strates 0-10 et 10-20 cm du sol ont été prélevés 10 jours, 2 semaines ainsi que 1, 2, 3 et 5 mois après la pulvérisation.

Enfin, mentionnons la récolte de quelques prélèvements de fruits (bleuets et framboises) dans des secteurs traités avec ce phytocide.

## 3. Collaboration à d'autres études

Dans le cadre de son programme de surveillance biologique des travailleurs forestiers utilisant des phytocides, le Ministère a renouvelé son entente avec le Centre de Toxicologie du Québec (C.T.Q.). A la suite d'une étude déjà réalisée dans le cas du glyphosate, on adapta la procédure développée (dosage du produit dans les urines) a été adaptée pour mesurer l'exposition des travailleurs à différents modes d'application de l'hexazinone en milieu forestier (pulvérisateur Boomjet MD, rampe de pulvérisation et application manuelle avec pistolet).

Une autre étude portant sur l'efficacité du lavage à l'eau froide pour éliminer le glyphosate sur les vêtements de travail a été finalisée cette année par le C.T.Q. Il ressort que le lavage ou possiblement un trempage prolongé sont des moyens efficaces pour enlever le glyphosate adsorbé sur les vêtements contaminés.

Finalement, le S.E.E. a effectué avec le Service de la régénération forestière du Ministère, un survol en hélicoptère des secteurs traités antérieurement afin de vérifier la qualité des pulvérisations et le respect des zones tampons.

# ENVIRONMENTAL MONITORING OF PESTICIDE SPRAYING IN QUEBEC PUBLIC FORESTS IN 1989

Report Prepared for the Seventeenth Annual Forest Pest Control Forum
in Ottawa
November 14 - 16, 1989

Sylvie Delisle
Jean Legris
Jean Cabana
Pierre-M. Marotte

Gouvernement du Québec
Ministère de l'Énergie et des Ressources
Service des études environnementales

## INTRODUCTION

The Service des études environnementales (SEE) has a mandate to evaluate the impact of pesticide spraying in forests. It is also responsible for ensuring that the products are safely used as regards human health or the environment.

Every year, the SEE carries out a quality control and environmental monitoring program of the insecticides sprayed by the ministère de l'Énergie et des Ressources (MER) to control forest pests. It also monitors the herbicides used for upkeeping plantations and preparing ground. In conducting these studies, it takes samples of various environmental components or oganisms which have been exposed to spraying.

This paper summarizes the various monitoring activities carried out in 1989. It also presents some preliminary results, the final analysis of which will be the subject of further reports.

## A. INSECTICIDE SPRAYING AGAINST THE SPRUCE BUDWORM

For the past three years, the MER has used only BTK-based (*Bacillus thuringiensis* var *kurstaki*) biological insecticides to control spruce budworm (*Choristoneura fumiferana* Clem.). Several studies have shown that this bacterium is innocuous to man, wildlife and the environment in general. However, insecticides contain spores that may persist, accumulate and possibly reproduce under suitable conditions. The SEE has therefore decided to monitor spraying in order to assess the short-and long-term persistence of these spores. An annual sampling program in various environmental surroundings has been worked out for this purpose. The SEE is also responsible for controlling the quality of BT formulations.

In 1989, the MER operational spraying program covered 164,216 hectares of forests. Dipel™ 132 was sprayed over 76% of the area and Dipel™ 176 over the remaining area. Most of the zone was treated at the rate of 30 MUI/ha. However, 34,579 hectares had two applications of BT for a total of 60 MUI/ha.

Details concerning experimental treatments will be exposed later.

### 1. Monitoring Operationnal Products

#### a) Persistence of Thuricide 48LV in Soil

In 1985, the MER undertook a study of the long-term persistence of BT in the soil of areas treated with Thuricide™ 48LV. Initially 29 sampling sites were established and sampled. Since then, several sites have had to be abandoned for various reasons. In 1989, the SEE was able to sample 12 sites. The aim of this project was to evaluate the presence of BT spores in soil four years after treatment and especially the increase of concentrations in the mineral layer. Twenty-four samples were analysed during the project.

b) Persistence of Dipel 132 in Soil

In 1987, the MER started to study the short-and long-term behaviour of Dipel$^{TM}$ 132 in forest soil. This oil-based product was used for the first time in Quebec for operational treatment spraying. The study aimed at evaluating the presence of BT spores a few days after treatment and their persistence one year later. For this purpose, samples were collected after the 1987 and 1988 sprayings.

In the spring of 1989, the SEE sampled 12 soil sites to evaluate BT concentrations one year after spraying in areas treated during two consecutive years. Twenty-four organic and mineral soil samples were collected.

c) Persistence of Dipel 132 in Lakes

In 1989, the SEE carried on a two-year old study on the behaviour of Dipel$^{TM}$ 132 in the water and sediments of lakes. This year, four lakes located inside areas treated in 1987 were sampled to assess BT persistence two years after spraying. Sampling was also done in four other lakes that were exposed to both 1987 and 1988 sprayings. The latter project aimed at evaluating BT concentrations and possible accumulation one year after a second consecutive year of treatment. A total of 40 sediment samples and 24 water samples were analysed during the study.

d) Evaluating BT Concentrations in Soil Following a Double Application

In 1989, some forest areas with high larval population received two applications of Dipel$^{TM}$ 132 or 176 spaced out over a few days. Both applications were done with the same product at the rate of 30 MUI/ha each. Twenty soil sites were established and sampled to evaluate the concentrations of BT viable spores after spraying. Samples were collected before the treatment and one to three days after each application. The last samples were taken three months later. This sampling and the one preceding the spraying included organic and mineral soil collections. In the days following the spraying only the organic layer was sampled. A total of 80 organic soil samples and 40 mineral soil samples were collected.

2. Monitoring Experimental Products

Experimental treatments in forests are essential for the registration process of new insecticides. The MER is currently participating in certain projects aimed at measuring the effectiveness of products and studying the behaviour of spores in the environment. In 1988, two products were subjected to environmental monitoring. These are E-492 by CIL and Condor™ by Ecogen. This study ended in 1989 with the assessment of long-term persistence.

The 1989 experimental program enable the MER to test seven new biological products over a total area of 504 hectares. The SEE monitored only one insecticide known as Foray™ by Novo Inc.

a) E-492 (CIL)

This formulation was sprayed in 1988 by aircraft at the rate of 30 MUI/ha. The SEE elaborated a sampling program in collaboration with CIL. The objective of the program was to study the behaviour of E-492 in the days and months following the treatment. Samples were taken in one stream and 16 soil sites. In 1989, the SEE sampled the same sites to verify the presence of BT after one year. Thirty-two organic and mineral soil samples and one water sample were collected.

b) Condor AF (Ecogen)

In September 1988, the MER carried out a study on the behaviour of Condor™ AF in forest soil after a manual application. Eight soil sites were treated with this product by means of a pneumatic sprayer. Eight other sites were treated simultaneously with Dipel™ 132 to compare the behaviour of both products under similar conditions. Samples were taken before treatment, just after treatment and three months later. In 1989, samples were collected at the 16 sites to assess the persistence of BT after a 9-month period. Twenty-two organic and mineral soil samples were taken during the project.

c) Foray 48B (Novo)

This water-based formulation was sprayed in 1989 by a Piper Pawnee single-engined aircraft over two areas of 36 hectares. Each area received a single application of 30 MUI/ha in a volume of 2.37 ℓ/ha. After the treatments, soil was sampled in both areas in order to evaluate BT concentrations. Eight soil sites were sampled in each area prior to spraying. Other samples were taken one to three days and three months after treatment. Forty-eight organic soil samples and 32 mineral soil samples were collected. BT concentrations will be evaluated again after a 12-month period in the spring of 1990.

3. <u>Quality Control</u>

Before starting the operational spraying program, the SEE microbiology laboratory sampled all BT lots. It also verified their insecticide efficacy and determined whether pathogenic species were present.

The insecticide efficacy of all lots fell within the limit defined as acceptable on the label. In addition, more than 27 different species of micro-organisms other than BT were identified (Table 2). Enterococci were detected in three Dipel$^{TM}$ 132 lots remaining from 1988. They were also found in 12 of the 19 Dipel$^{TM}$ 132 lots and eight Dipel$^{TM}$ 176 lots received in 1989.

The species <u>Enteroccus</u> <u>faecalis</u> was undetected in the 1988 Dipel$^{TM}$ 132 lots while detected in five 1989 Dipel$^{TM}$ 132 lots and four Dipel$^{TM}$ 176 lots. <u>Enterococcus</u> <u>faecium</u> was present in three 1988 Dipel$^{TM}$ 132 lots, twelve 1989 Dipel$^{TM}$ 132 lots and all Dipel$^{TM}$ 176 lots. In 1988, <u>E. faecalis</u> was found in eight of the 22 Dipel$^{TM}$ 132 lots and <u>E. faecium</u> in all lots.

Enterococci counts revealed concentrations lower than the detection limit (30 CFU/mℓ) to a maximum of 267 CFU/mℓ. In 1988, concentrations were below 100

CFU/mℓ in 12 of the 25 lots. In the other lots, they varied from 274 to 6,700/ CFU/mℓ.

Considering the low enterococci concentrations found this year the laboratory did not proceed to a weekly count as it was done last year. However, in August, the laboratory sampled the 1989 remaining lots and will do it again in November. The results of the first counts did not revealed any increase in the bacteria.

Furthermore, the species Enterobacter cloacae was isolated in four Dipel™ lots. Pseudomonas aeruginosa was also detected in one 1989 Dipel™ 132 lot as well as in one Dipel™ 176 lot. Both species were counted by the laboratory since they belong to the group of micro-organisms chosen as contamination indicators by Agriculture Canada in 1988. In all cases, concentrations of both species were under the detection limit.

Except for enterococci, Enterobactes cloacae and Pseudomonas aeruginosa no other indicator species designated by Agriculture Canada was detected. As a result, all the BT lots were approved and were able to be safely used in 1989.

## B. PHYTOCIDES SPRAYING ON PUBLIC LAND

To validate and complete our knowledge of the behaviour of the herbicides used by the MER in the forest environment, the SEE has continued to monitor glyphosate (Vision™) and hexazinone (Velpar™) in 1989. A total of 5,948 hectares received ground applications of herbicides to upkeep plantations and prepare lands to be reforested. Most treatments (4,376 ha) were done with glyphosate, to release coniferous plantations from competing vegetation.

### 1. Glyphosate

Nine samples were taken in lotic water, to validate the data collected in previous monitoring programs and verify the quality of spraying. Most of these samples were taken near the treated areas within two days following the first shower to occur in the area. Fourteen sediment samples were collected with the same approach within a period of one month after spraying. Twenty-four other sediment samples enabled the SEE to complete some studies initiated in 1987 and 1988. Ten soil samples were also taken to conclude the monitoring of some accidental dumping sites.

The amount of glyphosate residues in raspberries was measured in two sampling sites. Samples were collected prior to treatment, 3 hours, 1, 2, 3, 4, 5, 6, 7 and 14 days after treatment. This study aimed at evaluating the effect of precipitations on the behaviour of glyphosate in fruits. Fifteen other fruit samples (raspberries and bluberries) were taken during the first week following treatment to evaluate the maximum residual concentration. The same samples will be used to verify the effect of rain on the leaching of glyphosate on fruits. For this purpose, a part of each sample will be washed before analysis with a known amount of water.

Spray drift was evaluated in four different areas during ground spraying with a Boomjet™ type sprayer (OC 20 nozzle). Twelve series of aluminium foils (Chromatographic analysis) were placed perpendicular to spray lines, to measure drift at 0, 5, 25, 50 and 100 metres from the treated area. Note that the last three distances correspond to the width of the buffer zones given to sensitive areas and required by the MER.

## 2. Hexazinone

The hexazinone monitoring program was somewhat more limited than that carried out for glyphosate, since hexazinone is not widely used in Quebec and that several spraying techniques are still on trial. Nevertheless, three water samples and seven sediment samples were collected in lotic water.

Residual concentrations in soil were evaluated in an area of ground preparation treated with Boomjet™ sprayers. This type of sprayer give a more uniform application over all the area. Soil was sampled to the depths of 1-10 and 10-20 cm after 10 days, 2 weeks, 1, 2, 3 and 5 months.

A few raspberry and bluberry samples were also collected in areas treated with this herbicide.

## 3. Collaboration in Other Projects

This year, the MER renewed its agreement with the Centre de Toxicologie du Québec (CTQ) to carry on with the biological monitoring program of forest workers initiated last year. The objective of this year program was to determine the extent to which forest workers are exposed to hexazinone spraying done with various type of sprayers such as boom sprayer, Boomjet™ sprayer and spray gun. The technique developed for the study on the operational exposure to glyphosate (urine test) was adapted to carry out this project.

The CTQ concluded this year the study on the effiency of cold water washing to eliminate glyphosate on working clothes. This study revealeded that washing and possibly extended soaking are effective methods for removing adsorbed glyphosate from contaminated clothes.

Finally, to verify the quality of spraying and make sure that buffer zones were respected, the SEE carried out helicopter surveys in collaboration with the Service de la régénération forestière over sectors treated with herbicides in the past.

CONTAMINATION OF PONDS BY FENITROTHION

DURING FORESTRY SPRAYING

W. Ernst, G. Julien and P. Hennigar

Environmental Protection
Environment Canada
45 Alderney Drive

Dartmouth, N.S.
B2Y 2N6

## Introduction

Fenitrothion has been the chemical of choice in spray programs directed at forest defoliators in the Atlantic region for over twenty years. Contamination of watercourses by pesticide is an unavoidable aspect of large block spraying. In a recent review of the environmental effects of forestry fenitrothion use, it was indicated that although most watercourse contamination does not cause major biological impact there are certain water bodies which may be of higher risk (Fairchild et al. 1989). Those are small, still water bodies which are shallow and have reduced forest canopy. Such water bodies are of the type that are most difficult to detect from the air and therefore protect with buffer zones. There is also some evidence to indicate that in some ponds, those with low pH, biological impact may be more serious. Studies have indicated that at simulated operational dosage rates, aquatic invertebrate impacts in bog ponds are of such magnitude as to substantially alter energy flows through those ecosystems (Fairchild 1989). It was necessary to determine the contamination of small ponds by forestry insecticides during operational spray programs in order to assess the risk to the biological systems. This study was an attempt to do that, as well as determine whether there was an attempt on the part of operational spray pilots to avoid deposit on small water bodies.

## Methods

Five ponds were selected within operational spray blocks of the 1989 spruce budworm spray program in New Brunswick. The pond selection criteria were small size (less than 0.5 ha), easy accessibility and central location within the spray block. All blocks were to be treated twice, separated by an approximate 5-10 day interval. The intent was to monitor surface deposit and initial surface water contamination after both the first and second sprays to provide ten discrete deposit events.

Prior to each spray event six flat plate deposit samplers were distributed over the surface of the pond. Deposit samples consisted of styrofoam floats to which had been attached a 20 cm x 25 cm stainless steel plate. Immediately prior to the spray event, plates were cleaned with hexane and a cellulose filter paper was clipped to the plates. Within 15 minutes of the treatment, filters were retrieved and immersed in hexane until analysis.

One litre surface water samples (0-1 cm) were also obtained prior to and at 15 minutes post-spray at the same locations as deposit collectors. The initial extraction (100 mL hexane and shaken vigorously for 5 minutes) was begun within one hour of spray. Final extractions were subsequently performed in the EP laboratory, no longer than two weeks after collection and immediately prior to G.C. analysis (Department of Environment 1979). In addition, water samples were obtained from pond outflows at various times ranging from 0 to 2 h post spray and handled in the same manner.

Where possible, foliage samples from balsam fir were also collected before and immediately after spray at approximately 3/4 crown height. Sufficient needles were removed from collected branches to make up a 50 g sample which was immersed in 100 mL of hexane or maintained in a frozen state until analysis.

Additional measurements were made of windspeed (10 m), air temperature, and water quality parameters (D.O., pH, hardness, alkality). Pond size, depth and outflow rate as well as surrounding vegetation and topography estimates were made..

## Results

Ground observations at the time of spraying indicated that none of the ponds were subject to set-backs and therefore received direct application. Ground observation and review of spray team flight reports revealed that there were problems in flight line alignment in 30% of the observed sprays, resulting in skipped lines or double swathing.

Deposit on filter paper after spray ranged from 24.3 to 0.7 mg/m$^2$. Mean deposits ranged from 17.6 $\pm$ 4.6 mg/m$^2$ on Pond 2 after the first spray event to 1.2 $\pm$ 0.2 mg/$^2$ on Pond 1 after the second spray event. The highest mean deposit represents 84% to 57% of the emitted application rate .

Surface water concentrations of fenitrothion ranged from 2.5 mg/L to 0.006 mg/L. Mean surface water concentrations ranged from 1.5 ± 0.5 mg/L on Pond 2 after the first spray event to 0.04 ± 0.04 mg/L on Pond 4 after the second spray event.

The concentrations of fenitrothion in outflow water were much smaller than those in pond surface water. Table 2 contains the results of outflow water sampling, presented in the mean of two samples. Mean outflow concentrations ranged from 26.0 μg/L to 0.2 μg/L. No consistent pattern in outflow concentration changes in time was evident, however, in five of the seven spray events monitored concentrations increased or remained relatively stable with time up to 2 h after spray. Conifer foliage residues after the first spray event had a mean value of 3.0 μg/g with a standard deviation of 1.7 μg/g (N = 9). Foliage samples taken after the second spray event were lower than those taken after the first with a mean of 2.3 ± 1.5 μg/g (N = 9). Two samples obtained prior to the first spray event contained between 0.57 and 0.51 μg/g fenitrothion while those obtained prior to second spray (N = 6) contained a mean of 0.4 ± 0.2 μg/g.

## Discussion

Although the deposit on flat plate collectors was highly variable, the mean deposit (31.6% of emitted active ingredient) is very comparable to that reported by Armstrong (1977) to be typical of operational forestry spray (25-30% of emitted dosage rate), indicating that the sprays were normal. That deposit and the adjacent foliage deposit which was similar to that previously recorded for forest spraying (Pearce and Ernst 1988) corroborates the visual observation that no attempt was made to protect any of the ponds with buffer zones.

The surface water concentrations of fenitrothion reported here are substantially greater than those previously reported in lentic water after operational spraying. There have been several reports of peak lentic water concentrations which range between 0.2 mg/L and 1.1 mg/L (Mamarbachi *et al*.

1985, Moody et al. 1978, and Morin et al. 1986), however, most studies have reported peak concentrations of less than 0.06 mg/L (Ernst et al. 1980, Kingsbury 1977, Holmes et al. 1984). It must be realized, however, that all previous studies have measured concentrations in large bodies of water such as lakes, many of which may have been protected by buffer zones or at least not directly oversprayed. The maximum mean surface water concentrations observed are within the range of concentrations known to be acutely toxic to salmonid fish (Doe et al. 1988, Sanders et al. 1983, Wells et al. 1979). It must be recognized, however, that the maximum surface water concentrations would be rapidly diluted (Kingsbury 1977,Maguire and Hale 1980) thereby providing a safety factor for fish. Benthic biomass depletions of approximately 50% have been reported in bog ponds which had immediate post-spray concentrations of 42 - 81 µg/L fenitrothion in an experimental ground application (Fairchild 1989). While it has not been determined what effect low water pH has on modifying the magnitude of those impacts, our residue concentrations of 10 to 20 times those of Fairchild (1989) indicate that the impact on benthic invertebrates in small ponds is expected to be substantial and should be determined.

The residue concentrations in outflow water are probably more representative of the well mixed water column concentrations. The outflow concentrations were much lower than those in the ponds they drained. In some cases they exceeded the 20 µg/L threshold for lotic benthic invertebrate impact calculated by Ahern and Leclerc (1981). Furthermore the pattern of residue concentration changes with time in outflow water indicate that the duration of elevated residue concentrations may be somewhat longer than that normally encountered in lotic systems.

**Table 1** Fenitrothion deposit on flat collectors and immediate pond surface water after forest spraying

| Pond | Spray Event | Mean Deposit - mg/m$^2$ (X ± S.D.) | Mean Surface Water Concentration - mg/L (X ± S.D.) |
|---|---|---|---|
| 1 | 1 | 17.6 ± 4.6 | 0.8 ± 0.7 |
| 2 | 1 | 12.8 ± 3.0 | 1.5 ± 0.5 |
| 3 | 1 | 3.3 ± 0.5 | 0.04 ± 0.02 |
| 4 | 1 | 4.2 ± 0.8 | 0.2 ± 0.09 |
| 5 | 1 | 6.6 ± 0.4 | 0.1 ± 0.1 |
| 6 | 1 | 4.2 ± 2.9 | 0.2 ± 0.1 |
| 1 | 2 | 1.2 ± 0.2 | 0.02 ± 0.01 |
| 2 | 2 | 5.8 ± 1.2 | 0.3 ± 0.1 |
| 3 | 2 | 5.9 ± 0.8 | 0.3 ± 0.3 |
| 4 | 2 | 4.8 ± 0.7 | 0.04 ± 0.04 |

Table 2 Fenitrothion concentrations in pond outflow at various times after spray

| Pond | Spray Event | Mean Surface Concentration ($\mu g/L$) | Outflow Concentration* ($\mu g/L$) Pre-Spray | Post-Spray 15 Min. | 30 Min. | 1 h | 2 h |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 40 | 1.1 | 1.7 | 0.8 | 2.2 | 3.4 |
| 5 | 1 | 100 | 0.4 | 24.0 | 15.0 | 26.0 | 23.0 |
| 6 | 1 | 200 | 0.1 | 2.6 | 2.8 | 2.8 | 3.0 |
| 1 | 2 | 20 | N/A | 0.2 | 0.2 | 0.2 | 0.3 |
| 2 | 2 | 300 | <0.05 | 2.9 | 5.0 | 18.0 | 19.0 |
| 3 | 2 | 300 | <0.05 | 12.0 | | | |
| 4 | 2 | 40 | N/A | 13.0 | 12.0 | 8.3 | 8.0 |

* Represents mean of two samples.

## References


Ahern, A. and J. Leclerc. 1981. Comparative study of the impact of Matacil and fenitrothion on benthic populations in running water. Bio-Conseil Inc., Québec. 94 p.

Armstrong, J.A. 1977. Relationship between the rates of pesticide application and the quantity deposited on the forest IN Fenitrothion: The long-term effects of its use in forest ecosystems, Proc. Symp. Ottawa, Canada, 20-22 April 1977, National Research Council Canada, Report #16073.

Department of Environment. 1979. Laboratory manual. Department of Environment, Environmental Protection, Department of Fisheries and Oceans, Resource Services, Government of Canada.

Doe, K.G., W.R. Ernst, W.R. Parker, G. Julien and P. Hennigar. 1988. Influence of pH on the acute lethality of fenitrothion 2,4-D and aminocarb and some pH altered sublethal effects of aminocarb to rainbow trout (Salmo gairdneri). Can. J. Fish. Aquat. Sci. 45: 287-293.

Ernst, W., G. Julien, K. Doe, and R. Parker. 1980. environmental investigations of the 1980 spruce budworm spray program in New Brunswick. Env. Can. Surv. Rep. EPS-5-AR-81-3. 46 p.

Fairchild, W.L., W.R. Ernst and V.M. Mallet. 1989. Fenitrothion effects on aquatic organisms IN Environmental effects of fenitrothion use in Forestry eds. W.R. Ernst, P.A. Pearce and T.L. Pollock. Environment Canada Report #EN40-370/1989C. ISBN 0-662-16854-2.

Holmes, S.B., P.D. Kingsbury, G. Mamarbachi, and P. Mathieu. 1984. Distribution of fenitrothion residues in brook trout (Salvelinus fontinalis) and lake trout (Salvelinus namaycush) tissues following aerial applications to Lac Ste Anne, Québec. Bull. Environ. Contam. Toxicol. 33: 468-475.

Kingsbury, P.D. 1977a. Fenitrothion in a lake ecosystem. Can. For. Serv. Chem. Control Res. Inst. Rep. CC-X-146. 123 p.

Maguire, R.J. and E.J. Hale. 1980. Fenitrothion sprayed on a pond: kinetics of its distribution and transformation in water and sediment. J. Agric. Food. Chem. 28: 372-378.

Mamarbachi, G.R., Dostie, and P.M. Marotte. 1985. Persistence des residuous d'aminocarbe et de fénitrothion dans les eaux naturelles en milieu forestier. Ministere de L'énergie et des ressources, Québec. 19 p.

Moody, R.P., R. Greenhalgh, L. Lockhart, and P. Weinberger. 1978. The fate of fenitrothion in an aquatic ecosystem. Bull. Environ. Contam. Toxicol. 19: 8-14.

Morin, R., g. Gaboury, and G. Mamarbachi. 1986. Fenitrothion and aminocarb residues in water and balsam fir foliage following spruce budworm spraying programs in Québec, 1979 to 1982. Bull. Environ. Contam. Toxicol. 36: 622-628.

Pierce, W.L. and W.R. Ernst. 1988. Assessment of the variability of fenitrothion deposits on conifer foliage from a forestry spray program. Environmental Protection, Environment Canada Surveillance Report EPS-5-AR-88-9.

Sanders, H.O., M.T. Findley, and J.B. Hunn. 1983. Acute toxicity of 6 forest insecticides to 3 aquatic invertebrates and 4 fishes. U.S. Fish. Wildl. Serv. Tech. Pap. No. 110. p. 1-5.

Wells, P.G., R.A. Matheson, D.A. Lord, and K.G. Doe. 1979. Environmental monitoring of the 1978 spruce budworm spray program in New Brunswick, Canada - field sampling and aquatic toxicity studies with fish. Env. Can. Surv. Rep. EPS-5-AR-79-1. 14 p.

Agriculture Canada

Food Production and Inspection Branch
Direction générale, Production et inspection des aliments

Pesticides Directorate
Ottawa, Ontario
K1A 0C6
TEL: (613) 993-4544
FAX: (613) 998-1312

Your file Votre référence

Our file Notre référence

November 10, 1989

MEMORANDUM TO: Participants in the Workshop on Evaluation of B.t. Forestry Products - Pest Control Forum, November 16, 1989, Ottawa

FROM: Jean Irvin
Workshop Coordinator

---

Thank you for agreeing to participate in the workshop concerning methods for the evaluation of B.t. products for registration purposes. The initial aim of this workshop is to delineate/clarify the key issues/questions related to assessment of the merit and value of B.t. products; - the ultimate goal is the development of valid but flexible guidelines for field testing and overall assessment of B.t. forestry products. The following are a few questions which I would like you to consider as a starting point for our discussions.

1. Are there any established guidelines/protocols for efficacy testing of aerially applied foresty insecticides? (If so, what is their basis?)

2. Are there factors unique to the aerial application and testing of B.t. products which must be considered in the design of experimental protocols?

3. There have been considerable advances in our understanding of and methodology for spray efficacy/spray technology. (e.g. generation of optimum droplet size spectrum; relationship to spray efficacy; measurement of spray deposit on foliar target). How should these modern methods be incorporated into research protocols?

4. What data are essential for registration purposes?

5. Should the data requirements for registration reflect the data expectations/performance requirements of the end user?

6. How comprehensive should efficacy testing be? E.g. to what extent do 'new' formulations of 'old' products require testing?

7. Is testing in numerous provincial jurisdictions necessary for registration purposes?

8. Should operational trials be a necessary requirement for registration?

9. Aside from efficacy data, what other factors are relevant to product registration?

   - physical and handling characteristics of the product?
   - field persistence of formulation?
   - bioassay data?

10. What is the industry view of the registration requirements?

Please feel free to contribute other points, questions.

JI/aw
0416f

## ROLE AND MANDATE OF THE NATIONAL FOREST PEST CONTROL FORUM

The National Forest Pest Control Forum has been in existence since 1973 and represents the only national meeting when all forest pest management and pesticide specialists can meet to exchange information and discuss issues concerning their current year and forecast programs. The Forum replaced the long-standing Interdepartmental Committee on Forest Spraying Operations which carried out a similar function but with little or no provincial representation. The Interdepartmental Committee was originally formed to review and recommend federal involvement in and funding of pest control operations carried out in the late 1950's and 1960's.

In recent years, the Forum has permitted an exchange of information concerning pest management operations and research. This has been the principal function of the Forum.

At the Forum meeting at Ottawa, November 19-21, 1985, a Forum Mandate Review Committee was proposed because there were several attendees who felt that the Forum could and should be more than an information exchange session. The committee, consisting of B. H. McGauley (OMNR), G. Munro (MDNR), L. Dorais (QMER), G. M. Howse (CFS) and E. Kettela (CFS) was subsequently endorsed by the Director General, Research and Technical Services. The terms of reference for the committee as outlined in a letter dated December 17, 1985 from the Program Manager, Protection, to the Director General were as follows:

- i) examine the mandate of the Annual Forest Pest Control Forum.
- ii) consider a change in the mandate of the Forum,
- iii) if a change to the mandate is considered necessary, make recommendations for implementation of a change,
- iv) discuss and make recommendations for broadening of the Forum to include vegetation management research.

The committee met in May and August 1986 to address the terms of reference and prepare a proposed goal and mandate statement for presentation at the 1986 Forum. The proposal was debated at length and modified to take into consideration the comments of the attendees. The modified role and mandate as agreed upon at the 1986 National Forest Pest Control Forum are outlined in this paper.

### 1.0 National Forest Pest Control Forum:

A National Forest Pest Control Forum will be conducted each year under the aegis of the Canadian Forestry Service.

## 2.0 Goal:

The goal of the Forum is to review significant pest conditions, pest control operations and pest management/pesticide related issues.

The word "pest" is interpreted in its broader context and includes insects, diseases and weeds. Pesticides include insecticides, fungicides and herbicides.

## 3.0 Activities of the Forum:

The National Forest Pest Control Forum will undertake the following activities:

1. exchange information on significant insect and disease distribution and forecast spread in Canada;
2. review the pest management activities, environmental monitoring, assessment of current year insect and disease control programs, overview of the herbicide program and outline of issues relating to any pesticides;
3. outline pest control operations proposed for the next calendar year;
4. apprise of current research relating to pesticide application, pesticide and silvicultural or other research which would reduce future pest outbreak potential;
5. receive an annual update on forestry pesticides which are registered and pending registration and discuss product by product the gaps preventing full registration by Agriculture Canada;
6. gather statistical information from each province in a standardized format (to be developed federally and agreed to by the provinces) on the operational forest pesticide use (ground and aerial);
7. debate specific pest management/pesticide issues and present recommendations in an Executive Summary.

## 4.0 Membership:

A significant change in the activity of the Forum is point #7 in Section 3.0. A Steering Committee will be needed to prepare issue statements for discussion. The Forum attendees will debate the issues openly and then vote. Motions which are carried will constitute recommendations which will be included in the Executive Summary which attendees can subsequently use as they see fit.

### 4.1 STEERING COMMITTEE MEMBERS:

| | |
|---|---|
| Provincial forestry representatives: | . 1 from each of 10 provinces |
| Canadian Forestry Service: | . 1 from each of 2 institutes<br>. 1 from each of 6 regional establishments<br>. 2 from CFS Headquarters |
| Executive Secretary: | . FIDS - CFS Headquarters |

## 5.0 Attendance at the Forum:

The following will be invited:

- provincial pest control staff
- provincial and federal government health, wildlife, fisheries and oceans, and environment staff
- border-state and federal U.S. pesticide/pest control staff
- federal government survey, research and pesticide regulatory staff
- representatives of the forest industry, both at the organizational and company level
- researchers - provincial government
  - private research labs
  - universities and colleges
- others as approved by the voting membership (e.g. Eastern Spruce Budworm Council representative, forestry consultants).

The following will not be invited:

- media
- environmentalist groups
- pesticide industry representatives.

## 6.0 Forum Outputs:

### 6.1 Annual Report:

The Forum provides an opportunity for information exchange and as such, will continue to produce an Annual Report. The Annual Report will contain detailed written submissions by participants, a list of attendees and addresses and an executive summary with recommendations (see below). Each member of the steering committee will receive 2 copies of the Annual Report (one copy catalogued in a library and the other retained by the member) and one copy will be sent to each attendee. Those who are absent but entitled to an invitation (see Section 5.0) will receive a copy if a written request is received.

### 6.2 Executive Summary:

An executive summary (2-3 pages) will be prepared each year by the steering committee and include a brief overview of insect/disease distribution, pest management programs, and proposed pest management programs, plus a significant treatment of issue statements with recommendations. The executive summary will be distributed to Forum attendees and be included in the Annual Report.

## 7.0 Modus Operandi:

The Forum program will be chaired cooperatively by the federal and provincial program assistants (see Section 8.0).

## 8.0 Program:

Detailed reports of pest control programs and research will be required for the Annual Report. However, the Forum program will be streamlined to permit additional time for discussion. The existing time frame of 3 days of reports and workshops will be retained. The 3-day program will include a half-day on operational pest control reports, half-day on pest distribution, half-day on research, environmental monitoring and health concerns, and a half-day on issue debate and preparation of recommendations. With this tight time frame, it will be necessary for speakers to be focused and brief. Speakers will touch on highlights and identify issues which could be discussed during the issue debate period.

The program will be prepared by the Executive Secretary with assistance from the provincial representative and corresponding CFS representative. It is recognized that some CFS organizations span several provinces and may be called upon more frequently than others. The Ontario Ministry of Natural Resources and Great Lakes Forestry Centre will assist the Executive Secretary in 1987. Future program organizers are proposed as follows:

| YEAR | ORGANIZERS | CFS |
|---|---|---|
| 1 | Ontario | Sault Ste. Marie |
| 2 | British Columbia | Victoria |
| 3 | Quebec | Quebec |
| 4 | Alberta | Edmonton |
| 5 | New Brunswick/P.E.I. | Fredericton |
| 6 | Saskatchewan | Edmonton |
| 7 | Nova Scotia | Fredericton |
| 8 | Manitoba | Edmonton |
| 9 | Newfoundland | St. John's |

## 9.0 Location:

The Forum will remain in Ottawa in 1987 and 1988. However, in 1988 serious consideration should be given to holding the Forum in other provinces on an annual basis beginning in 1989.

## 10.0 Date:

The Forum should continue to be held during the third week of November.

## 11.0 Budget:

The Forum will continue to function under the aegis of the Canadian Forestry Service and incidental expenses (e.g. postage, publication of proceedings, meeting room) will be covered by the Federal government.

## RÔLE ET MANDAT DU FORUM NATIONAL SUR LA RÉPRESSION DES RAVAGEURS FORESTIERS

Le Forum national sur la répression des ravageurs forestiers, créé en 1973, est la seule occasion, pour tous les spécialistes de la lutte antiparasitaire au pays, de se rencontrer pour échanger des renseignements et discuter de leurs programmes en cours et prévus. Il remplace l'ancien Comité interministériel des pulvérisations forestières qui remplissait des fonctions semblables, mais au sein duquel les provinces étaient peu ou pas représentées. À l'origine, le Comité avait pour mission d'étudier et de recommander la participation du gouvernement fédéral à la lutte antiparasitaire et à son financement, durant la fin des années 1950 et les années 1960.

Ces dernières années, le Forum a permis d'échanger des données sur les ravageurs, la lutte qu'on leur fait et la recherche dans le domaine; il s'agit de sa principale fonction.

Lors du Forum qui s'est tenu à Ottawa du 19 au 21 novembre 1985, les participants ont proposé la création d'un comité d'étude du mandat du Forum, car, pour plusieurs d'entre eux, la recontre pouvait et devait être plus qu'une séance d'information. Le comité, formé de B.H. McGauley (MRNO), de L. Dorais (MERQ), de G.M. Howse (SCF) et de E. Kettela (SCF), a ensuite été appuyé par le directeur général, Services techniques et recherche; d'après la lettre (du 17 décembre 1985) du gestionnaire du Programme de protection au directeur général, il était chargé:

(i) d'étudier le mandat du Forum annuel sur la répression des ravageurs forestiers;

(ii) d'envisager sa modification;

(iii) si elle est nécessaire, de faire les recommandations pertinentes;

(iv) de discuter de la possibilité d'étendre le mandat du Forum à la recherche sur l'aménagement des végétaux et de faire les recommandations pertinentes.

Le Comité s'est recontré en mai et en août 1986 pour étudier la question; il a préparé un énoncé provisoire des objectifs et du mandat du Forum, énoncé qui a été débattu en 1986 et modifié en fonction des observations des participants. Voici donc un aperçu du rôle et du mandat nouveaux.

## 1.0 Forum national sur la répression des ravageurs forestiers:

Il sera tenu, chaque année, sous les auspices du Services canadien des forêts.

## 2.0 Objet:

Étudier les principaux ravageurs, la lutte qu'on leur fait et les questions connexes (lutte/pesticides).

Le mot "ravageur" est utilisé dans son acception la plus large et englobe les insectes, les maladies et les mauvaises herbes; les pesticides incluent les insecticides, les fongicides et les herbicides.

## 3.0 Activités:

Les activités du Forum sont les suivantes:

1. Échanger des renseignements sur la répartition et la progression prévue des infestations et des maladies importantes au Canada;

2. Passer en revue la lutte antiparasitaire, la surveillance de l'environnement, l'évaluation des programmes de lutte contre les insectes et les maladies (année en cours), les grandes lignes du programme d'épandage d'herbicides et l'aperçu des questions relatives au pesticides;

3. Énoncer les mesures de lutte proposées pour la prochaine année civile;

4. Évaluer la recherche actuelle (épandage de pesticides, pesticides comme tels, sylviculture, etc.) qui permettrait de réduire les possibilités d'infestations futures;

5. Recevoir une mise à jour annuelle des pesticides forestiers homologués et en voie de l'être; discuter, dans chaque cas, des points qui empêchent leur homologation complète par Agriculture Canada;

6. Recueillir, de chaque province, des statistiques (présentation normalisée établie par le gouvernement fédéral et approuvée par les provinces) sur l'usage de pesticides dans les forêts (épandage au sol et aérien);

7. Discuter de questions précises de lutte antiparasitaire et présenter des recommandations dans un sommaire.

## 4.0 Composition:

Le point n° 7 de la section 3.0 représente une grande modification des activités du Forum. Il faudra charger un comité directeur de rédiger des énoncés des questions dont les participants au Forum se serviront pour en discuter ouvertement, avant de passer au vote. Les motions adoptées deviendront les reommandations du sommaire que les participants pourront ensuite utiliser à leur gré.

### 4.1 MEMBRES DU COMITÉ DIRECTEUR:

| | |
|---|---|
| Représentants des services forestiers provinciaux: | - 1 par province (10) |
| Représentants du Service canadien des forêts: | - 1 par institut (2)<br>- 1 par bureau régional (6)<br>- 2 de l'administration centrale |
| Secrétaire de direction: | - RIMA - administration centrale du SCF |

## 5.0 Participants invités:

Pourront participer au Forum:

- les préposés à la lutte antiparasitaire au palier provincial
- les fonctionnaires fédéraux et provinciaux (santé, faune et flore, pêches et océans, environnement)
- le personnel chargé de la lutte antiparasitaire au gouvernement américain et dans les États avoisinants
- les préposés fédéraux aux relevés, à la recherche et à la réglementation des pesticides
- les représentants de l'industrie forestière (sociétés individuelles et regroupées)
- les chercheurs:
  - des gouvernements provinciaux,
  - des laboratoires privés de recherche,
  - des établissements post-secondaires
- d'autres personnes, comme approuvé par les membres votants (par ex.: représentants du Conseil de la tordeuse des bourgeons de l'épinette, experts-conseils en foresterie).

N'y seront pas conviés:

- les médias,
- les groupes écologiques,
- l'industries des pesticides.

## 6.0 Produits:

### 6.1 RAPPORT ANNUEL:

Le Forum permet l'échange de renseignements. Par conséquent, on continuera de produire un rapport annuel qui contiendra les exposés écrits détaillés des intervenants, leur nom et leur adresse et un sommaire incluant des recommandations (voir ci-dessous). Chaque membre du comité directeur en recevra deux copies (une cataloguée pour la bibliothèque, une pour son usage personnel); tous les autres participants en recevront une: les invités absents (voir liste, section 5.0) en recevront une également, s'ils en font la demande par écrit.

### 6.2 SOMMAIRE:

Un sommaire (2-3 pages) sera rédigé chaque année par le comité directeur et donnera en bref la répartition des insectes et des maladies, les programmes en cours et proposés de lutte antiparasitaire ainsi qu'un énoncé des questions et des recommandations. Il sera remis aux participants et inclus dans le rapport annuel.

## 7.0 Fonctionnement:

Le Forum sera présidé conjointement aux paliers fédéral et provincial (voir section 8.0).

## 8.0 Ordre du jour:

Pour le rapport annuel, il faut des exposés détaillés des programmes et de la recherche en matière de lutte antiparasitaire. Toutefois, l'ordre du jour sera rationalisé pour allouer plus de temps aux discussions. Le Forum continuera à durer trois jours (exposés et ateliers), mais on consacrera une demi-journée aux comptes-rendus sur la lutte antiparasitaire opérationnelle, une demi-journée à la répartition des ravageurs, une demi-journée à la recherche, à la surveillance environnementale et aux questions de santé ainsi qu'une demi-journée aux discussions et à la préparation des recommandations. Vu ce calendrier très chargé, les exposés devront être à propos et brefs, donner les grandes lignes et souligner des points de discussion, pour la période prévue à cette fin.

L'ordre du jour sera établi par le secrétaire de direction, de concert avec le représentant provincial et celui du bureau correspondant du SCF, soit le ministère des Ressources naturelles de l'Ontario et le Centre de foresterie des Grands-lacs, en 1987. Évidemment, certains bureaux du SCF regroupent plusieurs provinces; par conséquent, on y aura probablement recours plus souvent. Les responsables provisoires des forums à venir sont donc les suivants.

| ANNÉE | ORGANISATEUR | SCF |
|---|---|---|
| 1 | Ontario | Sault Ste Marie |
| 2 | Colombie-Britannique | Victoria |
| 3 | Québec | Québec |
| 4 | Alberta | Edmonton |
| 5 | Nouveau-Brunswick/<br>Île-du-Prince-Édouard | Frédéricton |
| 6 | Saskatchewan | Edmonton |
| 7 | Nouvelle-Écosse | Frédéricton |
| 8 | Manitoba | Edmonton |
| 9 | Terre-Neuve | St. Jean |

## 9.0 Lieu:

Le Forum se déroulera encore à Ottawa en 1987 et en 1988, mais on envisagera sérieusement de le tenir dans d'autres provinces, tous les ans, à compter de 1989.

## 10.0 Dates:

Elles devraient continuer à tomber durant la troisième semaine de novembre.

## 11.0 **Budget:**

Le Forum continuera à se tenir sous les auspices du Services canadien des forêts, et les frais accessoires (par ex.: affranchissement, publication de comptes-rendus des rencontres, salle de réunion) seront supportés par le gouvernement fédéral.

# Steering Committee Members
# Forest Pest Control Forum, 1989

| Location | Provincial Representative | Federal Representative |
|---|---|---|
| British Columbia | R.F. DeBoo | G.A. Van Sickle |
| Alberta | J. Benson | H. Cerezke |
| Saskatchewan | M. Pandila | H. Cerezke |
| Manitoba | A.R. Westwood | H. Cerezke |
| Ontario | G. Munro (Chairperson Issues) | G.M. Howse |
| | J. Churcher | |
| Quebec | M. Auger | D. Lachance |
| | L. Dorais | |
| New Brunswick | N.E. Carter | L. Magasi |
| Nova Scotia | T. Smith | L. Magasi |
| Newfoundland | H. Crummey | J. Hudak |
| FPMI | | E. Caldwell |
| PNFI | | M. Power |
| FC Headquarters | | B.H. Moody |
| | | D. Rousseau (Chairperson) |

## Issues Debate and Recommendations

Under the guidance of the Issue Debate Chairperson, several issues and recommendations were openly debated. The outcome of the debate was that two resolutions/statements were developed and ratified by over 80% of the attendees. The two issues were:

1. WHEREAS Canadian tree nurseries have demonstrated a need for Oxyfluorfen (Goal) herbicide in producing seedlings for forest regeneration; and

   WHEREAS Oxyfluorfen is a preferred product; and

   WHEREAS Oxyfluorfen registration will encourage replacement of a number of herbicides used in nurseries as well as a reduction in the quantity of active ingredient used;

   THEREFORE BE IT RESOLVED THAT The Forest Pest Control Forum request that Agriculture Canada give priority to reviewing the imminent registration request for the herbicide Goal for use in conifer tree nurseries.

2. WHEREAS In 1988, The 16th Annual Pest Control Forum recommended the formation of a group to deal with the implementation of recommendation #9 of the Forest Sector Strategy for Canada; and

   WHEREAS The Canadian Council of Forest Ministers (CCFM) at its recent meeting of October 89 formally sanctioned the forestry pesticides caucus to meet this need;

   THEREFORE BE IT RESOLVED THAT the Forest Pest Control Forum urge CCFM, the Canadian Pulp and Paper Association (CPPA) and other stakeholders to continue support of the "Forestry Pesticides Caucus"; and that the Forest Pest Control Forum use "The Forestry Pesticides Caucus" as a means to express its concerns and recommendations with regards to forest pest management issues.

# Forest Pest Control Forum
# Colloque sur la répression des ravageurs forestiers

Conference Centre, Ottawa
Centre de conférences, Ottawa

December 4, 1989

Dr. Roy
Agriculture Canada
Plant Health and Plant
Products Directorate
Neatby Building
960 Carling Avenue
Ottawa, Ontario
K1A 0C6

Dear Dr. Roy:

The National Forest Pest Control Forum has adopted as part of its agenda, an issue debate session designed to allow for open discussion of issues and concerns associated with Forest Pest Management in Canada.

Last year at the 16th Annual Forest Pest Control Forum a resolution was past with respect to the Agriculture Canada policy on Gypsy Moth. The forum steering committee wrote to you last summer in this regard. We have taken the liberty of enclosing a copy of that letter for your reference.

At the steering committee meeting associated with the 17th Annual Forest Pest Control Forum, November 13, 1989, this issue was discussed again in light of the fact that we have received no response to date. Part of this discussion included the establishment of a working group made up of concerned forestry representatives, to prepare a list of recommendations with respect to this policy.

The purpose of this letter is to advise you of the concern expressed by the forestry community represented by the Forest Pest Control Forum and to ask you for a confirmation of your willingness to consider the input from our working group. Like all resolutions passed at the forum, this represents the concerns and wishes of over 80% of attendees as mandated by our terms of reference.

We look forward to a response with respect to our potential input into Agriculture Canada's Gypsy Moth Policy.

Yours truly,

Denyse Rousseau
Chairperson
Steering Committee

Geoff Munro
Issue Debate Chairman

Attachment

Secretariat/Secrétariat: Canadian Forestry Service/Service canadien des forêts
Hull, Quebec K1A 1G5

Forest Pest Control Forum
Colloque sur la répression
des ravageurs forestiers
Conference Centre, Ottawa
Centre de conférences, Ottawa

April 7, 1989

Dr. Roy
Agriculture Canada
Plant Health and Plant
Products Directorate
Neatby Building
960 Carling Avenue
Ottawa, Ontario
K1A 0C6

Dear Dr. Roy:

The National Forest Pest Control Forum has adopted as part of its agenda an issue debate session designed to allow for open discussion of issues and concerns associated with Forest Pest Management in Canada. One item, that was raised at the 1988 annual meeting was the Agriculture Canada Gypsy Moth Policy and the impact of that policy on forest managers.

This issue was discussed at length and the recommendation contained in this letter has the support of over 80% of the attendees of the 1988 Forest Pest Control Forum, as is required by our terms of reference.

ISSUE/RECOMMENDATION:

"Whereas Agriculture Canada, Plant Health Directorate is to be congratulated for the development of a Gypsy Moth Policy, it none-the-less appears to have been made unilaterally without consultation with the Federal and Provincial Forestry Agencies, and whereas these agencies have real concerns about the policy, be it resolved that the National Forest Pest Control Forum request that Agriculture Canada consider this policy only to be a proposal open for negotiations with Federal and Provincial Forestry Agencies and that a revised policy be developed with the input from these agencies by the end of 1989."

........2

Secretariat/Secrétariat: Canadian Forestry Service/Service canadien des forêts
Hull, Quebec K1A 1G5

Our members look forward to the opportunity to cooperate with your staff on this subject and we anticipate your response in this regard.

Ed Kondo
Chairman
Steering Committee
National Forest Pest
Control Forum

Geoff Munro
Issue Debate Chairman
National Forest Pest
Control Forum

GM/dab

# Forest Pest Control Forum
# Colloque sur la répression des ravageurs forestiers

Conference Centre, Ottawa
Centre de conférences, Ottawa

December 15, 1989

Mr. W. Ormrod
Agriculture Canada
Pesticides Directorate
Room 467, Sir John Carling Building
930 Carling Avenue
Ottawa, Ontario
K1A 0C5

Dear Mr. Ormrod:

The National Forest Pest Control Forum has adopted as part of its agenda, an issue debate session designed to allow for open discussion of issues and concerns associated with forest pest management in Canada. One item that was raised at the 1989 annual meeting was the concern over the availability of registered pesticides for forest nurseries generally and the pending registration request for Oxyfluorfen (Goal herbicide) specifically.

This issue was discussed at length and the recommendation contained in this letter has the support of over 80% of the attendees of the 1989 Forest Pest Control Forum, as is required by our terms of reference.

ISSUE / RECOMMENDATION:

"WHEREAS Canadian tree nurseries have demonstrated a need for Oxyfluorfen (Goal) herbicide in producing seedlings for forest regeneration; and

WHEREAS Oxyfluorfen is a preferred product; and

WHEREAS Oxyfluorfen registration will encourage replacement of a number of herbicides used in nurseries as well as a reduction in the quantity of active ingredient used;

THEREFORE BE IT RESOLVED THAT The Forest Pest Control Forum request that Agriculture Canada give priority to reviewing the imminent registration request for the herbicide Goal for use in conifer tree nurseries."

A significant amount of background information was submitted to the forum as support for this recommendation. We have taken the initiative of forwarding this to you in the form of a background paper to support the request.

Secretariat/Secrétariat: Canadian Forestry Service/Service canadien des forêts
Hull, Quebec K1A 1G5

As chairpersons of the Steering Committee and the Issues Debate Session of the Forum, we respectfully submit to you the recommendation. We look forward to your reply which will be conveyed to all members who attended this year's Forest Pest Control Forum.

Yours truly,

Denyse Rousseau
Chairperson
Steering Committee

Geoff Munro
Issue Debate Chairman

Attachment

## BACKGROUND STATEMENT

Weeds are a major problem in both bareroot and container nurseries. During 1988, 230 million bareroot and 630 million container seedlings were shipped for planting with a total value of about $123 million. Handweeding, mechanical, and chemical weed control methods were utilized with unsatisfactory results. Handweeding costs were about $2.3 million but this weed control method resulted in loss of seedlings, about 35 million. Also, it was difficult to find the labour force to conduct handweeding within the narrow window required to achieve satisfactory weed control. Although there are various herbicides registered for forest tree nursery use pattern, there is "no" registered herbicide that can be applied over actively growing conifer seedlings that would provide satisfactory broad leaf weed control. Fusilade will provide postemergent grass control. Goal can be applied over actively growing conifer seedlings with good crop tolerance while providing excellent postemergent and preemergent weed control.

Weeds have resulted in extremely high handweeding costs, increased grading cost, provision of an ecological niche for harmful organisms, and a delay in plantation establishment and therefore subsequent delay in the harvesting schedule. The cost of the weed problem in forest tree nurseries during 1988 was about $10 million which includes weed control practices - handweeding, chemical, mechanical, loss of seedlings, and increased grading costs. It should be emphasized that weed control practices during 1988 did "not" solve weed problems.

If goal received registration for tree nursery use pattern then:

1) the combination of Goal with a "few" other herbicides and limited alternative weed control measures (i.e. handweeding) would provide excellent weed control;

2) the number of herbicide products used would be reduced (i.e. Gramoxone);

3) the total amount of active ingredient would be reduced;

4) the cost of weed control would be about $0.5 million;

5) the quality of tree seedlings would be improved;

6) there would be a reduction in the loss of seedlings;

7) production costs would be reduced;

8) elimination of an ecological niche for harmful organisms;

9) coordination of seedling production and plantation establishment would be improved.

The Canadian Forest Nursery Weed Management Association has contracted Deloitte, Haskins and Sells to write an economic benefit assessment of weed control in tree nursery production. The document should be completed in 1989. Submission to Agriculture Canada - Pesticide Directorate for registration of Goal for tree nursery use pattern should be completed in January 1990.

Agriculture Canada

Food Production and Inspection Branch | Direction générale, Production et inspection des aliments

Pesticides Directorate
Ottawa, Ontario
K1A 0C6
TEL: (613) 993-4544
FAX: (613) 998-1312

Your file Votre référence

Our file Notre référence

January 5, 1990

3305-1 OXR

Messrs. D. Rousseau & G. Munro
Secretariat
Forest Pest Control Forum
Canadian Forestry Service
Hull, Quebec
K1A 1G5

Dear Messrs. Rousseau and Munro:

Your letter of December 15, 1989, addressed to Mr. Wayne Ormrod, along with the attached background statement have been forwarded to me for response.

We recognize that herbicide options available for weed control in forest nurseries are limited. As a result, extra effort has been directed to making Fusilade and Devrinol available for use in forest nurseries. We are not prepared to consider the introduction of oxyflurofen (GOAL) herbicide for use in forest nurseries without adequate assessment of possible health effects and benefit information.

As you may be aware, oxyflurofen has been granted a restricted use registration for weed control in onions. The use of this herbicide in onions was considered essential, as evidenced by the agronomic and economic benefit information presented in the Discussion Document published by the Department. This document provided rationale for proceeding with registration. Although gaps in the oxyflurofen data package were identified, Agriculture Canada considered that the use of oxyflurofen in onions posed an acceptable level of risk when benefits were considered.

It is becoming extremely important to be able to support such decisions with good benefit information. For this reason, myself and colleagues in the Directorate, on occasion, put forth the suggestion to members of the forestry nursery fraternity that benefit data be generated. With this information, a best-balanced decision could be made.

A further aspect, and one that brings an added dimension to the use of oxyflurofen in forest nurseries, is that of worker exposure during re-entry to treated areas (i.e. the handling of treated seedlings). This element was heightened in 1987 when workers at the Nova Scotia Lands and Forests Strathmore Nursery reportedly developed health related problems in the form of skin rashes following use of oxyflurofen for research purposes. Although available information did not find the herbicide as the causal agent, the need to address such questions and provide answers is reasonable.

As a result, Nova Scotia Lands and Forests had initiated a research program on currently registered products to define residue levels on seedlings and to generate re-entry data. The need for this type of data for Goal is evident.

In summary, a decision on the use of oxyflurofen in forest nurseries would be better supported thorugh the development of both benefit and worker exposure data. We believe the proponents of uses for pesticides should be in the best position to generate some of this specific use data, and we are encouraged by the efforts in Canada to generate such data on this and other regulatory decisions.

This schedule of events, while tentative is, we believe, a fair reflection of the realities involved. We do not forsee registration of GOAL for use in forest nurseries in the short term future, e.g., 1990 use season.

We are not sure that this response will totally satisfy your needs and requirements. However, we cannot realistically commit to an instant registration, as per your request.

We would be pleased to chat further with you on the overall question if you feel it would be useful.

Sincerely,

Alan MacDonald

A.S. MacDonald
Product Manager
Herbicides and Plant Growth Regulators
Product Management Division

ASM/bb
0890h

c.c. S.W. Ormrod
M.P. Stewart

ACAFA

# STOP!!!!

## MARK YOUR CALENDAR NOW FOR OCTOBER 8 - 12 1990

That's when you should be at the Winnipeg Convention Centre for the **1990 Associate Committee on Agricultural and Forestry Aviation Conference!**

Take part in 4 days of discussions, workshops and exhibits on aircraft in agriculture and forestry: **"Industries' Future Needs."**

Exchange information and make recommendations to the National Research Council.

**WHAT TO EXPECT AT ACAFA' 90**
October 8 - 12, 1990 in Winnipeg

**WORKSHOPS**
A series of three workshops will run concurrently. Major topics include: Aerial Photography and Remote Sensing; Fire Management; and Aerial Distribution.

**POSTER/TRADE SHOW**
Posters and exhibits will be displayed in an area adjacent to where the workshops are being held. Registration and coffee breaks will also be held in the poster room. Information on either is available from Dave Smith (204) 945 3953.

**REGISTRATION/ ACCOMMODATION**
Your second notice will include a copy of the program, registration information and our recommendation for your best accommodation.

**PARTNERS/ SOCIAL PROGRAMS**
Banquets, tours and airport displays are but a few of the plans we've already made as part of ACAFA '90. Plan to bring your partner along – a special historical fashion show, tours and great shopping are among the items included in the partners program.

ACAFA

# ATTENTION!!!

## ENCERCLEZ LES DATES DU 8 AU 12 OCTOBRE 1990 SUR VOTRE CALENDRIER DÈS MAINTENANT!

C'est à ce moment-là que vous devriez être au Winnipeg Convention Centre pour le **colloque de 1990 du comité Associé de L'aviation Agricole et Forestière.**

Participez à 4 jours de discussions, d'ateliers et d'expositions sur les aéronefs en aviation agricole et forestière: **"Besoins futurs de l'industrie."**

Échangez de l'information et faites des recommandations au Conseil national de recherches.

**À QUOI S'ATTENDRE AU COLLOQUE DE 90 DU CAAAF**
8 - 12 Octobre 1990, à Winnipeg

**ATELIERS**
Trois ateliers se tiendront simultanément. Ils porteront sur les thèmes suivants : la photographie aérienne et la télédétection; la gestion des feux; et la distribution aérienne.

**AFFICHES/SALON PROFESSIONEL**
Des affiches de même que des produits et services seront exposés dans une salle adjacent à l'endroit où se tiendront les ateliers. L'inscription et les pauses cafés se tiendront également dans cette salle. On peut obtenir de l'information à ces sujets auprès de Dave Smith (204) 945-3358

**INSCRIPTION/HÉBERGEMENT**
La deuxième circulaire qui vous sera envoyée contiendra une copie du programme, des renseignements sur l'inscription et nos recommandations quant aux meilleurs lieux d'hébergement.

**PROGRAMME POUR CONJOINTES/ ACTIVITÉS SOCIALS**
Des banquets, des excursions et des expositions à l'aéroport ne sont que quelques-unes des activités que nous avons déjà prévues dans le cadre du colloque de 90 du CAAAF. Prévoyez emmener votre, car un programme est également prévu pour personnes qui accompagnont les délégues. Elles pourront assister à un défilé de mode historique spécial, participer à des visites organisées et faire des achats intéressants