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Report of the Sixteenth Annual Forest Pest Control Forum Government Conference Centre Ottawa, Ontario November 15-17, 1988

Rapport du seizième colloque annuel sur la répression des ravageurs forestiers Centre des conférences du Gouvernement Ottawa (Ontario) Du 15 au 17 novembre 1988

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Forêts Canada
Ottawa (Ontario)
Mars 1989

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Sixteenth Annual Forest Pest Control Forum
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Seizième colloque annuel
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Ottawa (Ontario)
Du 15 au 17 novembre 1988

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)
January 1989/Janvier 1989

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II. SPRUCE BUDWORM DISTRIBUTION AND PEST MANAGEMENT/ RÉPARTITION DE LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE ET GESTION DES RAVAGEURS

Note: Status of Spruce Budworm in other provinces given in Pest Reports listed in session on General Forest Pest Status and Pest Management

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

Newfoundland Department of Environment and Lands
R. Martin, 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
Louis Dorais, Quebec
Bruno Boulet, Quebec
Clement Bordeleau, Quebec

Ontario Ministry of Natural Resources
J. Churcher, Maple
C. Howard, Sault Ste. Marie
Lynn McIntyre, Kingston
Cathie Morris, Napance

Department of Natural Resources Manitoba
G. Munro, 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
D. Oxley, Saint John

Canadian Pulp and Paper Association
Jean-Pierre Martel, Montreal

Pestechon Inc.
S. Nicholson, King City, Ontario

Department of Fisheries and Oceans
Barry Hobden, Winnipeg

National Defence
R.A. Dingwall, Conservation and Environment Directorate, Ottawa

Ontario Ministry of Environment
Amy Luciani, Kingston

Environment Canada
Ian Nicholson, Pesticides Division, Ottawa

Environmental Protection Service
Bill Ernst, Darmouth, N.S.
Wayne Pierce, St. John's

Canadian Parks Service
Anne Rick, Ottawa

Canadian Wildlife Service
N. Garrity, Fredericton
Peter A. Pearce, Fredericton
D.G. Busby, Fredericton
Dora Boersma, Ottawa

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
R.G. Taylor, Pesticides Directorate, Ottawa
A. MacDonald, Pesticides Directorate, Ottawa
Hajo Versteeg, Pest Management Advisory Board, Ottawa

Forestry Canada
G.A. Van Sickle, Victoria
H. Cerezke, Edmonton
W. Jan A. Volney, Edmonton
L. Magasi, Fredericton
P.C. Nigam, Fredericton
D.G. Embree, Fredericton
D. Eidt, Fredericton
A. Juneau, Ste. Foy
D. Lachance, Ste. Foy
J. Robert, Rimouski
G.M. Howse, Sault Ste. Marie
A. Retnakaran, Sault Ste. Marie
B.V. Helson, Sault Ste. Marie
G. Green, Sault Ste. Marie
T.J. Ennis, Sault Ste. Marie
E.T. Caldwell, Sault Ste. Marie (chairperson)

Gary Grant, Sault Ste. Marie
Steve Holmes, Sault Ste. Marie
E.S. Kondo, Sault Ste. Marie (chairperson)
B.H. Moody, Ottawa (secretary)
Mike Power, PNFI
C.J. Sanders, Sault Ste. Marie
Jim Mullins, Ottawa
John Hudak, St. John's
Rick West, St. John's
Les Carlson, Ottawa
Peter Hall, Ottawa
John Cunningham, Sault Ste. Marie
Doug Pitt, Sault Ste. Marie
J. Maini, Ottawa

NOTICE OF 1989 MEETING

The Seventeenth Annual Forest Pest Control Forum

will be held in

Sussex Room, 1st Floor

Government Conference Centre

2 Rideau Street, Ottawa

November 14, 15, 16, 1989

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

Avis de la réunion de 1989

Le dix-septième colloque annuel

sur la répression des ravageurs forestiers

aura lieu dans le

Salon Sussex, 1er étage

Centre de conférences du Gouvernement

2, rue Rideau, Ottawa

du 14, 15, 16 novembre 1989

(de 8:30 h à 16:00 h)

SIXTEENTH ANNUAL FOREST PEST CONTROL FORUM/ SEIZIÈME COLLOQUE ANNUEL SUR LA RÉPRESSION DES RAVAGEURS FORESTIERS

GATINEAU ROOM, 4TH FLOOR
2 RIDEAU STREET, OTTAWA

NOVEMBER 15-17, 1988
8:30 - 5:00 P.M.

PROPOSED AGENDA/ ORDRE DU JOUR PROVISOIRE

1. Welcome and Introductory Remarks/ Discours de bienvenue — J. Maini

2. GENERAL FOREST PESTS STATUS AND PEST MANAGEMENT/ RAVAGEURS FORESTIERS ET GESTION: ÉTAT DE LA SITUATION EN GÉNÉRAL

2.1 Introductory Remarks/ Allocution d'ouverture — B.H. Moody/ L. Carlson (Session Chairmen)

Insects

2.2 Mountain Pine Beetle	BC Alberta	G.A. Van Sickle H. Cerezke
2.3 Jack Pine Budworm	Manitoba Saskatchewan Ontario	G. Munro, H. Cerezke M. Pandila J. Churcher G. Howse
2.4 Gypsy Moth	Ontario B.C. N.B. U.S.	J. Churcher G.A. Van Sickle L.P. Magasi D. Kucera
2.6 Hemlock Looper	Newfoundland	H. Crummey J. Hudak
2.7 Forest Tent Caterpillar	Ontario Prairie Provinces BC	G. Howse G. Munro, M. Pandila, H. Cerezke A. Van Sickle
2.8 Others		

Diseases

2.8 Scleroderris	Ontario Quebec Newfoundland	G.M. Howse D. Lachance J. Hudak Others

Status of Insecticides Research

5.8	Gypsy moth virus trials	J. Cunningham
5.9	B.t. trials	L. Cadogan
5.10	White pine weevil	A. Retnakaran
5.11	Zeiraphera trials	B. Helson
5.12	Residual efficacy of Dipel 12L sprayed aerially at the rate of 15 and 30 BIU/ha during 1988	P.C. Nigam

Status of Herbicides Research

5.13	Improved use trial	D. Pitt
5.14	Review of herbicide drift studies	C. Weisner
5.15	Monitoring of herbicide applications in Quebec	P.M. Marotte
5.16	Regional operational reports on herbicides	Provincial representative
5.17	Avian responses to fenitrothion exposure - the 1988 experience	P.A. Pierce
5.18	La surveillance environmentale et le contrôle de qualité effectué au Québec en 1988	Pierre M. Marotte
5.19	Experimental control against the hemlock looper	J. Hudak
	Experimental control against black army cutworm	J. Hudak
	Balsam woolly aphid control in Nfld.	J. Hudak
5.20	Spruce budmoth pheromone control study update	P. Silk
5.21	Pilot experiments using entomophilic nematodes against spruce budworm and seedling debarking weevil	D. Eidt
5.22	Jack pine budworm pheromone update	E. Butterworth

5.23 Reports on Environmental Monitoring

Maritime Provinces — W. Sexsmith

Quebec — A. Juneau, P.M. Marotte

Others

5.24 Status of Book on Control of Forest Insects in Canada — B. Moody for J. Armstrong

6. <u>ISSUE DEBATE AND PREPARATION OF RECOMMENDATIONS/ DISCUSSION SUR LE SUJET ET PRÉPARATION DE RECOMMENDATIONS</u>

6.1 Introductory Remarks — G. Munro (Session Chairman)

6.2 *B.t.* contamination

6.3 *B.t.* efficacy

6.4 Others

7. <u>WORKSHOPS / ATELIER (November 17)</u>

(Gatineau Room and Room 405 and 407)

7.1 Spray Technology Committee of the Eastern Spruce Budworm Council

7.2 Environmental Monitoring Committee Eastern Spruce Budworm Council

7.3 Discussion of the fentrothion review being undertaken by Environment Canada - Peter Pearce and Dan Bushy

7.4 Others

Committee for Review and Improvement of Survey Assessment Techniques (November 14) — H. Trial (Chairman)

Forum Steering Committee Meeting (November 14, 3:00 - 6:00 p.m.) — E. Kondo (Chairman)

FIDS Heads Meeting (closed session) November 17 and 18

Workshop on Herbicides spray technology - Nov. 18, Room 405 — G. Wiesner

SUMMARY OF OPENING REMARKS

Sixteenth Forest Pest Control Forum
Ottawa, Ontario - November 17, 1988

The attendees at the forum were honored this year by the presence of Dr. Jag Maini, Assistant Deputy Minister, Forest Policy, who welcomed members of the forum on behalf of Forestry Canada.

Dr. Maini explained that Forestry Canada is evolving and expanding its mandate into a new department. Forestry is a major part of the economy of Canada and is important to Canada's economic and social well-being. The federal government recognizes the significance of this service and has decided to form the Department of Forestry.

A brief description of the new organizational structure of Forestry Canada was given. Dr. Maini mentioned that the drafting of the legislation to establish the Department of Forestry provides an opportunity for the Minister of State (Forestry) and the new department to investigate the Forestry Development and Research Act (1966-67) and to obtain recognition in other acts such as the Plant Quarantine Act, the Seeds Act, the Pest Control Products Act, and the Statistics Canada Act.

Dr. Maini then directed his talk to pesticides. He said that we have a great investment in our resources. Ecologically forests are regenerated by many cultural methods which may result in large-scale pest epidemics. More insight into these situations is needed and more judicious use of pesticides is required.

In closing, Dr. Maini emphasized that we as researchers or pest managers should get together with other "stakeholders" and consider not only the scientific aspects of pest control but also the social, economic, health, and environmental aspects.

Résumé de l'allocution d'ouverture

Seizième Forum sur la répression des ravageurs forestiers

tenu à Ottawa (Ontario) le 17 novembre 1988

Les personnes présentes au forum ont été honorées par la présence de Monsieur Jag Maini, sous-ministre adjoint, Politiques forestières, qui a souhaité la bienvenue au nom de Forêts Canada.

Forêts Canada, selon Monsieur Maini, est en évolution et sur le point de devenir un nouveau ministère. La foresterie, un des principaux facteurs de l'économie canadienne, contribue énormément au bien-être économique et social du Canada. La création du ministère des Forêts par le gouvernement fédéral indique bien l'importance qu'il accorde à ce service.

Après une brève description de la structure organisationnelle de Forêts Canada, Monsieur Maini a déclaré que la préparation des documents juridiques devant servir à la création du ministère des Forêts était une occasion pour le ministre d'État aux Forêts et le nouveau ministère d'étudier à fond la Loi sur la recherche et le développement forestiers (Forestry Development and Research Act) de 1966-1967, en plus de faire reconnaître d'autres lois telles que la Loi sur la quarantaine des plantes (Quarantine Act), la Loi sur les semences (Seeds Act), la Loi sur les produits pour la répression des ravageurs (Pest Control Products Act) et la Loi de Statistique Canada (Statistics Canada Act).

Il a ensuite été question de pesticides. Nos ressources ont été l'objet de gros investissements. Sur le plan écologique, la régénération des forêts s'effectue à l'aide de plusieurs méthodes culturales qui peuvent être la source d'épidémies de ravageurs sur une grande échelle. Il faudra analyser en profondeur ces situations et favoriser un usage plus rationnel des pesticides.

En terminant, Monsieur Maini a souhaité ardemment que les chercheurs et les gestionnaires des ravageurs, de concert avec les "détenteurs d'enjeux", se réunissent et s'intéressent non seulement aux aspects scientifiques de la répression des ravageurs mais également aux côtés social, économique, sanitaire et environnemental.

I. GENERAL PEST REVIEW/REVUE GÉNÉRALE DES RAVAGEURS

ABSTRACTS / RÉSUMÉS

I. GENERAL PEST REVIEW/REVUE GÉNÉRALE DES RAVAGEURS

Pacific Region - 1988 Status of Important Forest Pests and Experimental Control Projects and Vegetation Management Research
G.A. Van Sickle, R. Alfaro, C. Dorworth, M. Hulme, I. Otvos, L. Safranyik, J. Sutherland, R. Whitehead, C. Wood...

About 20 pests have been selected as the pests most likely to be of interest to participants. Also included in this report are experimental control projects on bark beetles, white pine weevil, winter moth and budworms; pinewood nematode surveys; and vegetation management research.

Région du Pacifique - Situation relative aux ravageurs forestiers importants, projets de lutte expérimentale et recherches sur l'aménagement de la végétation en 1988
G.A. Van Sickle, R. Alfaro, C. Dorworth, M. Hulme, I. Otvos, L. Safranyik, J. Sutherland, R. Whitehead, C. Wood...

On a choisi de parler d'environ 20 ravageurs parmi les plus susceptibles d'intéresser les participants. On se penche également sur des expériences de lutte contre des scolytes de l'écorce, le charançon du pin blanc, la spongieuse et les tordeuses, de même que sur les relevés du nématode du pin et la recherche consacrée à l'aménagement de la végétation.

1988 Pest Control Forum - B.C. Forest Service Report
P.M. Hall, J.A. Muir

The mountain pine beetle remains a major forest insect problem in five of the six forest regions in British Columbia. A program was implemented in 1987 to quantify losses in stands affected by budworms and to establish the efficacy of B.t. in high value areas. Root diseases continued to be a major concern.

Forum sur la répression des ravageurs forestiers de 1988 - Rapport du service des forêts de la Colombie-Britannique
P.M. Hall et J.A. Muir

Le dendroctone du pin ponderosa est demeuré une source importante de préoccupations dans cinq des six régions forestières de la Colombie-Britannique. Un programme a été mis sur pied en 1987 en vue d'évaluer les pertes dans les peuplements touchés par les tordeuses et de déterminer l'efficacité de *B.t.* dans les zones de grande valeur. Les maladies des racines ont continué d'être une préoccupation majeure.

FOREST PESTS IN MANITOBA, 1988

by

Y. BEAUBIEN, T. BOYCE, K. KNOWLES
Y. MEYER, M. SLIVITSKY, S. VESCIO

This report reviews the status of the following forest pests in Manitoba in 1988: spruce budworm, jack pine budworm, white pine weevil, pine root collar weevil, plantation pests, dwarf mistletoes, Dutch elm disease, Armillaria root rot, and western gall rust.

Ravageurs des forêts du Manitoba en 1988

Y. Beaubien, T. Boyce, K. Knowles
Y. Meyer, M. Slivitsky et S. Vescio

Les auteurs examinent la situation relative aux déprédateurs suivants des forêts du Manitoba en 1988: tordeuse des bourgeons de l'épinette, tordeuse du pin gris, charançon du pin blanc, charançon du collet du pin, déprédateurs des plantations, faux guis, maladie hollandaise de l'orme, pourridié-agaric et rouille-tumeur.

STATUS OF FOREST PESTS OF SASKATCHEWAN IN 1988

by

MADAN PANDILA

Aerial and field surveys are conducted by the Forestry Branch of Saskatchewan Parks, Recreation and Culture in collaboration with Forestry Canada (FC) and the industry to identify the intensity of pest infestation. This information assists in developing management plans for the infested areas.

Situation relative aux déprédateurs des forêts de la Saskatchewan en 1988

Madan Pandila

La Direction des forêts du ministère des Parcs, des Loisirs et de la Culture de la Saskatchewan effectue, en collaboration avec Forêts Canada et l'industrie, des relevés aériens et au sol en vue de déterminer l'intensité des attaques par les déprédateurs. L'information obtenue aide à mettre au point des plans de lutte dans les zones touchées.

REPORTS ON THE STATUS OF FOREST PESTS IN THE WESTERN/NORTHERN REGION IN 1988, NORTHERN FORESTRY CENTRE, FORESTRY CANADA EDMONTON, ALBERTA

by

H.. CEREZKE

Reports are included covering the following agenda items: Mountain Pine Beetle, Jack Pine Budworm, Forest Tent Caterpillar, Pinewood Nematode, and Spruce Budworm Distribution and Pest Management.

Rapports concernant les déprédateurs forestiers de la région de l'Ouest et du Nord en 1988 - rapports produits au Centre de foresterie du Nord, Forêts Canada, Edmonton (Alberta)

H. Cerezke

Ces rapports portent sur les points suivants: les aires de distribution du dendroctone du pin ponderosa, de la tordeuse du pin gris, de la livrée des forêts, du nématode du pin et de la tordeuse des bourgeons de l'épinette et les mesures de lutte.

GYPSY MOTH IN ONTARIO, 1988

by

G.M. HOWSE AND J.J. CHURCHER

Gypsy moth infestations that declined in 1986 and 1987 rebounded in 1988, with the total area of moderate-to-severe defoliation increasing to 33 697 ha; up from 12 678 ha last year.

In 1988, the Ontario Ministry of Natural Resources aerially sprayed a total of 13 784 ha of forest in southern Ontario to protect stands from defoliation by gypsy moth.

La spongieuse en Ontario en 1988

G.M. Howse et J.J. Churcher

Les infestations de la spongieuse, qui avaient diminué en 1986 et 1987, ont repris en 1988. L'étendue totale touchée par une défoliation modérée à grave est passée à 33 697 ha, par comparaison à 12 678 ha l'année précédente.

En 1988, le ministère des Richesses naturelles de l'Ontario a effectué des arrosages aériens sur 13 784 ha dans le sud de la province pour protéger des peuplements contre la défoliation par la spongieuse.

SITUATION CONCERNANT QUELQUES RAVAGEURS FORESTIERS AU QUÉBEC

par

Denis Lachance

Ce rapport fait le bilan des insectes et maladies des arbres du Québec en 1988 et comprend le nématode du pin, la livrée des forêts, la spongieuse, et le chancre scléroderrien du pin.

This report reviews the status of major forest insects and diseases in Quebec in 1988 and includes the pinewood nematode, forest tent caterpillar, gypsy moth and scleroderris canker.

FOREST TENT CATERPILLAR IN ONTARIO, 1988

by

G.M. HOWSE AND J.J. CHURCHER

The current forest tent caterpillar outbreak continued unabated in 1988. Province-wide, a total area of 3 965 229 ha of moderate-to-severe defoliation was mapped by aerial and ground surveys, up from the 1 649 977 ha recorded last year. Five provincial parks were sprayed from the ground with B.t.

La livrée des forêts en Ontario en 1988

G.M. Howse et J.J. Churcher

L'infestation actuelle de la livrée des forêts n'a nullement perdu de son intensité en 1988. Les relevés aériens et au sol ont indiqué que, à l'échelle de la province, l'étendue totale touchée par une défoliation modérée à grave avait atteint 3 965 229 ha, par comparaison à 1 649 977 ha l'année précédente. Des arrosages de *B.t.* ont été effectués au sol dans cinq parcs provinciaux.

GYPSY MOTH CONDITIONS AND PLANNED SUPPRESSION 1988-89

by

DANIEL R. KUCERA

Gypsy moth populations and defoliation continued to decline throughout the Northeastern United States and Michigan in 1988, the lowest in nine years. Total defoliation was 291 101 ha (719 302 acres), down from 538 110 ha (1 329 653 acres) in 1987 and 976 424 ha (2 412 711 acres) in 1986. However, defoliation continues to expand in Michigan, Pennsylvania, Virginia, and West Virginia as the insect spreads into uninfested areas.

Conditions relatives à la spongieuse en 1988-1989 et lutte prévue

Daniel R. Kucera

Les populations de la spongieuse et la défoliation associée ont continué de diminuer dans tout le nord-est des États-Unis et au Michigan en 1988, atteignant les plus bas niveaux enregistrés en neuf ans. De 976 424 ha (2 412 711 acres) en 1986, l'étendue totale défoliée est passée à 538 110 ha (1 329 653 acres) en 1987, puis à 291 101 ha (719 302 acres) en 1988. Toutefois, l'insecte continue de gagner du terrain, la défoliation progressant au Michigan, en Pennsylvanie, en Virginie et en Virginie-Occidentale.

GYPSY MOTH ACTIVITIES IN NEW BRUNSWICK IN 1988

by

N. CARTER

Major efforts were made at two principal areas in Charlotte County in southwestern New Brunswick this past summer and fall.

Activités de lutte contre la spongieuse au Nouveau-brunswick en 1988

N. Carter

L'été et l'automne derniers, des efforts importants ont été consacrés à deux foyers importants situés dans la circonscription de Charlotte dans le sud-ouest du Nouveau-Brunswick.

THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1988

by

J. HUDAK, P.L. DIXON, and L.J. CLARKE

The hemlock looper continued to be the most important pest in Newfoundland in 1988. The annual aerial survey recorded moderate and severe defoliation on about 12 900 ha and light defoliation on about 4 700 ha of balsam fir forests.

L'arpenteuse de la pruche à Terre-Neuve en 1988

J. Hudak, P.L. Dixon et L.J. Clarke

L'arpenteuse de la pruche est demeurée le plus important ravageur forestier à Terre-Neuve en 1988. Le relevé annuel aérien a indiqué que les forêts de sapins baumiers étaient touchées par une défoliation modérée ou grave sur environ 12 900 ha et une défoliation légère sur environ 4 700 ha.

HEMLOCK LOOPER CONTROL PROGRAM IN NEWFOUNDLAND IN 1988

by

H. CRUMMEY

The Department of Forestry in conjunction with the two pulp and paper companies (Corner Brook Pulp & Paper [Kruger] and Abitibi-Price) proposed a control program on high priority stands in the moderate and severe forecast areas and on silviculturally important areas in the light forecast. The 1988 program was the fourth (1985-88 inclusive) during the present outbreak. In 1988, a total of 68 926 ha were treated.

Le programme de lutte contre l'arpenteuse de la pruche à Terre-Neuve en 1988

H. Crummey

Le ministère des Forêts, de concert avec les deux sociétés de pâtes et papiers Corner Brook Pulp & Paper (Kruger) et Abitibi-Price, a proposé un programme de lutte contre l'arpenteuse afin de protéger des peuplements de grande valeur, dans les zones où on prévoyait des dommages modérés ou graves, et des peuplements importants sur le plan sylvicole dans les zones où on prévoyait de faibles dommages. L'année 1988 a été la quatrième année d'application du programme (1985 à 1988 inclusivement) au cours de l'infestation actuelle. Au total, 68 926 ha ont été traités au cours de l'année.

THE BALSAM WOOLLY APHID IN NEWFOUNDLAND IN 1988

by

J. HUDAK AND L.J. CLARKE

In 1988 a preliminary survey was conducted to determine the distribution of active infestations of the balsam woolly aphid in relation to the distribution of thinned stands. Surveys indicated that the total area of active balsam woolly aphid infestations covered about 160 000 ha on Newfoundland.

Le puceron lanigère du sapin à Terre-Neuve en 1988

J. Hudak et L.J. Clarke

En 1988, un relevé préliminaire a été effectué en vue d'étudier la distribution des populations actives du puceron lanigère du sapin par rapport à celle des peuplements éclaircis. Les observations ont indiqué que l'étendue totale infestée activement par le puceron était d'environ 160 000 ha à Terre-Neuve.

SOME FOREST PESTS IN NOVA SCOTIA

by

DR. T.D. SMITH

The Department of Lands and Forests undertakes annual surveys for spruce budworm, hemlock looper, balsam twig aphid, and balsam gall midge. The department does work under the aegis of Agriculture Canada for the monitoring and/or eradication of gypsy moth. The following are brief comments on the status of various arbor pests that the department is involved with.

Quelques ravageurs forestiers de la Nouvelle-Écosse

T.D. Smith

Le ministère des Terres et des Forêts effectue chaque année des relevés de la tordeuse des bourgeons de l'épinette, de l'arpenteuse de la pruche, du puceron des pousses du sapin et de la cécidomyie du sapin. Il collabore également avec Agriculture Canada pour la surveillance et (ou) la suppression des populations de la spongieuse. L'auteur émet de brefs commentaires sur la situation de divers ravageurs auxquels le ministère s'intéresse.

THE SCLERODERRIS CANKER IN NEWFOUNDLAND IN 1988

by

J. HUDAK, G.R. WARREN AND G.C. CAREW

The 1988 survey showed that only the Roddickton plantation had typical symptoms of infection among the Sitka spruce plantations. The incidence of Scleroderris canker continued to increase in and around St. John's, Newfoundland.

Also, an effort was made to identify all locations where pines were planted from the Salmonier nursery.

Le chancre scléroderrien à Terre-Neuve en 1988

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

Le relevé de 1988 a indiqué que, parmi les plantations d'épinettes de Sitka, celle de Roddinckton était la seule à présenter des symptômes typiques du chancre scléroderrien. L'incidence de celui-ci a continué d'augmenter dans la région de St. John's.

D'autre part, un effort a été fait pour déterminer tous les endroits où des pins provenant de la pépinière de Salmonier ont été plantés.

THE PINEWOOD NEMATODE IN NEWFOUNDLAND IN 1988

by

W.W. BOWERS AND J. HUDAK

In 1988 the vector study took on national scope with participation by the other provinces. Insects were collected and shipped to Dr. Finney-Crawley and examined for presence of nematodes.

Le nématode du pin à Terre-Neuve en 1988

W.W. Bowers et J. Hudak

En 1988, l'étude sur le vecteur a pris une ampleur nationale, les autres provinces s'y joignant. Des insectes ont été récoltés et envoyés à Finney-Crawley; ils ont été examinés pour déterminer la présence de nématodes.

PACIFIC REGION - 1988

STATUS OF IMPORTANT FOREST PESTS, EXPERIMENTAL CONTROL PROJECTS AND VEGETATION MANAGEMENT RESEARCH

Prepared for the

Sixteenth Annual Pest Control Forum

November 15-17, 1988

Ottawa

Presented by:

G.A. Van Sickle
Pacific Forestry Centre
Victoria, B.C.

Contributors:

R. Alfaro
C. Dorworth
M. Hulme
I. Otvos
L. Safranyik
J. Sutherland
R. Whitehead
C. Wood

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 1988, 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 was similar to 1987, which followed three consecutive years of decline and was the lowest level in 7 years. More than 7600 active infestations still cover more than 58 000 hectares from the International Border to northeast of Prince Rupert. This is six times the area burned by forest fires in British Columbia in 1988 (9800 ha) and the volume lost (3.6 million m^3) represents about 15% 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. A new infestation in the Cariboo Region which developed in 1987 in mature pine at Chilko Lake near the Coast Mountain Range expanded to 1300 ha this year. Elsewhere, areas containing recently killed mature pine as mapped during the 1988 aerial surveys were: Kamloops Region - 17 642 ha, similar to 1987; Nelson Region - 25 650 ha, up 10%; down 50% in the Vancouver Region to 755 ha; unchanged in the Prince Rupert Region at 18 600 ha; and down 10% in the Prince George Region to 3975 ha.

Infestations along the British Columbia-Alberta border and in Glacier and Yoho National Parks declined for the third consecutive year but continued in Kootenay National Park at levels similar to 1987 with major concentrations of past and current attack south of Daer Creek and Redstreak Mountain, with smaller patches from the south border to Hector Gorge. (Recent overmature spruce blowdown in scattered pockets and on the Vermilion-Simpson river flats could present a potential spruce beetle problem). Cooperative aerial and ground surveys in Mt. Robson Provincial Park and west of Jasper National Park did not locate any mountain pine beetle-attacked trees. This followed successful cut-and-burn control operations which reduced the number of beetle-killed pine from 259 in 1985, 26 in 1986, and 25 in 1987.

Overwintering mortality was generally less than 10% providing an increasing population for flight and attack in July 1988 (75% of the ratios of progeny to parents at 42 locations were greater than 4.0 indicating increasing populations). The frequency of new attacks on mature lodgepole pine in 40 previously infested stands cruised in six forest regions ranged from an average of 3% in the Vancouver Region to 28% in the Nelson Region with a province-wide average of 13%. Current attacks exceeded the 1987 levels in three regions but declined in the Prince George, Prince Rupert and Vancouver regions. Secondary bark beetles, particularly Ips spp., and to a lesser degree, Dendroctonus murrayanae were again common for a third consecutive year in parts of the Cariboo, Prince George and Nelson regions.

Salvage of beetle-killed and adjacent susceptible pine continued at high levels in most beetle-infested Timber Supply Areas. Salvage harvesting in advance of increased stumpage rates and reduced availability of economically accessible beetle-killed pine may result in reduced AAC in the near future. Redirection of operators into the Okanagan Valley drainages due to expanding infestations resulted in increased transportation costs ($1.4 million).

The Canada/U.S. Mountain Pine Beetle Program sponsored a symposium from July 12-14, 1988 at Kalispell, Montana on the management of lodgepole pine to minimize losses. Field tours and discussions included present status of the beetle on both sides of the border, silvicultural strategies and developments in semiochemical (pheromone) use, risk assessment techniques and effects on resource planning.

Spruce Beetle

The area and volume of mature white and Engelmann spruce killed by the beetle in British Columbia was similar to 1987 and followed five consecutive years of decline. Host depletion, salvage and sanitation contributed to the decline. Most of the 3115 ha of infested spruce mapped in aerial surveys was in 27 separate infestations, mainly in the Kamloops Region.

Along the Haines Road in the Prince Rupert Region spruce trap trees and windthrow were again attacked by the beetle for a second consecutive year. Road construction in 1983 predisposed the trees to attack and contributed to population buildup. Through cooperative programs infested trees were removed or felled and peeled to prevent an outbreak, but successive years of windthrow are sustaining populations in the area.

Budworms

More than 360 000 ha of mixed age-class Douglas-fir in four forest regions were defoliated by western budworm, less than half the area affected in 1987. Defoliation was light on 83% of the area, with 16% moderate and 1% severe. There were more than 1240 separate areas of infestations.

Areas of decrease included the North Thompson, Adams and Bridge river drainages in the Kamloops Region. Areas of expansion included the Okanagan Valley, the southwestern part of the Nelson Region and near Pemberton in the Vancouver Region.

Parasitism of early and late-instar larvae occurred at all 26 sites sampled and averaged 16% (range 1% to 54%), similar to 1987, but still too low to effectively reduce populations. The cause of the decline 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 numbers of egg masses collected by FIDS at 52 infested stands in four regions were 70% fewer than in 1987 indicating a continuing overall decline. However, defoliation is still forecast to be severe at 10 of the sites, mostly in the Nelson Region, moderate at 16, light at 21 and none at five.

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. Greater damage exists where regeneration is overtopped by older trees and mortality is often high.

Operational aerial spray trials of Bacillus thuringiensis were applied over a total of 1800 ha including five new areas in the Kamloops Region, one in the Nelson Region, and 11 blocks sprayed in the Kamloops Region in 1987. Preliminary spray results are variable due to highly varied larval development and bud flush, and up to 80% natural reduction of populations in 8 of 11 plots. At Paul Lake Park, sprayed each year since 1986, population reduction was 80% and no current defoliation was apparent; however, egg masses, likely from neighboring infestations, forecast moderate defoliation in 1989.

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 12 sites still with low populations but a history of budworm outbreaks. Up to 32 larvae/tree were collected per 1 m^2 beating (3 branches on 25 trees/plot) and up to 680 male adults were caught in a total of 57 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 two-year cycle budworm was light and moderate over 102 165 ha in 490 infestations in three forest regions. This was more than double the area affected in 1987, largely a non-feeding year. The mature 'on-year' cycle budworm larvae defoliated 44 450 ha in the Kamloops Region; 40 215 in the Cariboo Region; and 17 500 in the Prince George Region. Egg samples at 15 previously infested sites in the Kamloops, Cariboo and Prince George regions indicate high numbers of immature budworm larvae in new buds in 1989 in the Cariboo and Prince George regions, but fewer in the Kamloops Region.

Current foliage of alpine fir and white spruce was defoliated by 1-year cycle eastern spruce budworm over 36 000 ha north and west of Fort Nelson. This is a decline of 40% following the build-up in 1986-87. Defoliation again extended into the Northwest and Yukon territories for a third consecutive year. Three 50-ha seed collection blocks near Fort Nelson were aerially treated with B.t. by the BCFS.

Larvae and adult male populations continued to be monitored in three regions to improve and calibrate methods to detect budworm populations in fir-spruce forests. Up to 34 adult males were collected in 13 non-sticky traps at three locations. Further study, however, is necessary before numbers can be correlated with population damage and potential.

Blackheaded Budworm and Hemlock Sawfly

Following three consecutive years of blackheaded budworm and, to a lesser degree, hemlock sawfly feeding, populations declined. Mature and some immature western hemlock over about 7000 ha on the Queen Charlotte Islands were defoliated, down from 15 600 ha of mostly moderate and light defoliation in 1987. Defoliation was classified severe for 10% of the area, moderate for 10% and light for the remainder. Populations in the Kamloops Region declined slightly to 900 ha following an increase in 1987. Near Holberg on northern Vancouver Island, mature western hemlock over 4800 ha were defoliated, up from 5 ha in 1987. 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 58 000 ha were lightly to severely defoliated.

Defoliation of western hemlock stands on the Queen Charlotte Islands mainly by the sawfly is expected to decline further in 1989. The numbers of Neodiprion tsugae larvae and cocoons in western hemlock stands indicates declining populations at 8 of 15 sample sites mostly on Graham Island, and static at the remainder. Parasitism is less than 10%. On northern Vancouver Island, however, defoliation is expected to increase in severity and area. Based on the number of eggs per 10 m^2 of hemlock foliage at 10 sample sites near Holberg, defoliation is forecast to be severe at three locations, moderate at five, trace or light at the remainder.

Douglas-fir Tussock Moth

Larvae and pupae were collected from Douglas-fir trees in urban Kamloops for the first time since the last outbreak collapsed in 1984, but to date none were collected at permanent sample sites or elsewhere in previously defoliated stands in either region. Egg masses were found on two newly defoliated ornamental spruce in Victoria.

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 third consecutive year. About 1717 adult males were trapped in 84 of 130 traps at 38 of 51 sites in the Kamloops Region. This is a significant increase over 1987 and 1986 when 387 adults in 45 traps and 75 adults in 25 traps were taken, respectively. This indicates defoliation and possibly an outbreak is expected to occur in 1989. Numbers decreased in the Nelson Region where none were trapped at one location and only one per trap at the other location, down from five and seven respectively in 1987. Egg mass surveys are in progress to determine if a spray program will be planned for 1989.

Results of observations of damage on 61 plots defoliated by tussock moth from 1982 to 1985 were analyzed and published in Forestry Chronicle (October 1987). Mortality was related to severity and duration of defoliation. Stands with severe defoliation sustained 66% tree mortality and 17% of the survivors were top-killed.

Larch Casebearer, Budmoth and Sawfly

Following three consecutive years of decline, larch casebearer populations in western larch stands in southeastern B.C. were at levels similar to 1987. 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 26 long-term parasite release study sites in the Nelson Region, defoliation was nil to generally light and only moderate near Castlegar. Parasitism at 22 of the sites ranged from 0 to 82% with a mean of 29% (median 23%), up 11% from 1987. Larval population assessments to predict defoliation in 1989 are in progress.

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 1988 and additional releases are not anticipated until the results to date can be further assessed. A paper submitted to Forestry Canada's biocontrol working group established that the benefits from collections by CIBC were worth the cost.

Populations of larch budmoth increased very slightly at Johnstone Creek in the West Kootenay. Elsewhere populations remained endemic.

Larch sawfly populations generally declined in 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 increased and moderately defoliated western larch in the West Kootenay, and exotic larch near Haney in the Vancouver Region and at Terrace and Prince George. Based on examinations of overwintering cocoons, defoliation is forecast to decline significantly in the East and West Kootenay due to the high incidence of parasitism by a chalcid, *Dibrachys saltans*.

European Larch Canker

Surveys for the potentially damaging European larch canker in western, alpine, eastern and some exotic larch stands in British Columbia were negative for the eighth successive year. 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

Conifer seedlings and herbaceous ground cover were severely defoliated and planting programs delayed by increased cutworm populations in two-year-old burns in the Cariboo, Nelson, Prince George and Prince Rupert regions. Populations declined in previously infested areas in the East Kootenay part of the Nelson Region. The worst damage was in one Engelmann spruce plantation in the Nelson Region where defoliation of seedlings exceeded 80%. In most other areas defoliation was limited largely to herbaceous ground cover.

Parasitism of cutworm larvae and pupae in new infestations is still being determined.

Populations are forecast to continue near most currently infested areas. This is based on 372 sticky traps baited with experimental pheromones which attracted up to 97 male moths per trap at 51 of 70 sites in four regions. Cutworms could pose a threat in the interior of B.C. for 1989 plantings following slash burning in 1987.

A contract to develop a predictive warning system linking moth catches in non-sticky pheromone traps with subsequent defoliation and including a seedling and vegetation damage index, which is building on earlier studies by R. Shepherd in co-operation with FIDS, completed its second field year but results are still being analyzed.

Rhizina Root Disease

Rhizina root disease infected and killed several hundred newly planted spruce and pine seedlings in 19 of 87 (20%) recently burned sites examined in parts of three forest regions. Although fruit bodies are observed occasionally most years, this is the first record of seedling mortality caused by this disease in British Columbia in 20 years. Up to 34% (average 14%) of the seedlings were killed in 10 sites in the Prince Rupert Region, up to 26% (average 8%) at four sites in the East Kootenay, up to 15% (average 6%) in four sites in the West Kootenay and 1% at one site in the Prince George Region. Fruiting bodies were present in at least 6 additional areas in three regions but there was no seedling mortality yet.

Pinewood Nematode

Based on more than 1000 samples from trees and potential vectors collected from 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. Examinations of chip piles at 11 mills during optimum insect flight times and weather conditions were all negative. Similar collections from slash piles and log decks resulted in 211 potential vector type beetles being captured and forwarded to Memorial University for extraction and identification of any nematodes. No results have yet been received. Of these insects, 78 were three different species of *Monochamus*; 19 were *Buprestis*; 7, *Pissodes*; 12, *Cylindrocopterus*; 36, *Hylurgops*; and 25 *Dendroctonus*.

Scleroderris Canker

Examinations of native lodgepole, ponderosa and whitebark pine at four locations in British Columbia where the North American strain of this fungus was previously collected were unable to relocate the fungus. Surveys of native pines elsewhere throughout B.C. were also negative. This important pathogen, which has caused extensive mortality of young pines in plantations and nurseries in eastern Canada and the United States, was found largely 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 thirteenth year of a cooperative program with Agriculture Canada (Plant Health) and B.C. Ministry of Forests and FIDS. Only 12 adult male gypsy moths were trapped this year in British Columbia in 12 pheromone-baited sticky traps in 7 areas. This compares with 216 moths in 56 traps in 8 areas in 1987. Male moths were caught near Kelowna (4) and CFB Colwood (1) for the third consecutive year and near Parksville (2) for the second consecutive year. New catches were made at Point Roberts (2), Coquitlam (1), West Vancouver (1) and at Yard Creek Provincial Park near Sicamous (1). No new egg masses have yet been found.

The capture near Sicamous was in one of 291 traps set out by FIDS in 251 forested recreation areas in national and provincial parks, commercial campgrounds or near military bases.

Following catches of more than 200 male moths and detection of new egg masses in 1987, three aerial and partial ground applications of *Bacillus thuringiensis* were completed by Agriculture Canada in May and June 1988 in parts of Kelowna and Colwood with ground-based sprays at Parksville. The *B.t.* was applied "neat" at 30 BIU/ha over 112, 40 and 4.5 ha, respectively, from April 27 to June 14. The above trapping results indicate successful control.

European Pine Shoot Moth

Surveys of interior native and exotic pines were initiated and three pheromone baits in sticky traps were tested at 5 interior and 6 coastal sites to determine the status of the shoot moth since provincial quarantine regulations lapsed in 1981. Survey results indicate that the shoot moth is established in localized urban areas but the areas have not increased in number and there is no evidence of shoot moth populations in native pines. Because of the large variability and small sample (60 traps), results are not significantly different, but the highest average number of moths per trap were at Penticton (33), Richmond (20), Kelowna (18), Ladner (11), and Cloverdale and Victoria (6). The three pheromones tested averaged 12, 8 and 6 moths per trap.

Balsam Woolly Adelgid

Ground checks and limited aerial surveys of amabilis and grand fir stands following the discovery in 1987 of the adelgid 80 km north of the regulation boundary found only very light active populations and only within the quarantine zone. Tests to determine effective control methods on seedlings continue.

Forest Tent Caterpillar

Severe defoliation of trees and shrubs by forest tent caterpillar was more widespread in 1988 in parts of the Cariboo Region, near Prince George, and in the East Kootenay. Populations in the West Kootenay and in the Kamloops Region declined.

Northwest of Prince George increased populations defoliated trembling aspen in 85 infestations over 35 000 ha, a fourfold increase from 1987. In the Peace River area defoliation of trembling aspen and cottonwood declined for second year to 5000 ha in 15 separate areas, down from 8650 ha in 1987. For the first time in four years populations in the Cariboo Region increased and severely defoliated trembling aspen over 460 ha in 28 pockets, mostly between Green Lake and Lac des Roches, east of 100 Mile House. In the Nelson Region, population increases resulted in widespread moderate and severe defoliation of trembling aspen over 2200 ha in 28 pockets from Creston to Fernie and north to Donald. Additional pockets of 0.5-5 ha of light defoliation were numerous from Wardner to Golden. Populations in the West Kootenay collapsed following four consecutive years of infestation.

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 from Creston to Donald in the East Kootenay, based on egg samples from 10 areas.

Cone and Seed Pests

Cone crops in British Columbia in 1988 were variable. Douglas-fir crops were heavy on eastern Vancouver Island but generally moderate in the Interior. Interior spruce cone crops were heavy but seed yield was severely reduced due to infection by inland spruce cone rust.

Twelve coastal and three Interior seed orchards were surveyed. For the third consecutive year Cooley spruce gall adelgid infested six Douglas-fir and two Sitka spruce coastal orchards (respectively) and one Interior white spruce spruce orchard. Western white pine at the center were severely infested by a pine adelgid. Balsam woolly adelgid lightly to moderately infested twigs on amabilis fir at two orchards near Victoria which are within the infestated regulation zone. Immature yellow cedar cones in one seed orchard were severely infested for the second consecutive year by a gall midge.

Cone crops were affected by several important pests, including spiral spruce cone borer which infested up to 60% (average 37%) of the light to moderate Engelmann spruce cone crop at five sites in the East Kootenay, 17% of the cones at two sites in the Kamloops Region, 15% near Prince George and 10% of the cones at one site in the West Kootenay. Spruce seed worm also infested 15% of the cones at the West Kootenay site and 22% of the white spruce in the Prince George Seed Orchard. Douglas-fir cone moth, Douglas-fir seed wasp and Douglas-fir cone scale midge infested an average of 12%, 12%, and 5% of the cones, respectively, in the northern part of the Kamloops Region and an average of 19%, 20%, and 15% of the light to moderate Douglas-fir cone crops in the eastern part of the Nelson Region with as much as half the cones affected near Skookumchuck. A pine cone borer infested up to 30% (average 15%) of the lodgepole pine cones in two of four stands sampled in the western part of the Prince Rupert Region.

EXPERIMENTAL CONTROL PROJECTS

Bark Beetles

Operational control actions against bark beetles involve harvesting of susceptible stands, salvage logging, trap tree programs, single tree treatments of cut and burn, debarking, and pre-adult post-attack injection with the silvicide MSMA. The biological and cost effectiveness of control programs are enhanced by the use of pheromone baits. Implementation of sanitation and salvage logging programs often require construction of access roads.

As part of the Canada/USA Agreement on mountain pine beetle, measurement of tree increment cores from the 150 plots established in lodgepole pine stands to evaluate six hazard rating systems is near completion. Methodology and programs for evaluating the hazard rating systems have been developed and a preliminary analysis for the Cariboo Region of B.C. has been completed and prepared for publication.

In cooperation with the B.C. Ministry of Forests, five 5-ha plots of mature lodgepole pine were selected and treated near Merritt using partial cut and spacing regimes to determine if losses from the mountain pine beetle could be reduced.

In studies of population quality, mountain pine beetles emerging sequentially from lodgepole pine trees did not differ significantly in quality as indicated by chromative distribution patterns. The results cast doubt on the concept of "pioneers" being physiologically different from their later-emerging siblings.

As part of a study on the effects of outbreaks on the structure and dynamics of residual stands of lodgepole pine, 10 stands have been sampled in the Cariboo Region. Also, collection of field data have been completed to evaluate the reliability of predicting population trends based on late spring sampling of brood.

Spruce Weevil (White pine weevil)

The search for natural enemies to import to control spruce weevil has continued in two directions. Two species of parasitoids imported from Europe readily accepted *Pissodes strobi* hosts in cage studies. *Eubazus semirugosus*, which is taxonomically very similar to a native species already found on coastal *P. strobi* is being examined for behavioral differences from the native species. If no behavioral superiority can be demonstrated in terms of increased parasitism, field releases will not be made. The second European species, *Coeloides sordidator*, has no native equivalent in western Canada and attempts will be made to rear larger numbers on *P. strobi*. There is, however, an equivalent species known in eastern Canada and in our second direction of research, collections of *P. strobi* have been made in Ontario and Quebec to obtain *C. pissodes* native to eastern *P. strobi*. So far very few specimens have been obtained, suggesting that the native parasite has little impact on eastern populations. Its possible impact on western northern American populations remains to be explored if enough specimens can be obtained.

A computer simulation model to calculate the impact of the Sitka spruce weevil on log yield was developed based on long term records from the Nitinat Lake area. The model predicts yield losses of 1-62% with infestation intensities varying from 1-30% attacked trees per year.

Winter Moth

Defoliation of deciduous trees, mainly Garry oak, shrubs and fruit trees, was very light throughout southeastern Vancouver Island. Populations remained very low for the fourth consecutive year over this area where defoliation had often been severe since the first report of winter moth in 1970. More than 300 000 parasites were released from 1979 to 1981.

Combined parasitism by Cyzenis albicans and Agrypon flaveolatum was about 70% at 7 sites selected for monitoring. Percent parasitism was determined by rearing field collected larvae then X-raying the pupae. Both parasites are recognizable on the X-ray plates. The native Cyzenis albicans was present, but reared in such low numbers as to have little effect on the overall parasitism.

Possible Control Projects in 1989 Using Biologicals

1. ULV application of undiluted B.t. to test its efficacy against the western spruce budworm under mountainous terrain.

2. With increasing numbers of moths in pheromone traps and if the planned egg mass surveys for the Douglas-fir tussock moth indicates that defoliation can be expected, DFTM NPV will be tested semi-operationally.

3. Blackheaded budworm egg surveys indicate moderate to high larval populations in 1989 in the northwestern part of Vancouver Island. An experiment is considered to field test the efficacy of B.t. against this budworm.

Pinewood Nematode Research

Inoculations with several pinewood nematode (PWN) isolates of over 20 species of Canadian conifers under shadehouse (ambient temperatures) and greenhouse (30°C days, 25°C nights) conditions showed that pines, e.g. red pine, are most susceptible to the nematode. Other conifers such as western red cedar and Douglas-fir often contain large numbers of PWNs without being killed. In general, both "m" and "r" forms of the nematode were equally pathogenic.

Inoculations with Canadian PWN in Scots pine and lodgepole pine seedlings from Finland (grown under the above greenhouse conditions) were completed last year. Both "m" and "r" form isolates increased to large numbers and killed the pines; a paper has been submitted to the Scandinavian Journal of Forest Research.

Inoculations with a Norwegian PWN isolate demonstrated that this nematode is quite pathogenic to 3-year-old Scots pine and (based on preliminary results) to certain Canadian conifers such as red pine.

In another experiment, 2- and 3-year-old Scots pine were killed (and yielded large numbers of PWNs) when grown and root damaged in potting medium amended with PWN-infested (either "m" or "r" form) wood chips.

Vegetation Management Research

In brief, the vegetation management research program at PFC involves avoiding potential weed problems through a manipulation of harvest, site preparation or planting activities; or controlling unavoidable weed problems through established options such as herbicide application or manual brushing and new options such as biological control efforts.

In the forest vegetation ecology study, techniques that will enhance establishment and growth of commercial tree species in competitive environments are being evaluated in this, the first of five years of measurements. Two sites with different scarification, prescribed burns and summer and winter logging methods are instrumented with weather recorders and measurements of seedlings and vegetation invasion and growth are being taken.

Evaluations of traditional approaches to weed control have included replicated plot establishment to evaluate treatments with clearing saws, glyphosate and 2,4-D amine applications in terms of seedling growth and survival, and weed species composition and competition over a five year period. Few results are yet available other than the average treatment cost with clearing saws in shrub dominated young plantations was $775/ha, and nearly 1 in 5 seedlings were damaged during the treatment.

In the new study of biological control of weed species, initial efforts have been on selecting and culturing the most promising bioagents, primarily fungi, useful against alder, salal, fireweed, big leaf maple, thimbleberry and raspberry. Tests are being conducted to determine if different provenances of the weed species exist which may have differential susceptibilities to the bioherbicides. Only native bioagents will be dispersed and techniques to predispose the hosts to maximum damage during the host-pathogen interaction will be sought. Initial attempts to control fireweed using a local variety of Armillaria have not yet been successful. Stump and frill treatments of red alder with different isolates, formulations and timing of inoculations using Chondrostereum purpureum have become established and are beginning to penetrate the wood; periodic assessments will follow. Raspberry plants inoculated with a range of native micro-organisms and stressed by clipping or non-lethal herbicide treatments showed considerable resilience and no pathogens with bioherbicide potential are yet evident. Several candidates collected from thimbleberry remain to be evaluated. Efforts to date have developed methods for this new study area and have focused attention where best results might be achieved.

G.A. Van Sickle, Head
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1988 PEST CONTROL FORUM

B.C. Forest Service Report

Entomology

The mountain pine beetle, *Dendroctonus ponderosae*, remains a major forest insect problem in five of the six forest regions in the Province. Although the total infested area in B.C. in 1988 has declined from about 66 500 ha in 1987 and a high of 482 000 ha in 1984, infestations remain active in many regions and have the potential for further expansion. Other bark beetles such as spruce beetle, *D. rufipennis*, and Douglas-fir beetle, *D. pseudotsugae*, appear to be continuing at relatively low levels - no large scale programs are underway for these insects; localized infestations are being dealt with through harvesting activities and/or limited trap tree programs. Balsam bark beetle, *Dryocoetes* sp, continue to cause mortality in chronic areas, but no management efforts have been directed at this pest at this time.

The 1988/89 fiscal year is the fifth year on an originally approved five year program for bark beetle management. Approximately $8.1 million were allocated this year to continue the program of intensive aerial and ground surveys, directed sanitation and salvage harvesting, single tree treatment projects utilizing fall and burn and pesticides, and use of aggregating semio-chemicals in conjunction with other activities. Virtually no access development is being funded under the bark beetle program in 1988/89.

As this is the last year of the originally proposed program, a comprehensive technical and financial value-received audit is being carried out. This audit is being conducted under contract to an external management consultant. The audit is intended to review the program as a whole, quantifying gains made as a result of management activities and making recommendations regarding the need for and structure of future programs. A report is due in November, 1988.

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Large amounts of susceptible host remain, even in areas where infestations have apparently collapsed. Therefore, some form of management effort is expected to continue.

Western spruce budworm, Choristeneura occidentalis, continued to defoliate dry-belt Douglas-fir, Pseudotsuga menziesii, stands in the interior of the Province, particularly in the Kamloops Forest Region. Indications are that the outbreak is declining in many areas.

A program was implemented in 1987 to quantify losses in stands affected by budworms and to establish the efficacy of B.t. in high value areas. Thirty-two permanent sample plots were established in 1987; about 20 additional plots were established in 1988. B.t. sprays were continued in 1988 with approximately 2 000 ha being treated in the Kamloops Region. Spray blocks were established around sample plots so that benefits of treatment could be assessed. B.t. was applied at 30 B.I.U. per hectare at an application rate of 2 litres per hectare. The results of 1988 spray trials will be compiled this fall; the report on the 1987 program is available on request.

B.t., applied at the same rate as in the Kamloops project, was also applied to approximately 150 ha in the Ft. Nelson District in northern B.C. to evaluate its efficacy for control of C. fumiferana in B.C. conditions. Results will be available this fall.

Gypsy moth Lymantria dispar, remains of concern to the B.C. Forest Service. As in past years, the Forest Service has continued to cooperate in the pheromone trapping survey with Agriculture Canada, Plant Health, and the Canadian Forestry Service. The B.C.F.S. continues to place and monitor approximately 2,000 traps placed in high use recreation sites and other forested areas. Forest Service staff also participated in public meetings and spray operations in the three eradication projects undertaken in 1988. A poster discussing gypsy moth and soliciting public cooperation in detection was jointly developed and funded by the Forest Service, Plant Health and the Canadian Forestry Service. Forest Service activities concerning gypsy moth (and other pests) was coordinated by the B.C. Plant Protection Advisory Council.

The Forest Service strongly supports the lead efforts of Agriculture Canada, Plant Health in gypsy moth survey and eradication efforts. The program has been highly successful to date and should be continued.

Other studies and specific projects concerning other pest problems have also been undertaken, although major management effort has not been undertaken. A priority has been placed on the development of various training modules, primarily for pests of regeneration and younger stands. In addition, completion of the remaining chapters of the Forest Service Protection Manual, Pest Management is expected by the end of the fiscal year. Major chapters to be written include those dealing with defoliators, terminal weevils, root collar weevils, nursery, and plantation pests.

Pathology

Root diseases continue to be a major concern. In coastal British Columbia, reports on a regional survey of incidence of laminated root rot, and occurrence and effects of root rot on tree growth in permanent sample plots are being prepared. Data on laminated root rot are being incorporated into recent timber supply analyses. Hopefully the projections will determine the benefits of an operational root disease control program. A new computer-based remote sensing technique, MEISS II, is being evaluated for root rot surveys.

In southeastern British Columbia, surveys and control trials were undertaken for armillaria root disease and laminated root rot. A limited survey of forest sites rated as medium to poor site quality based on standard inventory procedures, suggested that many sites were capable of more timber production if armillaria root disease were controlled. The approach - with further refinement - could be used to estimate the current impact of root disease on timber production over large areas. A new de-stumping tool manufactured in France was evaluated, and further trials are being planned. The stand model PROGNOSIS is being evaluated as a potential training method to show what gains could be achieved by treating root disease infestations on specific sites. Rhizina root disease was prominent and is being assessed in recently burned areas of new plantings.

In central British Columbia, projects are continuing on tomentosus root rot of spruce. Examinations of young plantation trees have shown that new infection originated from contact with old infected roots. A de-stumping trial was established. An Armillaria species, Group V, was found associated with immature and mature declining stands of subalpine fir. The role of this species, usually considered to be secondary, in the decline of established forests, and the potential threat to new forests need to be determined. Annosus root disease incidence was low in western hemlock stands spaced 10 to 15 years previously.

Dwarf mistletoes continue to be a concern in coastal western hemlock and interior lodgepole pine forests. In central B.C., a project to determine the impact of lodgepole pine dwarf mistletoe is continuing. Long-term sample plots to determine mistletoe effects were established or re-measured. Surveys of European leafy mistletoe discovered at Victoria are planned.

Stem diseases and injuries were assessed in several areas. Porcupine damage to young spaced stands was severe near Prince Rupert - Terrace. Control trials are underway. Western gall rust was assessed in young stands near Prince George. B.J. Van der Kamp, University of British Columbia, assessed canker damage and frost damage to trees in southeastern B.C.

Scleroderris canker is viewed as a potential threat to forests in British Columbia. The province participated in the national workshop to develop a nation-wide strategy and control program for the disease.

Air pollutants

A detailed survey of effects of sulphur dioxide emissions from a sulphite pulp mill at Port Alice was undertaken in cooperation with the B.C. Ministry of Environment. The work was also funded in part by the Western Conifers Cooperative of the U.S. National Air Pollution Assessment Program. the computer-imaging technique MEISS II also was evaluated.

Evaluation of potential impacts of ozone on forests in the lower Fraser River valley also is a continuing project. The Province is cooperating with several agencies, including the Canadian Forestry Service and the University of Washington.

FORESTS PEST IN MANITOBA, 1988

SPRUCE BUDWORM

JACK PINE BUDWORM

WHITE PINE WEEVIL

PINE ROOT COLLAR WEEVIL

PLANTATION PEST SURVEYS

DWARF MISTLETOE

DUTCH ELM DISEASE

ARMILLARIA ROOT ROT

WESTERN GALL RUST

by

Y. BEAUBIEN, T. BOYCE, K. KNOWLES

T. MEYER, M. SLIVITSKY, S. VESCIO

PRESENTED TO THE 16TH ANNUAL PEST CONTROL FORUM

by

GEOFF MUNRO

SPRUCE BUDWORM

The spruce budworm infestation persisted in eastern Manitoba predominantly in Whiteshell and Nopoming Provincial Parks and in the Abitibi-Price Forest Management License area. Approximately 33,670 hectares suffered moderate to severe defoliation.

An aerial spray program was implemented over an area of 1,182 hectares of high use recreational land including campgrounds and cottage subdivisions.

PRE-SPRAY SURVEY

The pre-spray survey was carried out through the period of May 24 to May 27. This survey confirms the necessity to spray and the correct timing of the application. Both larval development and shoot development were assessed. Pre-spray population levels were as follows:

Location	Larvae per 45 cm branch
Nopiming Park	19
Falcon-Westhawk Lakes	14
Dorothy Lake	7

As of May 27 the larval development index was 3.5 and the shoot development index (Auger's Class) was 4.0.

APPLICATION

Bacillus thuringiensis (Dipel 132) was applied undiluted at 30 B.I.U. per hectare at a rate of 2.4 litres per hectare. All spray blocks were officially opened as of Friday, May 27. No spraying took place through May 27-29 due to high public use of the recreation areas. Weather conditions which were hot and windy did not allow any applications to take place prior to May 31. In addition to wind, fog and heavy thunder showers had to be contended with.

Spray operations were completed by Friday, June 3. Due to the well above normal temperature conditions larval development advanced rapidly during this period. By the time spraying was complete, 5th and 6th instar larvae were very prevalent.

POST-SPRAY SURVEY

The post-spray survey was carried out June 13-15. Larval reduction due to insecticide (using Abbotts's formula) in each of the spray areas was as follows:

Location	Larval Reduction
Nopoming Park	56%
Falcon-Westhawk Lakes	70%
Dorothy Lake	47%

Despite some adverse weather conditions and as a consequence somewhat late timing of the application, some degree of foliage protection was achieved:

Location	Treated Area	Untreated Area
Nopoming Park	63%	86%
Falcon-Westhawk Lakes	42%	73%
Dorothy Lake	25%	50%

PREDICTIONS FOR 1989

Egg mass surveys were carried out in August to predict spruce budworm defoliation for 1989 in Whiteshell, Nopoming and Abitibi-Price FML. Populations are expected to remain high in 1989. Moderate to severe defoliation is predicted for the Whiteshell including the Falcon, Westhawk and Dorothy Lake areas. Severe defoliation is predicted for all sample locations throughout Nopoming Park and the Abitibi-Price FML.

JACK PINE BUDWORM COMPARISON STUDY

The study was initiated in 1984 with the purpose of developing an egg mass sampling system for the prediction of the following year's defoliation. Forty-five and sixty centimetre branches are being compared to determine if either is adequate for population predictions.

This study is conducted at 12 locations throughout the Spruce Woods Provincial Forest in Western Manitoba. The following variables are being measured: densities of egg masses, larvae, staminate buds and male flower clusters and % defoliation. Analysis of the data will commence this fall.

JACK PINE BUDWORM PHEROMONE STUDY

The objective of this study, which was initiated in 1985 is to develop an adult moth survey method capable of monitoring jack pine budworm populations at endemic levels.

Pheromone traps are placed at 12 locations throughout Manitoba. Three concentrations of the lure (0.3,0.03,0.003) and two trap types (non-saturating-Multipher and saturating Pherocon 1c) are being tested. Branches are collected at each location and assessed for % defoliation and eggmass and staminate bud counts. Analysis of the data is currently taking place.

Male moth captures declined from 1985 to 1987 but have increased two-fold in 1988. Following are the total male moths captures for all lure concentrations per location using the Pherocon IC trap only:

Location	Moth Capture 1985	Moth Capture 1986	Moth Capture 1987	Moth Capture 1988
Moose Lake	95	4	0	15
St. Martins	960	129	13	10
Sandilands	512	60	21	367
Porcupine	378	22	0	11
Nopoming	458	107	13	101
Belair	94	108	42	151
Spruce Woods	1080	504	415	460
Kississing	111	7	0	16
Reed Lake	84	12	9	2
Thompson	69	6	0	22
Lynn Lake	225	1	0	1
Whiteshell	107	122	70	54*
Total	9173	1082	583	1216

*50% of the traps were damaged

1988 WHITE PINE WEEVIL - CONTROL OPERATIONS

Sanitation pruning to control the white pine weevil, *Pissodes strobi*, continued for the 5th consecutive year in a high value white spruce plantation located in the Interlake Region. Regional staff became aware of the problem in 1983 while carrying out corrective pruning and release work in a portion of the 1100 ha. plantation. The 22 year old white spruce are planted in strips which were bulldozed through an aspen stand.

In 1988 a total of 2,813 infested white spruce trees were pruned over a 436 ha area. The number of pruned trees represent 0.4% of the total tree population. This compares to 0.8% in 1986 and 0.7% in 1987. These figures are well below the critical treatable level of 2.0% set in the Province of British Columbia.

In addition to pruning leaders with typical symptoms, all trees displaying old damage were examined for re-infestation in 1987 and 1988. In 1988, 23% of the 1,046 trees displaying old symptoms were found to be re-infested. Re-infested stem damage is generally restricted to the loss of one year's growth whereas 2-4 years growth loss results from an initial attack.

Due to the large area covered and the short time span between symptoms becoming visible and adult emergence, pruning crews start as soon as symptoms are visible. It became obvious in 1988 that crews were covering a larger area at the expense of missing trees not yet displaying symptoms. A follow up survey carried out after operational pruning showed 27% of the trees infested in 1988 were missed. Taking this figure into account would raise the number of pruned trees to 0.5% of the total tree population. Several study plots have been set up in released and unreleased areas to assess whether opening up the stand is resulting in a higher weevil population.

Research work on the life cycle of *Pissodes strobi* on white spruce is required to set pruning operations at their optimum time.

PINE ROOT COLLAR WEEVIL

As part of a jack pine dwarf mistletoe management program, resistant Scots pine was planted in 1971 in the Belair area of eastern Manitoba. Initial survival was good (over 80%) and growth occurred at a rate of approximately one foot per year once trees were established. In 1981 significant chlorosis and mortality were noticed. The cause was determined to be girdling by the root collar weevil, <u>Hylobius</u> <u>radicis</u>. In 1982 a general survey was done in three plantations. The level of mortality due to the weevil was 20%, 8% and 12%. Dead and infested trees combined equal 40%, 34% and 26% for the three plantations. In September of 1988 the general survey was repeated. The level of mortality due to weevil at this time had increased to 52%, 50% and 69%. Dead and infested trees combined now equal 59%, 54% and 73% for the three surveyed plantations.

The high susceptibility of Scots pine to the root collar weevil has rendered 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. Caution should be exercised by Christmas tree growers when planting Scots pine in close proximity to jack pine forest (the natural habitat of the weevil).

Ottawa Pest Control Forum

1988 PLANTATION SURVEY REPORT

The Manitoba plantation pest survey was conducted in 26 plantations this summer covering 871 ha. In total 2601 trees were assessed within 335 plots. Of the 26 plantations, 18 were conducted jointly with 1 provincial staff and 1 CFS ranger.

For the second consecutive year the survey was carried out in red and jack pine plantations in the Southeast Region of Manitoba ranging from 6-32 years of age. The survey is designed to gather baseline data on major plantation pests causing deformity, growth loss and/or mortality in young stands. More detailed impact studies and/or pest management decisions will be based on these initial surveys. Eventually survey data and maps will be downloaded into the Manitoba Forestry GIS system for use by regional staff.

Manitoba continued with the grid pattern survey which covers the plantation systematically. The survey method was modified in several ways in 1988 to simplify data collection and increase the area covered. Distance between plots and grid lines was increased from 80 to 150 metres. As a consequence, sampling intensity was reduced from 0.4% to 0.2% in 1988. Also, emphasis this year was placed on damage assessment rather than pest identification. These changes resulted in a four fold increase in the area covered using half the staff.

The survey allows for detection of tree damage/pest identification between plots as well as within plots. Accurate maps are drawn showing grid lines, plot locations, pockets of mortality, residual pockets etc. Pest damage observed between plots is recorded. Often significant pest problems and tree damage were found along grid lines rather than within plots.

The vast majority of damage occurred on the main stem. Main stem deformity category which includes double stem, forked stem, cabbage trees and others such as major stem crooks ranged from 1.4% to 38.4% of the plot trees examined. Half of the plantations examined had serious main stem deformity (10% plot trees affected). Main stem girdling caused predominantly by cankers, western gall rust, and pitch nodule makers occurred at levels 0.9% of plot trees examined in 5 of the 26 plantations. A portion with main stem girdling caused by cankers or gall rust has resulted in top kill.

Of the total number of plot trees examined for damage to the root and root collar area only 7 plot trees in 3 plantations were infested with armillaria root rot. However, when assessing the data collected along grid lines and plotted on maps, 8 of the plantations had scattered trees and/or pockets of armillaria infection. Infected trees were often found to have root deformities due to poor planting technique.

Dieback on twigs and branches ranged from 0 - 21.4% of the plot trees examined with 5 plantations having levels of 10% plot trees affected. Half the plantations surveyed had twig and branch galls on 10% of plot trees examined. Only one plantation had twig/branch girdling where the number of plot trees affected was 10%.

The plantation survey will be expanded to include white spruce plantations in the Western Region of the province.

DWARF MISTLETOE MANAGEMENT IN MANITOBA

A STATUS REPORT FOR 1988

Introduction

Dwarf mistletoe causes extensive damage in Manitoba, reducing both the quantity and quality of merchantable timber. Two species of dwarf mistletoe occur in the province; *Arceuthobium americanum* attacks jack pine and *A. pusillum* attacks white and black spruce. Since the spring of 1984, dwarf mistletoe surveys, research and operational sanitation projects have been carried out under the Canada-Manitoba Forest Renewal Agreement. The Agreement provides $280,000 per year for dwarf mistletoe management over its five-year duration. Due to other priorities, however, the totality of this sum is not always expended.

Aerial Survey

A comprehensive aerial survey for jack pine dwarf mistletoe was conducted in early 1988 over the central portion of Manitoba. An event recorder (a device consisting of an audio tape linked with a chart recorder) was used to map 7500 km^2 in the province. Parallel lines one mile apart were flown at 60 m.p.h. at an altitude of 500 feet over jack pine cover-type stands. The resulting information was interpreted and transferred onto provincial cover-type maps. Accurate navigation and maintenance of a constant ground speed by the aircraft are essential to the success of this method of passive mapping. Blocks are flown when snow is on the ground because this allows for better definition of the dark dwarf mistletoe brooms, symptomatic of *Arceuthobium americanum*, against the white snow background.

Subsequent ground truthing covered over 100 kilometres during which dwarf mistletoe infection was rated at fifty-metre intervals, resulting in over 2,000 point samples. During the course of the ground truthing, potential treatment sites and harvestable stands were identified. Research data, in the form of mature and juvenile transects, was also gathered.

A total of 11,500 km^2 has now been surveyed aerially with 200 km. of ground truthing. It is hoped that in the coming year the survey will be completed in its entirety.

Research

Research on the disease biology and epidemiology of dwarf mistletoe infecting jack pine is being conducted by Tim Meyer, Department of Botany, University of Manitoba. The focus of this research is the development of a volume loss simulator model. Parameters describing the behavior of dwarf mistletoe infection, required in the model, are being evaluated using a spatial analysis system under joint development between the Botany and Computer Science Departments, University of Manitoba. The analysis is being performed on data from 60 permanent plot sites in infected stands throughout Manitoba.

Additional research required in the development of the loss simulation model includes investigations into the interaction of Armillaria root rot with dwarf mistletoe infected trees, patterns of spatial and temporal disease development in young regeneration, role of primary and secondary inoculum in the development of mortality centers, and relationships between symptom development and tree mortality.

MANITOBA NATURAL RESOURCES

FOREST PROTECTION AND DED SECTION

DUTCH ELM DISEASE ANNUAL REPORT 1988

During the 1988 provincial summer surveillance season, approximately 14,000 elms were examined in and around urban and rural municipalities. Of these, 966 were confirmed to have Dutch Elm Disease and 12,022 were classified as hazards, many of these probably dead as a result of Dutch Elm Disease (DED). Due to the large number of elms infected in wild stands throughout southern Manitoba, particulary in eastern and central regions, control efforts were concentrated on elms in and around the 43 cost-sharing agreement communities. (C.S.A.) Trees in the wild were largely ignored due to the impracticality of controlling the disease in those areas. Within the C.S.A. communities most control efforts by the communities were concentrated in the areas of sanitation pruning & basal spraying with chlorpyifos for the control of overwintering elm bark beetles. The province is responsible for the survey & removal of diseased & dead elm trees within the agreement communities.

The number of municipalities with DED remained at about 77 during the year. Communities with the disease included major urban centres like Winnipeg, Brandon, Portage la Prairie, Morden, Neepawa, Selkirk, Steinbach & Winkler. The Northwestern disease front is located south of Dauphin in and around the village of Ste. Rose du Lac in the R.M. of Ste. Rose. It appears that the disease entered the area via the Turtle River tributaries from the east escarpment of Riding Mountain National Park. Further west, on the Assiniboine River, the disease was observed to have moved only about 3/4 of a kilometre northward from St. Lazare.

Although DED continues to increase in the wild stands, diseased elms in most urban centres with control programs were comparably low. Less than one percent of Winnipeg's elms were diseased, and in Brandon, less than two percent of the elms were infected.

The City of Winnipeg which is responsible for its own survey program reported 910 samples taken this year, 1,426 diseased trees were identified and an aditional 3,720 were marked as Hazards. A total of 5,146 trees are scheduled for removal in the city.

The disease has again continued to increase along most of southern Manitoba's rivers. Large increases in disease have occurred on the Red and Assiniboine Rivers in and around Winnipeg, along the Assinniboine to Portage la Prairie and west of Brandon as far as the St. Lazare area. Over the past few years, the Whitemud River around Westbourne has shown a considerable increase in disease, as well as the east escarpment of Riding Mountain National Park. The smaller river and creek systems in south central Manitoba also experienced more pockets of infection, thus endangering the farm shelterbelts in the areas around Winkler, Altona, Morden and Carman. The Souris River southwest of Brandon is extensively infected in Manitoba and southward into the United States. Although the river flows back into Saskatchewan, the natural elm population drops off just north of the border. It is expected that the disease will be exported to Saskatchewan via the Assinniboine River (Qu'Appelle Valley) west of the St. Lazare area.

In the western part of the province, the community of Minnedosa which had one diseased tree in 1987 experienced no disease this year. Rivers which was disease free last year remained disease free again this year. Neepawa, which had one diseased tree in 1987, had one tree again this year. Virden experienced their first diseased tree this year. Many of the Eastern & Central communties in the province experienced an increase again this year however, decreases were observed in Brandon and Stonewall.

A generally early spring with relatively low infestations of cankerworms, provided decent conditions for sampling of diseased trees. June was fairly productive for sampling, however, most identification was done in July and the first week in August.

From November 1, 1987 to October 31, 1988, the Provincial Dutch Elm Disease Sanitation Crew removed about 8,000 elm trees. In addition, approximately 3100 decadent elms were removed in the Brandon Buffer Zone and 1,000 in the Winnipeg Buffer Zone (La Salle and Assinniboine River areas). Most of the trees were removed using Community Services people in a winter works sanitation program which operated from November 1987 to the end of March 1988.

ARMILLARIA ROOT ROT

As part of a jack pine dwarf mistletoe management program through the 1970's, red pine, a non-host species was planted on 1,300 hectares of jack pine cutovers in Belair Provincial Forest. Growing on typical dry jack pine sites, the young planted red pine has experienced mortality due to drought and Armillaria root rot. In 1983 permanent plots were established in 5 root rot infection centres to monitor Armillaria activity. The increase in tree mortality due to Armillaria over the 5 year period has been 17%, 14%, 10%, 3% and 5%. Total tree mortality to date within each plot is 41%, 35%, 19%, 15% and 18%. During the summer of 1988, likely as a consequence of drought stress, there was a substantial increase in above ground symptoms observed in one of the infection centres.

The distribution of species in the Armillaria root rot complex is currently being evaluated in various forest ecosystems in Manitoba by Tim Meyer, Department of Botany, University of Manitoba, and Keith Knowles, Forestry Branch, Manitoba Natural Resources. Specifically, these studies evaluate the relationships between root rot infection in natural stands of jack pine and mortality in red pine planted on these sites. Jack pine conditions included mature and overmature stands on good and poor quality sites, as well as heavily dwarf mistletoe-infected stands.

To detect the presence of Armillaria and obtain fungal cultures for species determination a 'trap log' technique was used where fresh cut aspen stakes were driven into the ground according to the methods of Mallett and Hiratsuka (1987). The 'trap logs' were removed after a year, inspected for Armillaria colonization, and cultured to obtain fungus isolates. Roots of trees within the study sites were excavated and cultured for comparison with isolates from the 'trap logs'. These same techniques were also used in root rot centers located in intermediate-aged red pine plantations.

Interim results indicate substantial colonization of trap logs in older jack pine stands, notably on poorer, more xeric sites (80%), suggesting Armillaria may be a common component of these ecosystems. Armillaria also appears associated with heavily dwarf mistletoe-infected jack pine; perhaps a substantial determate factor in the development of discrete mortality centers in stands with heavy dwarf mistletoe infection. Armillaria was commonly detected adjacent to edges of root rot centers in older red pine plantations suggesting tree-to-tree spread from secondary inoculum is occurring. Final results from these studies will provide management strategies to minimize plantation losses, especially important with the continued intensification of forestry of Manitoba.

Footnote.

Mallett, K.I., and Y. Hiratsuka. 1985. The 'trap-log' method to survey the distribution of Armillaria Mellea in Forest Soils. Can. J. For. Res. 15! 1191-1193.

WESTERN GALL RUST

Western gall rust is a disease of jack pine that can lead to serious volume loss, especially when occurring in young plantations. At the present time, jack pine accounts for 23% of Manitoba Natural Resource's (MNR) planting stock and is projected to increase to 28% by the year 2000. Currently, the Canadian Forestry Service (CFS) and MNR have established an interim seed orchard and plan for future seed orchards from which all jack pine seed requirements for provincial renewal programs will be collected. The Western Gall Rust Resistant Study was initiated in order to identify jack pine families that are resistant to western gall rust and to include them in the ongoing jack pine tree improvement program in Manitoba.

This year was the first year of the three year study which is a joint project between CFS Edmonton and MNR, Forestry Branch. During this field season, seedlings (grown from excess seed that was used to establish the interim seed orchard) were inoculated with spores collected in the spring from the Eastern Breeding District. In the fall, field assessment for rust infection was conducted on the original family test replicates located in SE Manitoba. Their susceptibility to western gall rust will be included in the criteria for ranking families to determine which will be included in the province's second generation program.

STATUS OF FOREST PESTS OF SASKATCHEWAN IN 1988

MADAN PANDILA

SASKATCHEWAN PARKS, RECREATION & CULTURE

BACKGROUND:

Endemic population of various insects and diseases are always present in the forest. An abnormal increase of any pest population may cause concern and damage in the forest. Aerial and field surveys are conducted by Forestry Branch of Saskatchewan Parks, Recreation and Culture in collaboration with the Canadian Forestry Service (CFS) and the industry to identify the intensity of pest infestation. This information assists in developing management plans for the infested areas.

CURRENT STATUS

Climate conditions in 1988 have been rather abnormal. An earlier spring followed by drought conditions have resulted in erratic development of life cycles of various insects and diseases.

Aerial and field surveys indicate the following general conditions of various important pests in the Provincial Forest.

Spruce Budworm choristoneura fumiferana(clemens)

The current outbreak of spruce budworm appeared in Tall Pines area south of Hudson Bay in 1982, and in Red Earth area northeast of Carrot River in 1983 and in Torch River area in 1984. Since then spruce budworm infestations have been regularly monitored by Forestry Branch and CFS by aerial reconnaissance. The Inventory Section of Forestry Branch prepared maps of the infected areas and supplied information and field operation staff for developing management and harvesting plans.

The present status of spruce budworm infestations is as follows:

Tall Pines: Light to moderate level of infestations are still present around Tenant Lake Road and McBride Lake area. Moderate to severe infestations are present in the rest of the Tall Pine block near Eldridge Lake, Toboggan Lake and west of Highway 9. Harvest operations are ongoing in this block.

Red Earth: Harvesting operations in Red Earth area have reduced the infected area except in the Red Earth Indian Reserve where harvest operations were not possible. South of Highway 55, moderate to heavy infestations have progressed to the edge of the Pasqua Hills in 1988.

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Big Valley: Moderate to heavy pockets of infestations are scattered throughout the Big Valley area encompassed by Eagle, Jim, Apps and Big Valley Lakes. This block has increased in size and severity in 1988.

Jack Pine Budworm Choristoneura pinus pinus Freeman

The current Jack pine budworm infestation started in 1984 in several locales near Hudson Bay, Nipawin and along the Saskatchewan-Manitoba border near Creighton. By 1986 it progressively covered all the eastern and central commercial zones of the Provincial Forest up to Prince Albert. Since then it started declining in the eastern and central zones and in 1988 it is only present in small patches in Nisbet Provincial Forest west of Prince Albert and in McDowell area.

Fort-a-la-Corne and Torch River Provincial Forest had severe infestation for two years thus resulting in considerable top kill and tree mortality of Jack pine. Harvesting operations were planned for these areas.

Forest Tent Caterpillar and other Aspen Defoliators

The present outbreak of aspen defoliators (forest tent caterpillar and large aspen tortrix started in small areas in 1984 near Green Water Provincial Park in the east and south of Lloydminster area in the west. Since then these defoliators have been on the increase both in the agriculture and forest zones in the east and the west.

In the east it covered agriculture areas from Yorkton to Nipawin and in the forest zone in Porcupine Hills, Pasqua Hills to Tobin Lake areas.

In the west it extended from North Battleford and Lloydminster to Meadow Lake Provincial Park and Keeley Lake in the north and whole of Bronson Forest. This is one of the major outbreaks of aspen defoliator covering large tracks in the forest with severe defoliation.

The results of egg band survey for forest tent caterpillar indicate the same kind of infestation for next year (1989).

Mountain Pine Beetle

Mountain Pine Beetle is under control in Cypress Hills and is at its lowest population level since its first appearance in 1979-80.

Dutch Elm Disease

No incidence of DED has so far been reported by the surveys conducted by Saskatchewan Parks, Recreation and Culture and by the cities and municipalities this year

Public information program was shown in major cities.

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REPORT TO THE SIXTEENTH ANNUAL FOREST PEST CONTROL FORUM

November 15 - 17, 1988

Gatineau Room, 4th Floor
2 Rideau Street, Ottawa

REPORTS ON THE STATUS OF FOREST PESTS.
IN THE WESTERN/NORTHERN REGION IN 1988,
NORTHERN FORESTRY CENTRE, FORESTRY CANADA,
EDMONTON, ALBERTA

Reports are included covering the following agenda items:

2.2 Mountain Pine Beetle
2.3 Jack Pine Budworm
2.7 Forest Tent Caterpillar
2.9 Pinewood Nematode
4.7 Spruce Budworm Distribution and Pest Management

Prepared by H. F. Cerezke,
Head of FIDS at NoFC

2.2 Mountain Pine Beetle (*Dendroctonus ponderosae*): Status in Alberta, Saskatchewan and Rocky Mountain National Parks in 1988.

Infestations of the mountain pine beetle remained at low endemic levels, or were undetected at all locations in southwestern Saskatchewan (Cypress Hills), Alberta, and the Rocky Mountain National Parks, except in Kootenay National Park where population levels are still epidemic. Aerial and ground surveys conducted in 1988 indicated the following:

National Park	Estmated number of patches in 1988	No. of new fader trees in: 1987	1988
Banff	0	25	0
Kootenay	75	3870	3800
Yoho	15	105	108
Waterton Lakes	25	220	60
Jasper	0	0	0

No infested trees were detected in Banff National Park, while in adjacent Alberta (Kananaskis area) where semiochemical tree baits were deployed, only a few 1988-beetle attacks were observed. Control action was limited to hand-removal of some of these attacks that were considered successful. No tree removal was necessary.

No attacked trees were observed in Jasper National Park, while reduced numbers of attacked trees (60) occurred in Waterton Lakes National Park and a similar number (108) occurred in Yoho National Park. In Kootenay National Park, the numbers of new fader trees remained about the same and were confined to the same locations as in 1987. Elsewhere in Alberta and southwestern Saskatchewan, no new infestations were reported.

A Symposium on the Management of Lodgepole Pine to Minimize Losses to Mountain Pine Beetle was held in Kalispell, Montana on July 12-14, 1988. The Symposium was sponsored by the Canada/US Mountain Pine Beetle Program.

RECENT INFESTATIONS OF THE MOUNTAIN PINE BEETLE
IN THE WESTERN/NORTHERN REGION IN 1988

Forest Insect and Disease Survey
Canadian Forestry Service, NoFC

2.3 Jack Pine Budworm (*Choristoneura pinus*): Status in Alberta, Saskatchewan, and Manitoba in 1988.

Jack pine budworm infestations continued to decline in Saskatchewan, were reduced to endemic levels in Manitoba, and remained at a similar level in Alberta as reported in 1987. In Saskatchewan, infestations of moderate-severe defoliation occurred in the same locations as last year but were more patchy. Areas of infestation occurred near Prince Albert and to the northeast near Nipiwin Provincial Park. No control action was taken and no egg mass samples were collected for 1989 prediction.

In Manitoba, areas of infestation that had been reported annually since 1982, completely collapsed in 1988. Egg mass surveys indicate only light defoliation may occur at two of the 10 locations sampled in southeastern Manitoba in 1989.

In Alberta, a patch of about 70 ha of light defoliation occurred in the central part of the province; no 1989 predictive information was gathered.

2.7 Forest Tent Caterpillar (*Malacosoma disstria*): Status in Alberta, Saskatchewan, and Manitoba in 1988.

The forest tent caterpillar was the major insect pest in the prairie provinces in 1988, causing moderate-severe defoliation of aspen stands over a composite land area of over 18 million ha (see Table below and attached Map). This represents about a two-fold increase in Alberta, a three to four-fold increase in Saskatchewan, and about a 12-fold increase in Manitoba, compared to last year.

Province	Total area mapped (ha)	Estimated actual area of aspen stands defoliated* (ha)
Alberta	13,830,000	2,766,000
Saskatchewan	4,660,200	932,040
Manitoba	55,685	55,685
Totals	18,545,885	3,753,725

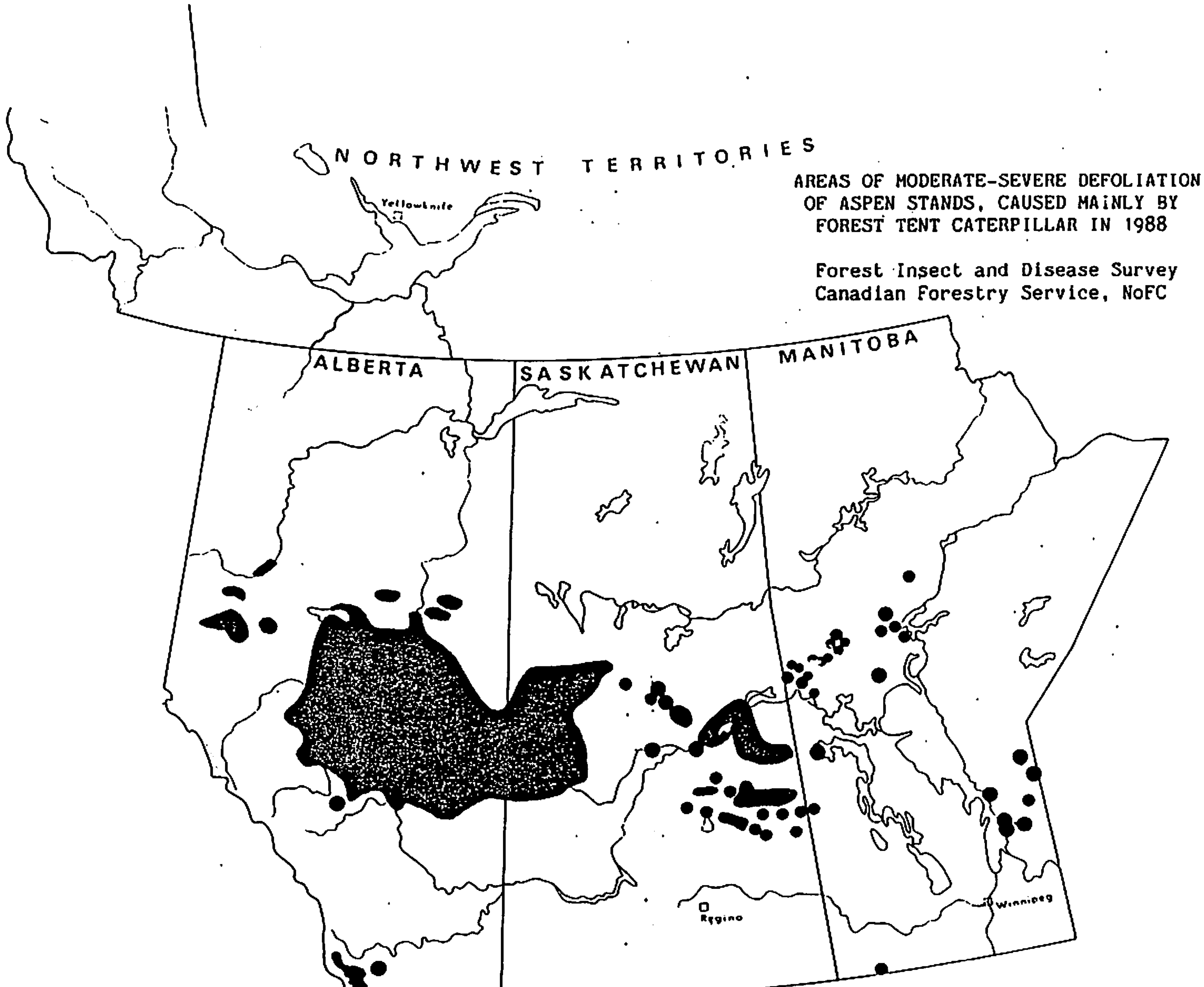
* Estimated as 20% of total area mapped for Alberta and Saskatchewan to exclude the non-forested agricultural areas.

In Alberta, most of the infestaion extended throughout the central part of the province, with considerable extension into the central forested areas and in southwestern Alberta. Caterpillar populations were extremely high in many park, recreation, rural and urban areas in central Alberta and necessitated several hundreds of ha to be aerially sprayed. Virus infection was common in Alberta infestations as well as the parasitic flesh fly, *Sarcophaga aldrichi*.

In Saskatchewan, much of the expanded areas of moderate-severe defoliation also extended into forested areas, especially within and adjacent to Meadow Lake Provincial Park and extending toward North Battleford. Additional large infestations occurred in east-central Saskatchewan, extending from Fort a la Corne Provincial Forest, southeastward to Hudson Bay and the Pasquia Hills. Other smaller infestations occur north of Prince Albert and Prince Albert National Park.

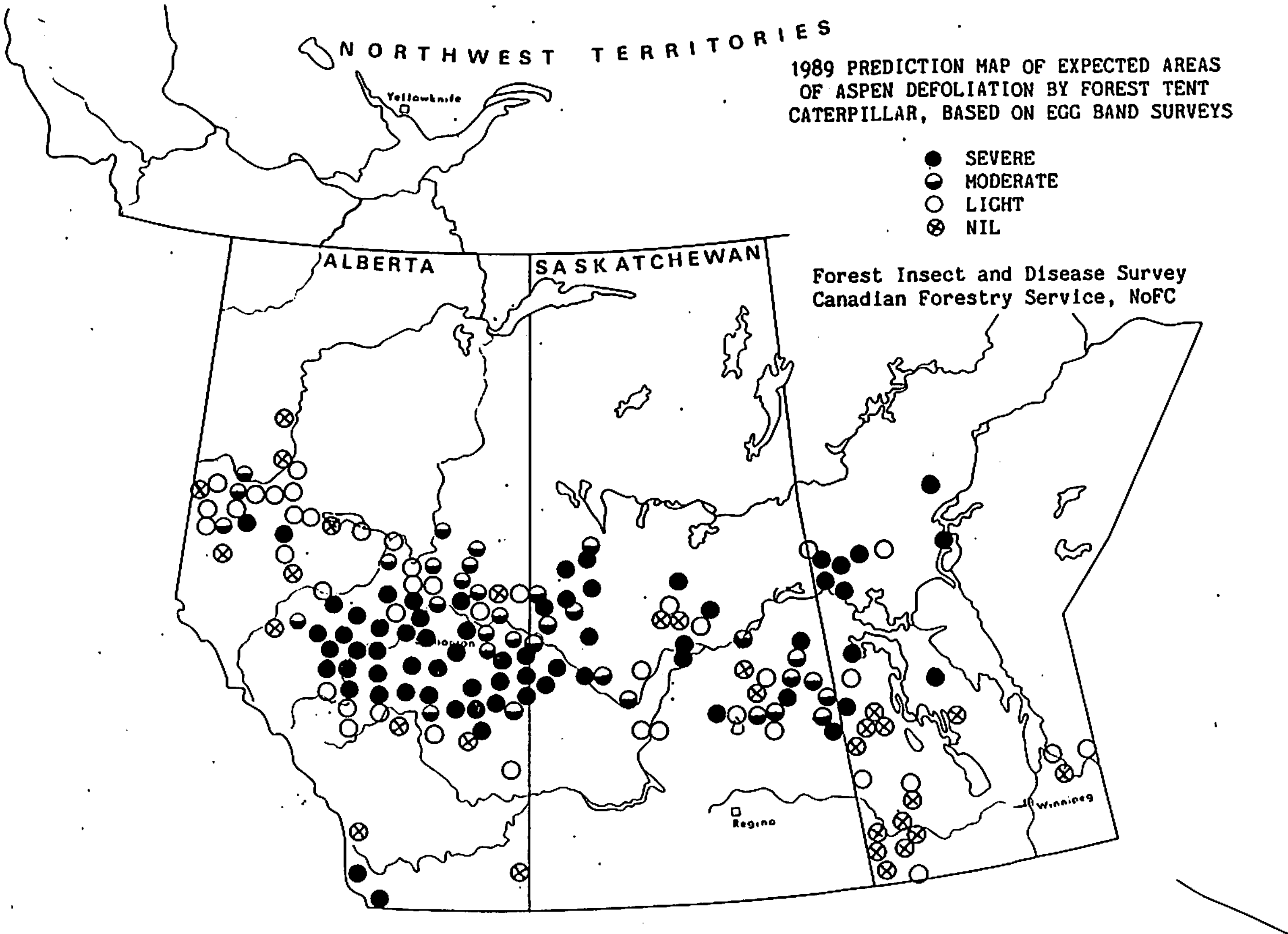
In Manitoba, large increases occurred in areas reported with high forest tent caterpillar populations in 1987. Much of the increases were reported between Flin Flon and The Pas and extending eastward, and between Lake Winnipeg and the Ontario border.

Egg-band surveys conducted in September and October across the region indicate a continuation of the outbreak in 1989 (see attached Map showing locations of sampling points and the predicted ratings).



AREAS OF MODERATE-SEVERE DEFOLIATION OF ASPEN STANDS, CAUSED MAINLY BY FOREST TENT CATERPILLAR IN 1988

Forest Insect and Disease Survey
Canadian Forestry Service, NoFC


NORTHWEST TERRITORIES
Yellowknife
1989 PREDICTION MAP OF EXPECTED AREAS
OF ASPEN DEFOLIATION BY FOREST TENT
CATERPILLAR, BASED ON EGG BAND SURVEYS
SEVERE
MODERATE
LIGHT
NIL
Forest Insect and Disease Survey
Canadian Forestry Service, NoFC
ALBERTA
SASKATCHEWAN
Regina
Winnipeg

2.9 Pinewood Nematode (Bursaphelenchus xylophilus): Status in Alberta, Saskatchewan, Manitoba and the Northwest Territories.

As part of a national survey to detect and identify insect vectors associated with the pinewood nematode, some 42 samples were submitted to Dr. Finney-Crawley at Memorial University over the summer months. The samples (including 200-300 insect specimens) included species of bark beetles, wood borers, carpenter ant, wood wasps and checkered beetles. No results have been received to date.

Wood samples extracted from recently dying balsam fir collected in east-central Alberta (near Lac la Biche) were extracted for pinewood nematode as a possible contributing agent. B. xylophilis was identified in one of the tree stems in which wood borers (Monochamus sp.) and carpenter ants (Camponotus sp.) were associated. Additional samples of dying balsam fir have been collected but nematode extractions are still incomplete.

Several unidentified samples of nematodes extracted in 1986 as part of an intensive region-wide survey for the pinewood nematode are being identified locally at NoFC by Dr. K. I. Mallett.

4.7 Spruce Budworm (Choristoneura fumiferana) Distribution and Pest Management in the Western/Northern Region in 1988.

Infestations of the spruce budworm increased significantly in Alberta and Manitoba in 1988, increased slightly in the Northwest Territories, and remained similar to 1987 levels in Saskatchewan (see attached Table and Map). About 138,000 ha of light to severe defoliated stands, affecting mostly white spruce, were recorded. Across the region, this represents about a 2-fold increase over last year, with the largest increases occurring in northern Alberta in the Footner Lake Forest.

Province/ Territory	Areas of Defoliation--(ha)		
	1987	1988	Change
Alberta	9,480	61,050	+51,570
Saskatchewan	31,600	31,600	0
Manitoba	15,540	30,821	+15,281
Northwest Territories	11,200	14,350	+3,150
Totals	67,820	137,821	+70,001

In the Northwest Territories, where a total of 14,350 ha were mapped, infestations occurred in most of the same locations as last year; ie, along the Slave and Liard rivers. Both outbreak areas have now persisted for 5 or 6 years. Most of this year's expansion occurred in adjacent stands along the Slave River, affecting both white and black spruces. No salvage or control plans are anticipated in the near future. However, the Department of Renewable Resources is now developing a Forest Management Policy plan for the N.W.T. and is encorporating important forest insect and disease pest concerns.

In Alberta, infestations were mapped at five locations, including two provincial parks, and in two provincial forest districts where spruce budworm management strategies are in place by the Alberta Forest Service. In one of the forest districts (Footner Lake Forest), the area of spruce budworm defoliation increased about 7-fold, compared to 1987, and is predicted to continue in 1989. Some of the infested merchantable areas are now being priorized for early harvesting and will be continually monitored for spruce budworm, spruce beetle (Dendroctonus rufipennis) population change as well as for damage impact.

Another smaller infestation of about 700 ha in the northern Grande Prairie Forest has persisted for 4 to 5 years and is now causing severe top-kill and some tree mortality. Bt application and selective salvage strategies are being considered by the Alberta Forest Service for this area in 1989.

In some provincial park and private areas, Bt was applied over about 250 ha in central Alberta.

In Saskatchewan, spruce budworm infestations occurred in the same two areas as in 1987 (Porcupine Hills and Red Earth outbreaks). The areas of infestation cover, respectively 16,600 and 15,000 ha. Timber harvesting to salvage the budworm-damaged timber has been on-going in the Red Earth outbreak area. Moderate-severe infestations are predicted to occur in the two main outbreak areas again in 1989.

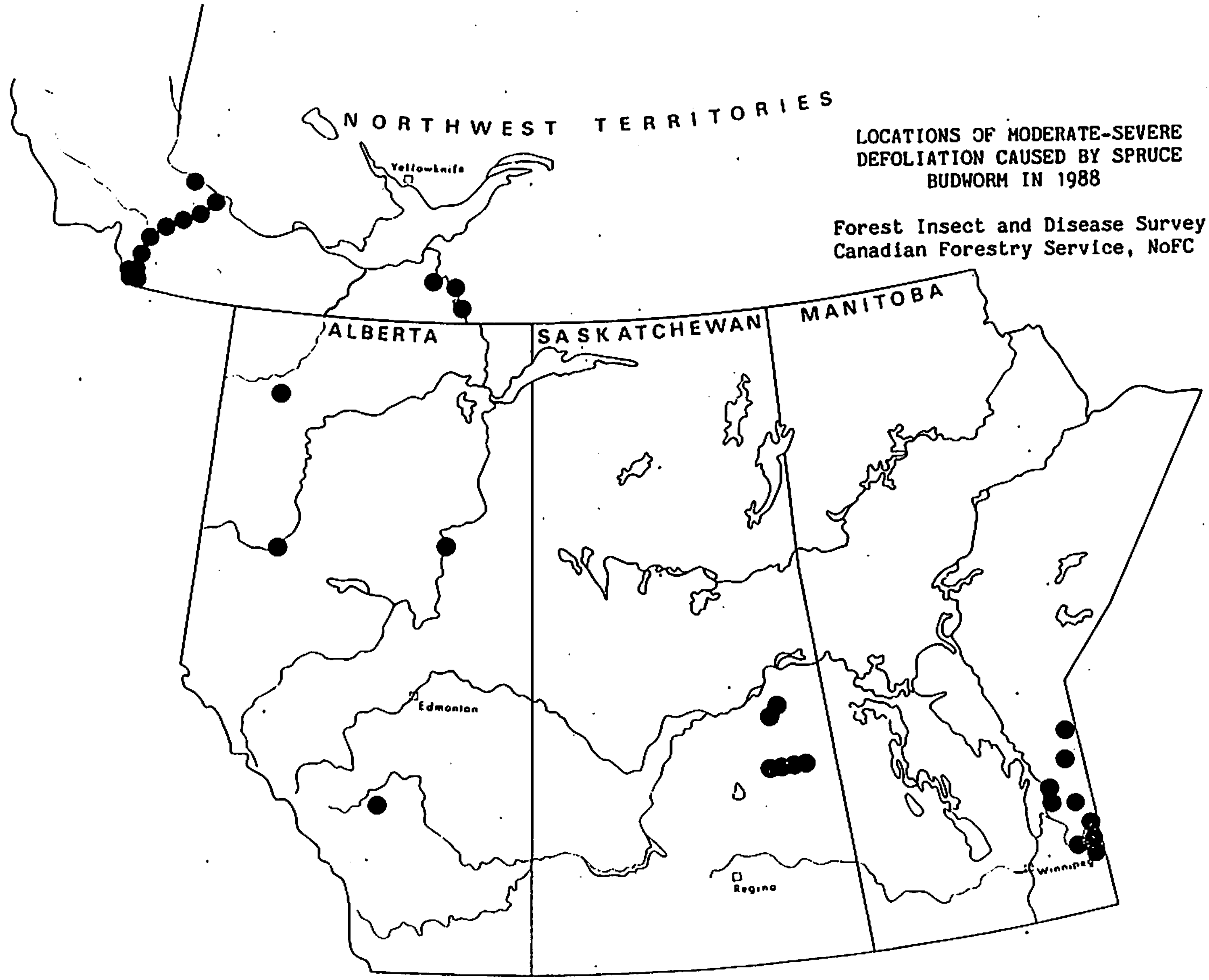
In Manitoba, the areas of moderate-severe defoliation increased about 2-fold over 1987, mostly in the southeastern part of the province near the Ontario border. Included in the total defoliated areas mapped was about 1000 ha of light defoliation in the Interlake area.

Foliage and egg mass samples were collected at 13 locations in Manitoba: light defoliation is predicted to occur at 4 locations, light-moderate at one location, and severe defoliation at two locations in 1989. This represents a general increase compared to 1988.

During 1988, the Manitoba Department of Natural Resources conducted an aerial spray application with Bt on some 1000 ha in spruce-fir forests in recreational areas of Whiteshell Provincial Park.

LOCATIONS OF MODERATE-SEVERE
DEFOLIATION CAUSED BY SPRUCE
BUDWORM IN 1988

Forest Insect and Disease Survey
Canadian Forestry Service, NoFC



GYPSY MOTH IN ONTARIO, 1988[1]

- Outbreak Status 1988
- Forecasts 1989
- Results of Spraying Operations, 1988

by

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

1 Report prepared for Sixteenth Annual Forest Pest Control Forum, Ottawa, November 15-16, 1988.

2 Canadian Forestry Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario.

3 Ontario Ministry of Natural Resources, Pest Management Section, Sault Ste. Marie, Ontario.

OUTBREAK STATUS 1988

Gypsy moth infestations which declined in 1986 and 1987 rebounded in 1988, with the total area of moderate-to-severe defoliation increasing to ~~33,697~~ 29,797 ha; up from 12,678 ha last year (Fig. 1 and Tables 1, 2 & 3). As in previous years the largest area of defoliation occurred in the Tweed District (16,089 ha) much of which was located in a large infestation along Highway 7 in the Kennebec-Sulphide area. Numerous small, scattered pockets were also recorded in the southwest Brockville District, the western Napanee District and the southern Lindsay District. The same pattern of scattered pockets was also recorded in the Pembroke District, the western Carleton Place District, the central Niagara District and the southern Simcoe District. Small numbers of larvae which did not cause any appreciable defoliation were collected at numerous other locations in southern Ontario.

Larval Trapping

A program of burlap larval trapping was carried out in 1988 (Fig. 2). In the Eastern Region positive results were recorded at 9 of 13 locations with the highest number of larvae, (1145) recorded at Sharbot Lake Provincial Park, a decline from the 2,135 larvae captured last year. Other areas in the region where high numbers were recorded were Silver lake, 227 larvae; Fitzroy, 584 larvae; Charleston Lake, 298 larvae and Frontenac, 910 larvae, up from 185 in 1987. In the Algonquin Region larvae were trapped at 7 of 23 locations with the highest number of larvae at Petroglyphs Park where 600 were captured, an increase from 22 last year. Trapping in the Central Region yielded positive results at 11 of 16 locations. The highest catches were at Awenda Park where the number of larvae caught increased from 15 to 240 and Six Mile Lake Park where catches increased from 0 to 821. In the Southwestern Region, 11 locations were trapped and larvae were caught at 4 of these. The largest catches in this region were at Turkey Point Park where 120 larvae were recorded. Two larvae were caught at Killarney Provincial Park in Sudbury District, a first record for this area.

Pheromone Trapping

The annual gypsy moth pheromone trapping program was carried out in both northern and southern Ontario parks and campgrounds (Fig. 3). In southern Ontario, moths were caught at all locations where traps were set out, with the single exception of Kearney Lake in Algonquin Provincial Park. Although numbers of moths captured fluctuated, no general pattern was evident except in Algonquin Park District where moth catches were generally down compared with those of last year. In northern Ontario, positive results were recorded at 16 parks in the Northeastern Region, most of which were located in the North Bay, Sudbury and Espanola districts where moth catches have been on the increase for several years. Moth catches were recorded at

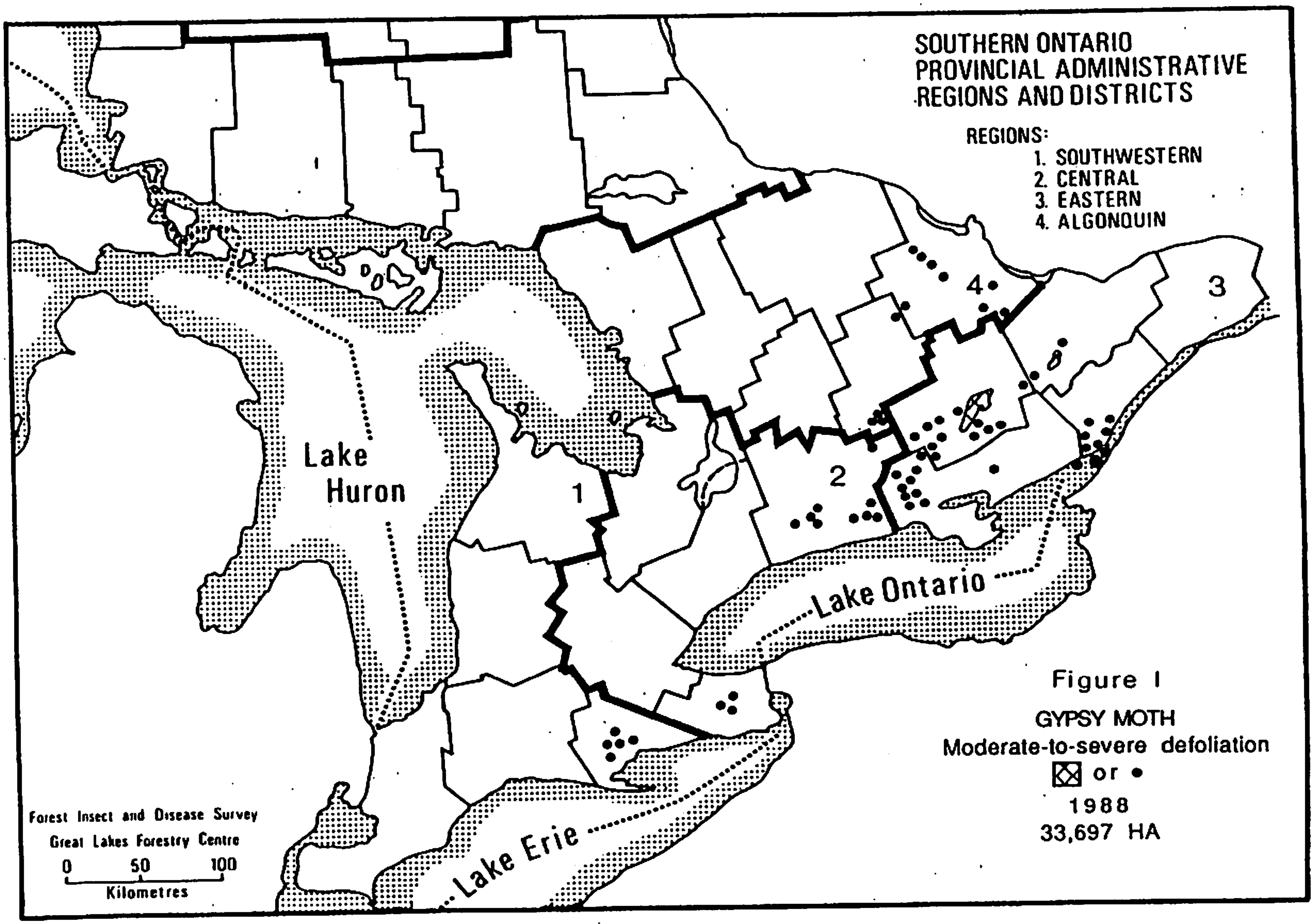


Figure I
GYPSY MOTH
Moderate-to-severe defoliation
⊠ or •
1988
33,697 HA

Table 1. Gypsy moth infestations in Ontario, 1981-1988.

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	33,697

Table 2. Gross area of moderate-to-severe defoliation by the gypsy moth, by district, 1985-88 (ha).

Region	District	1985	1986	1987	1988
Eastern	Tweed	172,232	73,525	3,329	16,089
	Napanee	58,326	57,780	4,781	6,198
	Carleton Place	4,197	13,386	1,355	3,918
	Brockville	11,232	22,283	2,099	1,865
Algonquin	Pembroke	90	221	0	124
	Bancroft	240	164	111	370
Central	Lindsay	25	417	888	4,865
	Niagara	0	0	0	28
Southwestern	Simcoe	0	0	115	240
		246,342	167,776	12,678	33,697

Table 3. Gross area of moderate-to-severe defoliation by the gypsy moth, by county, 1986-88 (ha).

County	1986	1987	1988
Northumberland	1,430	2,131	7,791
Peterborough	179	167	1,593
Hastings	11,668	4,511	5,625
Lennox and Addington	8,627	407	10,007
Prince Edward	540	0	0
Frontenac	109,442	1,775	1,861
Leeds	22,283	2,099	1,865
Lanark	13,356	1,355	3,918
Ottawa-Carleton	221	0	0
Durham	0	118	280
Haldimand-Norfolk (R.M.)	0	115	240
Victoria	0	0	385
Renfrew	0	0	124
Niagara (R.M.)	0	0	28
	167,776	12,678	33,697

several locations where negative results were obtained in 1987 including Finlayson Point Provincial Park, Temagami District, Rabbit Blanket Lake Campground in Lake Superior Provincial Park, Wawa District, Windy Lake and Fairbank Provincial Park, Sudbury District, and Martin River Provincial Park, North Bay District. Negative results were obtained at two locations where single moth catches were made in 1987, Fushimi Provincial Park, Hearst District and Kettle Lakes Provincial Park, Timmins District, this despite the installation of additional traps.

FORECASTS 1989

Egg-mass surveys were carried out as part of a spray evaluation program in southern Ontario (Tables 4 & 5) but are not considered to be sufficient to make accurate predictions. However, based on historical records of the insect in other areas and on the small amount of egg-mass survey data available, it is expected that an increase, possibly two-to-three fold, in the area of moderate-to-severe defoliation can be expected in 1989. Egg-masses were discovered in a number of previously uninfested areas. These included Bayham and Blandford townships, Aylmer District; Killbear Provincial Park, Parry Sound District; Bluewater Beach, Tiny Township, Huronia District; a number of locations in Minden District and Silent Lake Provincial Park, Bancroft District. Further north, a single egg-mass was found at Killarney Provincial Park, Sudbury District, and adult

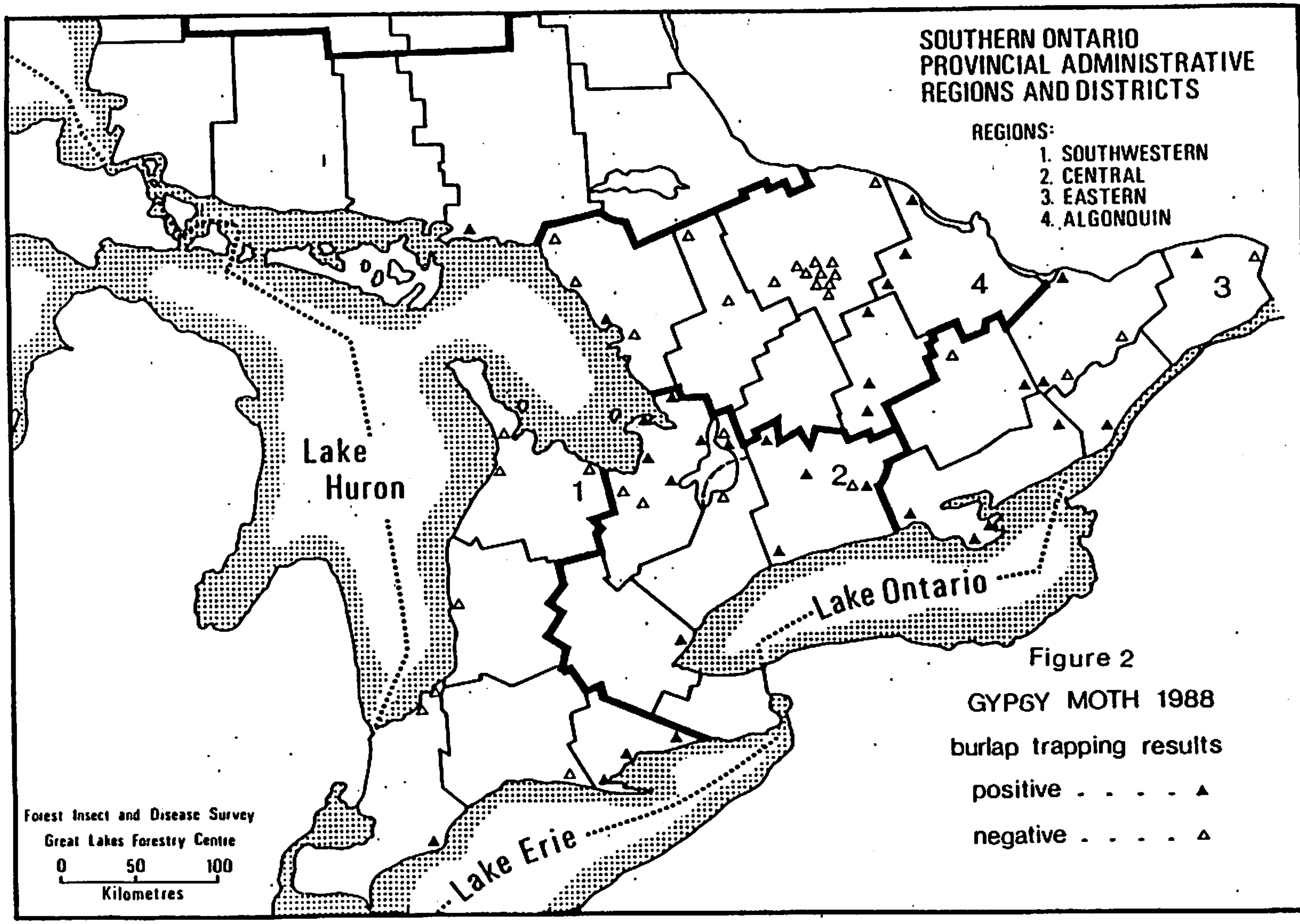


Figure 2
GYPGY MOTH 1988
burlap trapping results

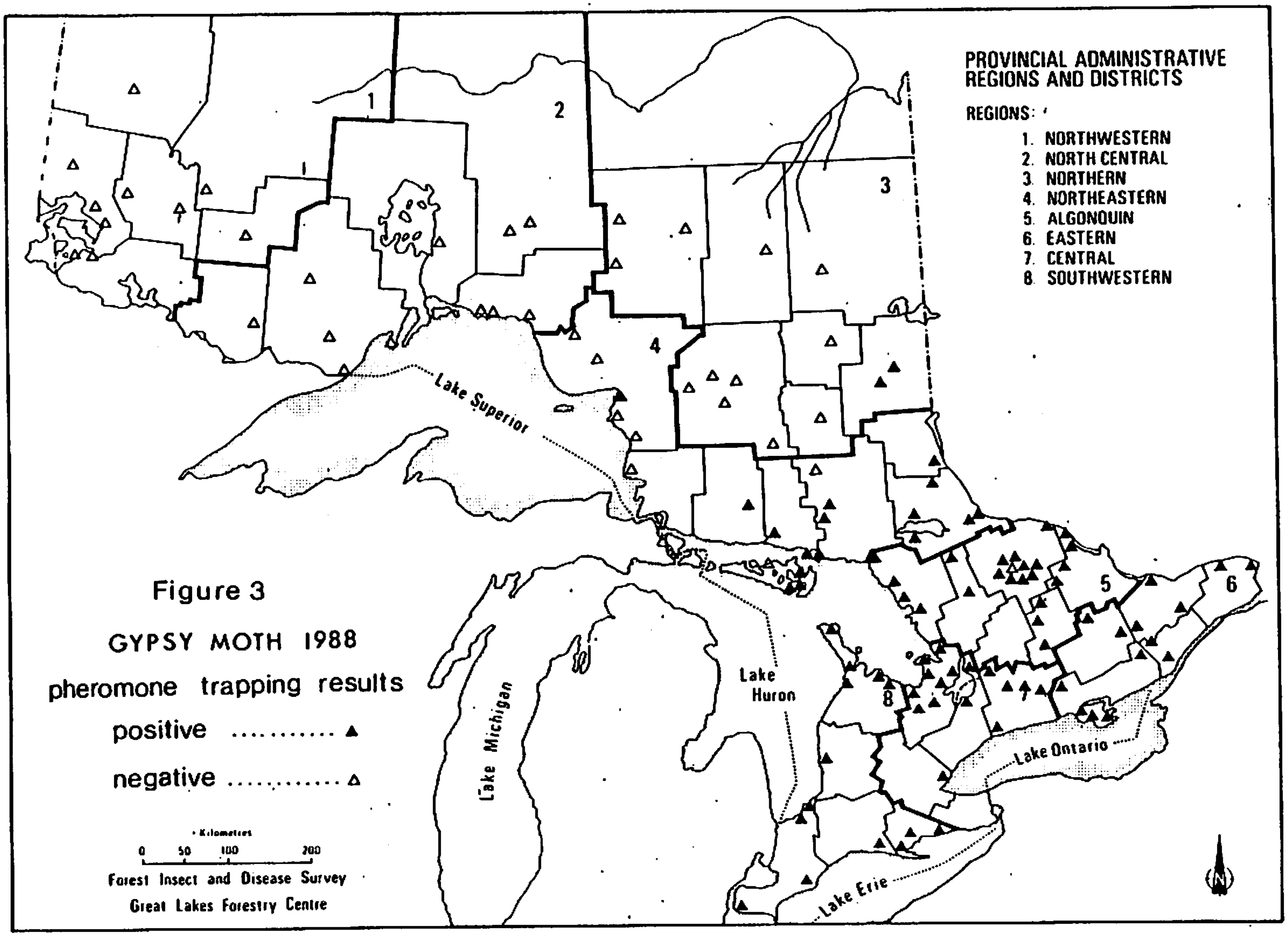


Figure 3

GYPSY MOTH 1988

pheromone trapping results

positive .... ▲

negative .... △

Table 4. Gypsy moth: Comparison of egg-mass densities in 1987 and 1988 in southern Ontario.

District	No. plots	Average egg-masses per .01 ha 1987	Average egg-masses per .01 ha 1988	% Change
Lindsay	60[1]	220	9.7	-95.6
Simcoe	15	158	65	-58.9
Carleton Place	16	39.75	7.25	-81.8
Overall	91	178	18.4	-89.7

1 includes 60 plots sprayed with _B.t._ in 1988.

Table 5. Gypsy moth: Egg-mass counts in sprayed and unsprayed areas in southern Ontario in 1987 and 1988.

	Sprayed				Checks			
District	No. plots	Average egg-masses per .01 ha 1987	Average egg-masses per .01 ha 1988	% Change	No. plots	Average egg-masses per .01 ha 1987	Average egg-masses per .01 ha 1988	% Change
Lindsay	40	263	2	-99	20	134	25	-81
Simcoe	10	222	6	-97	5	30	183	+507
Carleton Place	10	24	2	-92	6	66	16	-76
Overall	60	216	3	-99	31	104	49	-53

Table 6. Gypsy moth: Overwintering egg survival in southern Ontario, 1988.

Location	Ground			Bole		
	Egg-mass hatch (%)	Eggs per mass ($\bar{x}$)	Larvae per egg-mass ($\bar{x}$)	Egg-mass hatch (%)	Eggs per mass ($\bar{x}$)	Larvae per egg-mass ($\bar{x}$)
Simcoe	100	476	456	100	429	401
Ganaraska	96	242	236	100	225	217
Centreton	92	156	109	100	227	125
Kaladar	100	248	222	30	281	45
Joes Lake	92	270	231	0	270	0
Overall	96	280	252	66	232	161

Table 7. Gypsy moth: Overwintering egg survival from 1983 to 1988 in eastern Ontario.

Year	GROUND			BOLE		
	% Hatch	Eggs per mass ($\bar{x}$)	Larvae per mass ($\bar{x}$)	% Hatch	Eggs per mass ($\bar{x}$)	Larvae per mass ($\bar{x}$)
1983	100	285	274	100	241	223
1984	96	356	327	22	354	40
1985	84	375	315	45	276	125
1986	99	259	247	89	270	166
1987	98	217	207	48	285	108
1988	96	280	252	66	232	161

moths and two egg-masses were found in Prince Township, west of the city of Sault Ste. Marie, Sault Ste. Marie District.

It should be noted that the Ontario Ministry of Natural Resources conducted an extensive egg-mass survey in eastern Ontario this fall but final results are not yet available.

RESULTS OF SPRAYING OPERATIONS

In 1988, the Ontario Ministry of Natural Resources aerially sprayed a total of 13,784 ha of forest in southern Ontario to protect stands from defoliation by gypsy moth. As in previous years, the 1988 program involved both crown land spraying (4,528 ha) and private land spraying (9,256 ha).

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 egg-masses. Five locations were sampled in April 1988. 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. 96%) and the proportion of eggs hatching per egg-mass was also high (i.e. 90%). Survival of egg-masses laid above ground level on the boles of trees was very high for Simcoe, Ganaraska and Centreton whereas survival was low at Kaladar and Joes Lake. A comparison of egg hatch from 1983-1988 (Table 7) shows an increase in the average egg-mass size this year, at least for those egg-masses on the ground.

A helicopter and several fixed-wing aircraft were used to apply Dipel 132 at 30 BIU/2.4L/ha. All spray blocks received at least two treatments and some areas received a third application. Second applications followed the initial treatment by as little as two days in the case of Simcoe District and up to seven days for Carleton Place District. The date of spray for each application and the development of the insect and host at the time of application is presented in Table 8.

Gypsy moth egg hatch was first observed in the vicinity of Tweed and Kaladar on May 7 and 8 and May 9 in Simcoe District. April was warmer than normal although a cooling trend in late April and early May slowed development. A warming trend started about May 7 and 8 and heat accumulation remained ahead of normal (Fig. 4) for the rest of May and throughout June.

Spraying started May 26 at Ganaraska and St. Williams with the insects primarily in second instars and proceeded quite expeditiously with second and third applications going on with little delay.

Table 8. Gypsy moth: Spray application dates and insect and host development at time of sprays, 1988.

Location	Application	Spray dates	% larval instar I	II	III	IV	V	VI	% Host development rO[1]	wO[2]
Lindsay District										
Ganaraska County Forest	1	May 26, 27	5	82	13				55	41
	2	June 2, 6		11	49	36	4			
	3	June 11, 12			12	38	41	9		
Northumberland County Forest	1	May 29, 30 June 1		19	81				72	57
	2	June 7, 8, 9		4	43	51	2			
	3	June 17			6	58	13	23		
Simcoe District										
St. Williams	1	May 26, 27	4	70	26				44	40
	2	May 30, 31		9	91					
	3	June 3			68	32				
Carleton Place District										
Joes Lake	1	May 27	9	63	28				46	
	2	June 3		3	83	14				

1 rO = red oak

2 wO = white oak

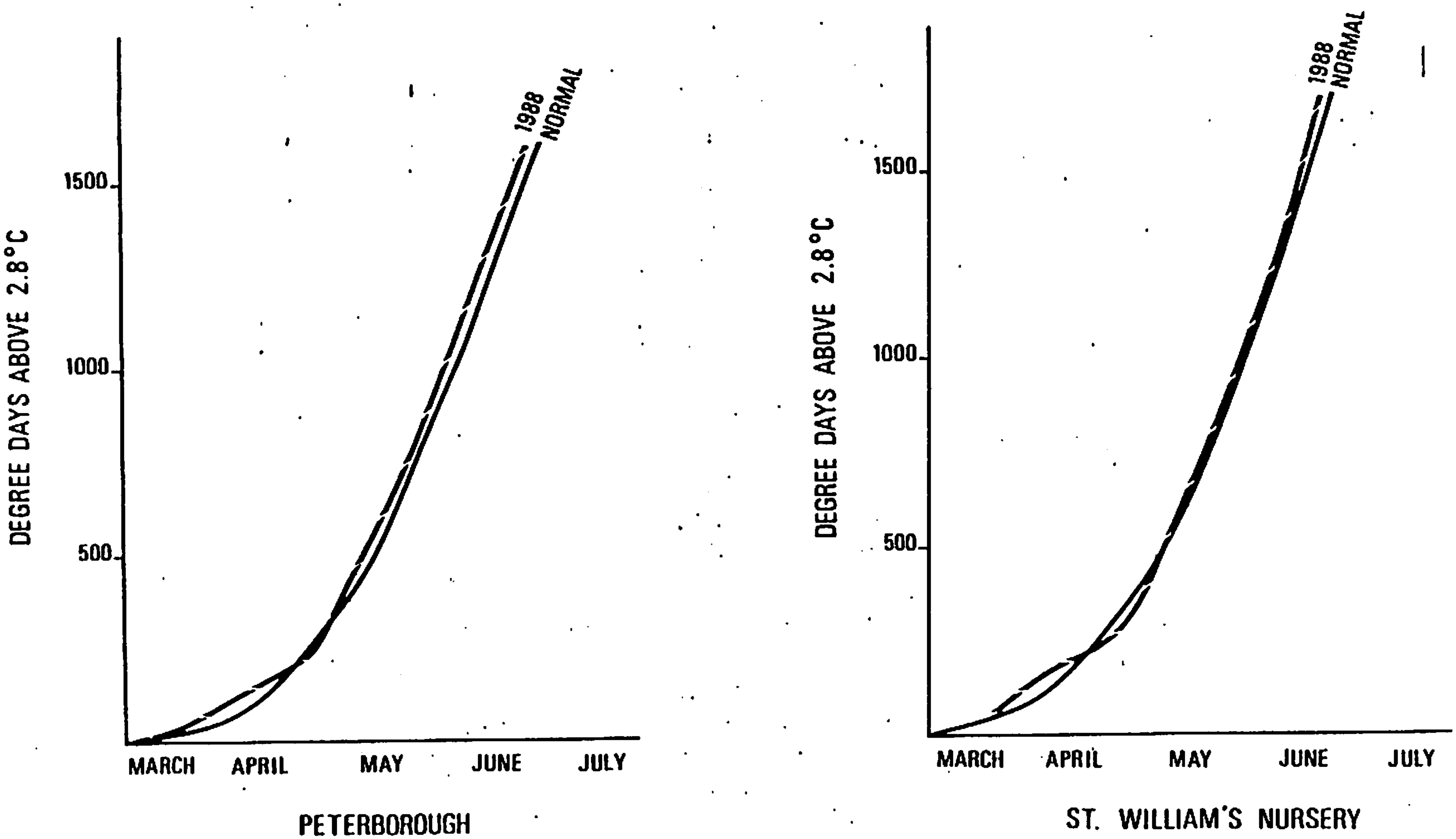


Figure 4. Heat accumulation in degree days for Peterborough, and St. William's Nursery, Ontario, 1988.

The bulk of the Crown spraying was completed by June 12 except for Northumberland County Forest where a third application could not be completed until June 17 due to mechanical problems with a helicopter.

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. It would seem evident based on the data and results in Table 9 that this year's program was highly effective in terms of controlling the insect and minimizing defoliation in sprayed forests. Defoliation was limited to 25% or less in sprayed stands whereas check plots ranged from 50-100% defoliation. Egg-mass densities in sprayed plots were reduced 98-100% with one or two exceptions compared to natural decreases of 61-98% or large increases in some situations.

Table 9. Gypsy moth: Egg-mass counts and current defoliation in sprayed and unsprayed (checks) plots in southern Ontario, 1988.

Location Block	No. Appl.	No. plots	Egg-masses per .01 ha 1987	Egg-masses per .01 ha 1988	% Change	% Defol. rO	% Defol. vO
Lindsay District							
Ganaraska County Forest							
R-20	3	7	827.4	2.1	-99	20	20
R-21	3	2	664.0	8.0	-99		15
R-22	2	1	234.0	4.0	-98	18	22
R-23	3	8	116.0	4.8	-96	25	
R-24	3	2	405.0	1.0	-99	21	
Checks		6	174.7	21.7	-88	73	62
Checks		4	80.5	25.0	-69	49	44
Northumberland County Forest							
R-15	2	6	48.0	0.2	-99	14	14
R-16	2	1	90.0	1.0	-99	9	9
R-17	2	3	60.3	0.0	-100	18	22
	3	5	71.8	0.0	-100	20	22
R-18	2	1	17.0	0.0	-100	15	17
R-19	2	4	122.0	0.3	-99	18	15
Checks		3	66.3	14.7	-78	25	
Checks		5	108.6	42.4	-61	55	61
Checks		2	280.0	5.0	-98	51	48
Simcoe District							
St. Williams	2	6	31.0	6.3	-80	12	11
	3	4	508.5	6.8	-99	22	20
Checks		2	51.0	97.5	+91	100	100
Checks		3	16.3	240.7	+1373	15	20
Carleton Place District							
Joes Lake	2	10	23.6	1.9	-92	13	26
Checks		2	86.5	31.5	-64	42	
Checks		2	48.0	1.0	-98	22	
Checks		2	63.0	15.5	-75	18	

FOREST TENT CATERPILLAR IN ONTARIO, 1988[1]

- Outbreak Status 1988
- Forecasts 1989
- Results of Spraying Operations, 1988

by

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

[1] Report prepared for the Sixteenth Annual Forest Pest Control Forum, Ottawa, November 15-16, 1988.

[2] Canadian Forestry Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario.

[3] Ontario Ministry of Natural Resources, Pest Management Section, Sault Ste. Marie, Ontario

OUTBREAK STATUS 1988

The current forest tent caterpillar outbreak continued unabated in 1988. Province-wide, a total area of 3,965,229 ha of moderate-to-severe defoliation was mapped by aerial and ground surveys, up from the 1,649,977 ha recorded last year (Table 1, Fig. 1)

In the northwestern part of the province, heavy defoliation was widespread in the southern Fort Frances District with scattered pockets of varying size across the northern Fort Frances District, the southern Kenora District and the southern Dryden District. Pockets of moderate-to-severe defoliation also occurred across the central Atikokan and Thunder Bay districts along with two small patches near Red Rock in Nipigon District.

In northeastern Ontario, the largest single infestation in the province occupied some 1,755,353 ha across the southern part of the Northeastern Region from Sault Ste. Marie eastward to the Quebec Border and extending south into the northern edges of the Algonquin Park District of the Algonquin Region. Included in this area were heavy infestations on Manitoulin and St. Joseph islands. Numerous small pockets occurred along the northern edge of this large infestation. Sporadic patches of moderate-to-severe defoliation were mapped in the Dubreuilville, Missanabie, Lochalsh area of Wawa District and a similar situation occurred in the White Lake area on the Wawa-Terrace Bay district boundary where a number of small infestations were recorded.

Infestations in the southern Kirkland Lake and northern Temagami districts collapsed this year as predicted by egg counts carried out in the fall of 1987 in this, the oldest part of the outbreak. New infestations were mapped in narrow bands along the Nagagami, Kenogami, Kabinakagami and Pitukupi rivers near the junction at the abandoned village of Mammamattawa in the Hearst District. Several small, isolated pockets were also mapped south and west of the town of Hearst.

In southern Ontario the main body of infestation was in the western Algonquin Region including large sections of the Parry Sound, Bracebridge, Minden and Bancroft districts and extending east into the western Tweed District of the Eastern Region and south into the northern Lindsay and Huronia districts of the Central Region. Scattered patches of defoliation were also recorded in the eastern Bracebridge and Minden districts along with central Algonquin Park, northern Pembroke and northern Carleton Place district. Sizable pockets of moderate-to-severe defoliation were also mapped in the central Owen Sound District of the Southwestern Region.

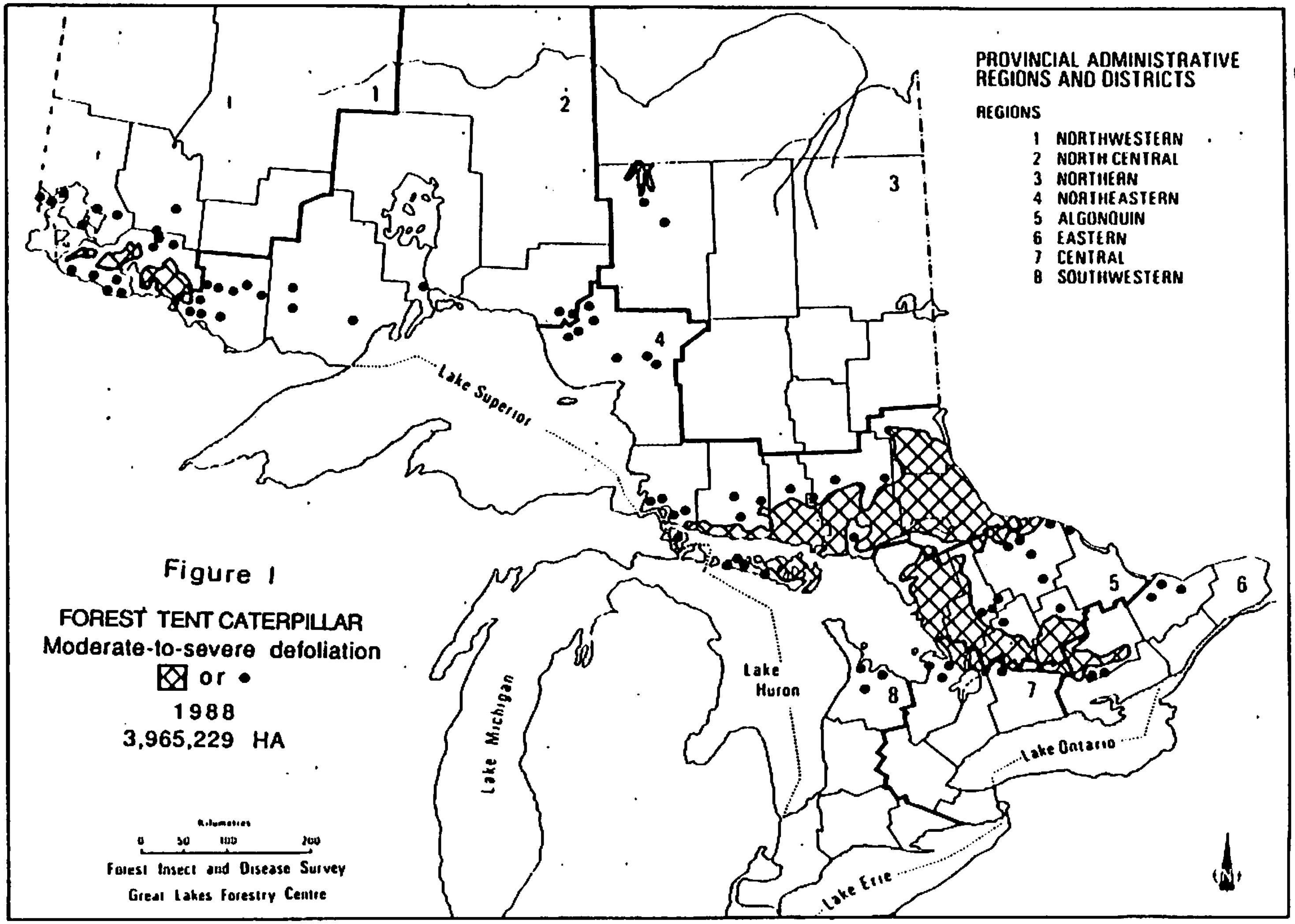


Figure 1

FOREST TENT CATERPILLAR
Moderate-to-severe defoliation
⊠ or •
1988
3,965,229 HA

Table 1. Gross area of current moderate-to-severe defoliation by the forest tent caterpillar in Ontario from 1986 to 1988.

Region District	Area of moderate-to-severe defoliation (ha) 1986	1987	1988
Northwestern			
Dryden	0	0	610
Fort Frances	0	5,025	257,305
Kenora	0	0	15,070
	0	5,025	272,985
North Central			
Atikokan	0	1,770	28,160
Thunder Bay	250	280	4,230
Nipigon	0	0	560
Terrace Bay	0	380	690
	250	2,430	33,640
Northeastern			
Wawa	14,335	10,720	12,087
Sault Ste. Marie	0	11,340	26,560
Blind River	4,940	35,867	102,852
Espanola	5,230	67,010	415,273
Sudbury	0	39,394	442,274
Temagami	163,540	292,913	252,650
North Bay	86,920	584,501	856,053
	274,965	1,041,745	2,107,749
Northern			
Hearst	0	0	10,550
Kirkland Lake	123,280	112,452	0
Gogama	21,370	0	0
Chapleau	1,975	460	0
	146,625	112,912	10,550
Algonquin			
Bancroft	0	28,628	148,125
Minden	0	53,653	268,633
Parry Sound	11,160	241,399	408,302
Bracebridge	0	150,104	330,845
Algonquin Park	0	0	62,579
Pembroke	0	180	39,425
	11,160	473,964	1,257,909
Eastern			
Cornwall	0	0	445
Carleton Place	0	78	3,835
Tweed	0	902	121,174
Napanee	0	0	190
	0	980	125,644
Central			
Lindsay	0	5,198	47,752
Huronia	0	7,723	104,240
	0	12,921	151,992
Southwestern			
Owen Sound	0	0	4,760
	0	0	4,760
	433,000	1,649,977	3,965,229

FORECASTS 1989

An egg band survey was carried out across Ontario during the latter part of the field season. A total of some 240 locations were sampled using either whole tree or branch sampling methods. An analysis of the results showed that 198 of these locations or 82.5% yielded forecasts of moderate-to-severe defoliation for 1989. Based on these results, and the pattern of previous outbreaks, it is probable that the total area of moderate-to-severe defoliation may increase to 8 or 9 million ha next year and increases will probably occur in all three parts of the province, Northwestern, Northeastern and Southern.

In northwestern Ontario, infestations will probably intensify and many of the pockets in the Kenora, Atikokan and Thunder Bay districts may coalesce to form fewer but much larger bodies of infestation. Similarly, the large bodies of infestation in northeastern and southern Ontario may merge to form a single, huge infestation from the Sault Ste. Marie area east to the Quebec border and southeast into the Eastern Region. Small pockets of infestation in the Owen Sound and Carleton Place districts will probably also enlarge considerably in 1989.

RESULTS OF SPRAYING OPERATIONS

During the fall/winter of 1987/88, the Ontario Ministry of Natural Resources, Algonquin Region decided to spray from the ground several provincial parks in the region. Since site-specific information with respect to infestation and defoliation potential was lacking for many of the parks, a survey was conducted in mid-April by the CFS in six provincial parks in the Algonquin Region and one park in the Central Region. The results of this survey are summarized in the following table (Table 2).

Table 2. Summary of FTC egg band counts at seven provincial parks (counts based on 2 branches from 5 trees at each location).

District	- Park	No. of locations	No. of branches	Total no. of egg bands	Aver. no. of egg bands/location
Bancroft	Silent Lake	8	80	68	8.5
Bracebridge	Arrowhead	9	90	40	4.4
	Mikisew	6	60	2	.3
Parry Sound	Oastler Lake	5	50	14	2.8
	Grundy Lake	9	90	24	2.7
	Killbear	8	80	2	.25
Huronia	Six Mile Lake	6	60	19	3.2

Based on these data, the Forest Insect and Disease Survey (CFS) recommended that Killbear and Mikisew provincial parks should not be treated whereas the other five parks could expect moderate or severe defoliation.

Egg band hatching was observed in Arrowhead and Silent Lake provincial parks on April 25 and in the vicinity of Tweed May 3. Based on Muskoka airport weather records, the Algonquin Region got off to a warm start in early to mid-April and was 12 days ahead of normal at one point (Fig. 2). However, cooler temperatures occurred in the latter part of April and early May and development slowed. Starting about May 6 or 7 warmer temperatures prevailed for the remainder of the month and insect and host development proceeded as expected but 5-6 days ahead of normal. On May 16, it was recommended that spraying start as soon as possible, however, due to mechanical problems with the equipment and a holiday weekend, spraying did not commence until May 24 in Silent Lake Provincial Park. The date each park was sprayed, area sprayed, and insect and host development at time of treatment is summarized in Table 3.

The insecticide used was a B.t. material, Futura FC which is produced in a formulation with a concentration of 14.8 BIU/L and was applied at a rate of 20 BIU/ha. Two pieces of equipment were used, an air blast sprayer and a mist blower. Areas treated were along the park roads and campgrounds.

Methods used in 1988 to assess the effectiveness of the ground spraying were originally developed and used in the mid 1970's by FIDS staff to assess a variety of experimental and operational aerial sprays conducted in Parry Sound, Bracebridge, Huronia and Owen Sound districts in 1975, 1977 and 1978. Post spray counts consisted of felling in each spray plot or in appropriate check plots, dominant or co-dominant aspen, sugar maple or red oak trees depending on the type of stand. All living larvae and pupae present on the trees were counted and the degree of defoliation was estimated. In conjunction with each sample tree, all living larvae or pupae within the limits of a 1 m x 1 m ground plot were counted. All current egg bands on the trees were recorded and collected. These were used to determine the number of eggs that hatched per egg band. These latter counts provided prespray population estimates on a per tree basis.

Results are summarized in Table 4. The four parks in the Algonquin Region, which happened to be the first four sprayed, all received a measurable degree of protection with the best results evident in Arrowhead and Grundy Lake. Oastler Lake received a fair degree of protection and Silent Lake somewhat less. In most instances, in addition to foliage protection, larval populations were reduced considerably which would minimize the nuisance caused by the caterpillars. Very little foliage protection was provided to Six Mile Lake Provincial Park due to the high insect populations and lateness of the spray.

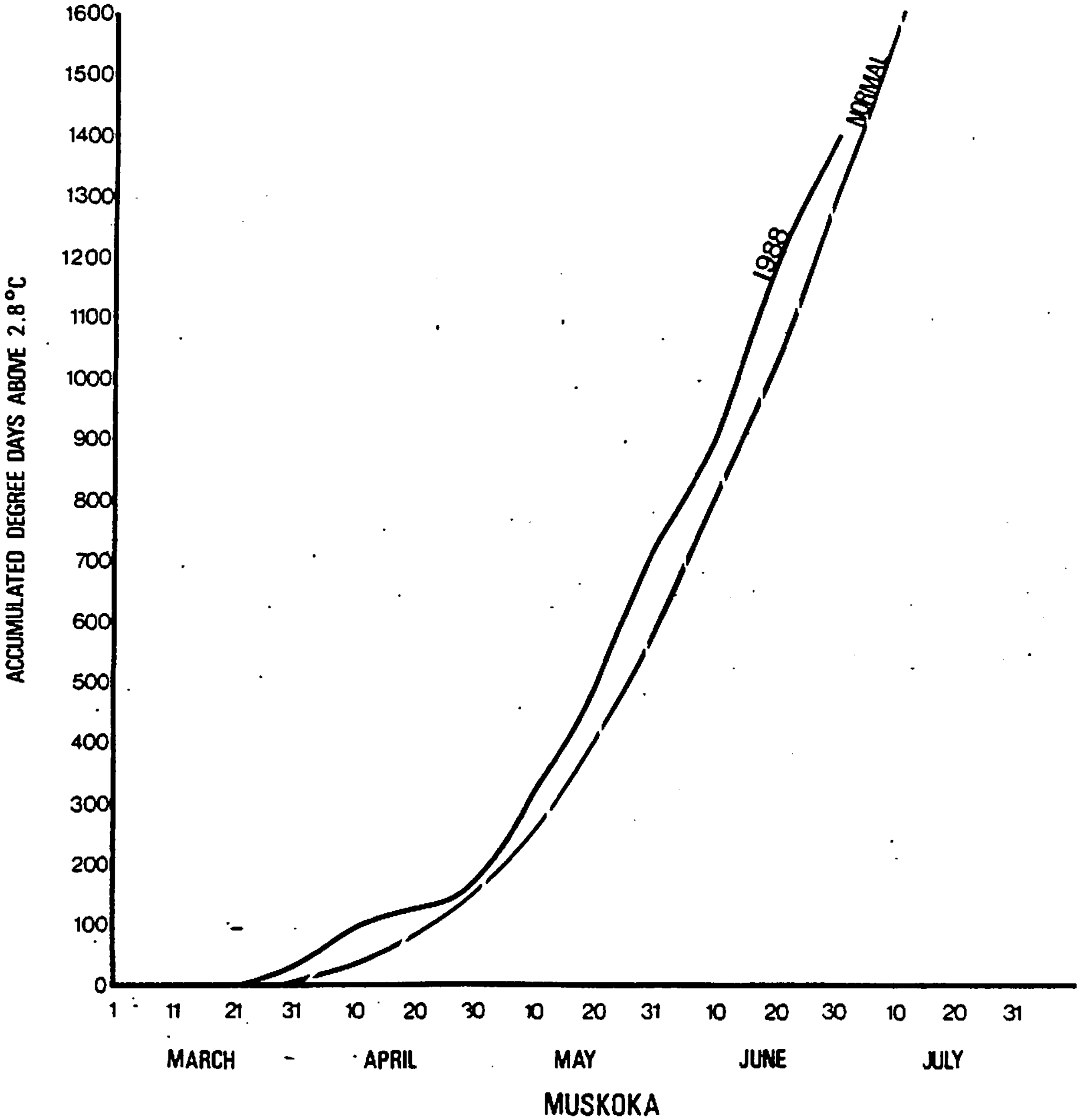


Figure 2. Heat accumulation in degree days for Muskoka, Ontario, 1988.

Table 3. Forest tent caterpillar: Spray dates, area sprayed, insect and host development for five provincial parks (four in the Algonquin Region, one in the Central Region) ground sprayed with Futura FC, 1988.

Region District Provinial Park	Date sprayed	Area (ha) sprayed	% Larval instar II	 III	 IV	 V	% Leaf development tA	 sM	 rO
Algonquin									
Bancroft									
Silent Lake	May 24, 25	32.5	1	98	1			82	
Bracebridge									
Arrowhead	May 26, 27	83.7	13	14	67	6	53	87	
Parry Sound									
Grundy Lake	May 30, 31	53.2			6	94	100		
Oastler Lake	May 31	10.0			45	55		100	
Central									
Huronia									
Six Mile Lake	June 2	22.1			4	96			100
		201.5							

Table 4. Forest tent caterpillar: Results of FUTURA ground spray in five provinical parks, Algonquin and Central region, 1988.

		Prespray		Postspray larvae-pupae		
Location	Host	Egg bands per tree	Larvae per tree	per tree	per m^2	% Defoliation
Silent Lake	sM	19.7	1,450	70	1	46
Checks	sM	14.7	1,082	185	5	57
Arrowhead	sM	13	1,152	11	0	41
	sM	3	266	6	0	16
	sM	19	1,683	13	0	28
	tA	0	0	6	0	9
Checks	sM	3	266	92	0	53
	sM	8	709	76	23	81
	sM	12	1,063	267	30	85
	tA	11	975	40	8	70
Grundy Lake	tA	16	1,198	539	2	54
	tA	2	150	167	0	19
	tA	5.5	412	6	0	13
Checks	tA	15.3	1,148	135	29	63
	tA	50	3,745	79	63	96
Oastler	sM	13	1,262	0	2	34
	hPo	11.3	1,097	48.3	2	49
Checks	sM	24	2,330	156.5	2.5	55
	tA	35.5	3,447	46.5	17.0	85
Six Mile Lake	rO	28.5	2,152	110	7	76
	tA	20.0	1,510	2	2	100
Checks	rO	19.0	1,434	164	57	86
	tA	15.0	1,132	0	23	77

Situation concernant quelques ravageurs forestiers au Québec
1988

(Préparé pour le 16e Colloque annuel sur la répression des ravageurs forestiers, Ottawa-Ontario, 15-17 novembre 1988)

Denis Lachance, CFL, Sainte-Foy

LE NEMATODE DU PIN

Des relevés effectués en 1985 et 1986 ont révélé la présence du nématode du pin au Québec, et ceci sous ses deux principales formes connues. La forme "R" (ronde) a été détectée en une vingtaine d'endroits, majoritairement sur le sapin baumier, mais aussi sur quelques pins. La forme "M" (mucronée) fut retrouvée en 1985 dans un empilement de pin sylvestre situé près de La Pocatière, puis sur quelques autres pins l'année suivante. Dans la majorité des cas, le nématode fut retrouvé sur des arbres isolés et moribonds. Il semble être indigène à nos forêts et il ne cause certainement pas de dommages notables.

En 1987 et 1988, notre relevé s'est porté sur les vecteurs probables du nématode. Des insectes, particulièrement des longicornes, furent collectionnés sur des billes de bois récemment coupées et empilées le long des chemins forestiers. Trente-deux endroits, situés surtout dans la plaine du Saint-Laurent, furent échantillonnés en 1987. Le nématode ne fut pas récupéré de ces insectes. En 1988, la méthodologie d'échantillonnage fut modifiée quelque peu, particulièrement les aspects conservation et transport des insectes, et l'extraction des nématodes. Cinquante-trois sites furent échantillonnés. Ils se répartissent de la région de Mont-Laurier à l'ouest jusque dans la Réserve de Matane à l'est; et de la région du Saint-Félicien au Lac St-Jean, à la frontière du Maine au sud.

Neuf essences furent échantillonnées; le sapin baumier (26 endroits), le pin gris (7), pin blanc (6), pin rouge (5), la pruche de l'est (2), des épinettes noire (3), blanche (2), rouge (1) et de Norvège (1). Au total 863 insectes, surtout des longicornes et des scolytes furent prélevés puis envoyés rapidement au Dr J. Finney-Crawley à l'Université Memorial de Terre-Neuve pour extraction et identification. Les résultats de ces extractions sont attendus en mars 1989.

LA LIVREE DES FORETS

Malacosoma disstria Hbn

Une infestation de cet insecte a débuté dans le nord-ouest québécois, région de l'Abitibi-Témiscamingue, en 1984. Après avoir atteint son apogée en 1986, elle a continué de régresser quelque peu en 1988. Cette régression s'observe par une diminution de la sévérité des défoliations et non par leur étendue. En fait, 970 000 ha de forêt ont subi une défoliation notable en 1988 soit, 80 000 ha de plus qu'en 1987. Cependant, seulement 85 000 ha furent défoliés sévèrement, soit une diminution de 29 % par rapport à 1987. D'autre part, la défoliation légère a augmenté de 28%, pour atteindre 429 000 ha.

Le peuplier faux-tremble est toujours l'essence la plus touchée dans ce secteur. Cependant, quelques érablières étaient défoliées sévèrement et modérément aux environs de Témiscamingue.

Des défoliations légères éparses furent notées ailleurs dans la province, entre le nord de Montréal et Saint-Michel (division de recensement de Bellechasse), dans l'Outaouais et aux environs de La Tuque où un centre de 2 000 ha fut observé. La livrée des forêts fut aussi observée à plusieurs endroits au Saguenay-Lac-St-Jean et sur la Côte Nord, mais ne causant pas de défoliation notable cependant. Cette dispersion de l'insecte laisse prévoir une augmentation sensible des populations en 1989.

LA SPONGIEUSE

Lymantria dispar (L.)

Les populations de cet insecte ont diminué à un point tel depuis quelques années au Québec, qu'en 1988, on ne rapporte qu'un seul centre de défoliation mesurable. Il s'agit d'un peuplement composé surtout de chênes rouge et blanc, de peuplier faux-tremble et de bouleau blanc, et situé près de Eardly, (D.R. de Pontiac). Une aire d'environ 300 ha y fut défoliée à 100%. De très petits foyers furent aussi observés dans les environs.

Un réseau de pièges à phéromone est établi et suivi chaque année au Québec depuis 1980. Ce réseau est établi par RIMA-CFL en collaboration avec Agriculture Canada. Les données recueillies permettent d'avoir une idée générale de l'évolution des populations dans le centre-sud du Québec. Les données de 1988 confirment la chute drastique des populations de cet insecte et laissent prévoir une autre année de peu de dommages pour 1989 (voir tableau ci-joint).

Résultats du piégeage des papillons mâles de la spongieuse dans le centre-sud du Québec

Secteur surveillé	Année	Nombre de pièges	Total des papillons	Moyenne par piège et max récolté dans un piège	Diminution en % par rapport à année préc.
St-Antoine	1986	45	376	8.4 (22)	
Tilly à	1987	45	106	2.3 (6)	72.6
Inverness	1988	48	97	2.0 (11)	13.0
Victoria-	1986	60	1267	21.1 (40)	
ville à	1987	59	986	16.7 (37)	20.9
Lotbinière	1988	60	773	12.9 (27)	22.7
Drummond-	1986	50	1188	23.8 (46)	
ville	1987	49	1164	23.8 (40)	0.0
	1988	47	797	17.0 (30)	28.6
Total	1986	155	2831	183.0 (46)	
	1987	153	2256	14.7 (40)	19.7
	1988	155	1667	10.8 (30)	26.5

LE CHANCRE SCLERODERRIEN DU PIN

Gremmeniella abietina (Lagerb) Morelet

Le personnel du Ministère de l'Energie et des Ressources du Québec (MER) a poursuivi un relevé de détection et d'évaluation du chancre scléroderrien dans les plantations de pin de plus de 1 000 arbres établies dans le sud du Québec. En 1988, 164 plantations furent visitées en Estrie (au sud de Sherbrooke) et 269 le furent dans la Beauce. Respectivement, 33 (20%) et 130 (47%) plantations furent trouvées infestées par cette maladie à ces endroits.

Pour avoir une idée générale de la distribution et de l'évolution des races (européenne et nord-américaine) de ce pathogène au Québec, depuis quelques années on fait des mises en culture suivies de tests électrophorétiques d'une façon systématique dans tous les cas où la maladie est détectée que ce soit, durant le relevé général ou lors des relevés spéciaux. A date, en 1988, 209 isolats furent testés et 54,5% d'entre eux se sont avérés de race européenne; les autres sont de race nord-américaine. Cette proportion de race européenne vs nord-américaine varie beaucoup selon les essences affectées cependant.

Le MER a aussi poursuivi en 1988 des opérations d'élagage dans des plantations rapportées infestées de la race européenne du pathogène lors des relevés et des tests subséquents effectués l'année précédente. Soixante-et-onze plantations furent ainsi revisitées en 1988 pour retrouver et évaluer l'importance de la maladie s'il y a lieu. Des opérations d'élagage ont débuté au début de septembre et devraient couvrir 51 plantations d'ici la fin des travaux prévus pour la fin octobre.

Un dispositif expérimental, établi dans l'ouest du Québec en 1982 par un chercheur du CFL, permet de suivre l'évolution de la maladie dans plusieurs plantations de pin rouge et de pin sylvestre. Ces données recueillies indiquent qu'il y a eu peu ou pas de progression de la maladie (en étendue et en sévérité) entre 1986 et 1988, alors qu'il y avait eu explosion des dommages de 1982 à 1985.

Des études taxonomiques d'isolats de G. abietina provenant de sapin baumier et d'épinettes blanche et noire furent effectuées par un chercheur invité et des collègues pathologistes au Centre de foresterie des Laurentides durant 1987-88. Ces études suggèrent d'établir G. abietina var. balsamea comme taxon de ces isolats. G. abietina et ses deux races respectives demeurent pour les isolats provenant du genre Pinus. Une publication est en préparation à ce sujet.

Pourcentage d'isolats de <u>Gremmeniella abietina</u> récoltés au hasard des relevés en 1988 et donnant la race européenne (test électrophorèse)

Essence	Nombre d'isolats testés	Nombre d'isolats race européenne	%
Pin sylvestre	28	25	89.3
Pin rouge	146	87	51.6
Pin gris	35	2	5.7
Total	209	114	54.5

GYPSY MOTH CONDITIONS AND PLANNED SUPPRESSION 1988 - 1989

Gypsy moth populations and defoliation continued to decline throughout the Northeastern United States and Michigan in 1988, the lowest in nine years. Total defoliation was 291,101 ha (719,302 acres), down from 538,110 ha (1,329,653 acres) in 1987 and 976,424 ha (2,412,711 acres) in 1986. However, defoliation continues to expand in Michigan, Pennsylvania, Virginia, and West Virginia as the insect spreads into uninfested areas (Figure 1).

In 1988, a total of 303,370 ha (749,618 acres) were treated on State, private, and Federal lands in Delaware, Maryland, Michigan, New Jersey, New York, Pennsylvania, Vermont, Virginia, West Virginia, and the District of Columbia (Figure 2). Of this total, about 37 percent constituted the application of *Bacillus thuringiensis* (*B.t.*), 63 percent diflubenzuron (Dimilin) and less than one percent with NPV (Gypchek). In spite of treatment, heavy loss of chestnut, white, and red oak continues in Pennsylvania. Fulton and Bedford counties are the hardest hit.

In addition, two major gypsy moth eradication projects on National Forest lands were conducted in North Carolina and Virginia in 1988. In North Carolina, 7,345 ha (18,150 acres) were treated, 870 ha (2,150 acres) with *B.t.*, and 6,475 ha (16,000 acres) with diflubenzuron. In Virginia, 10,138 ha (25,052 acres) were treated, 3,387 ha (8,370 acres) with *B.t.*, and 6,751 ha (16,682 acres) with diflubenzuron (Figures 2).

Gypsy moth cooperative State suppression planned for 1989 totals 381,754 ha (943,300 acres) in the States of Delaware, Maryland, Massachusetts, Michigan, New Jersey, Ohio, Pennsylvania, Rhode Island, Virginia, and West Virginia. Diflubenzuron and *B.t.* will be the primary insecticides used. Planned suppression on National Forest and other Federal lands in 1989 totals 14,986 ha (37,030 acres). In addition, 8,094 ha (20,000 acres) are proposed for treatment as part of an eradication project in Virginia in 1989. Final plans for this project are not yet available.

Additional treatment of State, Federal, and private land in 1989 will occur in portions of Virginia and West Virginia as part of the Appalachian Gypsy Moth Integrated Pest Management Demonstration Project (AIPM Project). However, no estimate is available concerning the amount of treatment and types of intervention tactics planned at this time.

Presented by Daniel R. Kucera, Staff Assistant, Northeastern Area, State and Private Forestry, USDA Forest Service, Broomall, Pennsylvania, at the Sixteenth Annual Forest Pest Control Forum, Ottawa, Ontario, November 15-17, 1988.

TABLE 1. SUMMARY OF GYPSY MOTH DEFOLIATION BY STATE, 1979-1988

STATE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
NORTHEASTERN AREA										
CONNECTICUT	7,486	272,213	1,482,216	803,802	153,239	544	89,544	237,237	65,364	1,639
DELAWARE	10	0	500	1,265	2,992	14,203	5,144	3,118	2,530	791
D.C.	0	0	0	0	0	0	0	0	12	0
MAINE	23,180	221,220	655,841	574,537	16,285	1,892	6,698	11,572	648	100
MARYLAND	0	3	8,826	9,162	15,570	41,824	83,488	58,190	76,803	58,507
MASSACHUSETTS	226,260	907,075	2,826,095	1,383,265	148,133	185,520	414,084	343,091	28,739	0
MICHIGAN	100	5	18	92	457	6,425	18,460	61,370	39,443	70,350
NEW HAMPSHIRE	5,980	183,999	1,947,236	878,273	560	0	0	0	290	1,015
NEW JERSEY	193,700	411,975	798,790	675,985	340,285	98,695	239,350	280,290	95,104	7,430
NEW YORK	162,275	2,449,475	2,303,915	825,629	290,843	33,678	129,820	175,365	55,150	15,700
PENNSYLVANIA	8,552	440,500	2,527,753	2,351,217	1,360,824	450,643	581,113	987,819	880,335	312,092
RHODE ISLAND	655	43,830	272,556	658,000	53,880	164,600	133,920	219,150	5,050	725
VERMONT	15,411	75,094	48,979	9,864	0	0	0	0	0	703
WEST VIRGINIA	0	0	0	0	0	0	2,470	8,250	12,490	59,250
SUBTOTAL NA	643,609	5,005,389	12,872,725	8,171,191	2,383,368	998,024	1,704,091	2,385,452	1,261,958	528,302
REGION 8										
VIRGINIA	0	0	0	0	0	374	5,200	27,259	67,695	191,000
TOTAL	643,609	5,005,389	12,872,725	8,171,191	2,383,368	998,398	1,709,291	2,412,711	1,329,653	719,302

TABLE 2. GYPSY MOTH SUPPRESSION BY STATE, 1979-1988

STATE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
NORTHEASTERN AREA										
DELAWARE	0	0	0	0	1,100	29,120	67,000	55,000	51,610	43,207
D.C.	0	0	0	0	0	0	0	0	0	5,341
MAINE	0	0	400	1,910	0	0		0	0	
MARYLAND	0	0	0	48,364	120,082	107,597	113,630	89,626	139,581	169,184
MASSACHUSETTS	0	0	0	4,160	1,598	0	0	3,909	0	
MICHIGAN										40,283
NEW HAMPSHIRE	0	0	0	440	0	0	0	0	0	
NEW JERSEY	41,500	35,500	75,800	101,740	81,045	39,524	45,748	70,092	62,188	14,005
NEW YORK	17,400	20,000	63,900	10,284	0	0	0	0	0	2,140
PENNSYLVANIA	10,900	24,800	178,200	494,743	371,723	284,972	208,793 #1	204,851	227,731	225,502
RHODE ISLAND	0	0	22,600	64,816	6,477	0	21,936	19,107	0	
VERMONT	3,100	0	0	300	0	0	0	0	0	550
WEST VIRGINIA	0	0	0	0	16,735	46,992	54,020	83,180	85,000	139,776
SUBTOTAL NA	72,900	80,300	340,900	726,757	598,760	508,205	511,127	525,765	599,156	639,988
REGION 8 VIRGINIA	0	0	0	0	0	4,000	0	31,629	40,626	152,832
TOTAL	72,900	80,300	340,900	726,757	598,760	512,205	511,127	557,394	639,782	792,820

#1 Allegheny N.F. treated 10,472 acres in 1985. This is the first year that National Forest lands were treated for gypsy moth control. Acres included in PA suppression figure.

Doc. #0926D

GYPSY MOTH ACTIVITIES IN NEW BRUNSWICK IN 1988

(Annual Forest Pest Control Forum, Nov. 15-17, 1988)

Major efforts were made at two principal areas in Charlotte County in southwestern N.B. this past summer and fall.

Mohannes

Back in 1983, an integrated control program was conducted in a small area at Mohannes on the N.B. - Maine border. An 18 ha red oak stand was cut and chipped by Georgia Pacific Co. The surrounding area, totalling 183 ha, was sprayed aerially with 3 applications of B.t. and, the Canadian Forestry Service-Maritimes released 5 800 egg parasites (Anastatus disparis Ruschka). Follow-up egg mass searches in that fall revealed no egg masses in the area.

Between 1984 and 1987, egg mass searches of varying intensity turned up some positive finds. In 1988 it was decided to treat the area (once again with 3 applications of B.t.) even though larvae have been very seldom encountered and no defoliation was detectable. Egg mass searching in the fall again failed to find any egg masses. Table 1 indicates the level of effort and results of egg mass searches in the Mohannes area from 1983 to 1988.

TABLE 1. Results of Egg Mass Searches in Mohannes 1983-1988.

Year	Man-hours	No. Egg Masses	e.m./m-h
1983	77.5	0	0.00
1984	20.0	1	0.05
1985	4.0	5	1.25
1986	94.8	41	0.43
1987	60.4	15	0.25
1988	76.5	1	0.01

Moores Mills

In the summer of 1987 a small 4-ha area of second growth poplar was found to be severely defoliated about 10 km north of St. Stephen in southwestern N.B. some 20 km northeast of the Mohannes site. This was the first confirmed visible defoliation by Gypsy Moth in the Province. The following actions were taken in that area:

- Root rake the area (4 ha).
- Egg mass search and destroy mission in the fall.
- Ground spray the 4 ha (2 x Permethrin).
- Male moth trap-out in and around the area.
- Burn the material root raked.

Follow-up action was deemed necessary for 1988 and the following actions were taken:

- Egg mass search and destroy missions in the spring.
- Ground spray the 4 ha (2 x Permethrin).
- Aerial spray surrounding area (134 ha, 3 x B.t.).
- Male moth trap-out in and around the area.
- Egg mass search and destroy missions in the fall.

The following tables summarize the effort and findings.

TABLE 2. Larval Searches at Moores Mills, Spring 1988.

	Man-hours	No Larvae	Larvae/m-h
Pre-spray	95	25	3.8
Post-spray	15	3	0.2

TABLE 3. Male Moth Trap-out at Moores Mills, 1988 compared to 1987.

Year	No. Traps	No. Moths	Moths/Trap
1987	247	3 322	9.57
1988	305	32	0.10

TABLE 4. Extensive Pheromone Trapping (Mean Trap Catches) at Moores Mills, 1988.

	Sector				
Year	N E	S E	N W	S W	Total
1987	12.8	8.7	4.4	8.7	8.3
1988	2.3	2.2	2.1	2.3	2.3
% Change	-82%	-75%	-52%	-74%	-72%

TABLE 5. Egg Mass Searching at Moores Mills, 1988 compared to 1987.

Year	*Man-hours*	*No Egg Masses*	*e.m./m-h*
1987	*135.7*	*380*	*2.80*
1988	*141.5*	*5*	*0.04*

Conclusion

In general, the data are too low to analyze in more traditional methods of assessment. Nonetheless differences between years appear to indicate changes in the desired direction (i.e. downward and not upward). Actions for 1989 have not yet being contemplated.

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SOME FOREST PESTS IN NOVA SCOTIA

By

Dr. T.D. Smith

Report prepared for the Sixteenth Annual Pest Control Forum, Ottawa, Ontario, Canada, November 15-17, 1988.

The Department of Lands and Forests undertakes annual surveys for: spruce budworm, hemlock looper, balsam twig aphid, and balsam gall midge. The Department does work under the aegis of Agriculture Canada for the monitoring and/or eradication of gypsy moth. The following are brief comments on the status of various arbor pests that the Department is involved with.

Spruce budworm:

The Department provides assistance to Forestry Canada (FIDS) for the determination of the extent of defoliation caused by spruce budworm. This year no defoliation was noted.

Only one spruce budworm moth and five hemlock looper moths were caught in three spruce budworm pheromone trap sites.

The spruce budworm continues to decline in numbers in the Province. The combined gross areas of moderate, high, and extreme have declined by 75 %, moderate and high by 72 %, moderate alone by 62 %, and low alone by 43 %. The overall reduction in gross area infested is 339 500 ha for a 46 % decline from 1987 (Tables 1 and 2, Figures 1 and 2).

No significant populations of spruce coneworm or spruce budmoth were detected from the L-2 survey.

There was no spray program for spruce budworm in 1988 nor is one contemplated for 1989.

Hemlock looper:

In 1987 there were four small pockets of hemlock looper infestation in the Province. This year samples from 40 locations were examined for hemlock looper eggs. Casual observation of the raw data indicates that populations are up at Diligent River in Cumberland County, McCallum Settlement in Colchester County, and Poplar Hill, Hardwood Hill, and Green Hill Picnic Park in Pictou County (Figure 3).

Balsam Twig Aphid and Balsam Gall Midge:

In the past these insects were surved concurrently with the spruce budworm egg-mass survey. The spruce budworm egg-mass survey was replaced by the L-2 survey in 1985 and the balsam twig aphid and balsam gall midge survey was dropped as the prime host sampled for the L-2 survey was red spruce. Because of the importance of these two species to the Christmas Tree industry a separate Provincial survey for the balsam twig aphid and balsam gall midge was started in 1988. The summary situation for the Province is shown in Figure 4.

Whitemarked tussock moth:

Local populations of whitemarked tussock moth have occurred at Fifth Lake Flowage and at New France in Digby County (Figure 5). Two hundred egg-masses have been collected and sent to the Great Lakes Forestry Centre for culture and determination of the degree and intensity of of the whitemarked tussock moth virus.

Gypsy moth:

The Department does cooperate with Agriculture Canada with the monitoring and/or eradication of this alien pest in Nova Scotia. This year the Department monitored gypsy moth populations in 18 towns, and in most cases the numbers of gypsy moth moth catches have increased; in particular, Canning, New Minas, Wolfville, Middleton, Bridgetown, Weymouth, and Bridgewater. Stable populations, for the present, are noted in Kentville, Digby, and Shelburne; where as, no moths were caught in Yarmouth. (Tables 3 to 5, and Figures 6 and 7). Agriculture Canada monitors gypsy moth populations in the Halifax-Dartmouth area and catch data indicates that the gypsy moth is increasing in Halifax. Unfortunately, the gypsy moth populations in Nova Scotia remain parasitoid-poor and disease-free.

Collections of egg-masses will be made for the USDA at Otis for the rearing of the northern strain and to provide stock for their sterile male programs.

Departmental efforts with the gypsy moth represent an expenditure of $18,000.00 and 0.8 PY of effort.

Seedling debarking weevils:

Seedling debarking weevils continue to be a serious plantation and nursery problem. _Hylobius congener_ D.T. continues to be the most destructive. However, a defoliating weevil the nut leaf weevil _Strophosomus melanogrammus_ defoliated a red pine plantation at Iona in Cape Breton.

Table 1. Gross area of infestation by overwintering second instar spruce budworm larvae by County, Nova Scotia, 1987-1988.

County	Low 1987	Low 1988	Moderate 1987	Moderate 1988	High 1987	High 1988	Extreme 1987	Extreme 1988	Total 1987	Total 1988
	Gross area (ha) of infestation class category									
A. Cape Breton Island										
Cape Breton	0	8000	0	0	0	0	0	0	0	8000
Inverness	93500	31250	0	0	0	0	0	0	93500	31250
Richmond	0	4000	0	0	0	0	0	0	0	4000
Victoria	61250	18750	0	0	0	0	0	0	61250	18750
B. Mainland										
Southern										
Annapolis	46500	26750	0	9000	0	0	0	0	46500	35750
Digby	5750	7750	0	0	0	0	0	0	5750	7750
Guysborough	0	4250	0	0	0	0	0	0	0	4250
Halifax	56250	20750	0	0	0	0	0	0	56250	20750
Hants	5750	0	0	0	0	0	0	0	5750	0
Kings	56000	27750	0	0	0	0	0	0	56000	27750
Lunenburg	28250	0	0	0	0	0	0	0	28250	0
Queens	29750	4000	0	0	0	0	0	0	29750	4000
Shelburne	30750	0	0	0	0	0	0	0	30750	0
Yarmouth	11500	4000	0	0	0	0	0	0	11500	4000
Northern										
Antigonish	35000	10000	2500	5000	2500	0	0	0	40000	15000
Colchester	44750	31000	10250	0	4750	0	0	0	59750	31000
Cumberland	138000	153250	13000	0	6250	0	6250	0	163500	153250
Pictou	42000	36750	11250	0	0	0	0	0	53250	36750
Total Area (ha)	685000	388250	37000	14000	13500	0	6250	0	741750	402250
Change from 1987 — ha		-296750		-23000		-13500		-6250		-339500
Change from 1987 — %		-43.32		-62.16		-100		-100		-45.77

Combined Changes (Actual Area (ha), Difference in ha, % Change from 1987)

Combined class	1987	1988
Moderate+High+Extreme	56750	14000
		-42750
		-75.33
Moderate + High	50500	14000
		-36500
		-72.28
High + Extreme	19750	0
		-19750
		-100

Table 2. Changes in total gross area of infestation by overwintering second instar spruce budworm larvae, Nova Scotia, 1987 - 1988.

Infestation Classes	Area (ha)			
	1987	1988	Diff.	% Change
Low	685000	388250	-296750	-43.32
Moderate	37000	14000	-23000	-62.16
High	13500	0	-13500	-100.00
Extreme	6250	0	-6250	-100.00
Total	741750	402250	-339500	-45.77
Combinations				
Mod+Hi+Ext	56750	14000	-42750	-75.33
Mod+Hi	50500	14000	-36500	-72.28
Hi+Ext	19750	0	-19750	-100.00

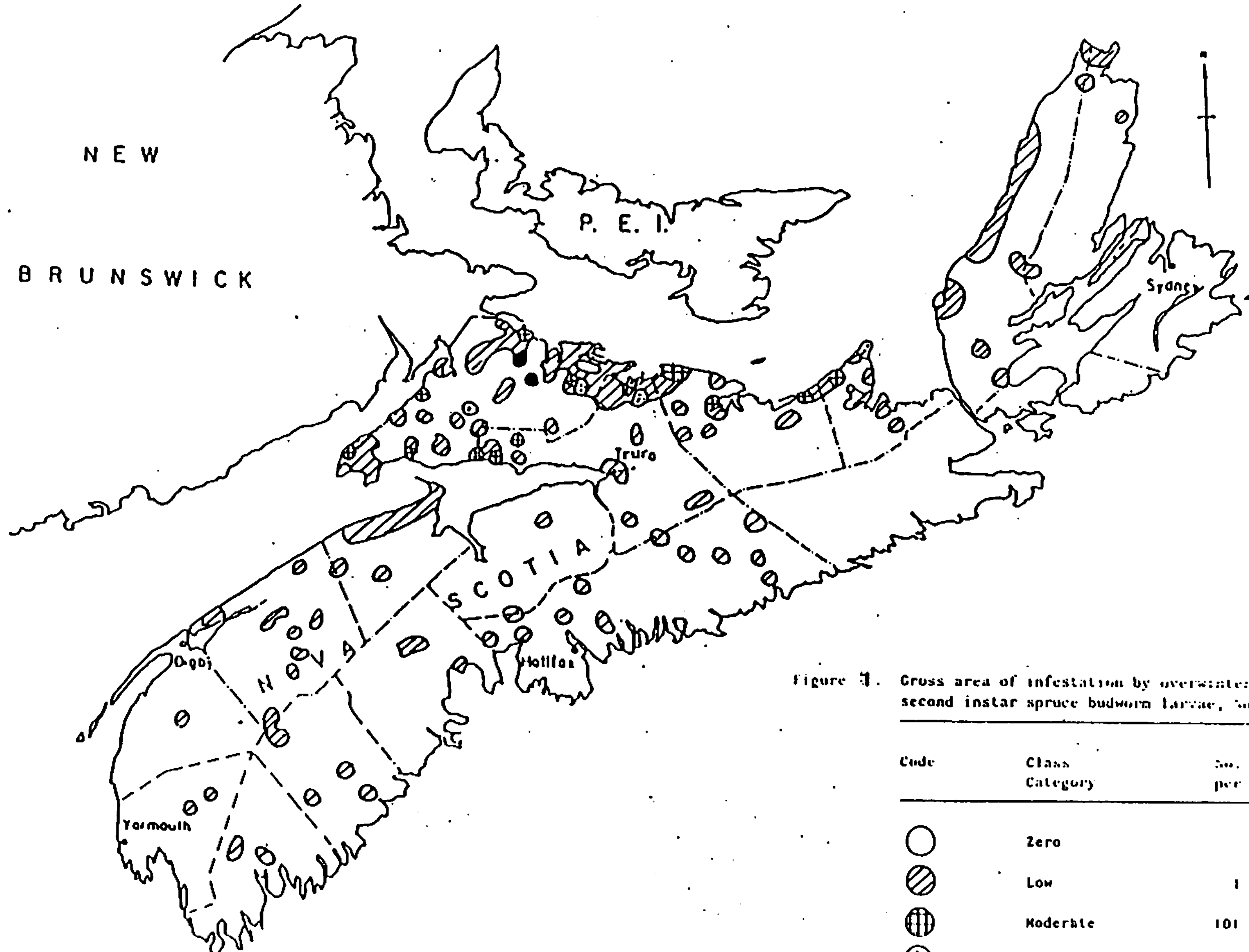

Figure 7. Gross area of infestation by overwintering (1987-1988) second instar spruce budworm larvae, Nova Scotia, 1987.

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

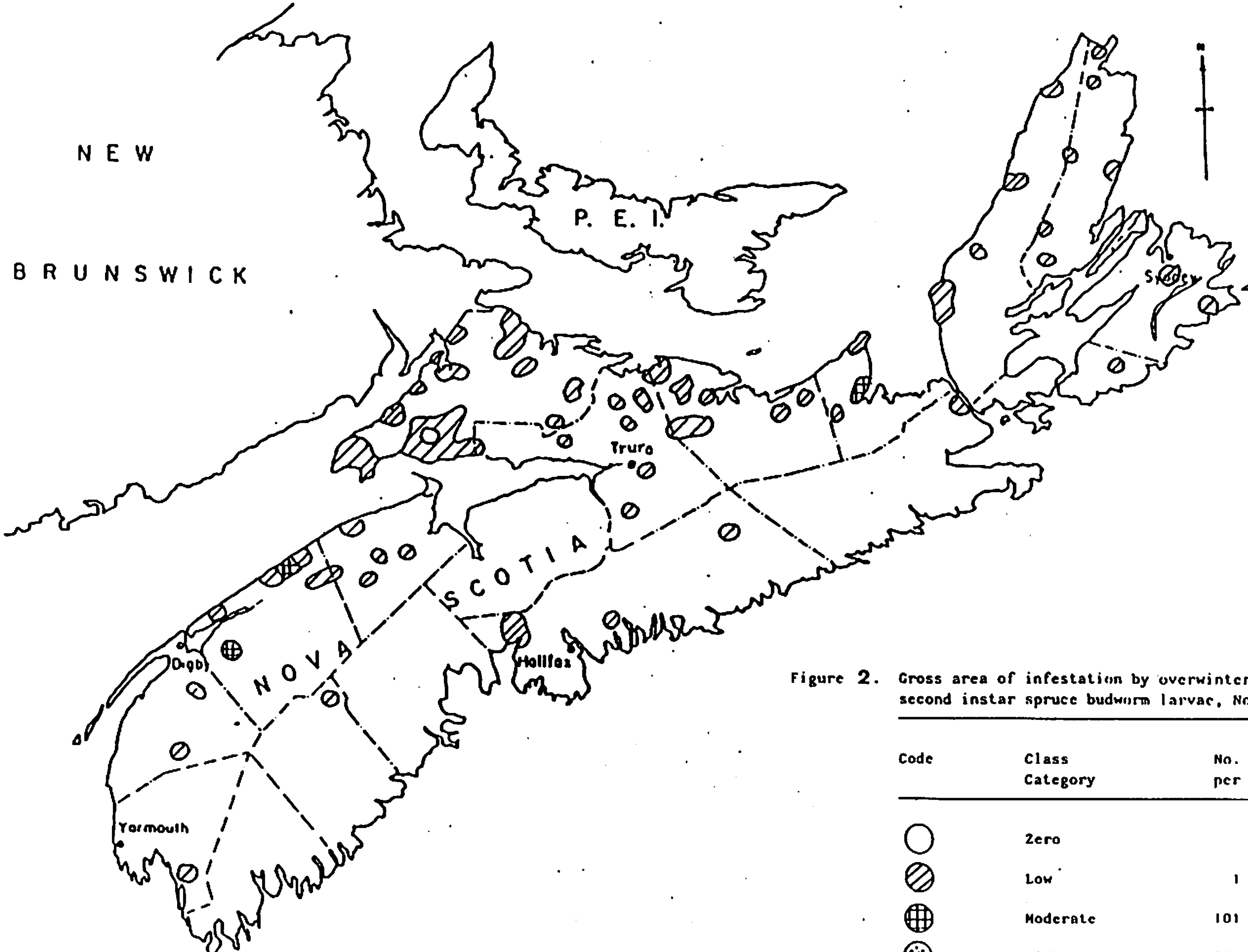

Figure 2. Gross area of infestation by overwintering (1988-1989) second instar spruce budworm larvae, Nova Scotia, 1988.

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

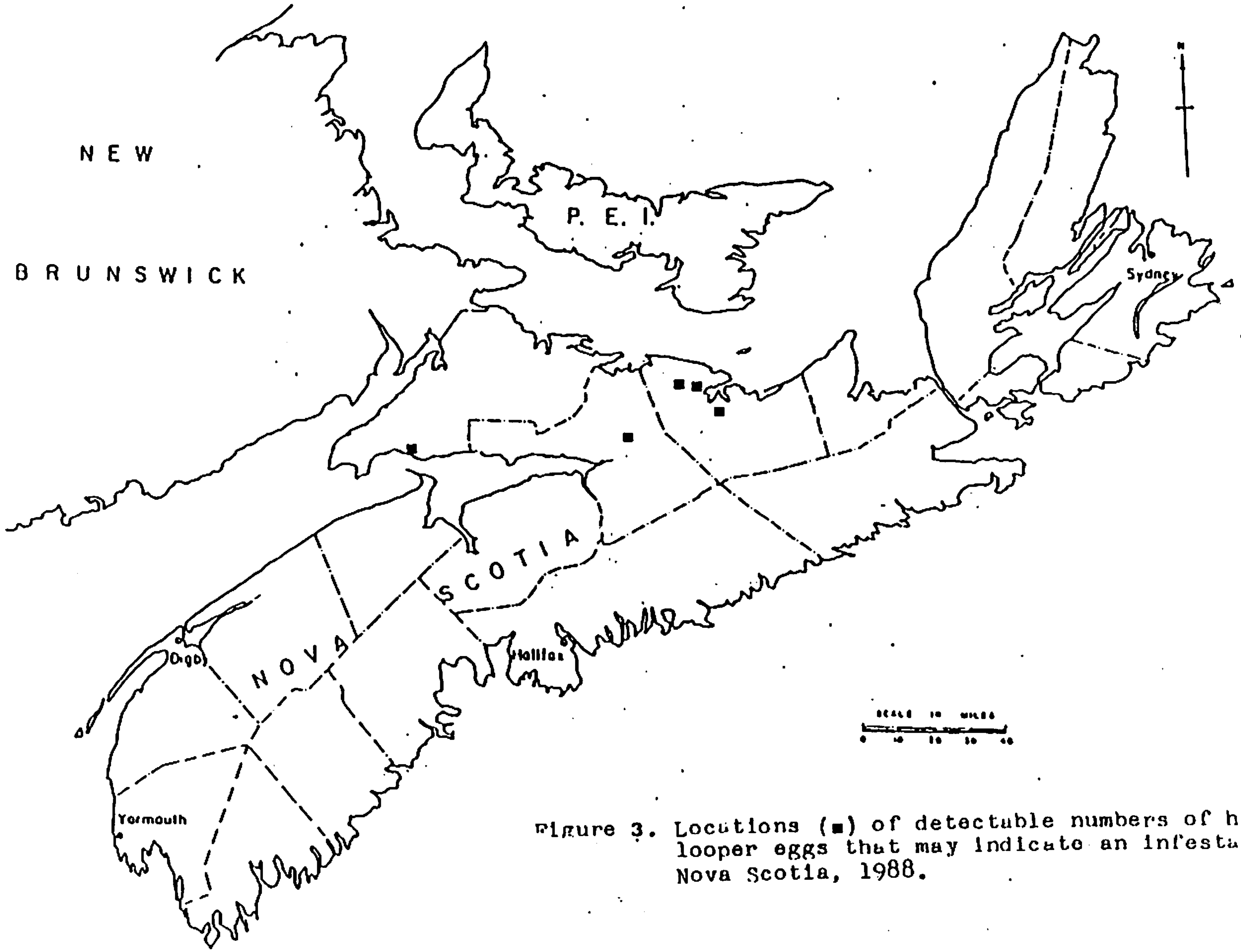

Figure 3. Locations (■) of detectable numbers of hemlock looper eggs that may indicate an infestation, Nova Scotia, 1988.

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	287	78.6	359	98.4
Low	68	18.6	6	1.6
Moderate	10	2.7	0	0.0
Severe	0	0.0	0	0.0
Total	365	100.0	365	100.0

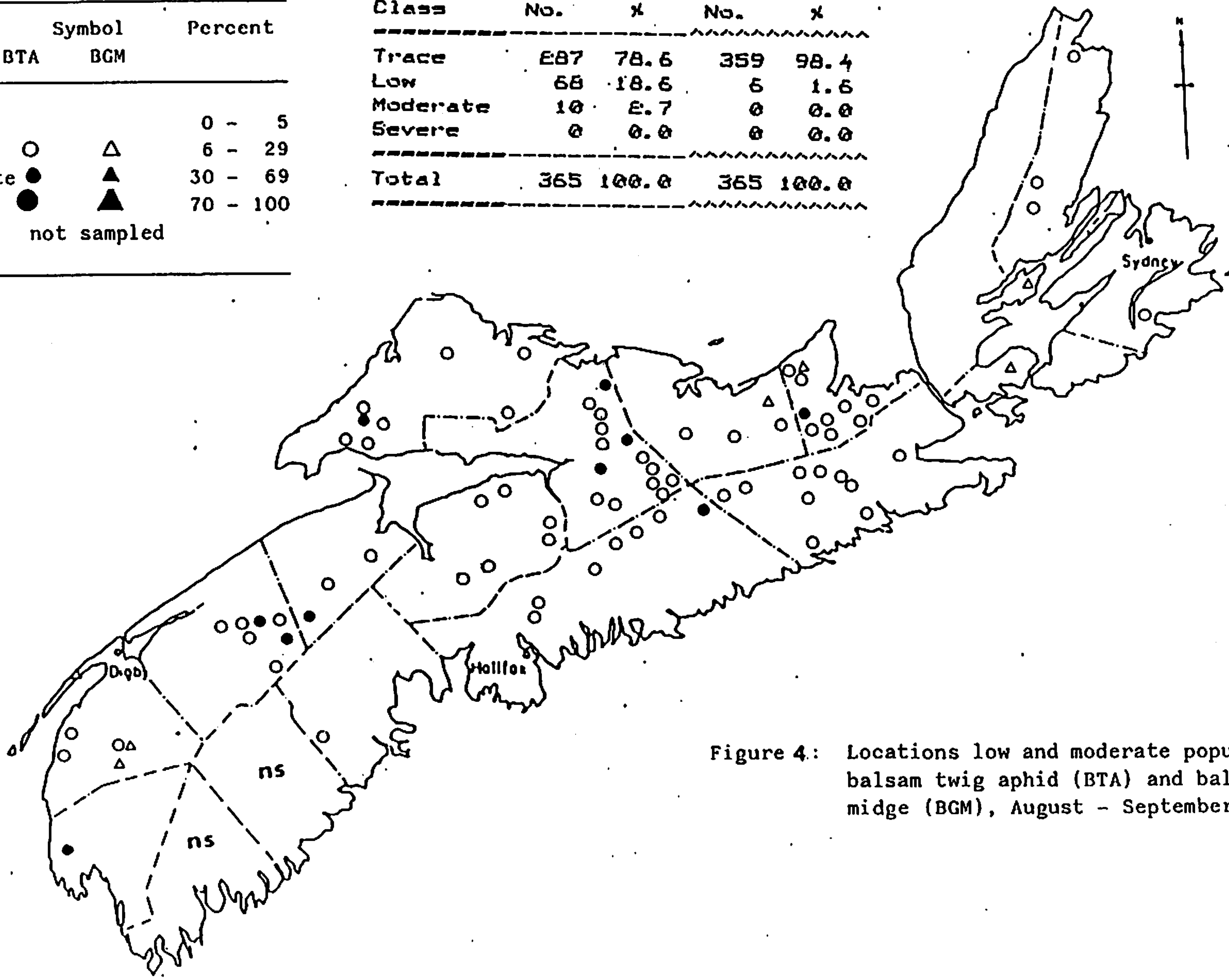

Figure 4: Locations low and moderate populations of balsam twig aphid (BTA) and balsam gall midge (BGM), August - September 1988, N.S.

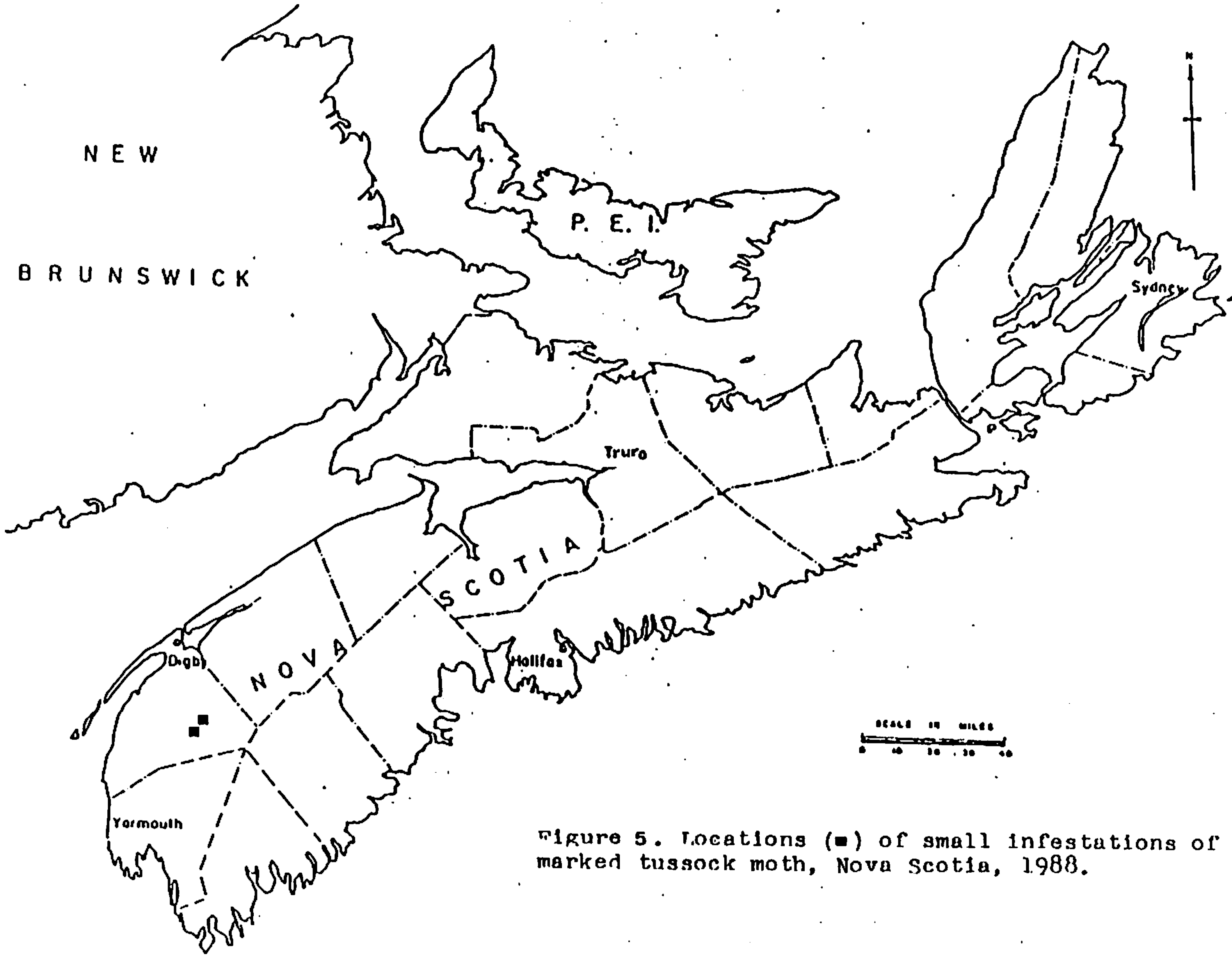

Figure 5. Locations (■) of small infestations of white-marked tussock moth, Nova Scotia, 1988.

Table 3.
COMPARSION OF GYPSY MOTH TRAP CAPTURES IN PHEROMONE TRAPS, NOVA SCOTIA, 1986-1988.

LOCATION	NO TRAPS COLL. 1986	NO TRAPS COLL. 1987	NO TRAPS COLL. 1988	% CHANGE 87/86	% CHANGE 88/87
Annap. Royal	50	49	284	-2.0	479.6
Bridgetown	0	0	31		100.0
Bridgewater	41	41	192	0.0	368.3
Canning	0	0	92		100.0
Digby	26	34	64	30.8	88.2
Kentville	29	50	679	72.4	1258.0
Middleton	0	50	0		0.0
New Minas	29	30	499	3.4	1563.3
Port Williams	24	20	96	-16.7	380.0
Shelburne	44	345	400	684.1	15.9
Weymouth	0	0	69		100.0
Wolfville	0	0	97		100.0
Yarmouth	50	33	75	-34.0	127.3
TOTAL	293	652	2578	122.5	295.4
MEAN	20.93	46.57	184.14	122.5	295.4
STD	19.51	87.24	199.78	347.2	129.0
MAX	50	345	679	590.0	96.8
MIN	0	0	0	0.0	0.0
No. Towns Ser	8	9	12	12.5	33.3

Table 4.

COMPARSION OF GYPSY MOTH TRAP CAPTURES IN PHEROMONE TRAPS, NOVA SCOTIA, 1986-1988.

LOCATION	TOTAL NO. MOTHS			% CHANGE	
	1986	1987	1988	87/86	88/87
Annap. Royal	329	454	1648	38.0	263.0
Bridgetown	0	0	180		0.0
Bridgewater	67	89	129	32.8	44.9
Canning	0	0	685		100.0
Digby	7	11	9	57.1	-18.2
Kentville	41	385	71	839.0	-81.6
Middleton	0	19	0		0.0
New Minas	58	366	2359	531.0	544.5
Port Williams	113	40	49	-64.6	22.5
Shelburne	505	544	319	7.7	-41.4
Weymouth	0	0	17		100.0
Wolfville	0	0	63		100.0
Yarmouth	1	4	0.0	300.0	-100.0
TOTAL	1121	1912	5529	70.6	189.2
MEAN	80.07	136.57	394.93	70.6	189.2
STD	149.09	198.66	710.42	33.2	257.6
MAX	505	544	2359	7.7	333.6
MIN	0	0	0	0.0	0.0
No. Towns Ser	8	9	12	12.5	33.3

Table 5.
COMPARSION OF GYPSY MOTH TRAP CAPTURES IN
PHEROMONE TRAPS, NOVA SCOTIA, 1986-1988.

LOCATION	MEAN MOTHS/TRAP			% CHANGE		NEW
	1986	1987	1988	87/86	88/87	1988
Annap. Royal	6.6	9.3	5.8	40.9	-37.6	NO
Bridgetown	0.0	0.0	5.8		100.0	YES
Bridgewater	1.6	2.2	0.7	37.5	-69.5	NO
Canning	0.0	0.0	7.4		100.0	YES
Digby	0.3	0.3	0.1	0.0	-53.1	NO
Kentville	2.0	7.7	0.1	285.0	-98.6	NO
Middleton	0.0	0.4			0.0	NO
New Minas	2.0	12.2	4.7	510.0	-61.3	NO
Port Williams	4.7	0.6	0.5	-87.2	-14.9	NO
Shelburne	11.5	1.6	0.8	-86.1	-50.2	NO
Weymouth	0.0	0.0	0.2		100.0	YES
Wolfville	0.0	0.0	0.6		100.0	YES
Yarmouth	0.0	0.1	0.0	400.0	-100.0	NO
TOTAL	29	34	27			
MEAN	2.05	2.46	2.07			
STD	3.34	4.03	2.69			
MAX	12	12	7			
MIN	0	0	0			
No. Towns Ser	8	9	12			

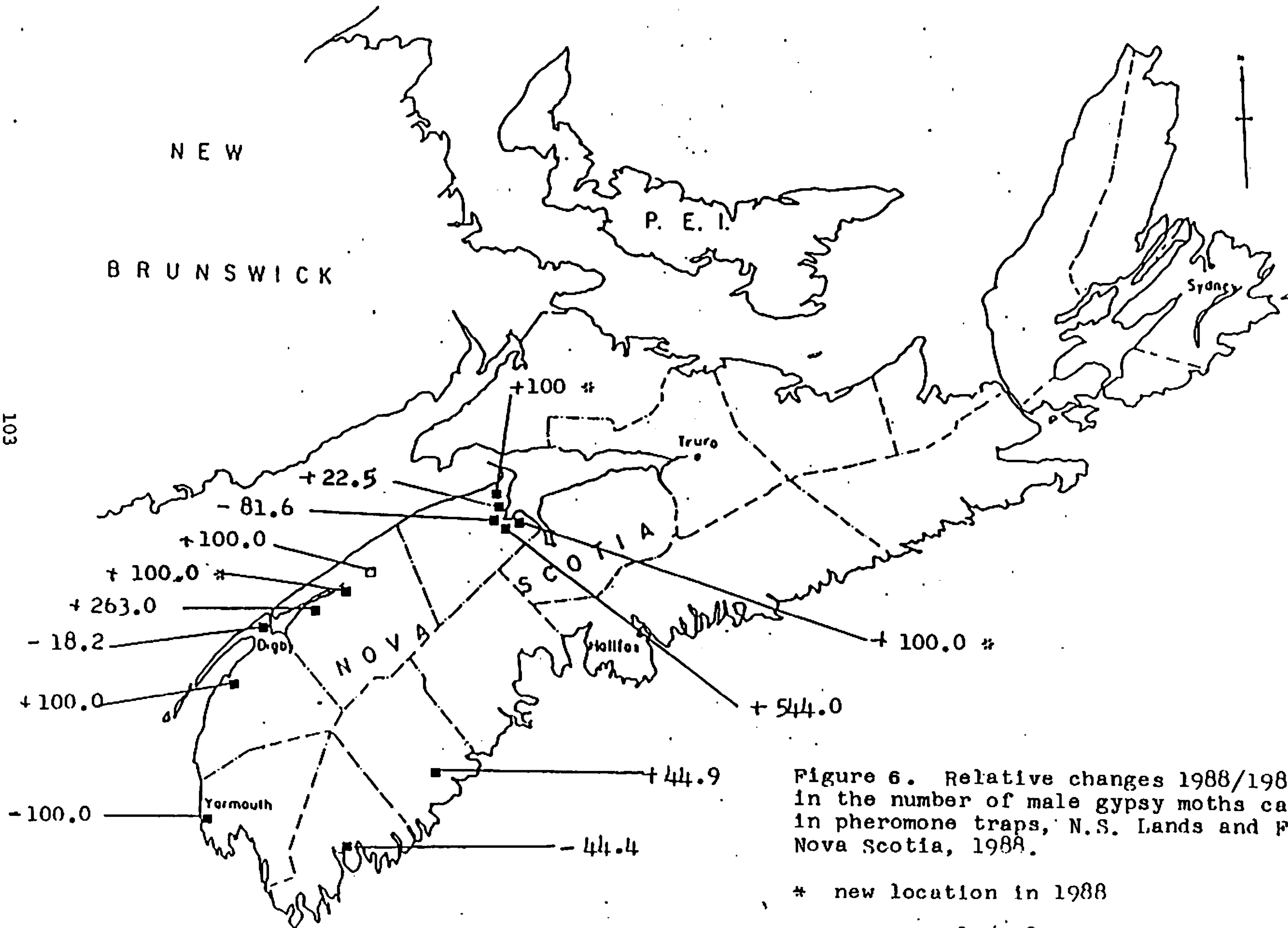

Figure 6. Relative changes 1988/1987, in the number of male gypsy moths caught in pheromone traps, N.S. Lands and Forests, Nova Scotia, 1988.

* new location in 1988

◻ change 1987/1986

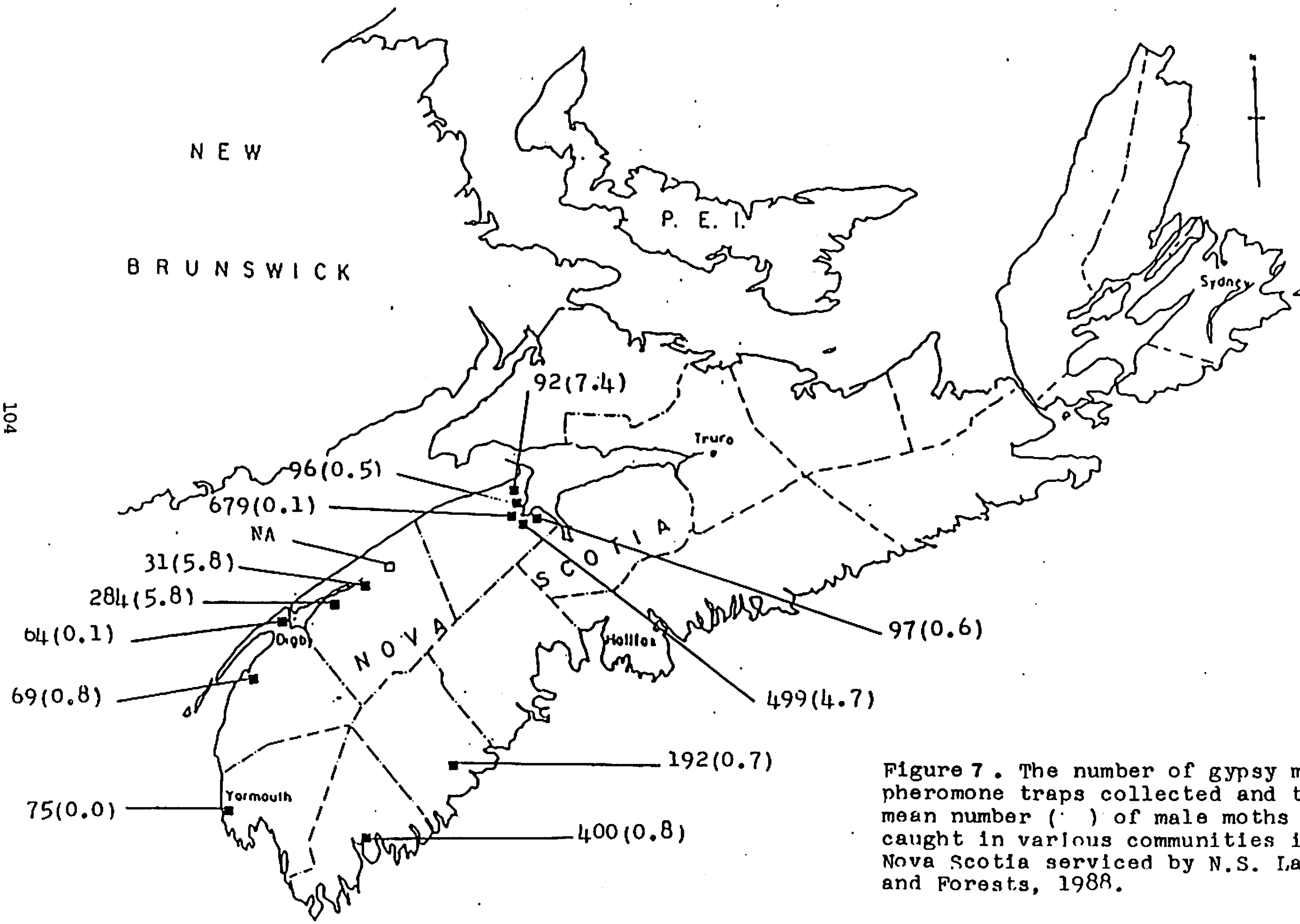

Figure 7 . The number of gypsy moth pheromone traps collected and the mean number ( ) of male moths caught in various communities in Nova Scotia serviced by N.S. Lands and Forests, 1988.

THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1988

Hudak, J., P.L. Dixon and L.J. Clarke

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 15-17 NOVEMBER 1988

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
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THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1988

by

Hudak, J., P.L. Dixon and L.J. Clarke

Larval Development and Defoliation - Weather conditions during June were sunny and warm throughout most of the Island. July was foggy and cool on the Northern Peninsula and cloudy, warm and humid with above normal precipitation for the rest of the Island. August was mostly sunny and warm while September was warm but above normal precipitation for western areas of the Island. Insect and tree development was near normal with an excellent cone crop on all species of softwoods throughout the Province.

The looper continued to be the most important pest in the Province this year. The annual aerial survey recorded moderate and severe defoliation on about 12 900 ha and light defoliation on about 4 700 ha (Table 1). Most of these areas were defoliated in 1987 and the reddish discoloration of foliage was less evident this year in most of these stands. The main outbreak occurred in western Newfoundland (Fig. 1). High larval numbers were recorded at O'Regan's, South Branch, Corner Brook, Gros Morne National Park, Portland Creek, Daniel's Harbour, River of Ponds, Hawkes Bay, Castor River, Ten Mile Lake, Main Brook and Northwest Arm near Roddickton.

In eastern Newfoundland population levels were high in several isolated areas on the Avalon Peninsula in Butterpot Provincial Park, Paddy's Pond, St. Phillips, LaManche Provincial Park and Shoe Cove Brook near Pouch Cove. No infestations occurred in central Newfoundland.

Many of these infestations both in western and eastern Newfoundland collapsed in the later larval instars due to the spray program and disease.

Hemlock looper outbreaks in Newfoundland usually last for 3-6 years with about 10-15 years between cycles. The present outbreak began in 1983 in central and eastern Newfoundland and in 1985 in Western Newfoundland. The outbreak started to collapse in 1986 in central and eastern Newfoundland and in 1987 and 1988 in western Newfoundland and on the Avalon Peninsula.

Control Programs - The Department of Forestry conducted an operational control program against the looper and treated about 48 000 ha with fenitrothion and about 24 000 ha with *Bacillus thuringiensis* (*B.t.*).

The Canadian Forestry Service in co-operation with the Newfoundland Department of Forestry conducted an experimental program testing the effectiveness of new formulations and dosages of *B.t.* and diflubenzuron. The results of these experiments are detailed in a separate report. The Canadian Forestry Service also assisted Parks Canada, providing pre-spray and post-spray data in a control program of the looper near camping areas in Gros Morne National Park. A separate report will be presented at a later date.

Biological Mortality Factors - In 1988 looper samples were collected from 17 locations throughout the infestations to assess the affects of biological mortality factors. The majority of larval and pupal parasitoids were the tachinid flies, Winthemia occidentis and Madremyia saundersii. Several specimens of parasitic wasps were also recovered. The incidence of pathogenic fungi was much greater in larval than pupal samples. Entomophaga aulicae was the major fungal disease. Erynia radicans, Paecilomyces farinosus and verticillium spp. also occurred.

Parasitism and fungal disease in late instar larvae averaged 13% and 33% respectively in the older part of the infestation and 1% and 5% in the younger part. Pupal parasitism was 29% and 4% in the older and younger infestations respectively, while fungi caused about 4% pupal mortality throughout the outbreak. Less than 1% of the larvae and pupae were infected by an unidentified microsporidian.

In addition to the above 14% and 28% of the larvae were infected in the older and younger infestations respectively by a fungus tentatively identified as Aureobasidium pullulans. This fungus was less common in pupae and its pathogenicity is being investigated.

Damage Assessment - The aerial survey showed that tree mortality reached over 90% on most stands severely defoliated in 1987. The intensity of defoliation in 1988 was not as severe as last year's as most of the looper populations collasped during the late larval instars which cause most of the damage. However, some tree mortality is expected to occur in stands not protected in 1988. The damage will be assessed at the inventory level by the Newfoundland Department of Forestry.

<u>**Forecast of Hemlock Looper Outbreak for 1989**</u> - The egg survey commenced in mid-October and branches were collected from about 560 sample points throughout the Island. The forecast will be provided after the processing of the samples have been completed.

Table 1. Areas (ha) of defoliation caused by the hemlock looper in productive forests of Newfoundland in 1988.

Management Unit No.	Defoliation Class*			
	Light	Moderate	Severe	Total
1	51	99	1 170	1 320
14	476	136	632	1 244
15	204	-	394	598
16	-	-	34	34
17	3 369	983	7 436	11 788
18	65	-	241	306
Total	4 165	1 218	9 907	15 290
GMNP	544	-	1 792	2 336
GRAND TOTAL	4 709	1 218	11 699	17 626

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

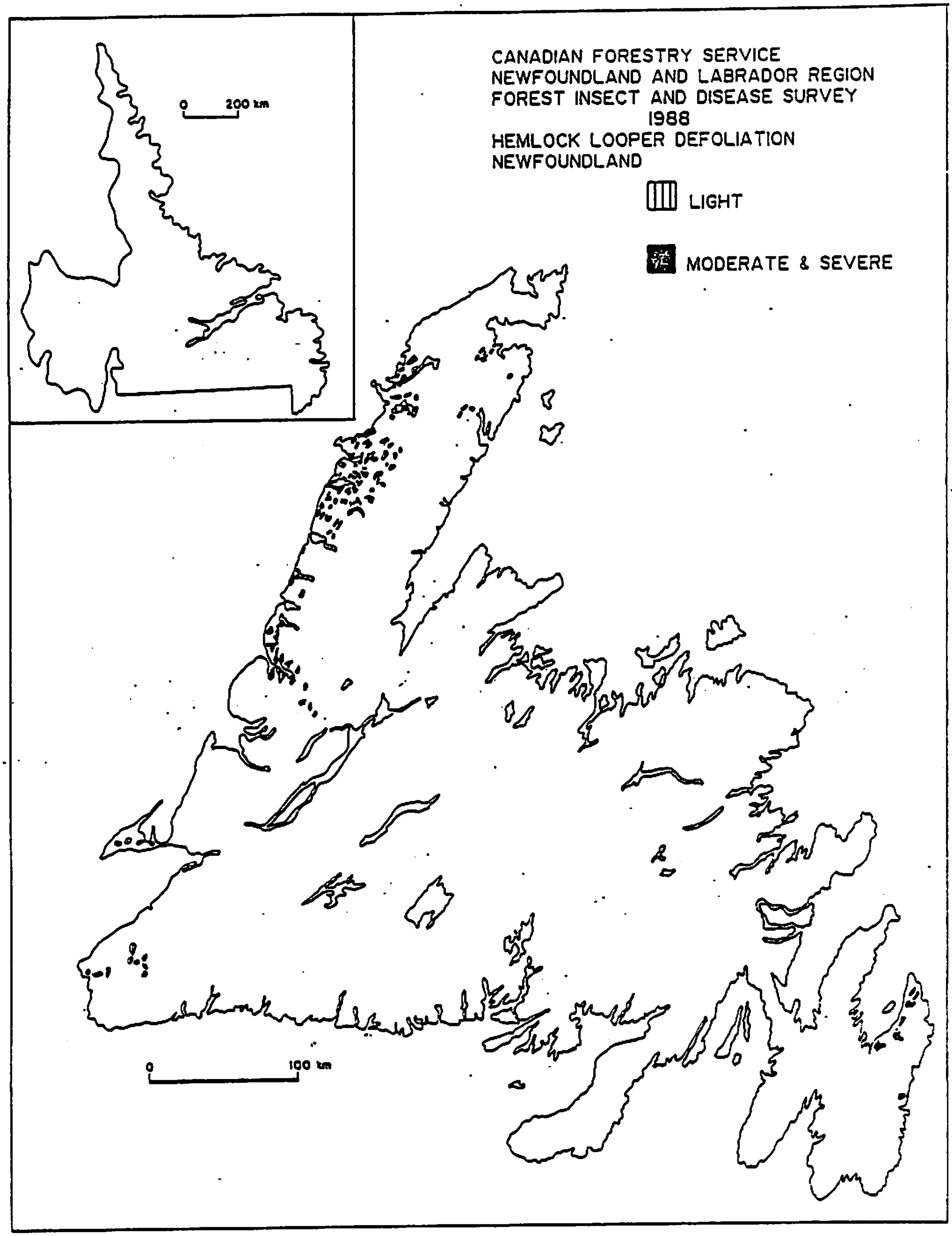


Figure 1. Areas of defoliation caused by the hemlock looper in Newfoundland in 1988.

HEMLOCK LOOPER CONTROL PROGRAM IN NEWFOUNDLAND IN 1988

by H. Crummey

(Report for the 1988 Annual Pest Control Forum, Ottawa, November 15 - 16, 1988)

This is the fifth year of the present hemlock looper outbreak in insular Newfoundland. The C.F.S. forecast for 1988 indicated that a total of 166 115 hectares including 117 756 hectares in the moderate and severe defoliation category were expected and situated mainly in western Newfoundland, with the major areas located on the Great Northern Peninsula.

Based on these figures, the Department of Forestry in conjunction with the two pulp and paper companies (Corner Brook Pulp & Paper [Kruger] and Abitibi-Price, proposed a control program on high priority stands in the moderate and severe forecast areas and on silviculturally important areas in the light forecast. The 1988 program was the fourth (1985-88 inclusive) during the present outbreak.

The proposed treatment areas (Table 1, Figure 1) totalled 74 650 hectares and consisted of twenty-one (21) blocks (48 702 ha) to receive two (2) applications (minimum 4 to 6 days apart) of Fenitrothion at 210 g a.i. in 1.5 litres per hectare per application in an oil-based formulation, and twelve (12) blocks (25 948 ha) to receive one (1) application of the biological insecticide - _Bacillus_ _thuringiensis_ (Bt) at 30 BIU and applied undiluted. Futura XLV was to be applied to three (3) blocks, approximately 5 000 hectares and the remainder was to receive Dipel 176. Futura had a temporary registration for 1988 while Dipel 176 received final registration in early 1988. Experimental results in 1987 using Dipel 176 under ideal weather conditions and on small blocks were good and therefore the decision was made to test this product in 1988 under operational spray conditions on a number of blocks. Futura XLV was also to be tested to compare this water-based formulation of Bt with the oil-based Dipel product. Therefore Bt was to be applied to about thirty-five percent (35%) of the proposed treatment area.

Spray aircraft were contracted from Agric Air Inc. (Beaver Air Spray Inc.) of Ste. Cecile de Milton, Quebec, and consisted of one (1) team of four (4) single-engine (600 h.p.) Grumman AgCats and one (1) team of four (4) single-engine (1200 h.p.) Ayres Bull Thrushes. All aircraft were equipped with six (6) mini-Micronair AU5000 atomizers. In addition, two (2) twin-engine fixed-wing aircraft and two (2) helicopters provided supervisory, navigational and/or sampling support for the program. There was one base of operation located at Port au Choix on the Northern Peninsula.

Spray operations commenced on June 25 and terminated on July 26. There were frequent weather delays throughout the program, especially in the first half when cool, wet weather was encountered. In fact, poor flying weather delayed the arrival of spray aircraft in Newfoundland. These delays although hampering spray activity, did not appear to jeopardize the program, as cool, wet weather also seemed to delay larval feeding and insect development in treatment areas. Spray missions took place on eighteen (18) of thirty-two (32) days, or fifty-six percent (56%) of available days.

The application strategy was to apply Bt first to maximize the chance of success in reducing looper larval numbers and thereby optimizing foliage protection, since Bt has to be ingested by the feeding larvae. The AgCats applied all the Bt and actually arrived in the Province about ten (10) days before the Bull Thrushes which were finishing the Quebec project and then were weather delayed enroute to the Island.

Larval population levels were monitored to determine initial numbers necessary to make a decision on the need to treat blocks, and insect development was recorded to accurately time the treatments. Sampling methodology consisted of 'beating' larvae from three trees per plot using a pole and a 1.8 m by 2.4 m beating sheet. An average number of larvae per tree was determined per plot and used to generate block data. Sampling continued from the time of hatching until the late larval instar (L4).

Based on initial sampling, three (3) chemical blocks (3 564 ha) and two (2) Bt (Dipel 176) blocks (2 160 ha) were deleted due to low insect numbers. The remainder of the program was carried out as prescribed. Through on-going sampling, it was found that after the initial application of Bt (both Futura and Dipel) to five (5) blocks, enough larvae remained to cause defoliation that a decision was made to apply a second application of insecticide to further reduce the population and prevent additional defoliation. It should be noted that the numbers of larvae that remained after the first application in these blocks were not the result of high pre-spray numbers. Some plots with low to moderate numbers still had sufficient larvae, as did some high population plots, to require re-treatment in some of these blocks.

Thus in 1988, the net result was that twenty-eight (28) blocks totalling 68 926 hectares were treated. Of this, eighteen (18) blocks, 45 138 hectares (or 65.5 %) of the final treatment area received two applications of Fenitrothion, and ten (10) blocks, 23 788 hectares (or 34.5 %) of the final treatment area received an initial one (1) applicaton of Bt. Three (3) of these Bt blocks (3 200 ha) received a second application of Bt, either Dipel 176 or Dipel 132 at 30 BIU/ha, and two (2) Bt blocks (9 311 ha) received an additional one (1) application of 210 g of Fenitrothion.

Pre-spray larval population levels were again quite variable over the proposed spray blocks, both within and between areas as expected. This occurs with the looper and becomes more pronounced where the infestation is declining and distribution becomes patchy. However, there were areas where larval numbers were very high. The average pre-spray larval population per tree-beat sample per plot in the treatment areas was about 157, but there were instances of larval counts up in the thousands

(1000s). Larval counts in the 20 to 30 range can cause significant defoliation and counts in the hundreds (100s) can cause severe defoliation.

The detailed analyses of the data by plot for the various treatments and regimes is on-going and has been complicated by the variability in the population distribution and hence the difference in the numbers of larvae encountered per plot. One of the basic requirements in accurately assessing the results of a program is that pre-spray population levels in treatment and check (untreated) areas be approximately equivalent. Because most of the moderate to severe forecast area was incorporated into spray blocks, the availability of sufficient numbers of adequate check areas for comparison purposes was limited, even though extensive sampling was carried out. Treated plots are now being compared with the nearest appropriate check plot(s) in terms of pre-spray numbers to provide corrected mortality and foliage saved figures. The relative ranking of the different insecticide products used is still to be determined.

As mentioned, cool, wet weather occurred during the first part of the program and may have had an effect on the results. It is important that post-spray weather be suitable to maximize the effects of insecticide treatment. Both chemical and Bt products have a short half-life and are usually effective on the foliage for less than one week. During that period, larvae have to come in contact with the chemical or ingest it during feeding. With Bt, larvae must actively feed on the foliage and ingest a lethal dose during this short period. If the weather is cool and/or wet, larvae may not be actively feeding and the product could deteriorate or wash off with rain in the interval. Further, the C.F.S. reported that a fungal disease became prevalent at some loctions about mid-way through the program (mid-July), thus influencing both population reduction and defoliation in those treated and untreated (check) areas where it occurred.

At present, keeping in mind the above complicating factors, individual plot data are being analyzed for population levels, timimg of spray application, product used, post-spray weather, and location.

Analyses of plot data to date indicate that uncorrected larval mortality averaged eighty-one percent (81%) after two (2) applications of Fenitrothion and averaged fifty-two percent (52%) after one (1) application of Bt. It should be stated that generally the Bt blocks had a higher average pre-spray larval population than did the chemical blocks, which could contribute to this mortality difference. Looking at individual Bt blocks, about half had good larval mortality (uncorrected) following treatment and reasonable foliage protection. When plot defoliation was determined from ground observations, it was evident that where there was low larval mortality there was generally higher defoliation, as would be expected. It appeared that there was more defoliation in the Bt blocks than in the chemical blocks, but this may have resulted from higher initial larval numbers in the Bt areas or other factors presently being considered.

The annual aerial defoliation survey has been completed by the C.F.S. and indicates that a total of 17 626 hectares were defoliated with 1 218 hectares in the moderate and severe categories. The results of this survey have been tabulated with respect to the spray blocks (Table 2). As can be seen from the figures, aerially, there appeared to be very little defoliation in the treated blocks, although some plots had observable defoliation recorded from the ground plots. Based on this survey, it was considered that the program contributed to the reduction in the larval population and thereby protected foliage. The objective of keeping trees alive was achieved.

Environmental monitoring was again required as a condition of the operators licence from the Provincial Department of Environment & Lands. The study was to assess the effect of

Fenitrothion on forest songbird populations. The objective was to determine the magnitude and pattern of brain cholinesterase recovery in white-throated sparrows after each of two (2) applications of Fenitrothion at 210 g a.i. per hectare in four (4) blocks. The consulting firm of S. Fudge & Associates of St. John's were awarded that work. This firm had been the consultant for monitoring studies for the past two (2) years. A draft report has recently been received and is being reviewed at this time.

As part of the operational Hemlock Looper program, the C.F.S., in coopertion with the Department of Forestry and the two paper companies again conducted an experimental spray program at Hawkes Bay, on the Northern Peninsula. The objective was to test single, undiluted applications of Bt, Dipel 176 and Dipel 264 (oil-based formulations) at both 30 BIU/ha and 40 BIU/ha, and Futura XLV (water-based formulation) at 30 BIU/ha, at various timings to further define the spray window. As well, Dimilin in Superior 70 oil was to be tested at bud break and shortly after larval hatch. A separate report is to be presented by C.F.S.

The forecast for hemlock looper is not yet available. Branch samples were collected in mid-October from about 560 sample points and are being processed. A forecast is expected from C.F.S. by early January. Based on the defoliation survey and the continuing population decline, it is anticipated that the program will be smaller than in 1988 and be around 35 000 to 40 000 hectares.

TABLE 1

1988 HEMLOCK LOOPER SPRAY BLOCKS

(Area Figures Treated in Ha)

Chemical Blocks

Block #	Block Size	One Applic.	Two Applic.	Total Ha Sprayed	Total Block Area Treated
101	5 721	-	5 721	11 442	5 721
102	3 322	-	3 322	6 644	3 322
103	500	-	500	1 000	500
104	664	-	664	1 328	664
105	3 071	-	3 071	6 142	3 071
106	4 285	-	4 285	8 570	4 285
107	3 282	-	3 282	6 564	3 282
108	3 905	-	3 905	7 810	3 905
109	3 875	-	3 875	7 750	3 875
110	270	-	270	540	270
111	520	-	520	1 040	520
112	251	-	251	502	251
113	5 122	-	5 122	10 244	5 122
114	2 531	-	2 531	5 062	2 531
115	5 346	-	5 346	10 692	5 346
116	1 173	-	1 173	2 346	1 173
117	970	-	970	1 940	970
118	330	-	330	660	330
119	300	-	-	-	Deleted
120	1 449	-	-	-	Deleted
121	1 815	-	-	-	Deleted
	48 702	-	45 138	90 276	45 138

TABLE 1
continued

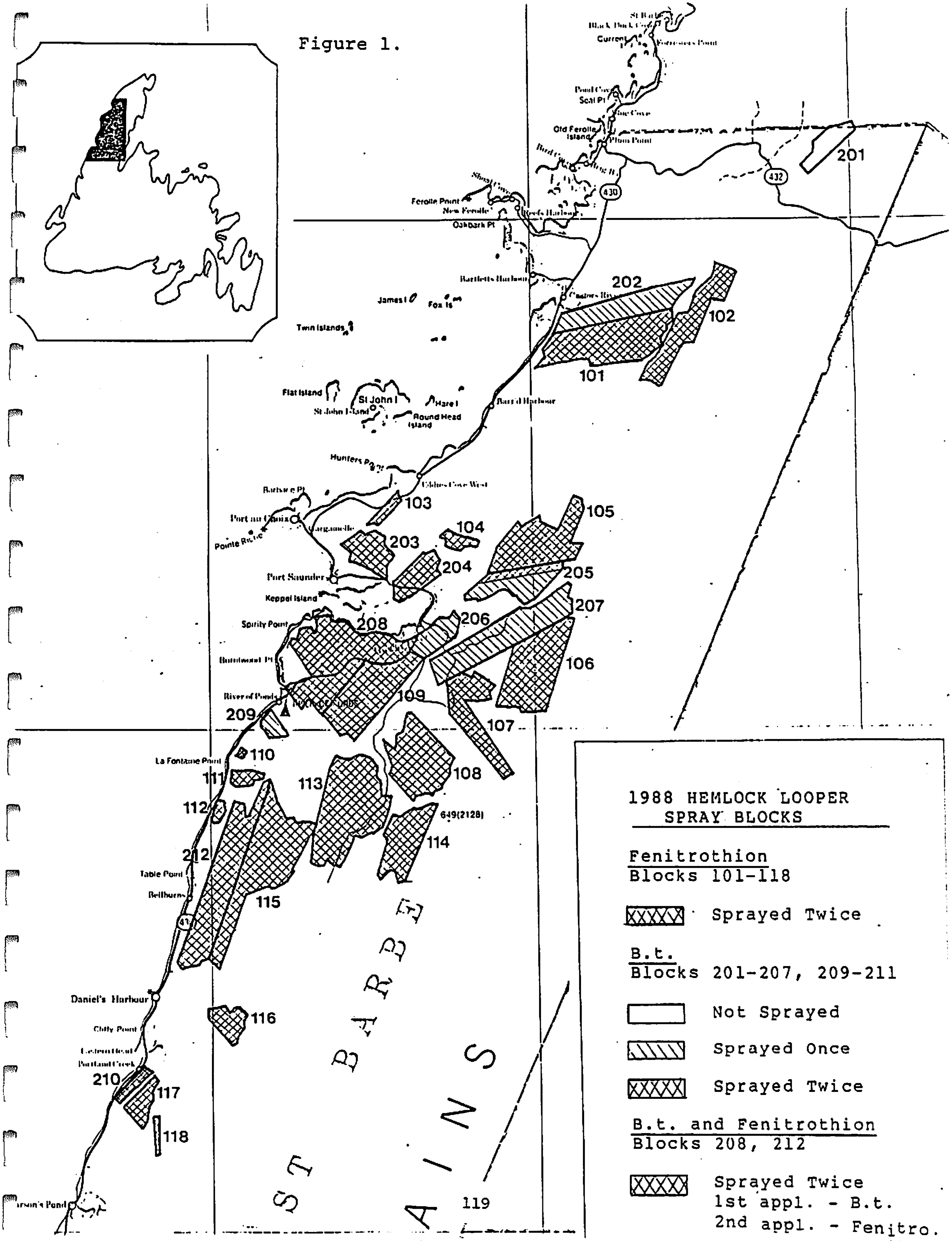
B.t. Blocks

Block #	Block Size	Spray Regime A	Spray Regime B	Spray Regime C	Spray Regime D	Spray Regime E	Total Block Total Ha Sprayed	Area Treated
201	1 565	–	–	–	–	–	–	Deleted
202	2 178	2 178	–	–	–	–	2 178	2 178
203	1 149	1 149	1 149	–	–	–	2 298	1 149
204	1 372	261	261	–	–	1 111	2 744	1 372
205	2 380	212	2 380	–	–	–	2 592	2 380
206	1 324	–	1 324	–	–	–	1 324	1 324
207	3 780	3 780	–	–	–	–	3 780	3 780
208	5 748	5 748	–	362	4 895	–	11 005	5 748
209	515	515	–	–	–	–	515	515
210	680	680	–	680	–	–	1 360	680
211	595	–	–	–	–	–	–	Deleted
212	4662	4 662	–	–	4 416	–	9 079	4 662
	25 948	19 185	5 114	1 042	9 311	1111	36 875	23 788

Total Block Area Proposed (Chemical + B.t.) = 74 650 ha
Total Ha Sprayed (Chemical + B.t.) = 127 151 ha
Total Block Area Treated (Chemical + B.t.) = 68 926 ha

Spray Regime A - 1 Applic. Dipel 176 (1.8 l/ha)
Spray Regime B - 1 Applic. Futura XLV (2.0 l/ha)
Spray Regime C - 1 Applic. Dipel 132 (2.4 l/ha)
Spray Regime D - 1 Applic. Fenitrothion (1.5 l/ha)
Spray Regime E - 2 Applic. Dipel 176 (1.8 l/ha)

Figure 1.


1988 HEMLOCK LOOPER
SPRAY BLOCKS
Fenitrothion
Blocks 101-118
Sprayed Twice
B.t.
Blocks 201-207, 209-211
Not Sprayed
Sprayed Once
Sprayed Twice
B.t. and Fenitrothion
Blocks 208, 212
Sprayed Twice
1st appl. - B.t.
2nd appl. - Fenitro.
ST BARBE
AINS
201
432
430
202
102
101
Ferolle Point
Oakbark Pt
Bartletts Harbour
James I
Fox Is
Twin Islands
Flat Island
St John I
Hare I
Round Head Island
Barr'd Harbour
Hunters Point
Eddies Cove West
103
Port au Choix
Pointe Riche
104
105
203
204
205
Port Saunders
Keppel Island
206
207
Spirity Point
208
106
River of Ponds
109
209
107
110
La Fontaine Point
111
108
113
112
649(2128)
114
212
Table Point
Bellburns
115
Daniel's Harbour
116
Portland Creek
210
117
118
119

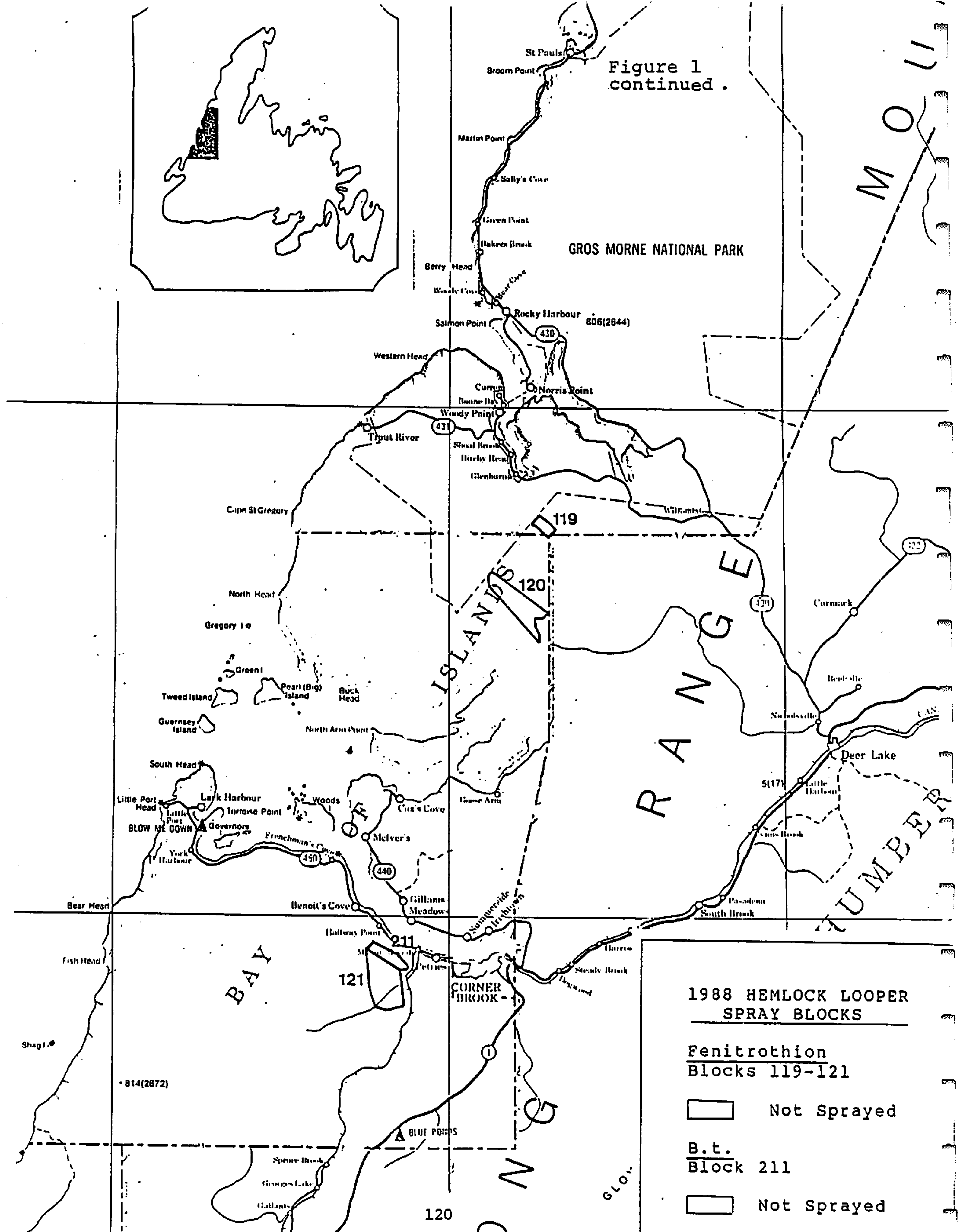


Figure 1 continued.

TABLE 2

1988

AERIAL DEFOLIATION - SPRAY BLOCKS

(% of Block Area Defoliated Per Category)

Block #	Area (Ha)	Nil (%)	Light (%)	Moderate (%)	Severe (%)	Sev. < 50% Mort. (%)	Sev. > 50% Mort. (%)
Chemical							
101	5 721	73	24	3	-	-	-
102	3 322	72	23	1	4	-	-
103	500	95	-	-	5	-	-
104	664	94	6	-	-	-	-
105	3 071	98	-	-	-	-	2
106	4 285	93	4	-	-	-	3
107	3 282	97	1	-	1	-	1
108	3 905	96	2	-	-	1	1
109	3 875	95	1	-	-	<1	3
110	270	100	-	-	-	-	-
111	520	95	-	-	-	3	2
112	251	100	-	-	-	-	-
113	5 122	95	2	-	-	1	2
114	2 531	95	-	-	-	2	3
115	5 346	98	-	-	-	-	2
116	1 173	100	-	-	-	-	-
117	970	100	-	-	-	-	-
118	330	100	-	-	-	-	-
	45 138	91	6	<1	<1	<1	1
B.t.							
202	2 178	78	20	1	1	-	-
203	1 149	99	-	-	1	-	-
204	1 372	100	-	-	-	-	-
205	2 380	96	-	-	-	-	4
206	1 324	89	10	-	1	-	-
207	3 780	97	1	-	-	-	2
208	5 748	95	4	-	-	-	-
209	515	92	-	-	-	-	8
210	680	95	-	-	<1	<1	4
212	4 662	99	-	-	-	-	1
	23 788	95	3	<1	<1	<1	1

THE BALSAM WOOLLY APHID IN NEWFOUNDLAND IN 1988

Hudak, J. and L.J. Clarke

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM,
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THE BALSAM WOOLLY APHID IN NEWFOUNDLAND IN 1988

by

Hudak, J. and L.J. Clarke

The balsam woolly aphid, *Adelges piceae* (Ratz.), is native to Europe and was accidentally introduced to North America at the turn of this century. The aphid was first recorded in Newfoundland in 1949 infesting balsam fir, *Abies balsamea* (L.) Mill., and it has since spread to most of the fir stands of the Island.

The balsam woolly aphid is a microscopic sucking insect and feeding on the branches causes severe swelling at the nodes and subsequent branch and crown dieback. Trees with crown damage may remain alive in a stagnant condition for several years. Feeding by the aphid on the stem of trees causes the formation of reaction wood which is undesirable for commercial wood utilization. High aphid population on the stem may kill trees within 2-3 years.

In the 1950s and 1960s the balsam woolly aphid caused considerable tree damage and mortality in mature and overmature stands during the 1950s and 1960s and increased the vulnerability of surviving damaged stands to rapid mortality from hemlock looper and spruce budworm defoliation.

Population levels of the balsam woolly aphid decreased during the 1970s but an increase was recorded during the 1980s. The increased damage was particularly evident in western Newfoundland in young balsam fir stands thinned at considerable expense to increase volume production to ameliorate the projected wood supply shortage caused by the recent outbreak of the spruce budworm. Since 1979 a total of 60 000 ha has been thinned at a cost of 40 000 000 dollars.

In 1988 a preliminary survey was conducted to determine the distribution of active infestations of the balsam woolly aphid in relation to the distribution of thinned stands. Over 80% of these thinned stands are situated in western Newfoundland and about one-third in management units 14 and 15. Surveys indicated that the total area of active balsam woolly aphid infestations covered about 160 000 ha on the Island and about 45% of these damaged stands are in management unit 14 and 15 (Table 1, Fig. 1). Management units 14 and 15 contain over 90% of all damaged thinned stands. Overall in these two units about 20% of all thinned stands are damaged by the balsam woolly aphid. Damage from the aphid is of serious concern to forest managers of government and industry because there is no effective, practical method to control aphid populations.

The management of aphid damaged young stands is controversial as one approach favours thinning based on intermediate-term economic considerations and the other promotes prescribed burning and planting to non-host species on the basis of long term biological reason.

The balsam woolly aphid problem is expected to increase in the near future therefore Forestry Canada, Newfoundland and Labrador Region in cooperation with the Forest Pest Management Institute initiated research to develop effective, practical methods to control aphid populations. More intensive surveys to delineate the distribution of aphid infestations and damage in relation to long term forest management plans are also an integral part of the program.

Table 1. Distribution of infestation and damage (10^3 ha) by the balsam woolly aphid in Newfoundland in 1988.

Mgmt Unit	Balsam Woolly Aphid Damaged Areas L	M	S	Total (ha)	Area (ha) Stand Age (yr) 40	40	Area PCTs[1] (ha)	Areas of Precommercial Thinning with Aphid Damage L	M	S	Total
14	35	13	4	52	45	6	7	1	0.5	0.5	2.0
15	18	1	2	21	20	1	13	1	-	0.5	1.5
16	10	1	-	11	11	-	3	-	0.5	-	0.5
TOTAL	63	15	6	84	76	8	23	2	1	1	4
OTHER UNITS	60	7	9	76	32	44	34	0.5	0.5	-	1
TOTAL ISLAND	123	22	15	160	108	52	57	2.5	1.5	1	5

[1] PCT - Precommercial thinning.

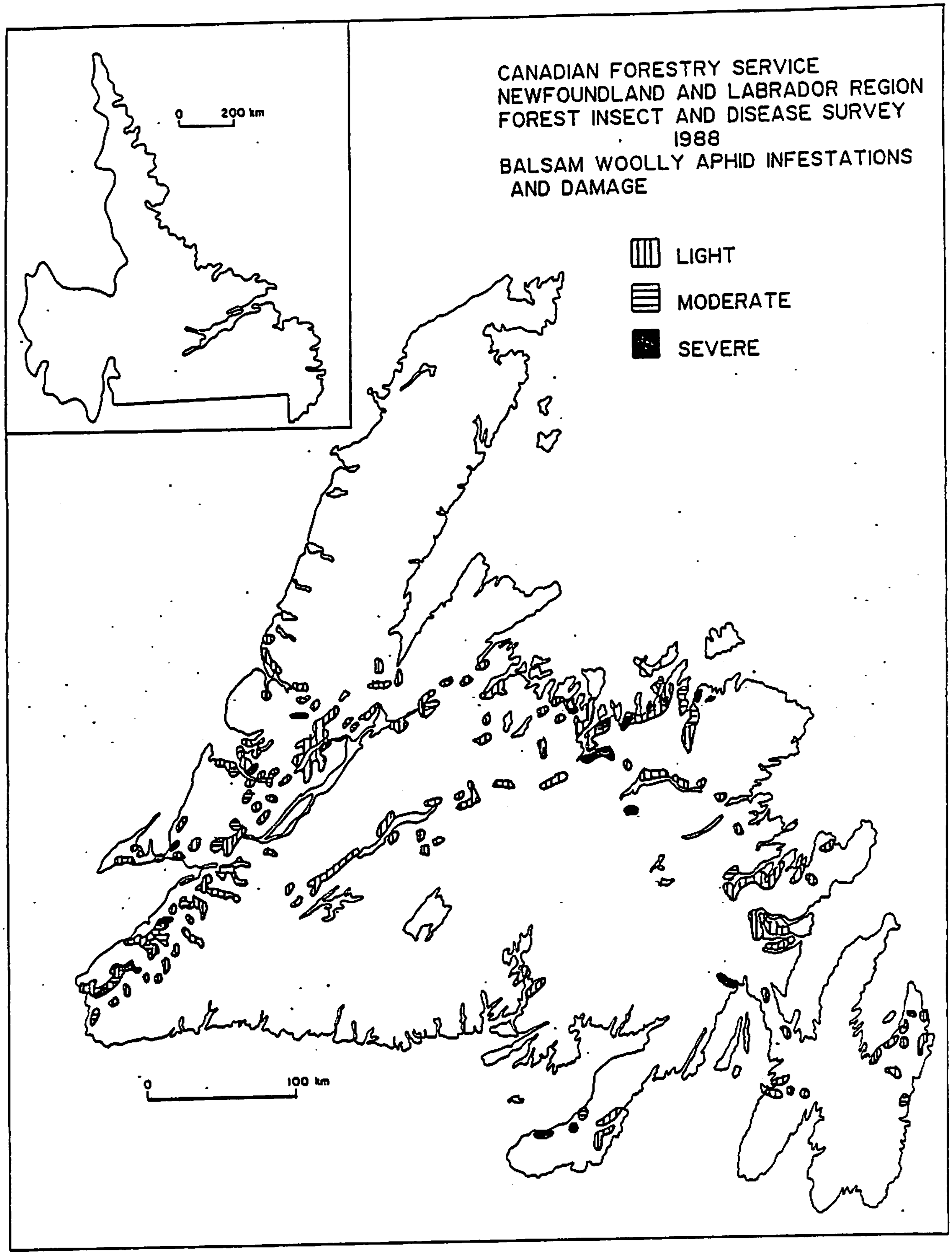

Figure 1. Distribution of balsam woolly aphid infestations and damage in Newfoundland in 1988.

BLACK ARMY CUTWORM CONTROL IN NEWFOUNDLAND IN 1988

by H. Crummey

(Report for the 1988 Annual Pest Control Forum, Ottawa, November 15 - 16, 1988)

Black Army Cutworm, in the past, has basically been known as an agricultural pest. However, in recent in years in Canada, coincident with the dramatic increase in reforestation, the Black Army Cutworm has caused extensive damage in newly established conifer plantations. In Newfoundland, this insect was relatively rare although widely distributed. The first incidence of damage to a black spruce plantation was recorded in 1983. Up until last year, it had not recurred as a problem. In 1987 this pest was discovered in two black spruce plantations, one at Journois Brook (270 ha) and the other at St. Fintans (180 ha) both of which were burned in 1985. Some control measures were initiated in 1987 using both ground applied permethrin (Ambush) and aerially applied Fenitrothion. Due to the late discovery of the insect in the plantations, only limited protection was achieved.

In 1988, the Department anticipated that the cutworm would again be a problem. Since there is one insecticide registered for use, permethrin (Ambush), and only by ground application, the Department purchased an Automatic MB200SK Mist Sprayer equipped with a Micronair AU5000-2 Airblast Atomizer. This seemed to be the only equipment available to ground-treat larger areas.

In early May, high numbers of larvae were present at both Journois Brook and St. Fintans and were feeding on black spruce seedlings, basically the only vegetation available at the time. The decision was made to mount a control program at both sites using 140 ml (70 g a.i.) of permethrin (Ambush 500 EC) in 30 to 45 litres per hectare of water carrier.

The program at Journois Brook (an Abitibi-Price plantation) was a cooperative effort between the Department of Forestry and Abitibi. The Mist Sprayer was mounted on a Prime Mover - a Tree

Farmer C5D Porter (Forwarder) supplied by Abitibi. Personnel from both Agencies were involved. Spray operations commenced on May 13 and ended on May 31, with a total of 13 spray missions. The total area treated at this site was 87.2 hectares.

The program at St. Fintans (a Crown plantation) was carried out by Department personnel. A Mist Sprayer, similar to the one used at Journois Brook, was borrowed from Nova Scotia Lands & Forests and was mounted on a Forwarder. Spray preparations commenced on May 21 and operations ended on May 30. A total of 47.6 hectares were treated.

In both cases, strict Provincial Environment guidelines had to be followed including buffers from water for mixing sites (300 metres) and for spray lines (100 metres). Buffers had to be identified by flagging.

It should be obvious that, looking at the hectares sprayed over that period of time, even with lost days due to poor weather, that ground application is very inefficient especially for treating larger areas, and of course larvae are continually feeding over this period prior to insecticide application. As well, the available equipment, although giving reasonable coverage (swath of 30 metres), was not suitable for natural plantation sites which had many stumps, rocks, depressions, and generally rugged terrain. With these constraints, it is doubtful whether any more than 100 hectares per sprayer could be treated over the larval feeding period. At present, there are twenty (20) general locations, involving approximately 4 800 hectares of potential cutworm susceptible plantation sites (established or proposed) in both Labrador and on the Island that could require protection. Not all of these would be infested at any one time, but it is likely that 500 to 1 000 hectares could be infested and would require protection in any one year, with the resulting operational problems.

The C.F.S. carried out efficacy assessment in 1988 at the Journois Brook plantation. Pre-spray larval counts in 1 square metre quadrats were taken in May 19 and post-spray counts on May 28, with five (5) replicates of six (6) quadrats sampled in both treated and untreated areas. Damage to seedlings was evaluated on July 5 in terms of percent of buds attacked, percent of defoliation per seedling and leader growth. In each area, 100 seedlings were examined.

Larvae were essentially eliminated from the treatment area within ten (10) days of application of Ambush, while numbers of larvae remained high and actually increased in the check (untreated) areas. Sprayed seedlings had little damage and displayed good leader growth whereas, the check seedlings were severely damaged.

There were also three (3) black spruce plantations in central Newfoundland and another unplanted burn infested. Damage to seedlings in central was variable and ranged from light to severe.

Based on trapping of adults in late summer, it is anticipated that the cutorm will continue to be a problem in 1989 at a number of sites infested in 1988 and will probably require some treatment. The exact locations and size of the infestation will be determined from field surveys starting in early May 1989.

THE SCLERODERRIS CANKER IN NEWFOUNDLAND IN 1988

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

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM,
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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. All other pine plantations established with stock from Salmonier nursery will be inspected in 1989 and infected plantations will be sanitized.

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. Cultures obtained in 1988 have not been tested for race identification. Following the results of the culturing, the damaged trees will be pruned or cut and burnt. A research program is planned in cooperation with the Laurentian Forestry Centre to elucidate the etiology of Scleroderris canker in Newfoundland.

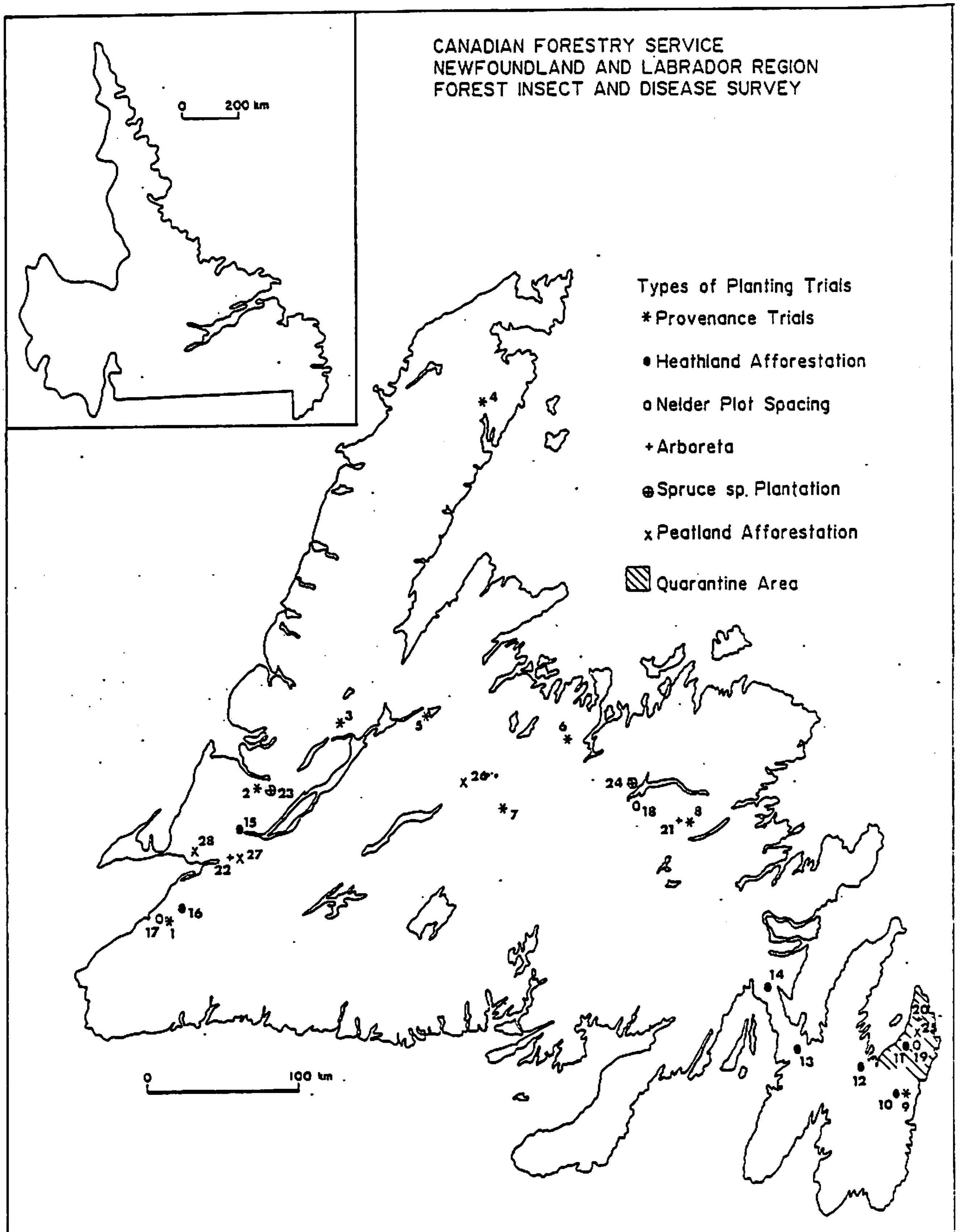

Figure 1. Locations of Scleroderris canker quarantine area and the Sitka spruce experimental plantations in Newfoundland using seedlings from Acadia Forest Nursery, N.B.

THE PINEWOOD NEMATODE IN NEWFOUNDLAND IN 1988

Bowers, W.W. and J. Hudak

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM,
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THE PINEWOOD NEMATODE IN NEWFOUNDLAND IN 1988

by

Bowers W.W. and J. Hudak

The pinewood nematode, Bursaphelenchus xylophilus (Steiner and Buhrer) Nickle, (formerly B. lignicolus Mamiya and Kiyohara) is associated with heavy losses of native pines in Japan and since 1979 has been implicated as the causal agent of pine wilt disease in the United States. The parasitic mycophagous nematode is capable of rapidly colonizing the resin canals of trees and destroying their epithelial linings which in turn results in disruption of water transport and mortality. The Forest Insect and Disease Survey (FIDS) conducted regional surveys in 1985 and 2 forms of the nematode were identified in Canada, the 'R' form limited to Pinus species and the 'm' form found on spruce and balsam fir. Sawyer beetles of the genus Monochamus are the primary vectors of the nematode in Japan and the United States. The identity of the vector responsible for tree-to-tree transmission in Canada has not been established. In Canada the pinewood nematode is not associated with tree mortality and therefore is not a problem, however the nematode is of concern to forest managers because European countries perceive the organism as a threat to their forests and have imposed an embargo against the importation of wood chips from Japan, the United States, and Canada. Potential exists for additional restrictions on the export of sawlogs and pulpwood.

The pinewood nematode has major regional, national and international implications for the forest sector therefore the Newfoundland Forestry Centre initiated work to address the possible role of the nematode in contributing to decline and mortality of native trees. Beginning in 1985 three 1-year contracts have been awarded to determine the incidence of pinewood nematode in major tree species of the Province. Research is also underway to investigate tree-to-tree transmission of the nematode. Both studies are under the direction of Dr. J. Finney-Crawley (Biology Dept.- Memorial University of Newfoundland) in cooperation with the Forest Insect and Disease Survey.

Pinewood Nematode Host Tree Survey

Objective: To survey the major tree species in insular Newfoundland and Labrador for pinewood nematode

In 1985 a total of 99 wood samples from healthy, damaged and recently dead trees were collected from sites in insular Newfoundland and Labrador (Fig. 1). Tree samples included wood shavings removed by carpenters auger from larch, white spruce, black spruce, red pine, white pine, Scots pine and balsam fir. Samples were collected at 1.6 meters from the base of each tree. After labelling, each sample was placed in a plastic bag and transported to the laboratory for analysis. Samples were processed using the Baermann funnel technique. Nematodes which emerged from the samples within 48 hr were heat killed, fixed in Formalin-Acetic acid (4:1), processed by the Seinhorst method and mounted in glycerine on slides for identification.

Surveys in 1985 identified 13 genera of nematodes associated with Newfoundland and Labrador trees including Rhabditis spp., Tylaphelenchus spp., Ektaphelenchus spp., Parasitaphelenchus spp., Cryptaphelenchoides spp., Trilobiatus spp., Koerneria spp., Parasitorhabditis spp., Mesorhabditis spp., Cryptaphelenchus spp., Rhabdontolaimus spp., Aphelenchoides spp., Bursaphelenchus spp., and Bursaphelenchus xylophilus (the 'm' or mucronate tail form). The 'm' form was identified from recently dead balsam fir and recently dead black spruce near Aspen Brook and from dead balsam fir from Twillick Brook.

The host tree survey continued in 1986 and 1987 in insular Newfoundland (Fig. 1) with the collection of 347 and 98 samples, respectively. Six additional nematode genera were identified including Plectus spp., Diplogaster spp., Teratocephalus spp., Laimaphelenchus spp., Deladenus spp., and Neotylenchus spp. In 1986 B. xylophilus 'm' form was found at 4 new sites and in 1 new species of tree in the province; healthy larch at Lake Ambrose and in dead balsam fir at Lake O'Brien, Pinchgut Lake and along Camp 33 road 2 km from the Trans Canada Highway. In 1987 B. xylophilus 'm' form was isolated from 3 samples of larch from Lake Ambrose and from black spruce from the same area. The nematode was also found in larch and balsam fir from Marystown on the Burin Peninsula.

Surveys of the incidence of pinewood nematode continued in 1988 with emphasis on tree species of Labrador, notably black spruce, white spruce, and larch. Collections were conducted in October by FIDS throughout areas of future timber supply (Fig. 1). Processing of samples is in progress.

PINEWOOD NEMATODE VECTOR STUDY

Objective: To determine the mode of transmission of B. xylophilus

Research to investigate the mode of pinewood nematode transmission began in Newfoundland in 1986. Two study sites were selected for collection of potential vectors, the first at Millertown Junction in Central Newfoundland and the second on South Brook Road near Pasadena (Fig. 2). At both sites 2 trees each of white spruce, black spruce, white pine, balsam fir, and larch were cut, sealed with wax and piled to attract insects. In addition, at the 2 sites 5 discs of balsam fir and white spruce were cut and placed on the ground to attract Hylobius spp. Log piles were checked 3 times weekly between 1100 and 1500 hrs for potential vectors. Throughout the field season several incidental collection sites including active cutting sites were periodically checked for vectors. A few insects were also collected by FIDS crews working in Labrador. Upon completion of the field work 2 balsam fir trees infested with woodborers were cut into bolts, waxed, and placed into rearing cages maintained at 28°C. Captured insects were placed in tissue and maintained in loosely capped vials. Following dissection, legs, antenna, elytra, wings and spiracles were placed in petri dishes with distilled water. Portions of the gut and trachea were placed in Lum's Ringer and after 24 hr examined for nematodes. Extracted nematodes were heat killed, fixed in F:A (4:1), processed by the Seinhorst method and mounted in glycerine.

Two potential vectors collected in 1986 included Monochamus scutellatus and Hylobius spp. Other insects examined included Anoplodera monticolae, Serropalpas striatus, and Dendroctonus rufipennis. Nematodes were found infecting all captured insects except H. warrenii and A. monticolae. Nematodes isolated from infected insects were identified as Diplogaster spp., Parasitorhabditis spp., Aphelenchoides spp., and Cryptaphelenchus spp. No insects captured in the 1986 study harbored B. xylophilus. During 1986, 160 adult Hylobius spp. were also received from Fredericton, New Brunswick. B. xylophilus was not associated with any of these weevils.

In 1987 vector studies were conducted throughout Canada by regional FIDS units. In order to establish a national perspective on pinewood nematode vectors a standardized methodology for collecting, handling, and processing insects and for isolating and culturing nematodes was developed. Guidelines developed by CFS-FIDS established the following insect priorities:

Source

Priority I	Woodborers in the host; recently emerged woodborers; borers and bark beetles excised from the host
Priority II	Insects attracted to chip piles
Priority III	Insects landing on host trees or log piles
Priority IV	Woodborers visiting flowers, road sides, cars, etc.

Host

Priority I	Hard pines
Priority II	True firs and soft pines
Priority III	Douglas fir and larch
Priority IV	Spruces

Insects

Priority I	Monochamus spp.
Priority II	Primary woodborers and bark beetles
Priority III	Secondary woodborers and bark beetles
Priority IV	Other bark-inhabiting insects

Guidelines for isolation of nematodes recommended the method described above for 1986. It was also recommended that nematodes obtained as dauerlarvae be cultured on Botrytis cinerea on potato dextrose agar at 20°C until the adult form is produced.

Material collected from Quebec and Newfoundland in 1987 was processed by Dr. Finney-Crawley. Quebec collections consisted of Monochamus spp., Xylotrechus spp., Ips pini, Dendroctonus spp. as well as other members of the Cerambycidae, Buprestidae, and Scolytidae. Two bark beetles and 42 Monochamus spp. contained nematodes, however B. xylophilus 'm' form was found in only 1 female Monochamus spp. Collections were made in Newfoundland at the Abitibi-Price chip pile in Stevenville, Barney's Brook, Lake Ambrose, Pinchgut Lake, South Brook Valley near Pasadena, and St. John's. In 1987 multiple funnel traps were placed at log pile sites to intercept insects flying to log piles. One trap was also erected adjacent to the Abitibi-Price chip pile in Stevenville. Among the insects collected at the various sites were M. scutellatus, Hylobius congera, Stictoleptura canadensis, Urocerus albicornis, Xylotrechus undulatis, Sirex cyaneus as well as members of the Scolytidae. Nematodes found associated with M. scutellatus were identified as Diplogaster spp. No insects were found to vector B. xylophilus.

In 1988 the vector study took on national scope with participation by British Columbia, Alberta, Ontario, Quebec, New Brunswick and Nova Scotia, and Newfoundland. Insects were collected based on guidelines outlined earlier, shipped to Dr. Finney-Crawley and examined for presence of nematodes. In Newfoundland study sites included Abitibi-Price chip piles at Stevenville and at Grand Falls, and wood piles at Aspen Brook, Buchans Road, Hawks Bay, Lake Ambrose, Salmonier Line, Pinchgut Lake and South Brook Valley. With 1 exception, sampling of vectors followed the methodology of 1987. In 1988 pitfall traps baited with ethanol and alpha-pinene were established at log piles in an attempt to increase catches of Hylobius spp. Insects from Goose River Road and Churchill River Road in Labrador were also examined. The 1988 project is now in its final phase of nematode extraction, culture, and identification.

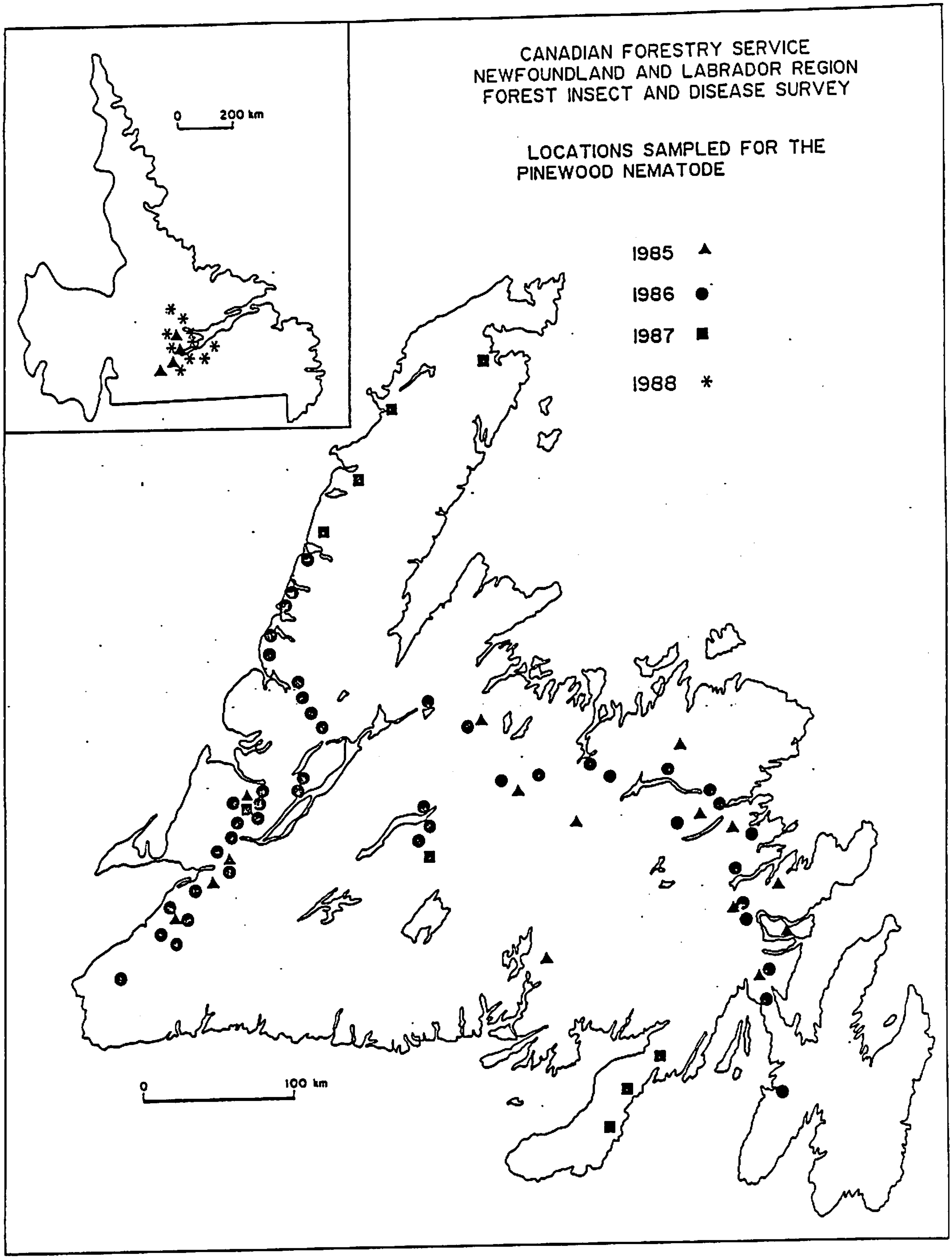

Figure 1. Host tree survey for pinewood nematode in Newfoundland, 1985-88.

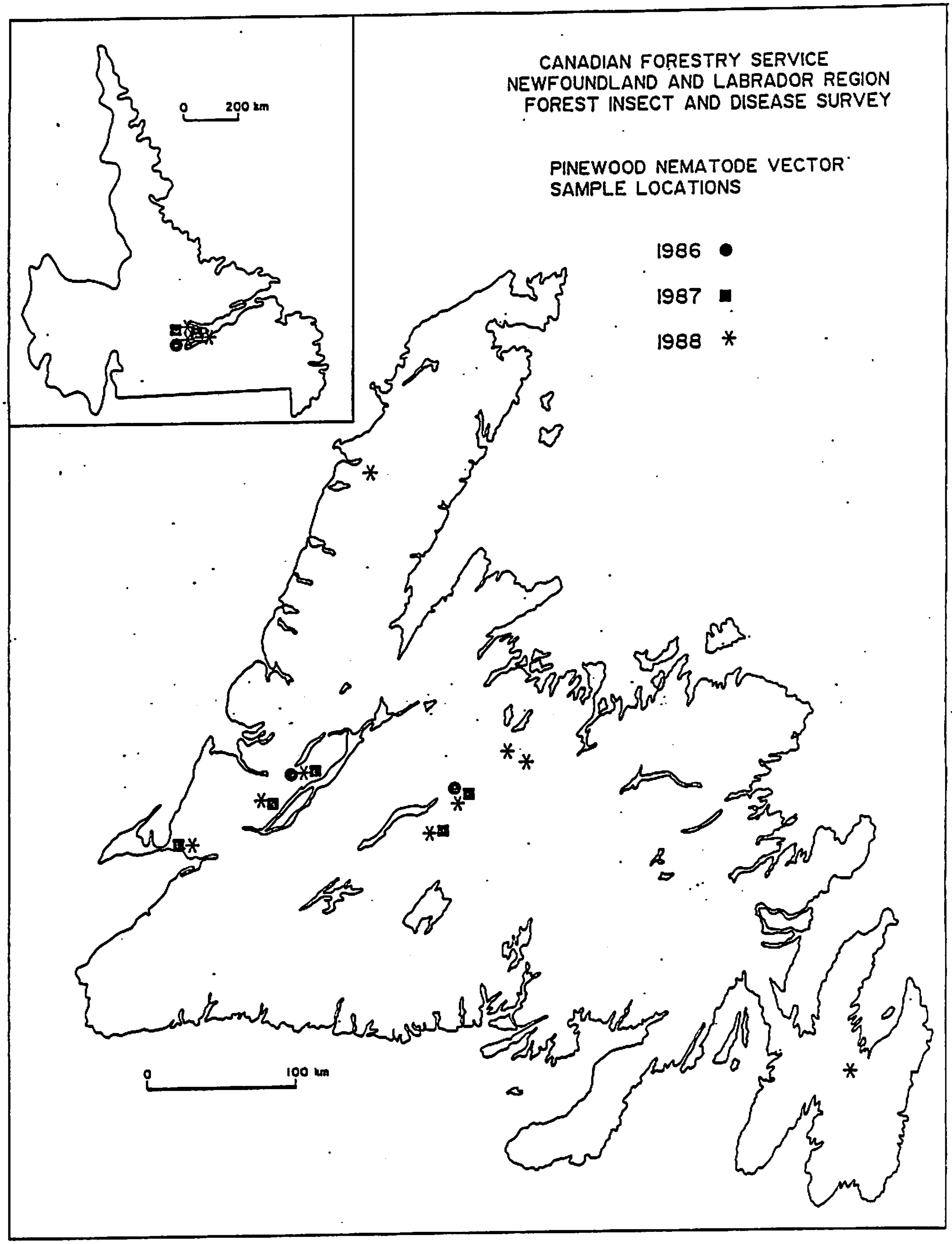

Figure 2. Pinewood nematode vector sample locations in Newfoundland, 1986-88.

II. SPRUCE BUDWORM DISTRIBUTION AND PEST MANAGEMENT / RÉPARTITION DE LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE ET GESTION DES RAVAGEURS

II. SPRUCE BUDWORM DISTRIBUTION AND PEST MANAGEMENT/ RÉPARTITION DE LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE ET GESTION DES RAVAGEURS

THE SPRUCE BUDWORM IN NEWFOUNDLAND IN 1988

by

J. HUDAK, A.G. RASKE, P.L. DIXON AND L.J. CLARKE

The area of defoliation was estimated at 306 ha including 272 ha in the moderate and severe category. There was no operational or experimental control program conducted against the spruce budworm in 1988.

La tordeuse des bourgeons de l'épinette à Terre-Neuve en 1988

J. Hudak, A.G. Raske, P.L. Dixon et L.J. Clarke

L'étendue de la défoliation a été estimée à 306 ha, et son intensité a été jugée modérée ou grave sur 272 ha. Aucun programme opérationnel ou expérimental de lutte contre la tordeuse n'a été réalisé en 1988.

1988 NEW BRUNSWICK PROTECTION PROGRAM AGAINST SPRUCE BUDWORM

by

N. CARTER

The 1988 aerial defoliation survey was conducted in the standard manner and revealed an estimated 43 000 ha of light, 196 000 ha of moderate (M), and 304 000 ha of severe (S) defoliation. Approximately 65.5% of the M-S defoliation was outside the treated areas.

The 1988 Spruce Budworm Spray Program conducted by Forest Protection Limited, in New Brunswick covered approximately 448 500 ha. Another 98 000 ha were sprayed by J.D. Irving Ltd. on its own freehold limits.

Programme du Nouveau-Brunswick pour la protection contre la tordeuse des bourgeons de l'épinette en 1988

N. Carter

En 1988, le relevé aérien de la défoliation a été effectué de façon normale. La défoliation aurait été légère sur 43 000 ha, modérée sur 196 000 et grave sur 304 000. Environ 65,5 % de l'étendue où la défoliation a été jugée modérée ou grave se trouvait hors des zones traitées.

Le programme d'arrosages contre la tordeuse mené par Forest Protection Limited au Nouveau-Brunswick a couvert approximativement 448 500 ha en 1988. J.D. Irving Ltd. a également effectué des arrosages sur 98 000 ha de ses propres terrains.

THE SPRUCE BUDWORM IN QUEBEC IN 1988

by

MICHEL AUGER

The spraying program against spruce budworm carried out in 1988 covered an area of 192 073 ha located entirely within the Bas-Saint-Laurent - Gaspésie region. This represents an increase of 9% compared with the area treated last year in this region.

La tordeuse des bourgeons de l'épinette au Québec en 1988

Michel Auger

En 1988, le programme d'arrosages contre la tordeuse des bourgeons de l'épinette a couvert une étendue de 192 073 ha et a été entièrement réalisé dans la région du Bas-Saint-Laurent et de la Gaspésie. Il s'agissait d'une augmentation de 9 % de la superficie traitée dans cette région par comparaison à l'année précédente.

Quatrième année d'applications de *Bacillus thuringiengis* contre la tordeuse des bourgeons de l'épinette dans les boisés privés de l'est du Québec

André Juneau

En 1988, dans le cadre du Programme forestier du Plan de développement de l'Est du Québec, Forêts Canada a parrainé pour une quatrième année un programme d'arrosages de *Bacillus thuringiensis* pour protéger les boisés privés contre la tordeuse des bourgeons de l'épinette. Les traitements ont porté sur environ 16 000 ha et ils ont en majorité été effectués dans des zones où on avait commencé à observer des arbres morts.

A FOURTH YEAR OF TREATMENT WITH BACILLUS THURINGIENSIS AGAINST SPRUCE BUDWORM ON PRIVATE WOODLOTS IN EASTERN QUEBEC

by

ANDRÉ JUNEAU

In 1988, within the framework of the Forestry Program of the Eastern Quebec Development Plan, Forestry Canada sponsored its fourth program of spraying with Bacillus thuringiensis to control spruce budworm in private woodlots. Some 16 000 ha of forest were treated in 1988, most of them in areas where tree mortality had started.

THE STATUS OF THE SPRUCE BUDWORM IN MAINE - 1988, AND FORECAST - 1989

by

HENRY TRIAL, JR.

The spruce budworm infestation in Maine remained at a very low level in 1988. The Insect and Disease Management staff of the Maine Forest Service looked for areas on budworm activity throughout the state as part of the normal Forest Insect Survey.

There are 55 000 acres of moderate to severe defoliation and an additional 10 000 acres had light damage. Damage throughout the mapped area was extremely spotty.

Situation de la tordeuse des bourgeons de l'épinette au Maine en 1988 et prévisions pour 1989

Henry Trial, Jr.

L'ampleur de l'infestation de la tordeuse des bourgeons de l'épinette au Maine est demeurée très faible en 1988. La section Insect and Disease Management du service forestier du Maine a cherché des foyers d'activité de la tordeuse dans tout l'État dans le cadre de son relevé habituel des insectes forestiers.

Une défoliation modérée à grave a été observée sur 55 000 acres, ainsi que des dommages légers sur 10 000 acres additionnels. Les dommages sur toute l'étendue cartographiée étaient extrêmement localisés.

SPRUCE BUDWORMS CONDITIONS IN THE UNITED STATES - 1988

by

DANIEL R. KUCERA

Eastern spruce budworm populations continued to decline throughout the Lake States for the third consecutive year.

Extremely low spruce budworm populations continued throughout the Northeastern States in 1988 and predictions for 1989 indicate continued decline. No suppression was conducted in the northeast in 1988 and none is planned for 1989.

Regionwide western spruce budworm defoliation increased from 757 400 ha in 1987 to over 817 000 ha in 1988.

Conditions relatives aux tordeuses des bourgeons de l'épinette aux États-Unis en 1988

Daniel R. Kucera

Pour la troisième année de suite, les populations de la tordeuse des bourgeons de l'épinette ont diminué dans tous les États des Grands Lacs.

Les populations sont demeurées extrêmement faibles dans tous les États du Nord-Est, et on prévoit qu'elles continueront de diminuer en 1989. Aucun arrosage n'a été effectué dans le Nord-Est en 1988 et aucun n'est prévu en 1989.

D'autre part, la défoliation régionale causée par la tordeuse occidentale de l'épinette est passée de 757 400 ha en 1987 à plus de 817 000 ha en 1988.

SPRUCE BUDWORM IN ONTARIO, 1988

by

G.M. HOWSE AND J.J. CHURCHER

Spruce budworm infestations declined in 1988, with a reduction of approximately 27% in the total area of moderate-to-severe defoliation. Aerial and ground surveys revealed some 5 224 734 ha of defoliation, down from 7 189 763 ha in 1987 all of which occurred in the northwestern and north central regions. A total of 14 023 ha was aerially sprayed with B.t. in 1988.

La tordeuse des bourgeons de l'épinette en Ontario en 1988

G.M. Howse et J.J. Churcher

Les infestations de la tordeuse des bourgeons de l'épinette ont décliné en 1988. La superficie totale des foyers de défoliation modérée à grave a notamment diminué d'environ 27 %. Les relevés aériens et au sol ont indiqué une défoliation présente sur quelque 5 224 734 ha, par comparaison à 7 189 763 ha en 1987, et ce exclusivement dans les régions du Nord-Ouest et du Centre-Nord. Des arrosages aériens de *B.t.* ont été effectués sur 14 023 ha au total.

THE SPRUCE BUDWORM IN NEWFOUNDLAND IN 1988

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

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM, OTTAWA, 15-17 NOVEMBER 1988

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

THE SPRUCE BUDWORM IN NEWFOUNDLAND IN 1988

by

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

Larval Development and Defoliation - Population levels in the three small infestations at South Branch, Baie Verte and Ten Mile Lake decreased this summer. Sampling in these areas showed initially high larval numbers in the South Branch area with moderate and severe defoliation occurring near Overfalls Brook and Mollychignic Brook. Low numbers were collected near Southwest Brook on the Baie Verte Peninsula and very few spruce budworm larvae were recorded in the Ten Mile Lake infestation where most of the defoliation was caused by blackheaded budworm.

General sampling during early summer showed high spruce budworm populations along the west coast of the Northern Peninsula, however populations decreased during later instars and in some areas collapsed.

The area of defoliation was estimated at 306 ha including 272 ha in the moderate and severe category (Fig. 1).

Control Program - There was no operational or experimental control program conducted against the spruce budworm in 1988.

Biological Mortality Factors - In 1988 spruce budworm samples were collected from near Baie Verte. The main larval parasitoids were *Glypta fumiferanae* and *Apanteles fumiferanae*, causing about 10% mortality. Nearly 30% of pupae were parasitized, about half of these by tachinids which are currently overwintering as larvae and are therefore unidentified. Several tachinid parasites also emerged from budworm larvae.

The most commonly detected fungal pathogen was Paecilomyces farinosus causing about 1% infection. Entomophthoraceous fungi apparently did not occur in this budworm population in 1988. Less than 1% of the samples were infected by Nosema fumiferanae.

In addition about 4% of the budworm samples were infected by a fungus tentatively identified as Aureobasidium pullulans. The pathogenicity of this fungus is being investigated.

Pheromone Trapping of Moths - Pheromone traps were placed at 50 permanent sample locations throughout the Island. The number of moths trapped decreased from 477 in 1987 to 186 in 1988. This is the third consecutive year of decrease. Most moths were tapped along the western coast line with the highest numbers recorded at Overfalls Brook (136) near an infestation. The number of moths trapped ranged from 1 to 10 at 9 of 16 locations along the west coast, extending as far North as Daniel's Harbour, and no moths were trapped at the other seven sites. Only two moths were trapped near an infestation on the Baie Verte Peninsula. Three sites about 40 km inland produced a total of four budworm moths. No moths were trapped in central or eastern Newfoundland.

Forecast of Spruce Budworm Defoliation for 1989 - Sampling was conducted in conjunction with the hemlock looper egg survey in mid-October. The forecast will be provided after the completion of processing of samples.

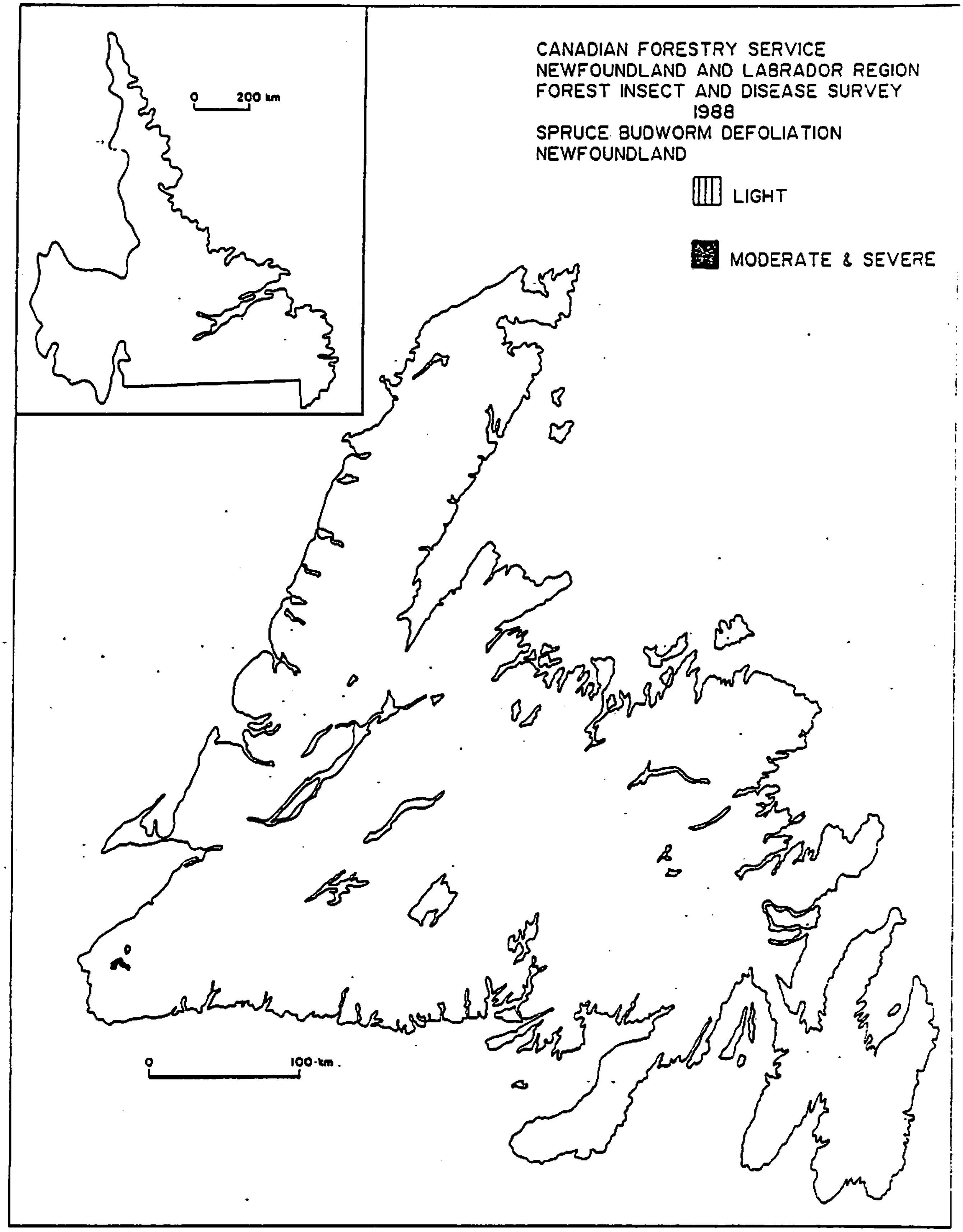

Figure 1. Areas of defoliation caused by the spruce budworm in Newfoundland in 1988.

SPRUCE BUDWORM CONTROL IN NEWFOUNDLAND IN 1988

by H. Crummey

(Report for the 1988 Annual Pest Control Forum,
Ottawa, November 15 - 16, 1988)

The Canadian Forestry Service (C.F.S.) forecast for 1988 indicated that a total of 5 840 hectares were expected to be defoliated, with 2 240 hectares (one location) of this in the moderate and severe defoliation class. Because of the locations of these infestations, no control program was proposed.

The forecast for 1989 is not yet available. Branch samples were collected in mid-October and are now being processed. Results should be available by the end of this year. At this time, it is felt that the budworm population will remain at the 1988 level and therefore will not warrant a control program in 1989.

Doc.: 0413J

1988 NEW BRUNSWICK PROTECTION PROGRAM AGAINST SPRUCE BUDWORM

(Annual Forest Pest Control Forum, November 15-17, 1988)

Spruce Budworm Conditions in 1988

The 1988 aerial defoliation survey was conducted in the standard manner and revealed an estimated 43 000 ha of light, 196 000 ha of moderate, and 304 000 ha of severe defoliation (Figure 1). Approximately 65.5% of the M-S defoliation was outside the treated areas. Defoliation was detected in largest concentrations throughout the north-central part of the Province, primarily in Restigouche County. Except for occasional small pockets of defoliation the majority of the rest of the Province was undamaged. The 500 000 ha of M-S defoliation represents a 16% increase from 1987, but is still 75% below the 2.03 million ha in 1983.

1988 Spray Program

The 1988 Spruce Budworm Spray Program (Figure 2) conducted by Forest Protection Limited, in New Brunswick covered approximately 448 500 hectares. This is 6.3% less than the 478 300 ha treated in 1987. Another 98 000 ha were sprayed by J. D. Irving Ltd. on its own freehold limits (compared to 105 000 ha in 1987).

Of the total area treated by FPL, 51.5% received a double application of the chemical fenitrothion (Sumithion) and 1.4% received a single application. About 47.0% of the area received a single treatment of bacterial insecticide, Bacillus thuringiensis var. kurstaki (B.t.) in the form of two products, viz. Futura XLV (41.2%) and Dipel 132 (5.8%) (Table 1).

Spray aircraft included 12 TBMs, 1 four-engine DC-6, and 2 single-engine agricultural-type small spray planes (SSPs). TBMs were used to treat 58% of the total area and the DC-6 treated 41% of the area. This year's program was characterized by the largest area (210 000 ha) and proportion (47%) of B.t. in any of New Brunswick's spray programs to date. The Dipel 132 was sprayed by TBMs; the Futura XLV was primarily sprayed by the DC-6 (a few small blocks were done with SSPs).

The first operational spray blocks were declared biologically ready for chemical spraying on May 24th and spray operations commenced that morning. The first B.t. blocks were declared biologically ready on May 27th and spraying began the next day. The operational program was completed on the evening of June 13th. Better than usual spray weather was experienced throughout the spray period although mean daily temperatures were cool.*

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* *Excludes three small black spruce seed production areas.*

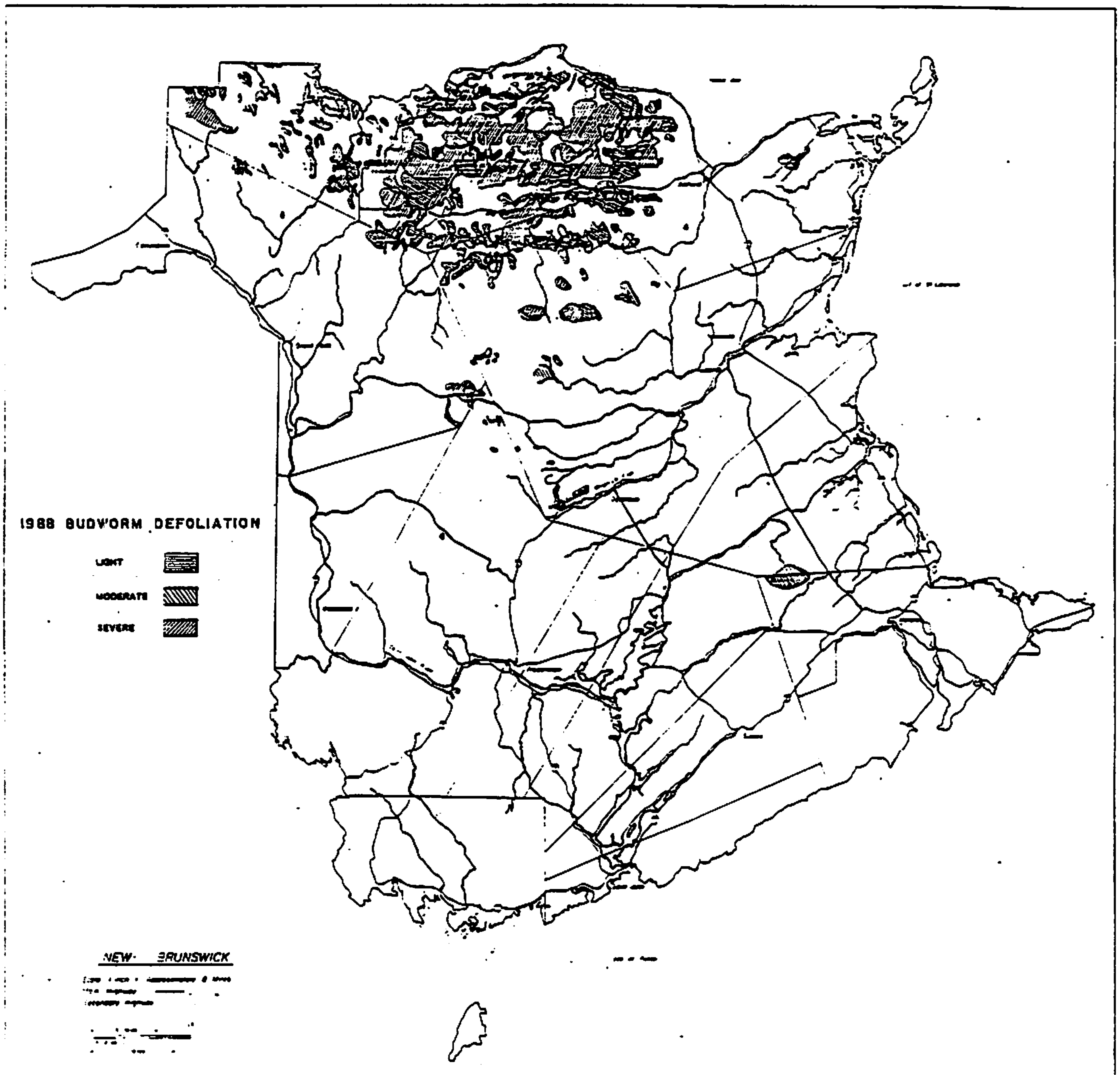

Figure 1. Areas of light, moderate and severe defoliation based on 1988 aerial defoliation survey.

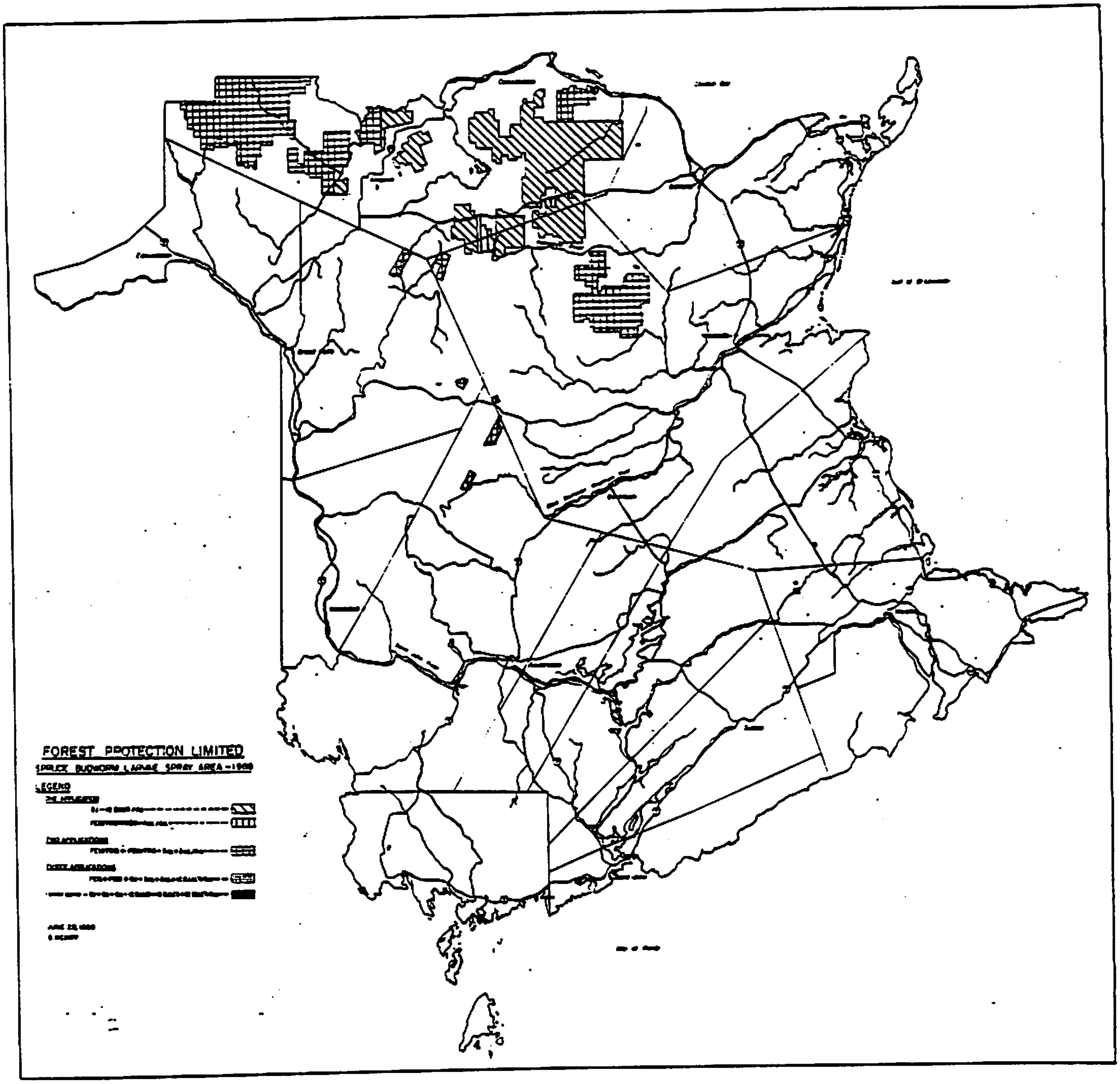

Figure 2. Areas sprayed by FPL for spruce budworm control in New Brunswick in 1988. (Does not include J. D. Irving Ltd. program).

Table 1. Areas sprayed by Forest Protection Limited for spruce budworm control in 1988 in New Brunswick*. (Does not include J.D. Irving program).

Treatment	Hectares Thousands	(%)	Acres Thousands	Aircraft Type
One Application - Biological				
30 B.I.U./ha B.t. (Dipel 132)	26.0	(5.8)	64.0	TBM
30 B.I.U./ha B.t. (Futura XLV)	184.5	(41.2)	456.2	DC-6, Ag Truck
SUB-TOTAL	210.5	(47.0)	520.2	
One Application - Chemical				
280 g/ha Fenitrothion	6.3	(1.4)	15.5	TBM
Two Applications				
210 g/ha Fenitrothion+ 210 g/ha Fenitrothion	231.1	(51.5)	571.0	TBM, Ag Truck
SUB-TOTAL	237.4	(53.0)	586.5	
Three Applications (Seed Production Areas) 210 g/ha Fenitrothion + 210 g/ha Fenitrothion + 30 (B.I.U./ha (Futura XLV)	0.6	(0.1)	1.5	Ag Truck
GRAND TOTAL	448.5	(100.0)	1108.2	

*Source: Forest Protection Ltd.

Results of Spray Program

This year's B.t. program was the largest ever conducted in New Brunswick. It took place in the north where last year's forecast revealed a very significant increase in budworm population levels over the previous year. B.t. and fenitrothion were used over approximately 210 000 ha and 238 000 ha, respectively. Although the forest received some benefits due to B.t. treatment, results were far superior with fenitrothion (Table 2; Figures 3 & 4).

For instance, budworm mortality due to fenitrothion averaged 72%, compared to 50% for B.t.; mean branch defoliation in fenitrothion plots was only 34% compared to 68% in B.t. plots; and percent reduction in defoliation in fenitrothion plots averaged 61%, but was only 24% in B.t. plots. Furthermore, only 19% of the fenitrothion area had moderate and severe defoliation compared with 60% of the B.t. area. The area of moderate and severe defoliation in protected areas using fenitrothion is much closer to the previous 11-year average of 14% (range 6% to 20%) in programs based almost solely on chemical treatments.

There is no single explanation for the poor results with B.t. in 1988. There is a myriad of factors which could have influenced the results. The following facts are known. Population levels were higher this year than in operational B.t. treatment blocks for the past several years. B.t. has primarily been sprayed in the south under conditions of declining populations in past programs. Defoliation levels were more severe at any given population in the north this year compared to levels seen in the southern part of the Province in the past few years. This year's B.t. program was large-block spraying with large aircraft. Past B.t. programs were primarily small blocks sprayed by small aircraft and timed for either fir or spruce depending on predominant host. Because spray blocks were so large this year the topographic variability resulted in insect and tree development being more diverse within the blocks. A single application of insecticide (B.t. or chemical) cannot adequately address this variability. Topography can adversely influence aircraft application height, but there were no measures of deposit to confirm whether deposit was adequate or not. Finally, there was a cool spell which coincided with the spray period and might have suppressed larval behaviour mitigating against good B.t. results.

Forecast of Infestation for 1989

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 1988. 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

Table 2. Summary of data collected from balsam fir samples in fenitrothion, B.t. and check plots in 1988.

Block	Lines*	Aircraft	n	Pre-spray Larvae Per 45-cm	Per Bud	% Mortality Obs.	Corr.	Defoliation Obs.%	%Red.
KEDWICK									
Fenitrothion - 2 x 210 g/1.46 L/ha									
A-1	50-85	TBM	40	32.8	0.520	84.6	42.8	38.7	58.1
A-2	21-42	TBM	40	23.2	0.269	85.2	54.5	43.8	53.3
A-2	52-67	TBM	40	21.8	0.422	91.4	66.1	32.8	62.6
A-2	70-92	TBM	40	22.1	0.308	89.2	63.4	41.4	53.2
A-3	5-20	TBM	40	14.3	0.178	83.7	66.7	32.8	57.9
A-4	55-76	TBM	40	8.9	0.149	97.4	95.1	14.4	82.3
A-5	37-55	TBM	40	17.8	0.217	94.9	86.1	27.5	66.7
Bacillus thuringiensis									
Dipel 132 - 1 x 30 BIU/2.36 L/ha									
A-6	44-52	TBM	40	16.3	0.232	83.4	61.4	46.5	41.0
A-7	9-25	TBM	40	21.9	0.244	87.2	83.8	62.0	24.4
Futura XLV - 1 x 30 BIU/2.03 L/ha									
D-2	10-26	DC-6	40	14.2	0.235	87.8	71.6	27.4	64.4
D-2	72-90	DC-6	40	39.3	0.659	94.3	70.2	94.2	4.2
Untreated									
Check 1	-	-	35	11.1	0.189	57.5	-	56.4	-
Check 2	-	-	40	18.5	0.236	58.3	-	72.5	-
Check 3	-	-	40	19.2	0.258	63.6	-	95.9	-
Check 4	-	-	40	11.4	0.151	32.0	-	72.1	-
CAMPBELLTON									
Bacillus thuringiensis									
Futura XLV - 1 x 30 BIU/2.03 L/ha									
D-1	10-30	DC-6	40	40.8	0.603	87.2	58.4	78.9	16.8
D-1	42-65	DC-6	40	27.3	0.288	83.5	50.9	64.0	25.3
D-1	75-85	DC-6	40	45.6	0.605	88.1	61.4	69.5	25.9
D-1	95-112	DC-6	40	38.8	0.515	74.8	0.1	74.3	22.0
D-1	120-140	DC-6	40	28.6	0.383	74.3	0.0	73.9	15.0
D-1	125-145	DC-6	40	20.5	0.430	78.2	14.2	70.2	21.6
D-1	75-90	DC-6	40	45.1	0.539	91.9	73.0	91.5	3.9
Untreated									
Check 1	-	-	40	30.1	0.427	79.2	-	96.9	-
Check 2	-	-	40	30.0	0.479	73.7	-	98.1	-
Check 3	-	-	40	24.7	0.383	79.3	-	90.8	-
Check 4	-	-	40	52.8	0.753	64.8	-	99.7	-
Check 5	-	-	40	34.5	0.439	66.3	-	97.5	-
SEVOGLE									
Fenitrothion - 2 x 210 g/1.46 L/ha									
A-13	10-24	TBM	40	40.2	0.582	93.7	76.1	56.3	40.6
A-15	20-23	TBM	40	12.9	0.187	99.6	99.2	17.0	77.7
Untreated									
Check 1	-	-	40	25.5	0.307	80.6	-	60.9	-

* Portion of block that was sampled.

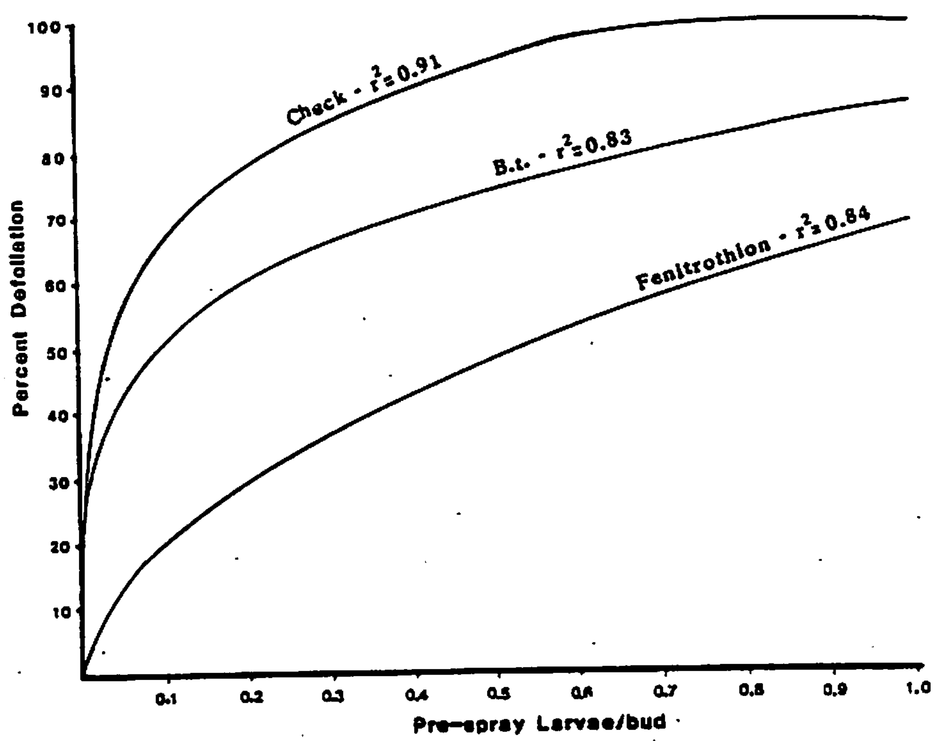

Figure 3. Comparison of percent defoliation on balsam fir from treatment and check plots.

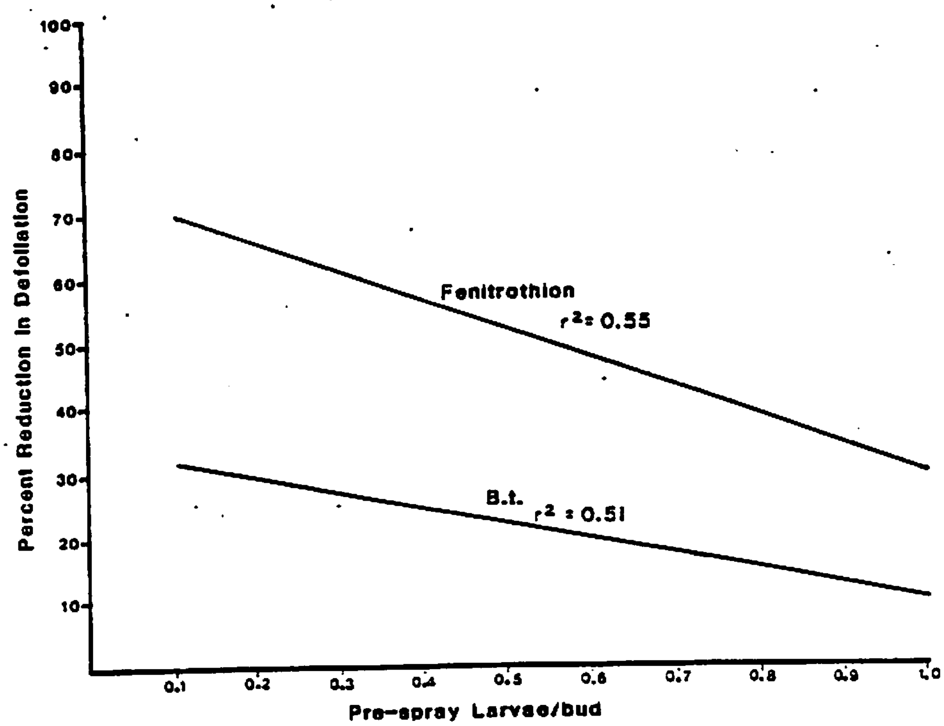

Figure 4. Comparison of percent reduction in defoliation on balsam fir in plots treated by Fenitrothion and B.t.

of the Province and within Restigouche County the population increased by an average of 15 L2/branch. This year, in the same County there was a decrease in overall mean L/2 branch, (1987 = 24 L2/branch; 1988 = 14 L2/branch). Hundreds of supplementary L2 samples are also collected throughout the winter months to assist in planning the protection program.

The forecast for 1989 is for 1.65 million ha (Figure 5) of variable and moderate to high infestation, which is a 10% increase from last year's forecast (Table 4). The most severe damage is again expected in the northern part of the Province with an extension to the northeast. A few pockets remain in the central area. No significant damage is expected in the southern half of the Province with the exception of one area northwest of Moncton.

Plans for 1989

Spray plans for 1989 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.

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Table 3. Comparison of Spruce Budworm Forecast Infestation Levels 1981-1988.

YEAR	FORECAST INFESTATION LEVEL 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%)	227 (19%)	99 (8%)	1205[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 1982-1988.

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

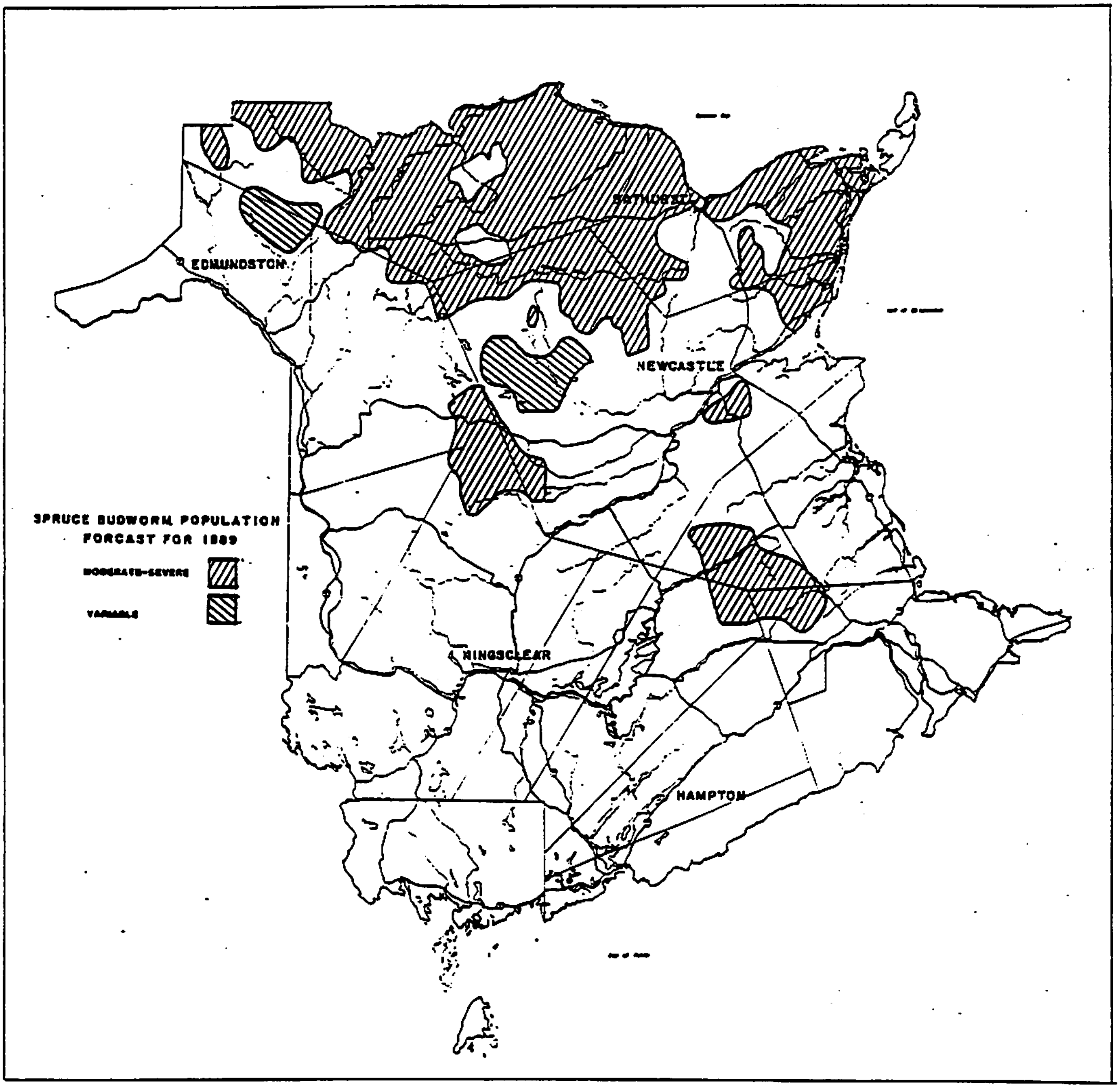


Figure 5. Areas forecast to have moderate and high infestation levels in 1989 based on the 1988 L2 survey.

The Spruce Budworm in Québec in 1988

- Spraying program
- State of the epidemic
- Outlook for 1989

by Michel Auger, Forest Engineer

MINISTÈRE DE L'ÉNERGIE ET DES RESSOURCES
DIRECTION DE LA CONSERVATION

Service de la protection contre
les insectes et les maladies

Louis Dorais, Forest Engineer, M.Sc.
Head of Service

Québec, November 1988

1. <u>Areas treated</u>

The spraying program against spruce budworm carried out in 1988 covered an area of 192 073 ha located entirely within the Bas-Saint-Laurent - Gaspésie region. This represents an increase of 9 % compared to the territory treated last year in this region (Figure 1). In 1987, the area treated totaled 197 992 ha, including 21 563 located in the Côte-Nord region.

2. <u>Insecticide</u>

The biological insecticide Dipel 132, manufactured by Abbott Laboratories Ltd., was sprayed at a rate of 30 billion international units (BIU) per hectare, for a volume of 2.37 liters per hectare.

3. <u>Spray aircraft</u>

Two four-engine DC-4's and 12 single-engine aircraft (5 AgCats, 2 Thrush Commanders, 5 Bull Thrushes) were required to spray a volume of 455 213 liters of biological insecticide.

Treatment began on June 3 and continued until June 25. The operation was greatly hampered by rain, wind and fog, because of which 57 % of spraying activities had to be cancelled.

The four-engine aircraft were equipped with a system of longerons fitted with 110 nozzles. The single-engine aircraft were equipped with 6 Micronair AU-5000s fitted with long blades (12 cm).

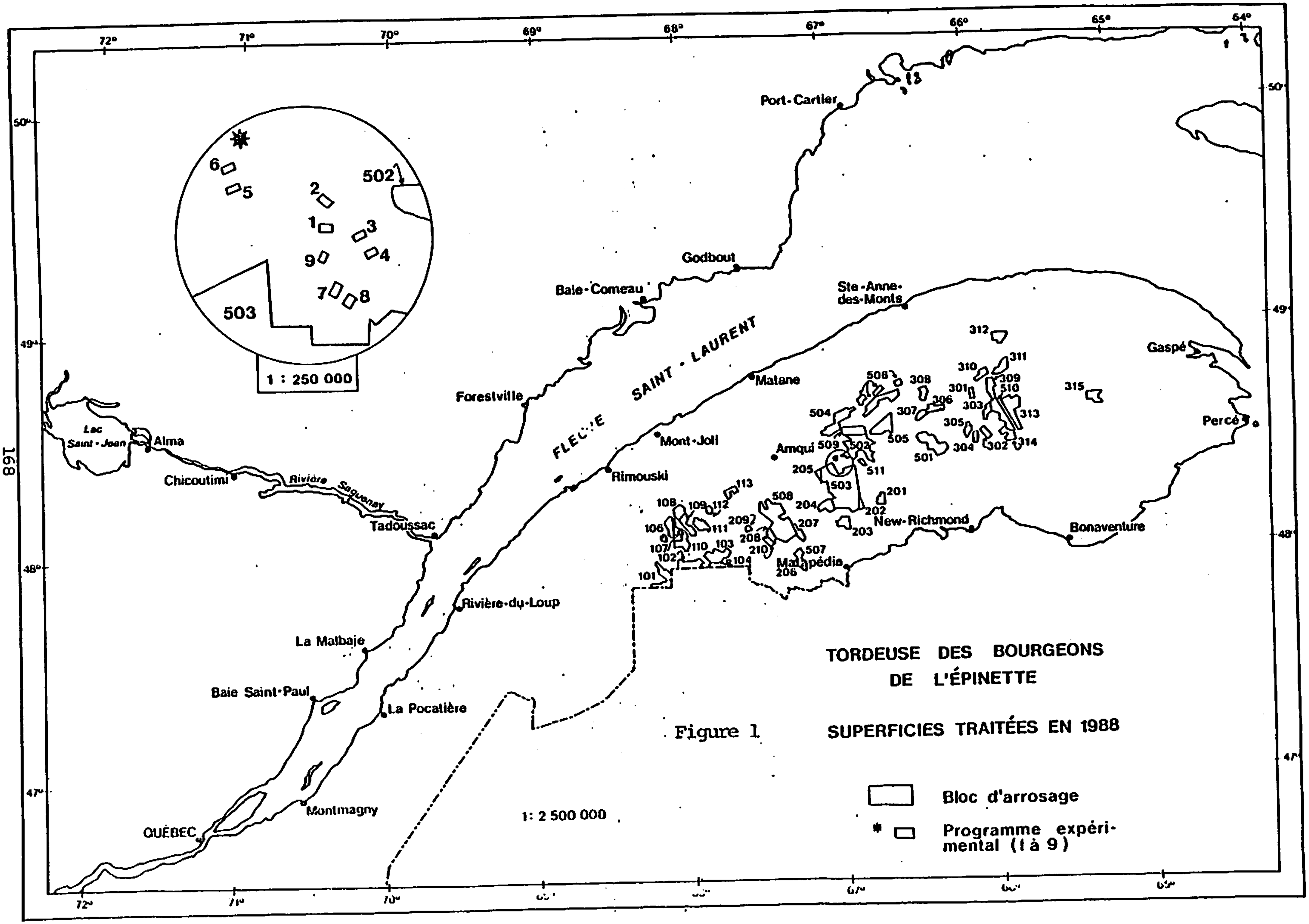

TORDEUSE DES BOURGEONS
DE L'ÉPINETTE
SUPERFICIES TRAITÉES EN 1988
Bloc d'arrosage
Programme expérimental (1 à 9)
1 : 250 000
1: 2 500 000
FLEUVE SAINT - LAURENT
Lac Saint-Jean
Rivière Saguenay
Port-Cartier
Godbout
Baie-Comeau
Forestville
Ste-Anne-des-Monts
Matane
Mont-Joli
Rimouski
Amqui
New-Richmond
Bonaventure
Gaspé
Percé
Matapédia
Alma
Chicoutimi
Tadoussac
Rivière-du-Loup
La Malbaie
Baie Saint-Paul
La Pocatière
Montmagny
QUÉBEC
72°
71°
70°
69°
68°
67°
66°
65°
64°
50°
49°
48°
47°

Figure 1

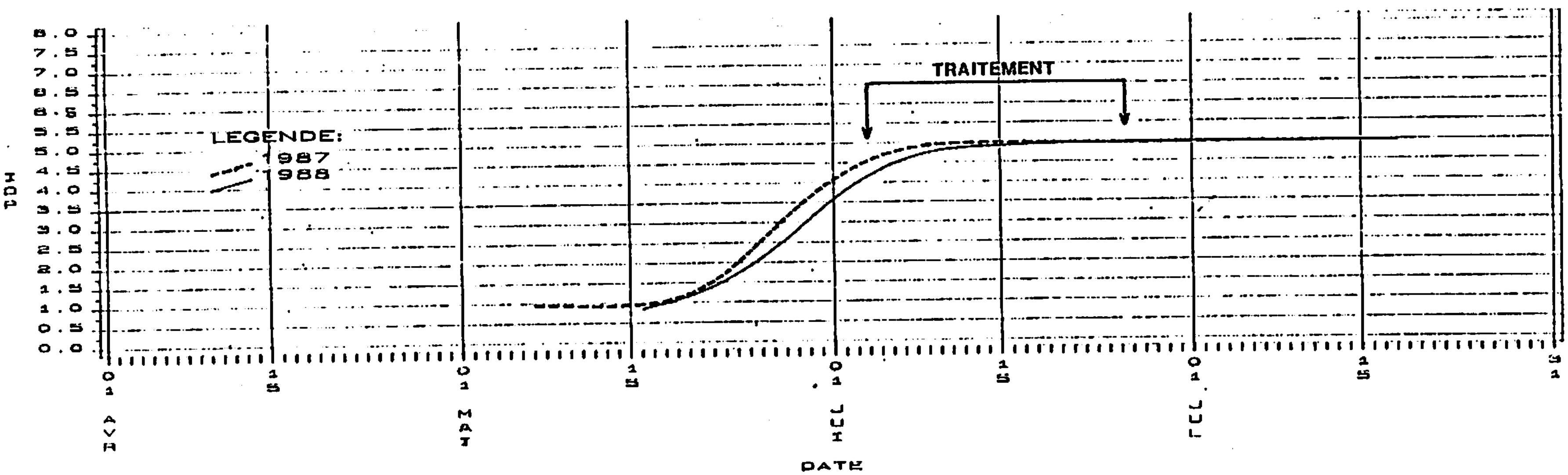
A total of 191 flights were made out of the Mont-Joli (34), lac Côté (82), Causapscal (21) and Murdochville (54) airports.

4. <u>Timing of treatment</u>

On average, May was warmer in 1988 than in the last few years, whereas the weather was markedly colder in the beginning of June. Despite the less favourable conditions which prevailed in the beginning of June, most of the territory (96.9 %) was treated when the fir annual shoot was well extended (shoot development indicator >4). Because of the cold, insect development was still at a very early stage at the time of spraying (Figure 2), with the result that 48 % of the territory was treated before the peak of the budworm's 4th instar. The larvae were thus small; their mobility was minimal and they ate very little. All of these factors reduced the chances of their being contaminated by droplets sprayed on the foliage (0.75 to 1.0 droplet/needle).

Nearly 80 % of the territory received an application of insecticide between the 3rd and 5th instar, and no treatment was carried out after the 6th one. (Table 1). It is very likely that a treatment carried out in the 5th and 6th instars would have produced a higher larval mortality while still protecting annual foliage.

INDICE DE LA POUSSE
DUNIERE (AVRIL A JUILLET)
1988—87



INDICE DE L INSECTE
DUNIERE (AVRIL A JUILLET)
1988—87

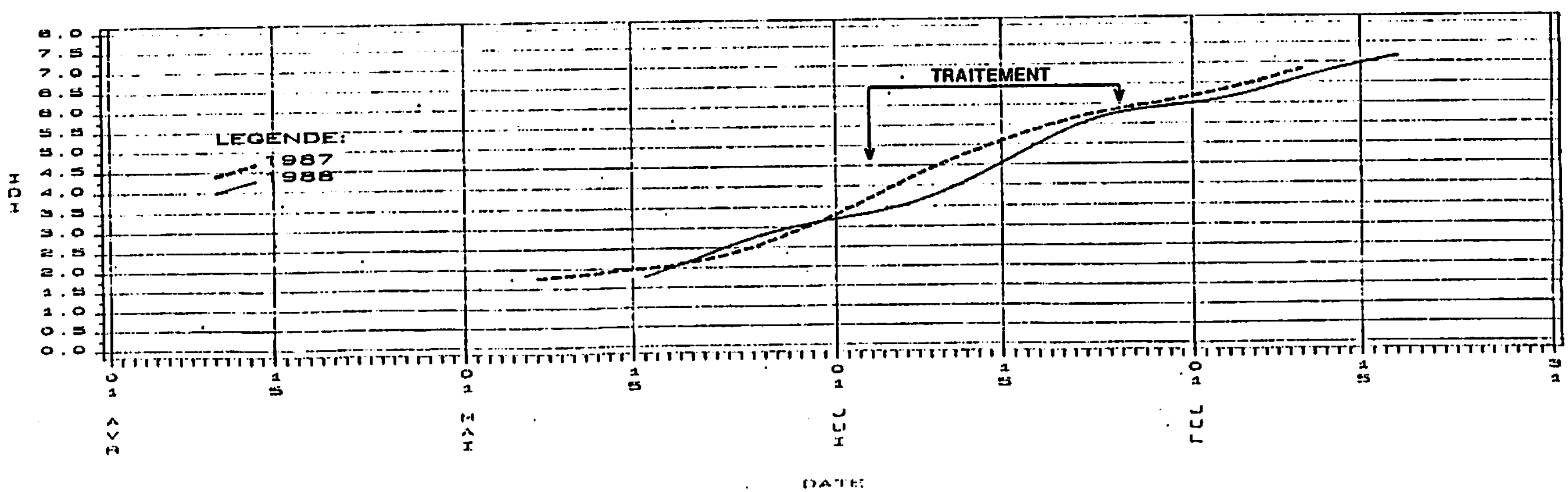


Figure 2

Table 1: Proportion of the territory treated in 1988 according to insect and fir annual shoot development

Indicator	Four-engine craft (113 232 ha)	Single-engine craft (78 841 ha)	Total
	Shoot development Percentage of the territory treated		
2.5 - 3.0			
3.1 - 3.5			
3.6 - 4.0	8.4	-	3.1
4.1 - 4.5	14.2	-	10.3
4.6 - 5.0	77.4	100	

Indicator	Four-engine craft (113 232 ha)	Single-engine craft (78 841 ha)	Total
	Insect development Percentage of the territory treated		
2.5 - 3.0	16.2	-	9.6
3.1 - 3.5	24.1	12.6	19.4
3.6 - 4.0	9.2	33.9	19.1
4.1 - 4.5	30.5	28.6	29.8
4.6 - 5.0	-	24.9	10.2
5.1 - 5.5	20.0	-	11.9
6.1 - 6.5	-	-	-

5. Results of treatment

- Larval populations

The average population in the sectors treated was evaluated at 15 larvae per 45-cm branch; the insect population was superior to 10 larvae per 45-cm branch in 55 % of the 222 sample plots (Figure 3).

Outside the treated areas, the larval population generally tended to be lower, with an average of 9.7 larvae per branch. Only 10 % of the sample plots were severely affected (>20 larvae), and 75 % of the sample plots had a population of less than 10 larvae per branch.

Table 2 shows the results according to three levels of larval populations. A total of 222 treated sample plots and 125 untreated plots were used to evaluate larval mortality and the protection afforded by the treatment.

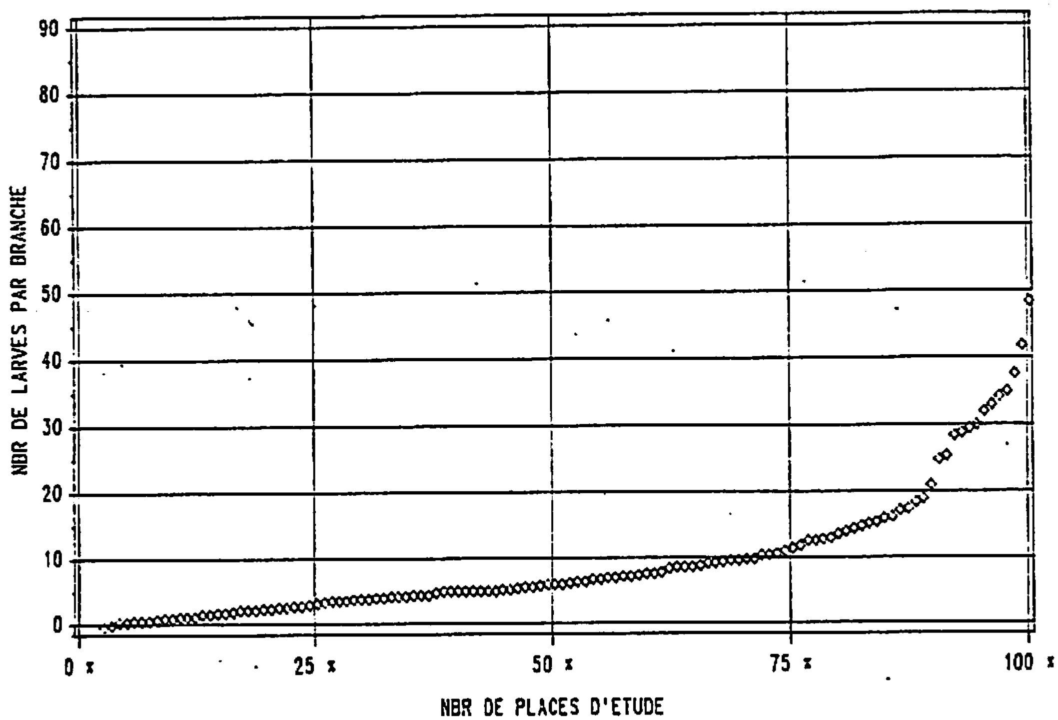
- Larval mortality

Total mortality in the treated sectors was 81 %, compared to a mortality rate of only 61 % outside the treated areas. This natural mortality rate is markedly lower than the average of 68 % obtained over the past 17 years.

Figure 3

DISTRIBUTION DES POPULATIONS LARVAIRES.

SECTEURS NON TRAITES EN 1988



DISTRIBUTION DES POPULATIONS LARVAIRES

SECTEURS TRAITES EN 1988

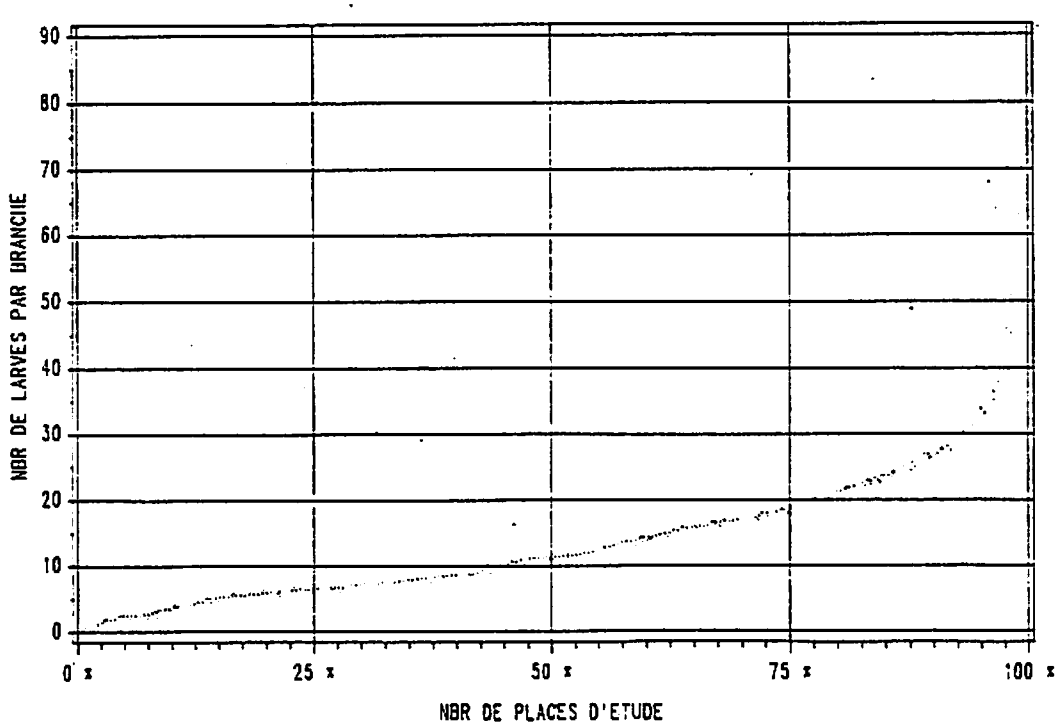


Tableau 2: Efficacité des pulvérisations d'insecticide contre la tordeuse des bourgeons de l'épinette, *Choristoneura fumiferana (Clem.)* en fonction des populations larvaires.

Niveau d'infestation	Nb PE	Pop. pré-trait. Lar./br.	Pop. pré-trait. Lar./brg.	Pop. post Lar./br.	Mort. (%)	Défoliation Obs.	Défoliation Prév.	Abbott*	Protection (1)	Protection (2)
Faible (0-10 l/br)	95	0.09	6.1	1.8	70	26	40	32	14	35
Moyen (11-20 l/br)	75	0.22	14.7	3.2	78	50	77	46	27	35
Elevé (21 et + l/br)	52	0.33	31.7	4.4	86	71	88	59	17	19
Total	222	0.19	15.0	2.9	81	45	65	51	20	31

* $\frac{\text{Survie Témoins - Survie Traitées}}{\text{Survie témoin}} \times 100$

(1) Défoliation prévue - défoliation observée

(2) $\frac{\text{Défoliation prévue - défoliation observée}}{\text{défoliation prévue}} \times 100$

- Defoliation and foliage protection

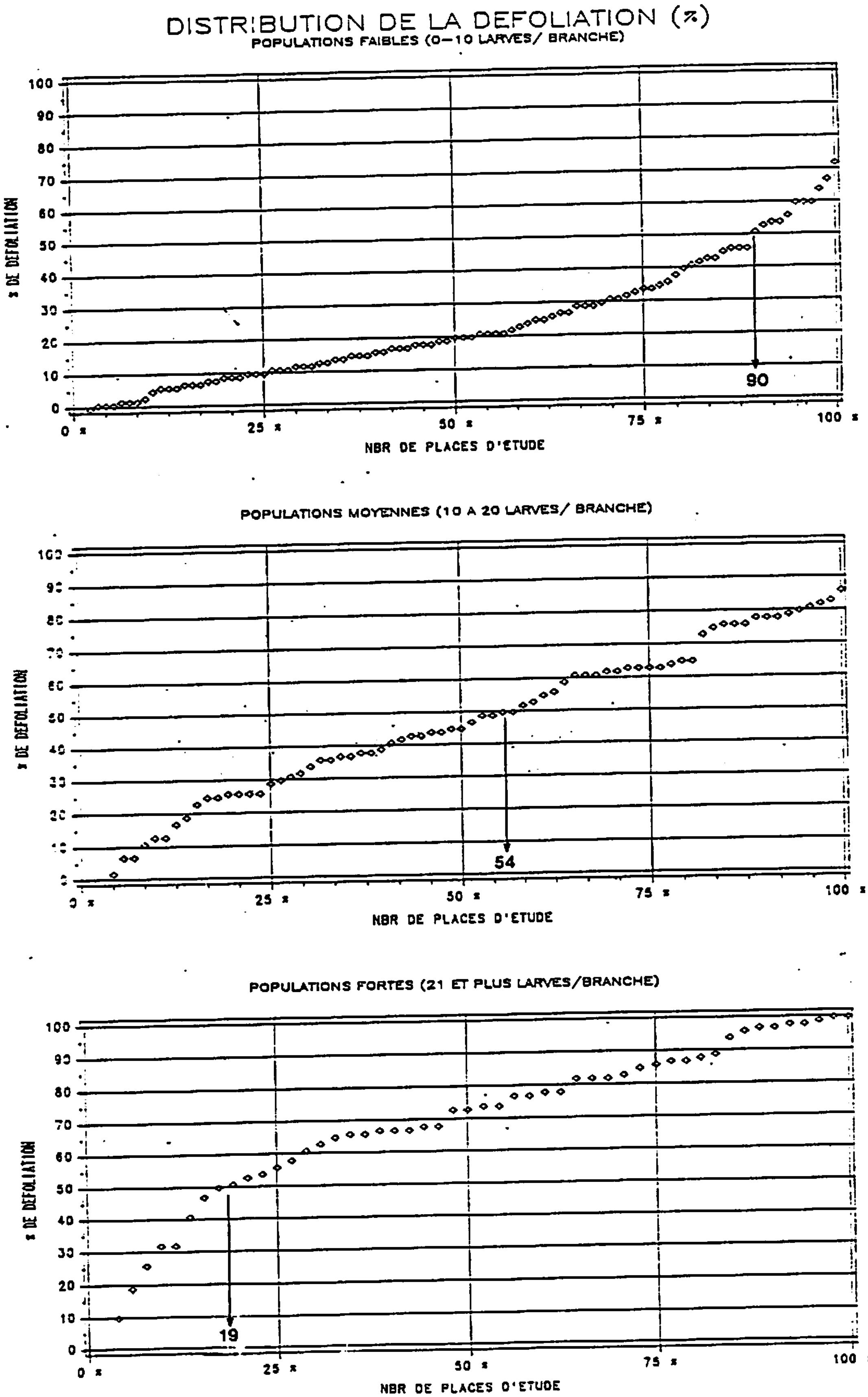
Average defoliation was 45 % in the treated sectors, compared to 65 % in the untreated sample plots. Treatment made it possible to protect 35% of the annual foliage in stands where populations were low to high, and 19 % in severely infested stands (Table 2). Annual defoliation was less than 50 % in 61 % of the plots sampled in 1988, compared to 1986 and 1986 when the percentages were 75 % and 70 % respectively.

In sample plots only lightly infested by budworm (<10 larvae), defoliation was 26 %, and 90 % of the sample plots showed a defoliation rate of less than 50 %. The average defoliation was 50 % in the sample plots where populations were between 10 and 20 larvae per branch, compared to defoliation rates of less than 50 % in 54 % of the plots evaluated. The highly infested sectors (>20 larvae) showed an average defoliation of 71 %, and only 15 % of the sample plots showed a defoliation rate of less than 50 % (Figure 4).

The most severely affected sectors, that is about 23 % of the territory treated, were severely defoliated, and only 19 % of the foliage was successfully protected.

The high larval populations recorded in these sectors (31.7 larvae/branch) show that the application of biological insecticide was insufficient to effectively reduce larval populations and prevent a high rate of defoliation.

Figure 4



DISTRIBUTION DE LA DEFOLIATION (%)
POPULATIONS FAIBLES (0–10 LARVES/ BRANCHE)
% DE DEFOLIATION
NBR DE PLACES D'ETUDE
90
POPULATIONS MOYENNES (10 A 20 LARVES/ BRANCHE)
% DE DEFOLIATION
NBR DE PLACES D'ETUDE
54
POPULATIONS FORTES (21 ET PLUS LARVES/BRANCHE)
% DE DEFOLIATION
NBR DE PLACES D'ETUDE
19

- Aerial survey

Aerial survey of the damage has revealed severe defoliation on 14 % of the territory treated, compared to 65 % of the territory that was only slightly or not at all defoliated (Table 3).

- Impact on hibernating populations (L2)

Despite the low rate of foliage protection provided by the treatment in certain severely infested areas, spraying activities had a very appreciable impact on larval populations.

Indeed, only 25 % of the sample plots treated in 1988 will show an increase in larval populations in 1989, whereas 58 % of the untreated plots will show such an increase. This contrast was even more pronounced last year when increases of 10 % and 51 % were expected for this year in treated and untreated sample plots respectively.

Because of the decline in larval populations registered in the sectors treated in 1988, certain sectors will be removed from the 1989 spraying program. These sectors will undoubtedly be easier to protect thanks to the anticipated reductions in larval populations.

TABLEAU 3 : Superficies (hectares) affectées par la tordeuse des bourgeons de l'épinette, <u>Choristoneura fumiferana</u> (Clem.) dans les secteurs traités en 1988.

U.G.	Nul	Léger	Modéré	Sévère	Total
12	193	58 859	13 605	9 716	82 373
13	1 127	31 430	15 124	12 516	60 197
14	-	1 521	314	-	1 835
15	269	32 213	12 116	3 070	47 668
Total	1 589	124 023	41 159	25 302	192 075
	1%	65%	21%	13%	

- Conclusions

The aerial spraying of biological insectide produced good results in 1988 although they were slightly less satisfactory than in previous years. In sectors where larval populations were high (>20 larvae), the treatment was unsuccessful in maintaining 50 % of annual foliage, and adjustments will be required to improve these results. Increased volume and/or dosage and a second application of insecticide are the measures considered for the severely infested sectors next year.

6. State of the epidemic in 1988

The spruce budworm infestation continued to recede in 1988 in the center of Québec and in the Côte-Nord region. An upsurge in larval populations was observed in the Bas-Saint-Laurent - Gaspésie region, and heavy damage was recorded in the center of the Gaspé Peninsula.

In the other regions of Québec, the budworm populations have persisted at an endemic level. The infestation covered an area of 0.70 million hectares in 1988, compared to 1.04 million hectares in 1987, that is a reduction of 33 % in the territory infested (Figure 5). On the other hand, in the Bas-Saint-Laurent - Gaspésie region, the infested area increased by 5 % and it totaled 594 552 ha in 1988 (Table 4).

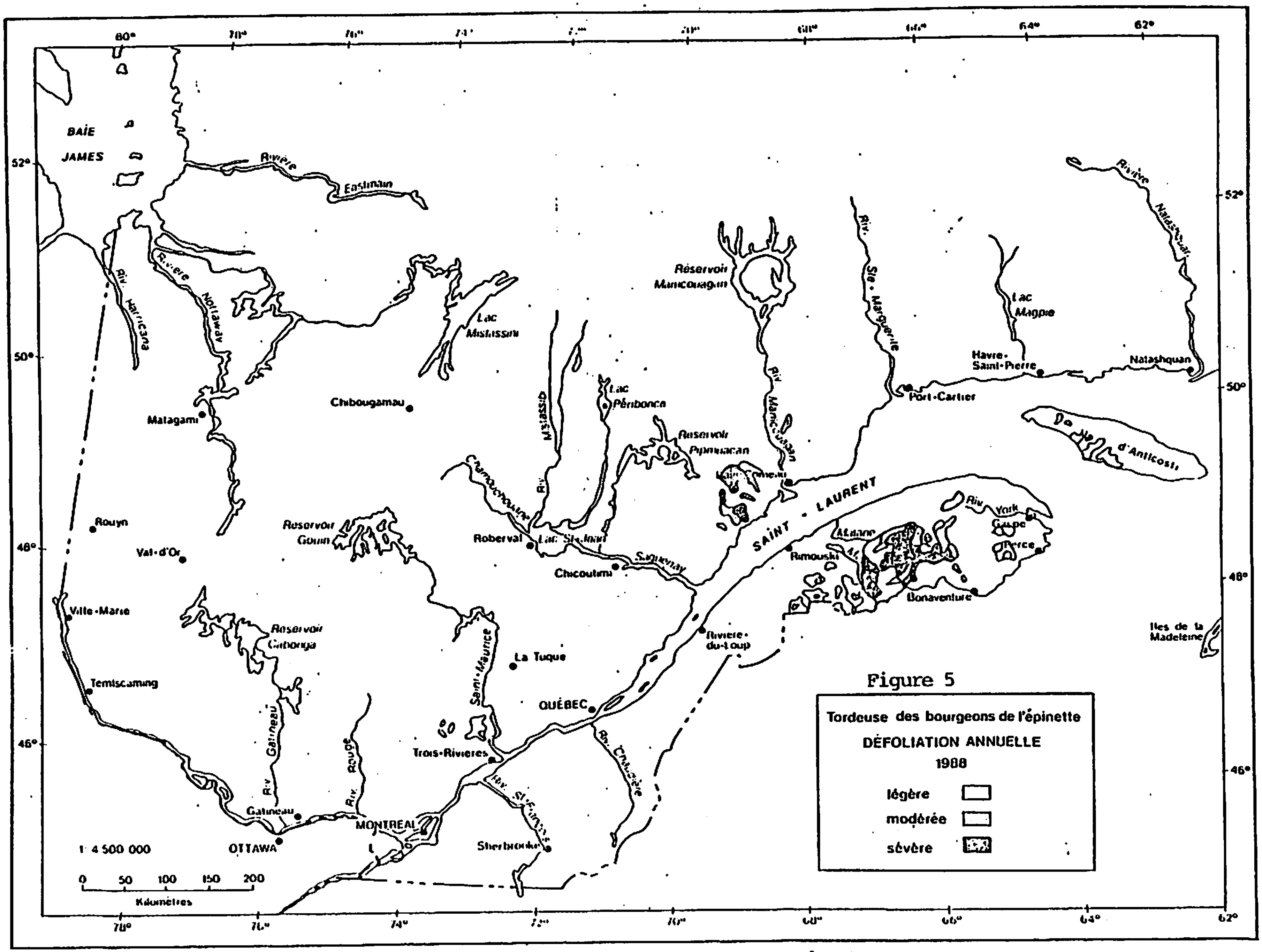

BAIE JAMES
Rivière Eastmain
Rivière Nottaway
Riv. Harricana
Lac Mistassini
Chibougamau
Matagami
Rouyn
Val-d'Or
Ville-Marie
Temiscaming
Réservoir Gouin
Réservoir Cabonga
Riv. Gatineau
Riv. Rouge
Gatineau
OTTAWA
MONTREAL
Saint-Maurice
La Tuque
Trois-Rivières
QUÉBEC
Sherbrooke
Riv. Chaudière
Riv. St-François
Roberval
Lac St-Jean
Chicoutimi
Saguenay
Riv. Mistassini
Lac Péribonca
Réservoir Pipmuacan
Réservoir Manicouagan
Riv. Manicouagan
Riv. Ste-Marguerite
Lac Magpie
Havre-Saint-Pierre
Port-Cartier
Natashquan
Rivière Natashquan
Île d'Anticosti
SAINT-LAURENT
Rivière-du-Loup
Rimouski
Matane
Riv. York
Gaspé
Percé
Bonaventure
Iles de la Madeleine
1: 4 500 000
0 50 100 150 200
Kilomètres
Tordeuse des bourgeons de l'épinette
DÉFOLIATION ANNUELLE
1988
légère
modérée
sévère

Figure 5

Table 4: Areas infested by the budworm from 1982 to 1988

Year	Québec (millions of hectares)	Gaspésie (millions of hectares)
1988	0.70	0.59
1987	1.04	0.56
1986	2.83	0.69
1985	9.26	1.55
1984	11.04	2.84
1983	13.21	4.06
1982	9.85	4.01

7. Outlook for 1989

Surveying of larval budworm populations in hibernation has been intensified in forest stands selected for their productive potential in order to predict the infestation level for the coming year.

Outside of these stands, extensive sampling has made it possible to determine the area that will be infested in 1989.

The epidemic should continue to recede in 1989, outside the Bas-Saint-Laurent - Gaspésie region. Larval populations will be on the rise in the central and southern parts of the Gaspé Peninsula, where damage is expected to be severe. Severe damage is also expected in very limited areas in the Côte-Nord and Trois-Rivières regions.

A total area of 175 000 ha will be treated in 1989. A second application of insecticide is planned on a 45 000 ha area to combat the very heavy larval populations expected in those sectors.

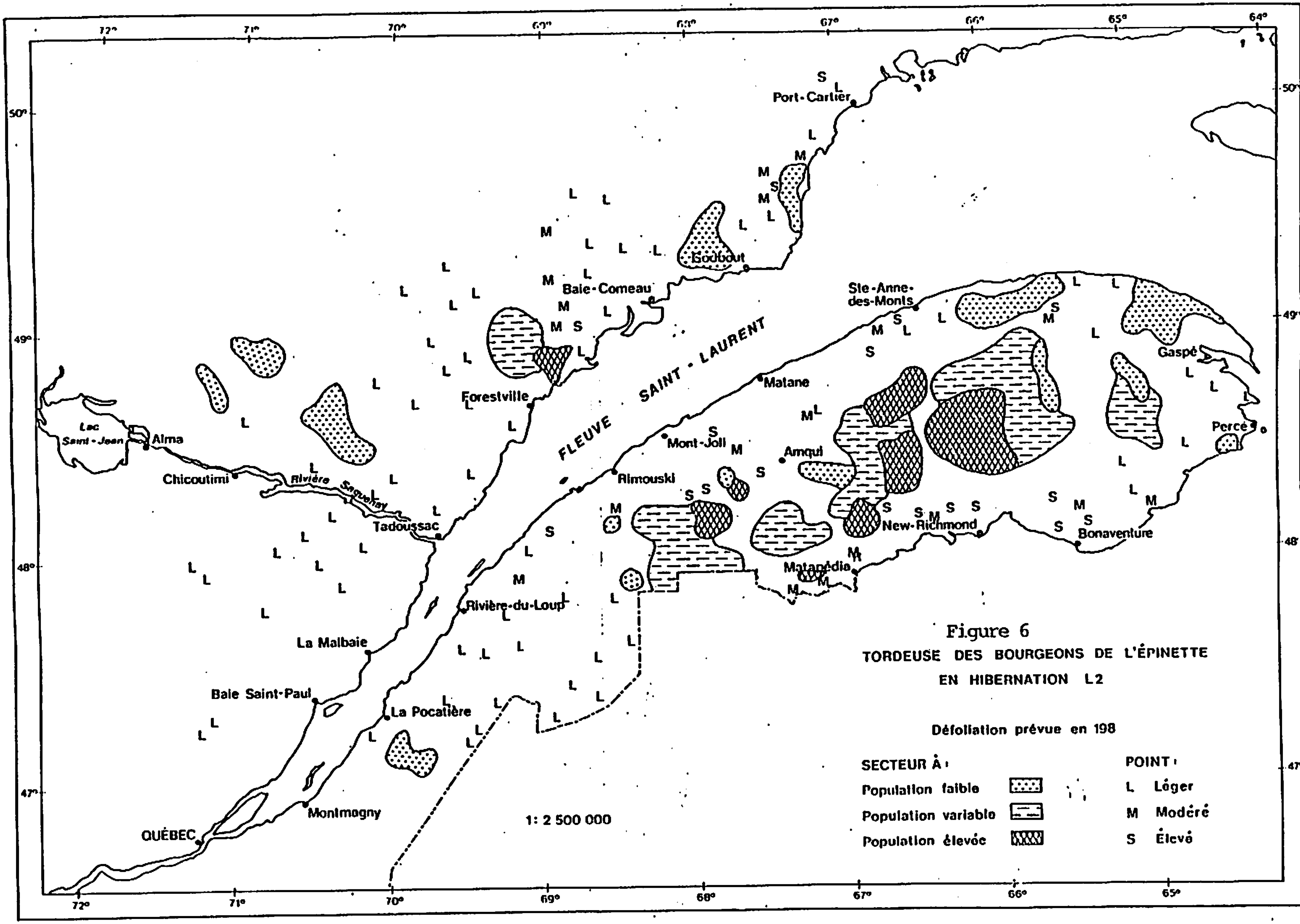


Figure 6
TORDEUSE DES BOURGEONS DE L'ÉPINETTE EN HIBERNATION L2

A FOURTH YEAR OF TREATMENT WITH BACILLUS THURINGIENSIS AGAINST SPRUCE BUDWORM ON PRIVATE WOODLOTS IN EASTERN QUEBEC

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OTTAWA, NOVEMBER 15-17, 1988

PRESENTED AT THE SIXTEENTH ANNUAL INSECT

PEST CONTROL FORUM

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INTRODUCTION

In 1988, within the framework of the Forestry Program of the Eastern Quebec Development Plan, the Canadian Forestry Service sponsored its fourth program of spraying with Bacillus thuringiensis to control spruce budworm in private woodlots. The program was carried out by the wood producer associations of La Pocatière, the Lower St.Lawrence and the Gaspé regions. Some 16 000 ha of forest were treated in 1988, most of them in areas where tree mortality had started, making the protection program essential to the managment of these woodlots.

The present paper summarizes the results of the 1988 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.

Insecticides

Bacillus thuringiensis preparation Futura FC® and XLV® from Chemagro Limited, Mississauga, Ontario.

Dosage, 2.5 litres/ha:

1.5 L Futura®
1.0 L water
1.56 mL Chevron sticker®

Aircraft

Three AgCat®, 600 H.P., supplied by Les Arrosages aériens du Saguenay Lac-St-Jean, Limitée, Shipshaw, Quebec.

Mix plants

Two mobile units set up by the wood producer associations.

Spray system

Boom and 25 nozzles (Teejet Flat Fan 8004).

Navigation system

Helium-inflated balloons were used where road access was available. Otherwise, a Hughes 500-C® helicopter was used.

RESULTS

TREATED AREA

Between June 3 and 16, 1988, 15 991 ha were treated, which involved 288 private woodlot owners. Ten blocks, ranging from 250 to 4 100 ha in area, were sprayed; with 13 226 ha being in the Lower St.Lawrence region and 2 765 ha in the Gaspé peninsula.

Deposit

Petri dishes containing nutrient agar medium placed at every 30 m on lines perpendicular to flight paths were used to determine deposit in terms of number of droplets/cm^2, which corresponds to the number of colonies/cm^2. During an operation, the target was a minimum of 6 colonies/cm^2 throughout the sprayed territory. Deposit assessment was done on 4 blocks (128-6, 128-7, 128-8, 129-1) and the minimum deposit was obtained each time.

Larval mortality

Pretreatment populations were particularly important in the southern part of the Matapedia River Valley (blocks S 128-8, 129-1 and 129-3), reaching 34.0 larvae/45 cm branch tip in treated blocks and 40.2 larvae/45cm in untreated area (table 2). Intermediate larval mortality (15 days after treatment) was 60.0 % in the lower St.Lawrence and 77.0 % in the Gaspe region.

Current year growth defoliation

In the Lower St.Lawrence region, current year growth defoliation was 25.0% in treated plots and 40.0 % in untreated ones. The same values were 10.0 and 39.0% in the Gaspe region (Table 1).

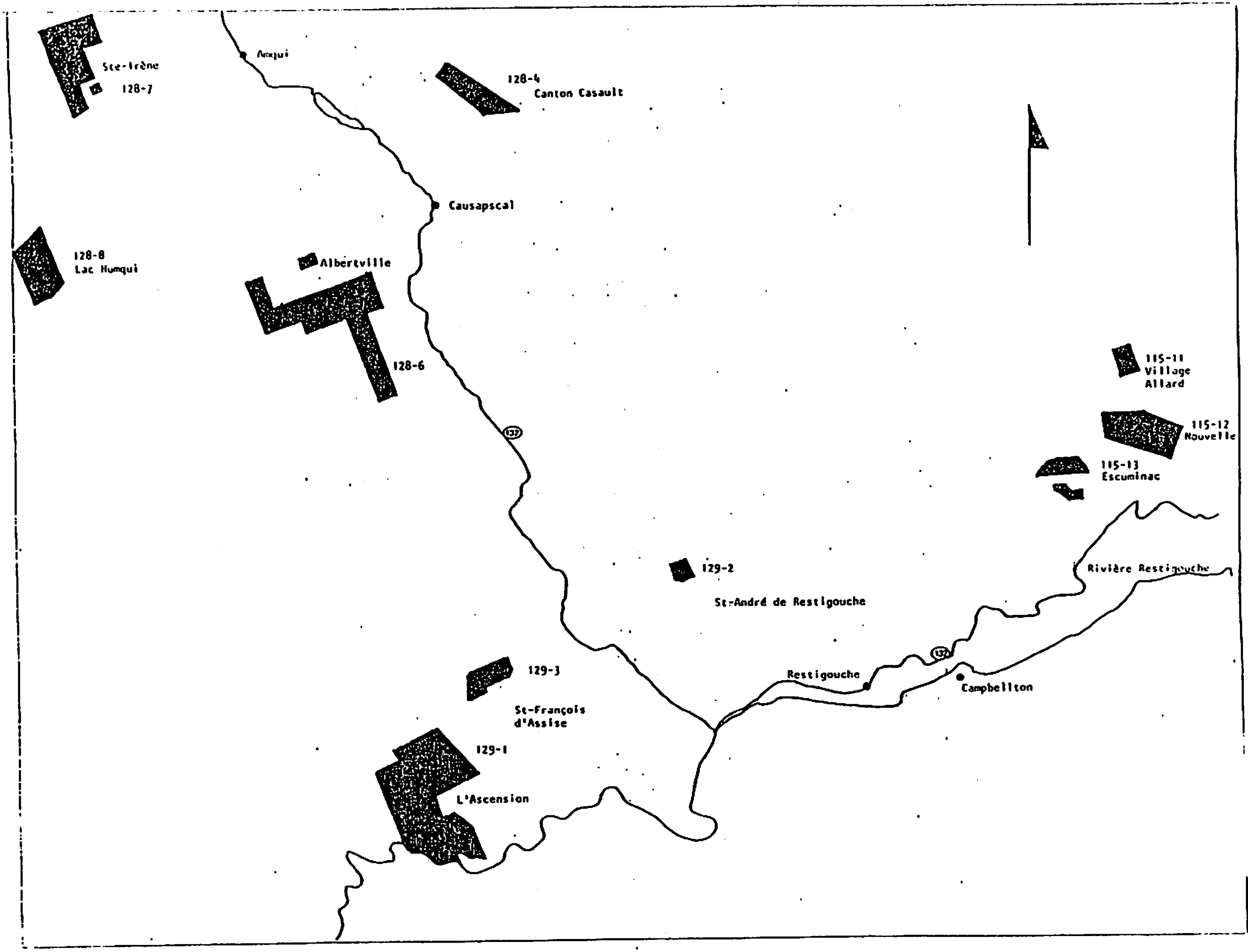


FIGURE 1: Localization of treated blocks - 1988.

TREATMENT PROGRAM WITH B.T. ON PRIVATE WOODLOTS IN EASTERN QUEBEC - 1988

TABLE 1. LARVAL MORTALITY, TREATMENT EFFICIENCY AND DEFOLIATION

BLOCK NO	SAMPLING PLOT	PRETREATMENT POPULATION larvae/branch	INTERMEDIATE POPULATION larvae/branch	INTERMEDIATE POPULATION Mortality (%)	INTERMEDIATE POPULATION Efficiency (%)	RESIDUAL POPULATION larvae/branch	RESIDUAL POPULATION Mortality (%)	DEFOLIATION[1] 1988 (%)
GASPE PENINSULA								
115-11	1	13.4	6.2	53.7	52.1	3.6	73.1	22.2
Village Allard	T1	24.2	23.4	3.3		8.6	64.5	57.9
152-12	1	18.6	2.6	86.0	66.1	0.8	95.7	8.2
Nouvelle	2	12.4	1.4	88.7	72.6	1.6	87.1	6.3
	3	14.4	3.6	75.0	39.5	0.2	98.6	4.6
	T1	10.6	4.8	54.7	-	2.2	79.2	21.5
	T2	18.2	6.8	62.6	-	2.8	84.6	33.4
115-13	1	12.2	2.4	80.3	61,5	0.2	98.3	10.7
Escuminac-Glen	T1	16.0	8.2	48.7	-	3.0	81.3	42.0
LOWER ST-LAWRENCE								
128-4	1	5.0	1.2	76.0	47.8	0.8	84.0	4.2
Zec Casault	2	6.8	3.2	52.9	-	0.8	88.2	6.6
	T1	4.8	2.2	54.0	-	1.0	79.1	12.8
128-6[2]	1	16.0	7.4	53.7	35.2	1.8	88.7	26.3
Albertville	2	29.6	15.2	48.6	28.1	5.6	81.1	63.6
	3	17.8	5.2	70.7	59.0	0.6	96.6	14.4
	T1	13.4	9.6	28.4	-	2.6	80.5	58.6
	T2	8.4	6.0	28.5	-	1.2	85.7	29.3

1 According to the method of FETTES (1950)

TABLE 1 (continued)

BLOCK NO	SAMPLING PLOT	PRETREATMENT POPULATION larvae/branch	INTERMEDIATE POPULATION larvae/branch	INTERMEDIATE POPULATION Mortality (%)	INTERMEDIATE POPULATION Efficiency (%)	RESIDUAL POPULATION larvae/branch	RESIDUAL POPULATION Mortality (%)	DEFOLIATION[1] 1988 (%)
128-7 Ste-Irène	1	21.2	10.8	49.1	28.8	6.8	67.9	59.1
	2	11.8	2.2	81.3	73.8	1.6	86.4	19.4
	T1	13.4	9.6	28.4	-	2.6	80.5	58.6
	T2	8.4	6.0	28.5	-	1.2	85.7	29.3
128-8 Lac Humqui	1	29.4	9.4	68.0	55.2	4.2	85.7	54.2
	2	34.0	17.0	50.0	30.1	2.6	92.3	34.7
	T1	13.4	9.6	28.4	-	2.6	80.5	58.6
	T2	8.4	6.0	28.5	-	1.2	85.7	29.3
129-1 Ascension	1	13.8	8.2	40.5	7.7	5.0	63.7	16.1
	2	28.4	3.0	89.4	83.5	0.0	100.0	8.1
	3	17.4	7.2	58.6	35.8	3.6	79.3	8.9
	4	14.8	3.8	74.3	60.1	1.8	87.8	7.2
	T1	36.0	17.4	51.7	-	9.4	73.9	63.4
	T2	40.2	32.4	19.4	-	12.0	70.1	63.0
129-2 St-André	1	8.6	4.4	48.8	-	1.2	86.0	15.3
	T1	3.6	4.0	-	-	3.8	-	14.0
129-3[2] St-François	1	26.6	17.4	34.5	46.5	8.0	69.9	33.0
	2	11.6	4.6	60.3	6.5	1.4	87.9	21.9
	T1	36.0	17.4	51.7	-	9.4	73.9	63.4
	T2	40.2	32.4	19.4	-	12.0	70.1	63.0

1 According to the method of FETTES (1950)

2 This block is compared to the untreated plots of blocks 128-7 and 128-8

INFORMATION ON PROGRAM COSTS

Table 2 summarizes the costs for each wood producer association with total costs. Insecticide and aircraft cost 270 270 $ or 51.1% of the total cost. The particular character of the private woodlots generated social costs of 23 230 $ or 4.4% of the total expense. Biological assessment was 62 990 $ or 11.7% of the cost. Finally, the Canadian Forestry Service contributed 38 000 $ which include a portion of the salary of the technical advisor attributed to the program, his travelling expenses and the communication program.

CONCLUSION

The above reported results confirm the necessity of treating 15 991 ha in 1988 on the private woodlots within the responsability of the Eastern Quebec Development Plan. Foliage protection was satisfactory, most of the defoliation values were lower than 33%. The difference between larval mortality in treated and untreated plots was significative, particularly where pretreatment populations were high. The operation was carried out as part of the forest management activities supported by the Forestry Program of the Easten Quebec Development Plan and was most useful and successful.

TABLE 2. COSTS ANALYSIS OF THE TREATMENT PROGRAM WITH B.T. ON PRIVATE WOODLOTS IN EASTERN QUEBEC - 1988

TREATED AREA	OPB LA POCATIÈRE Costs $	BAS ST-LAURENT Costs $	SPB GASPÉSIE Costs $	TOTAL COST $	COST REPARTITION %	COST/ TREATED HA (15 991 ha)
Social costs						
- information, recruting and request for authorization	-	18 870	4 360	23 230	4.4	1.45
- printing and distribution of the final reports	11 580	3 270	3 270	18 120	3.4	1.13
SUB-TOTAL	11 580	22 140	7 630	41 350	7.8	2.59
Treatment costs						
- aircraft	-	104 080	22 940	127 020	24.0	7.94
- product	-	113 710	29 540	143 250	27.1	8.96
- calibration, navigation, mix plant, mobile radio	-	85 050	29 480	114 530	21.7	7.16
SUB-TOTAL	-	302 840	81 960	384 800	75.8	24.06
Biological assessment and advice						
- pretreatment	-	9 440	3 700	13 140	2.4	0.82
- post-treatment	-	15 830	6 680	22 520	4.2	1.41
- laboratory	27 330	-	-	27 330	5.1	1.71
SUB-TOTAL	27 330	25 270	10 390	62 990	11.7	3.94
TOTAL	38 910	350 250	99 980	489 140	92.3	30.59
Internal costs CFS Forestry section Inform. Communication				38 000	7.7	2.37
GRAND TOTAL				527 140	100.0	32.96

THE STATUS OF THE SPRUCE BUDWORM IN MAINE - 1988 AND FORECAST - 1989

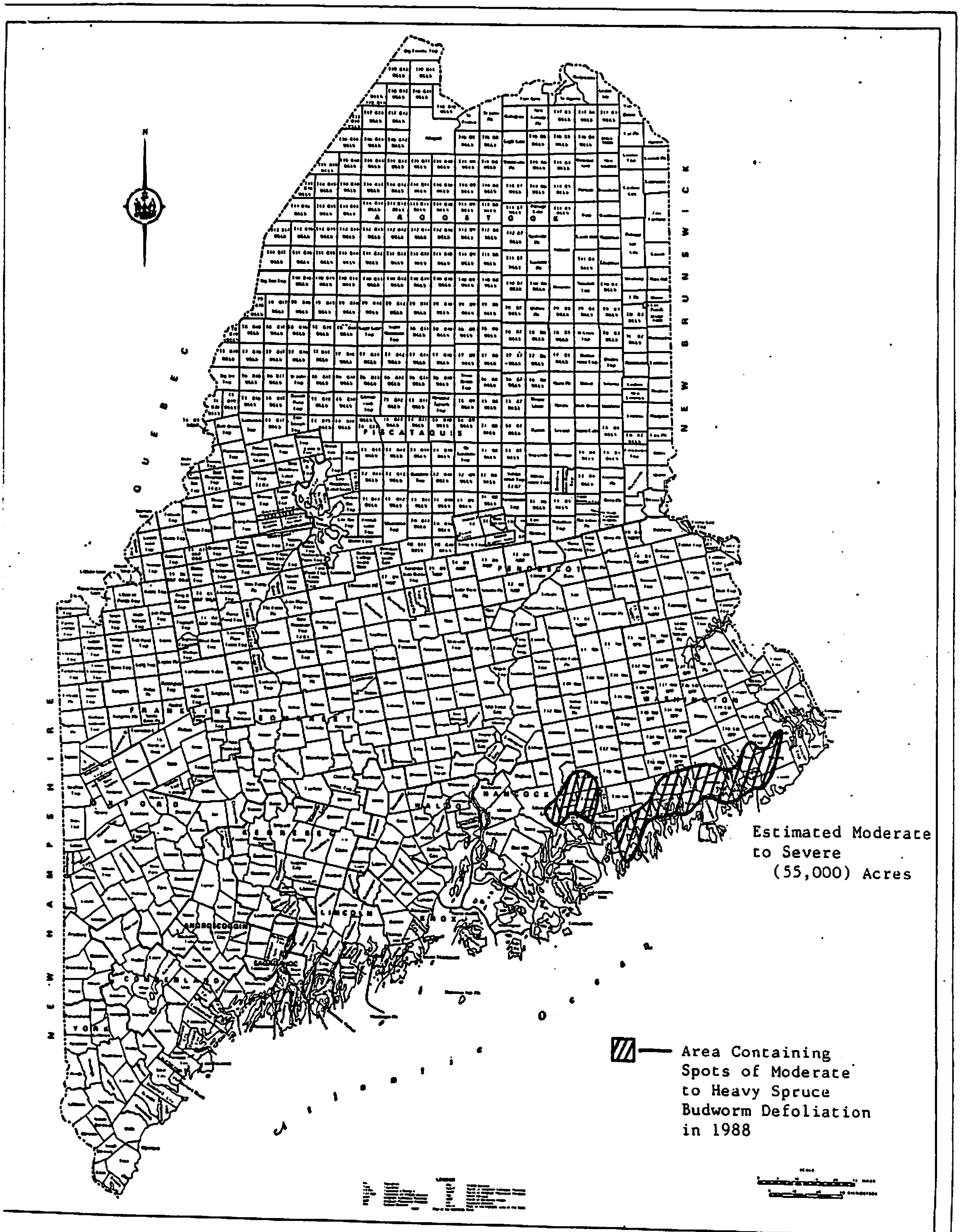
HENRY TRIAL, JR. - MAINE FOREST SERVICE

The spruce budworm infestation in Maine remained at a very low level in 1988. The Insect and Disease Management staff of the Maine Forest Service looked for areas on budworm activity throughout the State as part of the normal Forest Insect Survey. The only populations found were in the Southeast (Hancock and Washington Counties), as had been the case in 1987. An aerial survey conducted in July confirmed the larval findings. The area containing light, moderate, or severe defoliation is shown in Figure 1. Within this area, the MFS estimates there is 55,000 acres of moderate to severe defoliation and an additional 10,000 acres had light damage. Damage throughout the mapped area was extremely spotty.

A pheromone moth trapping survey was conducted throughout the spruce-fir region of the State with approximately 250 locations trapped. The effectiveness of this survey is in doubt because high numbers of moths were not trapped in heavily defoliated areas, even though much moth activity was observed near the traps. Moth counts are not complete, but no moths were caught in the North, West, or Central portions of the survey area. Many traps in Hancock and Washington Counties caught moths, but count were very low.

Scattered spruce mortality continues to occur in heavily defoliated portions of Hancock and Washington Counties. Losses directly attributable to budworm defoliation have ceased in Northern, Western, and Central Maine, however, losses due to secondary or associated factors such as spruce beetle and Stillwell's Syndrome continue.

Based on 1988 defoliation and pheromone trap catches the MFS predicts low population again in 1989. Defoliation in 1989 should be confined to the southeast and should be of similar magnitude to the 1988 area. A significant reduction in area or intensity would not be surprising in view of the steady decline of budworm in Maine.



Q U E B E C
N E W B R U N S W I C K
N E W H A M P S H I R E
A R O O S T O O K
P I S C A T A Q U I S
P E N O B S C O T
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W A L D O
H A N C O C K
A N D R O S C O G G I N
L I N C O L N
K N O X
C U M B E R L A N D
Y O R K
Estimated Moderate to Severe (55,000) Acres
Area Containing Spots of Moderate to Heavy Spruce Budworm Defoliation in 1988

SPRUCE BUDWORMS CONDITIONS IN THE UNITED STATES
1988

EASTERN SPRUCE BUDWORM

LAKE STATES

Eastern spruce budworm populations continued to decline throughout the Lake States for the third consecutive year. Michigan and Wisconsin reported no defoliation while Minnesota reported 80,740 ha, or a 53 percent decrease from defoliation reported in 1987. Defoliation continued to be heaviest in Cook and Lake counties and in northeastern St. Louis County. A summer drought in Wisconsin and Minnesota resulted in a heavy loss of seedlings planted this past spring. Survival of trees planted this spring was 10 to 30 percent in many areas of Wisconsin. Because of dry weather, the number of acres burned increased significantly.

NORTHEAST

Extremely low spruce budworm populations continued throughout the Northeastern States in 1988 and predictions for 1989 indicate continued decline. No defoliation was observed in New Hampshire, New York, and Vermont. In Maine, a total of 26,305 ha of defoliation was reported in 1988 (4,047 ha of light, 22,258 ha of moderate to severe). This is the lowest defoliation since the late 1950's. Pheromone trap catches were low to very low in all the New England States.

No suppression was conducted in the Northeast in 1988 and none is planned for 1989.

WESTERN SPRUCE BUDWORM

REGION 1 (Northern Region)

Regionwide western spruce budworm defoliation increased from 757,400 ha in 1987 to over 817,000 ha in 1988. Due to the record forest fire season, it was not possible to make a complete aerial survey. For example, infested stands on both the Gallatin National Forest and Yellowstone National Park were burned but not surveyed. Other areas were surveyed but often under smoky conditions. For this reason, actual defoliation could well have been over 900,000 ha in 1988.

Presented by Daniel R. Kucera, Staff Assistant, Northeastern Area, State and Private Forestry, USDA Forest Service, Broomall, Pennsylvania, at the Sixteenth Annual Forest Pest Control Forum, Ottawa, Ontario, November 15-17, 1988.

The budworm outbreak in northern Idaho continues to increase. Defoliation on the Nez Perce is now over 7,570 ha. If the trend of recent years continues, this outbreak may reach the 540,000 ha level of the early 1970's. In Montana, defoliation increased by over 155,000 ha to 649,800 ha on the Deerlodge, Helena, and Lewis and Clark National Forests and from 25,000 ha in the Garnet Mountains in 1987 to 36,500 ha in 1988. The only decrease in 1988 occurred on the Beaverhead and Custer Forests east of the Continental Divide,the Bitterroot and Lolo National Forests, and on the Flathead Indian Reservation.

In 1988, no control operations were conducted with the exception of Acephate implants in two Seed Production Areas on the Gallatin and Helena National Forests. Excellent cone harvests were made in these orchards.

For 1989, budworm outbreaks are expected to continue to increase in the Northern Region because of the record dry summer in 1988. Defoliation could reach over a million ha next year.

REGION 2 (Rocky Mountain Region)

Western spruce budworms population declined for the fifth consecutive year in Colorado and Wyoming. An estimated 4,856 ha were visibly defoliated. Defoliation along the Front Range is highly scattered and in small pockets of the light defoliation category.

Most of the visible defoliation in 1988 occurred on the Dolores District of the San Juan National Forest in Colorado. Concerned landowners in the area were advised that treatment was not necessary because of the level of egg masses detected in the area. However, Douglas-fir beetle activity continues to cause mortality in stands that were defoliated in previous years. Because of the steep terrain found in the area, little salvage is being done.

No treatment is being planned for 1989.

REGION 3 (Southwestern Region)

Defoliation was detected on 195,704 ha of National Forest, other Federal and State and private lands in 1988, which is up from 120,000 ha in 1987. Moderate to severe defoliation was detected on 101,985 ha and light defoliation on 89,766 ha. Most of the defoliation occurred on the Carson and Lincoln National Forests and on State and private lands.

No suppression projects were conducted in 1988, however, 14 campgrounds were treated with _B.t._ The major objective of treatment was to maintain the visual or scenic quality of the campground trees.

REGION 4 (Intermountain Region)

Populations collapsed throughout the region in 1988 resulting in the lowest levels of defoliation since aerial surveys were initiated in 1952. Conifers on approximately 17,119 ha were visibly defoliated compared to 353,560 ha in 1987. Defoliation was observed on the Boise, Challis, Salmon, Sawtooth, and Targhee National Forests.

Although current western spruce budworm activity is low, the effects of pest defoliation is apparent throughout areas which sustained long periods of heavy defoliation. Douglas and true firs weakened by past defoliation and three years of below normal precipitation continue to die on the Boise, Sawtooth, Caribou, and Wasatch-Cache National Forests.

REGION 5 (Pacific Southwest Region)

Choristoneura retiniana, the Modoc budworm defoliated approximately 8,000 ha in 1988. Since 1985, this outbreak has remained at endemic levels. Defoliation continues to be light to moderate. No tree mortality was reported in 1988 and no suppression is anticipated for 1989.

REGION 6 (Pacific Northwest Region)

In 1986, western spruce budworm reached its peak in this Region, when almost 2.5 million ha (6 million acres) were defoliated in north central and northeastern Oregon, and parts of Washington State. Since then, the area decreased to 1.75 million ha (4.2 million acres) in 1987, and to approximately 1.18 million ha (2.8 million acres) in 1988.

One of the largest suppression projects in this Region was conducted in 1988, when 242,118 ha were treated with a total of 288,500 gals. (U.S.) of *B.t.* The objective of the project was to reduce the budworm populations to less than one larva per 45 cm. branch tip. This target was achieved on all but one of the treated units. This is the largest project using a biological insecticide.

REGION 10 (Alaska Region)

Budworm activity was minimal in 1988. No defoliation was detected during this year's aerial surveys. Results of the cooperative Canadian-USDA Forest Service pheromone trapping studies indicate the following:

1) In southeastern Alaska's Sitka spruce forests, both *C. biennis* and *C. orae* were trapped.

2) In south-central Alaska on white and Lutz spruce , *C. orae* is the only species present.

3) In the interior of Alaska on white spruce stands, *C. orae* and probably *C. fumiferana* are present.

For 1989, budworm activity is expected to increase in south-central Alaska.

ESTIMATED DEFOLIATION BY SPRUCE BUDWORMS
IN 1987 AND 1988

REGION/STATE	AREA DEFOLIATED 1987	AREA DEFOLIATED 1988
Eastern Spruce Budworm		
Lake States		
Michigan	0	0
Minnesota	174,018	80,940
Wisconsin	0	0
Northeast		
New Hampshire	0	0
New York	0	0
Maine	101,173	26,305
Vermont	0	0
Subtotal	275,191	107,245
Western Spruce Budworm		
R-1	757,400	817,000
R-2	343,181	4,856
R-3	120,200	195,704
R-4	353,560	17,119
R-5	10,000	8,000
R-6	2,225,800	1,118,000
R-10	486	0
Subtotal	3,810,627	2,160,679
Total	4,085,818	2,267,924

SPRUCE BUDWORM IN ONTARIO, 1988[1]

- Outbreak Status, 1988
- Forecasts, 1989
- Results of Spraying Operations, 1988

by

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

[1] Report prepared for the Sixteenth Annual Forest Pest Control Forum, Ottawa, November 15-16, 1988.

[2] Canadian Forestry Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario.

[3] Ontario Ministry of Natural Resources, Pest Management Section, Sault Ste. Marie, Ontario.

OUTBREAK STATUS 1988

The extent of spruce budworm infestations declined in 1988, with a reduction of approximately 27% in the total area of moderate-to-severe defoliation. Aerial and ground surveys revealed some 5,224,734 ha of defoliation, down from 7,189,763 ha in 1987 all of which occurred in the Northwestern and North Central regions (Fig. 1 and Table 1).

The bulk of the decline occurred in the North Central region where sharp reductions occurred in all five districts - Atikokan, Thunder Bay, Nipigon, Terrace Bay and Geraldton. In the Northwestern Region, declines in the Fort Frances, Ignace and Sioux Lookout districts were somewhat offset by increases in the Dryden, Kenora and Red Lake districts.

Declines notwithstanding, two large bodies of moderate-to-severe defoliation persist, along with a number of smaller ones. The largest, 3,892,027 ha in size, stretched from the Manitoba border through the Kenora, Red Lake, Fort Frances, Dryden, Sioux Lookout, Ignace and Atikokan districts to the south central Thunder Bay District. The second body occupied 820,249 ha from the eastern Thunder Bay District through the southern Nipigon and central Terrace Bay District to the southwest corner of Geraldton District. There were numerous smaller pockets around and between these two larger bodies ranging in size from a few hectares to a 52,516 ha pocket on the Sibley Peninsula of Thunder Bay District.

Surveys for spruce budworm induced tree mortality are carried out during the latter part of the field season. These revealed approximately 448,637 ha of new mortality in the Northwestern and North Central regions, bringing the total recorded during the current spruce budworm outbreak to 14,515,719 ha (Fig. 2).

FORECASTS 1989

The annual spruce budworm egg-mass survey was carried out during August with some 430 locations sampled province-wide. A comparison of 345 locations sampled in 1987 and 1988 showed an overall increase of 7% in egg-mass densities (Table 2). In the Northwestern Region, egg-mass densities declined by 24% overall with increases of 4% and 38%, respectively, in Dryden and Sioux Lookout Districts and decreases of 60%, 24% and 51% in the Fort Frances, Ignace and Kenora districts. Egg-mass densities were unchanged in Red Lake District. In contrast, increases were recorded in all districts of the North Central Region, ranging from 6% in Atikokan District to 729% in Geraldton District and averaging 85% overall. Increased but still low egg-mass densities were recorded in the Northern and Northeastern regions and in Southern Ontario.

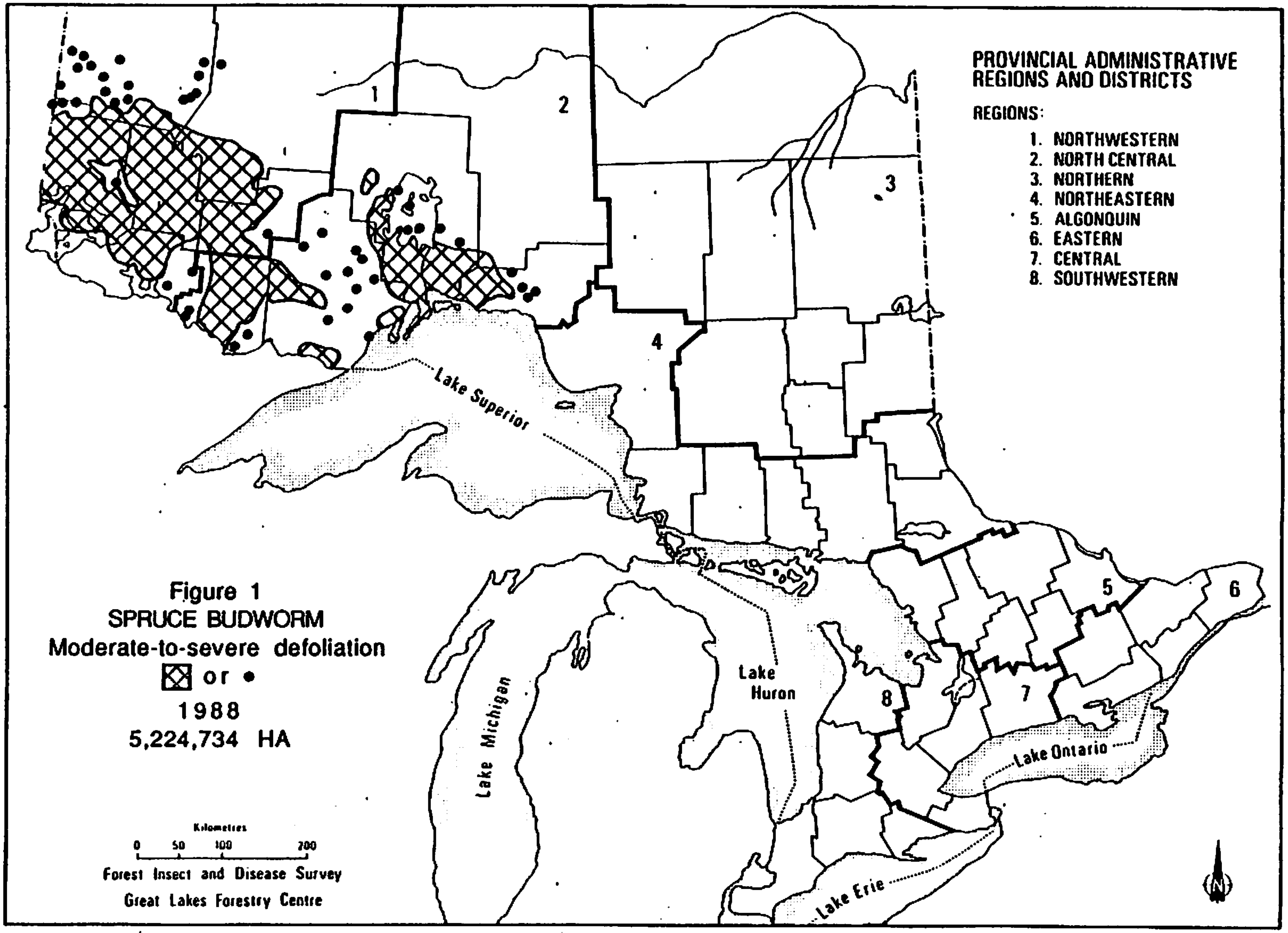

Figure 1
SPRUCE BUDWORM
Moderate-to-severe defoliation
or •
1988
5,224,734 HA

Table 1. Gross area (ha) of current moderate-to-severe defoliation by spruce budworm in Ontario from 1985 to 1988

Region	Area of moderate-to-severe defoliation (ha)			
District	1985	1986	1987	1988
Northwestern				
Ignace	599,895	530,761	584,322	512,961
Dryden	952,385	891,997	835,308	907,685
Sioux Lookout	240,048	428,830	556,457	540,334
Fort Frances	700,172	542,176	497,579	275,817
Kenora	911,037	906,917	821,074	886,627
Red Lake	10	200,349	256,167	266,361
	3,403,547	3,501,030	3,550,907	3,389,785
North Central				
Atikokan	918,500	890,691	808,508	578,464
Thunder Bay	2,315,563	2,005,718	1,101,963	376,395
Nipigon	1,125,751	985,961	987,526	605,741
Terrace Bay	1,168,400	1,023,773	528,555	260,393
Geraldton	683,178	400,486	211,954	13,956
	6,211,392	5,306,629	3,638,506	1,834,949
Northern				
Chapleau	6,120	70	0	0
Cochrane	600	0	0	0
Gogama	11,570	428	0	0
Hearst	1,173,734	32,384	0	0
Kapuskasing	0	0	0	0
Kirkland Lake	1,125	0	0	0
	1,193,149	32,882	0	0
Northeastern				
Blind River	0	0	0	0
Espanola	1,980	408	0	0
North Bay	20,305	1,802	0	0
Sault Ste. Marie	7,875	0	0	0
Sudbury	105,805	455	0	0
Temagami	245	0	0	0
Wawa	1,386,547	11,389	0	0
	1,522,757	14,504	0	0
Algonquin				
Bracebridge	720	436	350	0
Algonquin Park	800	206	0	0
	1,520	642	0	0
	12,332,365	8,855,687	7,189,763	5,224,734

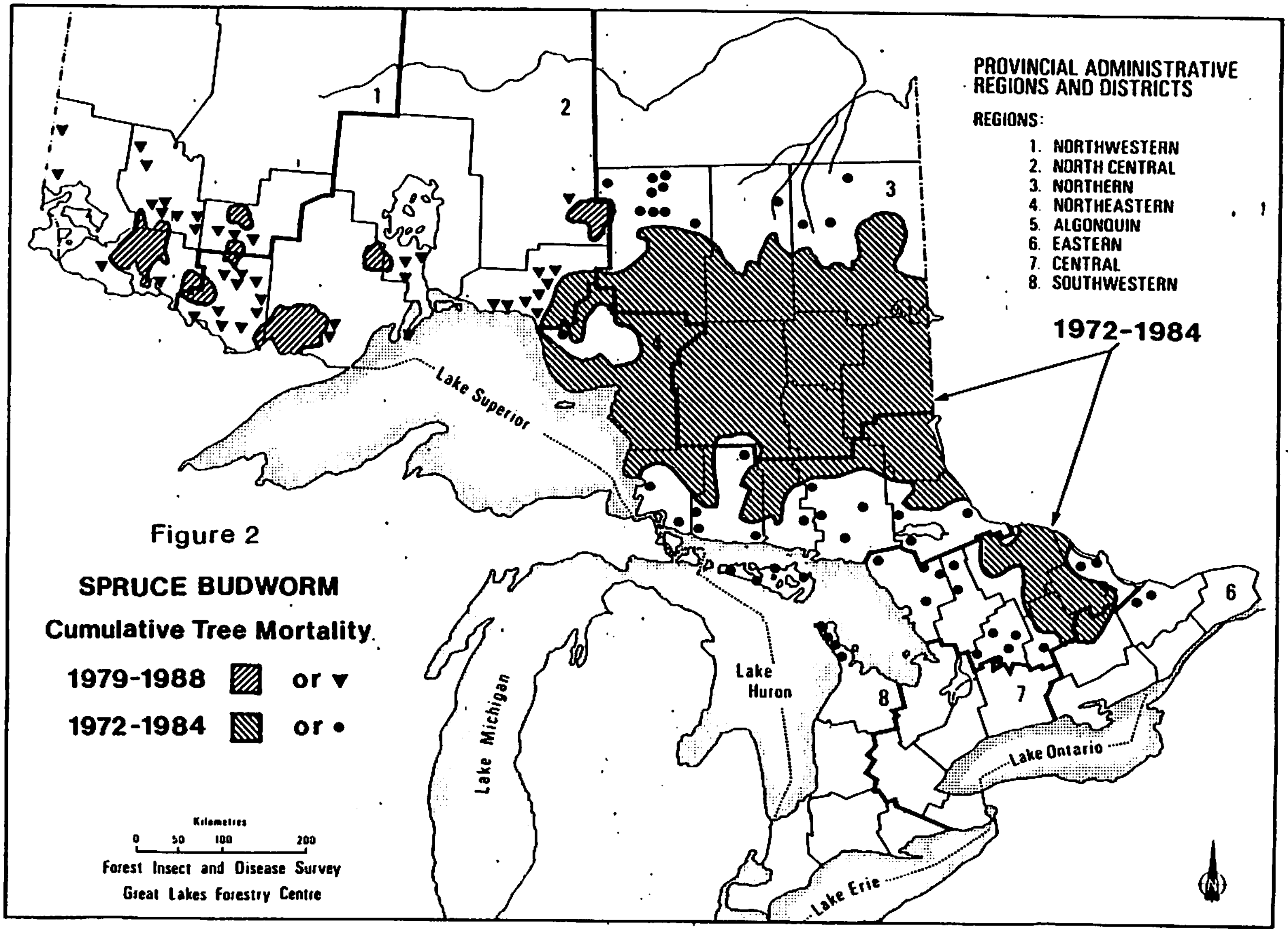

Figure 2

SPRUCE BUDWORM

Cumulative Tree Mortality

Despite the overall declines in the Northwestern Region egg densities remain sufficiently high that moderate-to-severe defoliation will persist throughout much of the area infested in 1988 although little or no expansion in the area is anticipated. In the North Central Region it is expected that infestations will intensify and defoliation will increase within areas affected in 1988. Little expansion is expected in the area affected except in the eastern section of the outbreak where some expansion may occur along the northern edge of the infestation in the eastern Nipigon District, the western Terrace Bay District and the southwest corner of the Geraldton District.

Table 2. Comparison of spruce budworm egg-mass densities in Ontario in 1987 and 1988.

OMNR Region	No. of locations sampled in 1988	No. of locations common to 1987 and 1988	Average egg-mass density per 9.29 m^2 1987	Average egg-mass density per 9.29 m^2 1988	% Change
Northwestern	140	125	391.3	297.3	-24
North Central	219	154	121.7	225.8	+85
Northern	35	32	0.3	5.6	+1767
Northeastern	22	20	2.4	6.2	+158
Southern Ontario	14	14	7.3	12.4	+70
Overall	430	345	196.6	209.9	+7

RESULTS OF SPRAYING OPERATIONS

A total of 14,023 ha was aerially sprayed in 1988 in the Nipigon and Thunder Bay district in the North Central Region (Table 3). As in previous years, the 1988 program included commercial stands of balsam fir and spruce as well as a provincial park and plantations. All areas treated were sprayed with a single application of Dipel 132 at a rate of 30 BIU/2.4L/ha (neat). Three helicopters, Bell 206's, were used in this year's program. One was equipped with Micronair dispersal system, the other two with Beecomist.

Table 3. Area and date sprayed in Nipigon and Thunder Bay districts in 1988.

District/location	Area (ha)	Date sprayed
Thunder Bay		
Arrow Lake	1,093	May 30 - June 1
Bedivere Lake	3,619	June 3-6
Sibley Prov. Park	166	June 17
	4,878	
Nipigon	9,145	June 7-16
Total	14,023	

For the third consecutive year, the North Central Region experienced unusually warm and dry weather in April, May and June. For example, based on weather data from Thunder Bay airport, the mean monthly temperature was above normal whereas the mean monthly precipitation was below normal for each of the three months in question. The data are presented in Table 4 . Emergence occurred in early May, for example, May 5-6 in the Black Sturgeon Lake area. Heat accumulation varied from one to four days ahead of normal through May but accelerated in early June to about 7-8 days ahead of normal by June 15. Insect development data at spray time is presented in Table 5 and this year's heat accumulation graph for Thunder Bay is presented in Figure 3.

Insect development was furthest advanced at Arrow Lake, followed by Bedivere Lake followed by the Nipigon blocks and Sibley Provincial Park. These locations were sprayed in that order but because of the extremely warm weather in late May and early June which was accompanied by windy weather conditions which frequently delayed spraying as well as problems with the helicopters, the spray timing for the Nipigon blocks and Sibley was less than ideal. It had been planned to spray Lake Nipigon Provincial Park but this was canceled due to advanced insect development.

Approximately 267 balsam fir, white spruce and black spruce plots consisting of 5 trees per plot for a total of 1,335 trees were established to assess the effectiveness of this year's program. In spray blocks, 450 balsam fir, 315 white spruce and 45 black spruce were sampled whereas 290 balsam, 220 white spruce and 15 black spruce were sampled in untreated check plots. Results in terms of population reduction and foliage protection due to the treatment are presented by

Table 4. Temperature and precipitation data for eight locations throughout Ontario for April, May and June, 1988.

TEMPERATURES (C°)

	April		May		June	
	Normal	Mean	Normal	Mean	Normal	Mean
Kenora	2.7	4.0	10.5	14.5	16.1	21.1
Thunder Bay	2.5	3.8	8.9	10.0	14.0	16.0
Sault Ste. Marie	3.1	3.4	9.1	11.3	14.6	15.2
Kapuskasing	0.5	1.4	8.3	10.2	14.1	13.0
North Bay	3.2	3.9	10.6	12.7	15.7	14.9
Ottawa	5.6	6.0	12.8	14.9	18.0	17.6
Muskoka	4.5	4.8	10.9	12.2	15.9	15.2
London	6.4	6.6	12.4	14.5	17.9	18.1

TOTAL PRECIPITATION (mm)

	April		May		June	
	Normal	1988	Normal	1988	Normal	1988
Kenora	45.2	3.0	65.8	26.6	91.7	68.9
Thunder Bay	50.7	13.4	73.3	59.7	76.6	32.1
Sault Ste. Marie	64.4	63.1	84.2	36.9	74.2	10.2
Kapuskasing	53.2	42.8	74.3	69.8	84.7	82.4
North Bay	62.3	77.0	69.3	76.0	85.1	63.6
Ottawa	69.1	91.6	67.9	32.4	73.4	94.0
Muskoka	73.3	92.4	77.8	62.6	81.9	65.0
London	81.2	62.9	66.9	73.5	73.6	9.6

Table 5. Spruce budworm larval development at spray locations in Thunder Bay and Nipigon districts, 1988.

Location	Tree species	Date	Stage (%) II	III	IV	V	VI	Remarks
Thunder Bay District								
Arrow Lake	bF	May 29	6	57	37			Sprayed May 30 – June 1/88
	bF	June 1		2	58	37	3	
	wS	May 29		15	51	34		
	wS	June 1			33	41	26	
Bedivere Lake	bF	May 30	4	37	53	6		Sprayed June 3-6/88
	bF	June 4			15	64	21	
	bF	June 10			2	22	76	
	wS	May 30		2	55	41	2	
	wS	June 4				5	95	
Sibley Provincial Park	wS	June 11			12	19	69	Sprayed June 17/88
Nipigon District								
McMaster Twp	bF	June 6		3	32	54	11	Sprayed June 7-16/88 in Purdom, Nipigon and Cockeram townships.
	bF	June 13			2		98	
	wS	June 6			34	54	12	

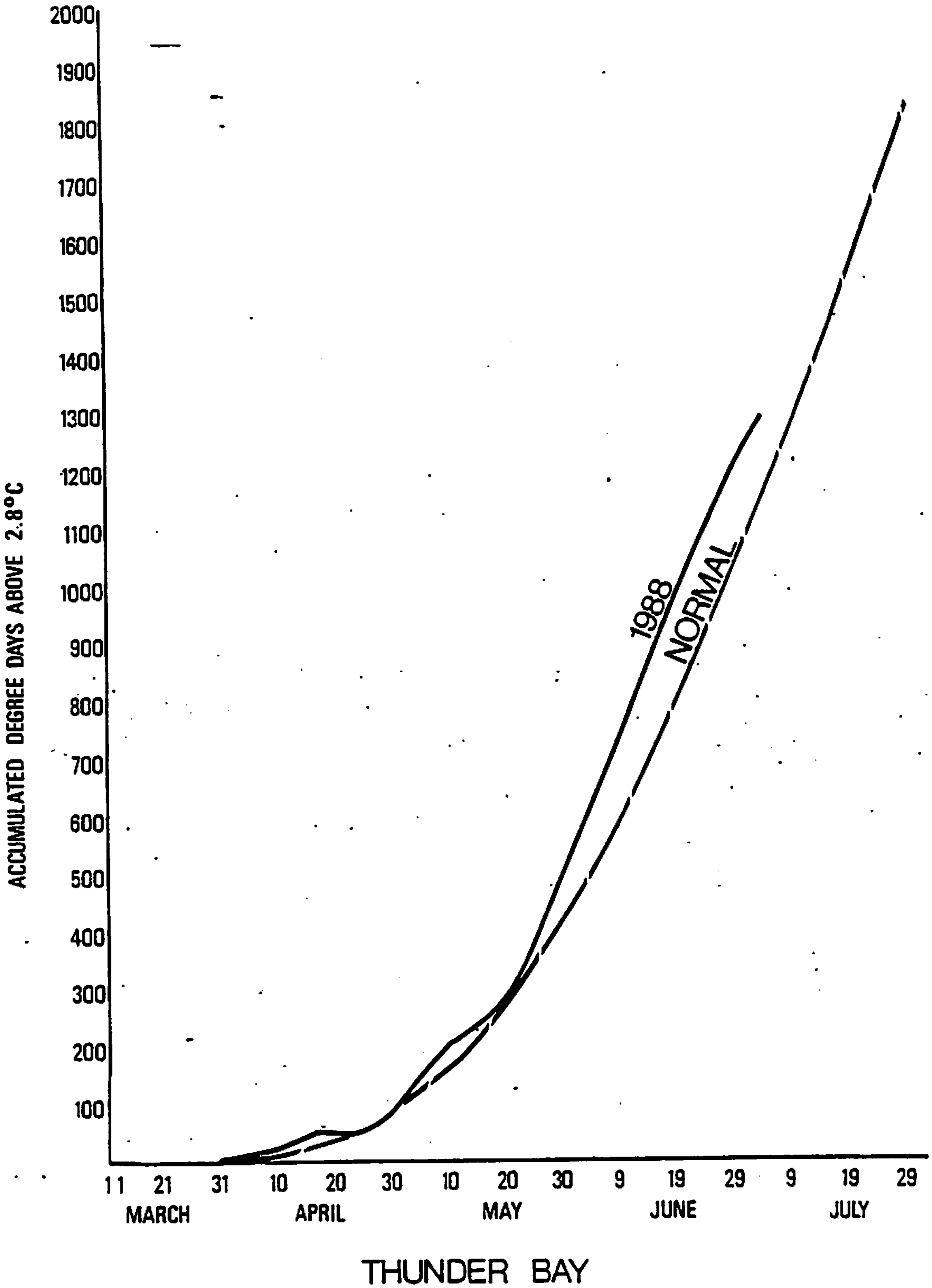

Figure 3. Heat accumulation in degree days for Thunder Bay, Ontario, 1988.

spray block in Tables 6 and 8 for Thunder Bay and Nipigon districts, respectively. Population reduction and foliage protection on an individual plot basis are presented in Tables 7 and 9 for each district.

Overall, this year's results are quite variable ranging from good to poor. However, it appears that the areas sprayed the earliest, particularly Arrow Lake and Bedivere Lake in Thunder Bay District, received better protection than Sibley or the Nipigon District blocks which were sprayed later. Even so, several of the Nipigon District blocks, namely, Purdom Twp - Block 2, Nipigon Twp - Block 4 and Cockeram Twp - Blocks 8, 9 and 10 received fairly good protection, particularly the balsam fir.

Table 6. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray block assessed in Thunder Bay District, North Central Region, 1988.

Location	Spray date	Host	No. of plots	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 defoliation (%)
Arrow Lake	May 30–June 1	bF	10	21.8	95	15
Checks				23.6		54
Arrow Lake		wS	2	50.4	72	70
Checks				45.4		74
Bedivere Lake, Block A	June 3–6	bF	2	8.2	97	5
Checks				7.1		21
Bedivere Lake, Block A		wS	1	29.6	81	12
Checks				27.6		65
Bedivere Lake, Block W		wS	1	22.1	20	26
Checks				21.8		59
Sibley Prov. Park	June 17	bF	5	8.1	57	24
Checks				7.1		21
Sibley Prov. Park		wS	4	25.1	0	49
Checks				27.6		65

Table 7. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Thunder Bay District, North Central Region, 1988.

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 defoliation (%)
Arrow Lake				
P1	bF	22.7	95	9
Checks	bF	23.6		54
P2	bF	21.9	91	13
Checks	bF	23.6		54
P3	bF	31.8	98	17
Checks	bF	30.2		66
P4	bF	22.8	91	13
Checks	bF	23.6		54
P5	bF	25.3	94	12
Checks	bF	23.6		54
P6	bF	21.8	84	17
Checks	bF	23.6		54
P7	bF	13.2	100	6
Checks	bF	13.7		45
P8	bF	19.4	95	25
Checks	bF	19.3		56
P9	bF	17.9	97	18
Checks	bF	19.3		56
P10	bF	21.2	98	24
Checks	bF	19.3		56
P1	wS	46.8	79	71
Checks	wS	41.4		75
P7	wS	54.0	51	69
Checks	wS	53.4		73
Bedivere Lake				
Block A, P2	bF	9.6	97	5
Checks	bF	10.8		29
P3	bF	6.8	98	5
Checks	bF	7.1		21

Table 7. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Thunder Bay District, North Central Region, 1988 (concl.)

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 defoliation (%)
Bedivere Lake				
Block A, P2	wS	29.6	92	12
Checks	wS	30.2		67
Block W, P1	wS	22.1	20	26
Checks	wS	21.8		59
Sibley Provincial Park				
P1	bF	3.4	79	7
Checks	bF	3.2		10
P2	bF	14.2	31	25
Checks	bF	13.7		45
P2A	bF	9.6	66	43
Checks	bF	10.8		29
P3	bF	3.8	7	15
Checks	bF	3.2		10
P5	bF	9.5	93	31
Checks	bF	10.8		29
P2	wS	33.7	46	65
Checks	wS	30.2		67
P2A	wS	39.4	0	55
Checks	wS	39.1		64
P3	wS	12.0	0	23
Checks	wS	13.4		22
P5	wS	15.3	38	54
Checks	wS	16.7		32

Table 8. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray block assessed in Nipigon District, North Central Region, 1988.

Location	Spray date	Host	No. of plots	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Purdom Twp						
Block 2	June 9	bF	5	18.5	72	12
Checks				19.3		56
Block 2		wS	5	36.9	0	39
Checks				39.1		64
Block 3[(1)]	June 9	wS	5	4.2	57	8
Checks				3.7		11
Nipigon Twp						
Block 4	June 16	bF	1	16.0	32	26
Checks				15.9		51
Block 4		bS	4	13.4	0	8
Checks				13.5		6
Block 5	June 16	bF	5	24.8	92	54
Checks				23.6		54
Block 5		bS	5	15.6	35	15
Checks				16.2		9
Cockeram						
Block 7	June 9	bF	6	23.6	66	48
Checks				23.6		54
Block 7		wS	7	67.1	60	78
Checks				45.4		74
Block 8	June 7-9/88	bF	10	18.2	74	36
Checks				19.3		56
Block 8		wS	10	46.2	70	61
Checks				45.4		74
Block 9	June 7-10	bF	10	21.5	94	32
Checks				23.6		54
Block 9		wS	7	34.7	49	51
Checks				39.1		64

Table 8. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray block assessed in Nipigon District, North Central Region, 1988 (concl.)

Location	Spray date	Host	No. of plots	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Cockeram						
Block 10	June 7-11	bF	7	19.0	90	20
Checks				19.3		56
Block 10		wS	6	53.3	83	57
Checks				45.4		74

(1)-plantation, small trees

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Nipigon District, North Central Region, 1988.

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Purdom Twp				
Block 2				
P1	bF	20.7	86	14
Checks	bF	19.3		56
P2	bF	23.6	65	12
Checks	bF	23.6		54
P3	bF	13.9	93	15
Checks	bF	13.7		45
P4	bF	16.4	82	6
Checks	bF	15.9		51
P5	bF	17.8	84	15
Checks	bF	19.3		56
P1	wS	49.4	44	78
Checks	wS	53.4		73
P2	wS	33.5	65	29
Checks	wS	30.2		67
P3	wS	32.0	76	37
Checks	wS	30.2		67
P4	wS	24.8	34	16
Checks	wS	27.6		65
P5	wS	44.8	34	34
Checks	wS	41.4		75
Block 3[2]				
P1	wS	5.6	79	5
Checks	wS	7.1		26
P2	wS	3.6	50	6
Checks	wS	3.7		11
P3	wS	5.9	80	8
Checks	wS	7.1		26

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Nipigon District, North Central Region, 1988 (cont'd)

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Purdom Twp (cont'd)				
Block 3[2]				
P4	wS	3.0	70	10
Checks	wS	3.7		11
P5	wS	3.0	50	9
Checks	wS	3.7		11
Nipigon Twp				
Block 4				
P1	bS	17.4	37	11
Checks	bS	16.2		9
P2	bS	13.8	0	7
Checks	bS	13.5		6
P3	bS	11.6	0	6
Checks	bS	13.5		6
P4	bF	16.0	32	26
Checks	bF	15.9		51
P5	bS	10.6	0	6
Checks	bS	13.5		6
Block 5				
P1	bF	20.7	86	52
Checks	bF	19.3		56
P2	bF	24.7	83	52
Checks	bF	23.6		54
P3	bF	18.4	69	43
Checks	bF	19.3		56
P4	bF	40.7	96	77
Checks	bF	41.5		78
P5	bF	19.6	95	47
Checks	bF	19.3		56
P1	bS	15.8	29	13
Checks	bS	16.2		9

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4/ha for each spray plot assessed in Nipigon District, North Central Region, 1988 (cont'd)

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Nipigon Twp (cont'd)				
Block 5				
P2	bS	7.6	64	10
Checks	bS	13.5		6
P3	bS	14.9	0	19
Checks	bS	16.2		9
P4	bS	13.5	20	17
Checks	bS	13.5		6
P5	bS	26.2	90	14
Checks	bS	29.7		33
Cockeram				
Block 7				
P4	bF	20.2	57	10
Checks	bF	19.3		56
P5	bF	27.9	78	49
Checks	bF	30.2		66
P6	bF	13.0	88	33
Checks	bF	13.7		45
P7	bF	29.5	0	95
Checks	bF	30.2		66
P8	bF	19.8	76	25
Checks	bF	19.3		56
P4	wS	33.6	93	36
Checks	wS	30.2		67
P5	wS	116.0	92	82
Checks	wS	53.4		73
P6	wS	61.4	70	72
Checks	wS	53.4		73
P7	wS	70.6	33	93
Checks	wS	53.4		73

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Nipigon District, North Central Region, 1988 (cont'd)

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Cockeram (cont'd)				
Block 7				
P8	wS	70.7	0	93
Checks	wS	53.4		77
P9	wS	71.0	35	77
Checks	wS	53.4		73
P10	wS	46.4	36	94
Checks	wS	41.4		75
Block 8				
P1	bF	8.6	0	66
Checks	bF	7.1		21
P2	bF	21.4	82	30
Checks	bF	19.3		56
P3	bF	13.7	96	18
Checks	bF	13.7		45
P4	bF	18.2	89	22
Checks	bF	19.3		56
P5	bF	15.7	85	13
Checks	bF	15.9		51
P6	bF	16.6	90	62
Checks	bF	15.9		51
P7	bF	20.3	63	25
Checks	bF	19.3		56
P8	bF	7.2	93	36
Checks	bF	7.1		21
P9	bF	30.4	80	53
Checks	bF	30.2		66
P10	bF	29.5	100	35
Checks	bF	30.2		66

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Nipigon District, North Central Region, 1988 (cont'd)

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Cockeram (cont'd)				
Block 8				
P1	wS	58.6	84	45
Checks	wS	53.4		73
P2	wS	71.1	100	56
Checks	wS	53.4		73
P3	wS	43.6	79	37
Checks	wS	41.4		75
P4	wS	23.6	35	41
Checks	wS	21.8		59
P5	wS	35.8	40	73
Checks	wS	39.1		64
P6	wS	42.5	57	80
Checks	wS	41.4		75
P7	wS	43.9	67	54
Checks	wS	41.4		75
P8	wS	44.8	62	79
Checks	wS	41.4		75
P9	wS	42.7	71	73
Checks	wS	41.4		75
P10	wS	55.3	72	71
Checks	wS	53.4		73
Block 9				
P1	bF	13.1	88	18
Checks	bF	13.7		45
P2	bF	16.8	93	32
Checks	bF	15.9		51
P3	bF	15.7	100	10
Checks	bF	15.9		51
P4	bF	48.8	94	62
Checks	bF	41.5		78

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Nipigon District, North Central Region, 1988 (cont'd)

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Cockeram (cont'd)				
Block 9				
P5	bF	16.7	98	10
Checks	bF	15.9		51
P6	bF	43.7	72	66
Checks	bF	41.5		78
P7	bF	15.1	89	40
Checks	bF	15.9		51
P8	bF	14.0	96	7
Checks	bF	13.7		45
P9	bF	17.6	90	22
Checks	bF	15.9		51
P10	bF	13.5	100	55
Checks	bF	13.7		45
P1	wS	37.6	62	43
Checks	wS	39.1		64
P5	wS	11.7	18	17
Checks	wS	13.4		22
P6	wS	68.9	91	85
Checks	wS	53.4		73
P7	wS	25.2	73	77
Checks	wS	27.7		65
P8	wS	25.8	58	17
Checks	wS	27.7		65
P9	wS	35.6	60	37
Checks	wS	39.1		64
P10	wS	38.4	11	82
Checks	wS	39.1		64

Table 9. Spruce Budworm: Population reduction and foliage protection attributable to aerial application of Dipel 132 at 30 BIU/2.4L/ha for each spray plot assessed in Nipigon District, North Central Region, 1988 (concl.)

Location	Host	Prespray larvae per 46 cm branch tip	Population reduction due to spray (%)	1988 Defoliation (%)
Cockeram (cont'd)				
Block 10				
P1	bF	12.0	89	11
Checks	bF	10.8		29
P2	bF	24.3	98	20
Checks	bF	23.6		54
P3	bF	16.9	90	20
Checks	bF	15.9		51
P4	bF	22.0	89	21
Checks	bF	23.6		54
P5	bF	17.1	98	22
Checks	bF	15.9		51
P7	bF	21.4	96	29
Checks	bF	19.3		56
P1	wS	45.4	75	47
Checks	wS	41.4		75
P2	wS	78.4	86	57
Checks	wS	53.4		73
P3	wS	43.0	98	62
Checks	wS	41.4		75
P4	wS	60.5	75	62
Checks	wS	53.4		73
P7	wS	39.0	49	55
Checks	wS	39.1		64

(2) plantation - small trees

III.RESEARCH, ENVIRONMENTAL MONITORING AND HEALTH CONCERNS/ PRÉOCCUPATIONS TOUCHANT LA RECHERCHE ET LE CONTRÔLE ET LA SANTÉ DE L'ENVIRONNEMENT

III. RESEARCH, ENVIRONMENTAL MONITORING AND HEALTH CONCERNS/ PRÉOCCUPATIONS TOUCHANT LA RECHERCHE ET LE CONTRÔLE ET LA SANTÉ DE L'ENVIRONNEMENT

BIORATIONAL CONTROL AGENTS PROGRAM

by

E. KONDO

This program is organized into three logical project groupings namely Microbial Control Agents, Biological Interactions and Physiological Mechanisms. The rationale for this grouping is to ensure optimum coordination and efficiency of resources while ensuring interaction with other institute programs as necessary.

Programme sur les agents de lutte biologique

E. Kondo

Le Programme regroupe trois secteurs de recherche: agents de lutte microbiologique, interactions biologiques et mécanismes physiologiques. Le regroupement de ces trois secteurs de recherche sous un même programme vise une coordination optimale et une efficacité maximale des ressources, tout en assurant l'interaction nécessaire avec les autres programmes de l'Institut.

STUDIES CARRIED OUT BY THE CHEMICAL CONTROL AGENTS PROGRAM, FOREST PEST MANAGEMENT INSTITUTE - 1988

by

E.T.N. CALDWELL

This report summarizes highlights of research for 1988 in the Chemical Control Agents Program.

Études réalisées dans le cadre du Programme sur les agents de lutte chimique à l'Institut pour la répression des ravageurs forestiers en 1988

E.T.N. Caldwell

Les grandes lignes de la recherche effectuée dans le cadre du Programme sur les agents de lutte chimique en 1988 sont présentées.

STATUS OF ACTIVE MINOR USE PROGRAM SUBMISSIONS - 1988

by

H. KREHM AND R. McNEIL

A list of minor use of pesticides submissions is presented.

Situation concernant les demandes se rapportant au programme d'emploi limité en 1988

H. Krehm et R. McNeil

Une liste de demandes d'emploi limité de pesticides est présentée.

CPPA FOREST PROTECTION PROGRAM - 1988

by

J.P. MARTEL

The primary objective of the program is to help improve public understanding of the need for better forest protection and of the need to have the technology to accomplish the task. This goal is being achieved through the provision of public information and technical information materials for use by member companies in their programs, and for professional reference.

Programme de protection des forêts de l'ACPP en 1988

J.P. Martel

Le principal objectif du programme est de sensibiliser davantage le public à la nécessité de mieux protéger les forêts et de disposer des moyens techniques pour y arriver. Pour atteindre cet objectif, on produit de la documentation à l'intention du public ainsi que des documents techniques que pourront utiliser les sociétés membres, soit dans leurs programmes, soit comme documents de référence.

OPERATIONAL HERBICIDE RESEARCH CONDUCTED BY FPMI IN 1988

by

D. PITT

Project FP-54-1 conducts operational conifer release and site preparation trials that are designed to evaluate the weed efficacy, crop tolerance, and crop growth response aspects of various forestry herbicides and herbicide use strategies. This paper briefly outlines new and ongoing herbicide research that FP-54-1 has been involved with this past year.

Recherche opérationnelle sur les herbicides effectuée par l'IRRF en 1988

D. Pitt

Le groupe FP-54-1 effectue des essais opérationnels de dégagement de conifères et de préparation du terrain pour évaluer les caractéristiques de divers herbicides pour usage forestier et diverses stratégies d'utilisation d'herbicides, plus particulièrement en ce qui a trait à l'efficacité contre la végétation indésirable, à la tolérance de la végétation à conserver et aux effets sur la croissance de celle-ci. Un bref compte rendu des efforts nouveaux et continus de recherche du groupe au cours de l'année est présenté.

SUMMARY REPORT OF THE STUDIES ON HERBICIDE PHYSIOLOGY

by

R. PRASAD AND J. STUDENS

The aims of the Herbicide Physiology Study are to determine the toxicological and physiological properties of herbicides and their formulations and other chemicals on forest weed species and selected crop trees and for those that show potential for use, to provide possible dosage levels and use patterns for further field testing.

Compte rendu des études sur les propriétés physiologiques des herbicides

R. Prasad et J. Studens

Est présenté un compte rendu des études effectuées pour déterminer les propriétés toxiques et physiologiques d'herbicides d'intérêt, de leurs préparations et d'autres substances chimiques chez la végétation indésirable forestière et les arbres à conserver, ainsi que pour établir les doses possibles et les profils d'emploi en vue d'essais plus poussés sur le terrain dans le cas des substances jugées potentiellement utilisables.

HERBICIDE CHEMICAL ACCOUNTABILITY (1988)

by

D.G. THOMPSON

Project objective is 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.

Devenir chimique des herbicides (1988)

D.G. Thompson

L'objectif des recherches dans ce domaine est de mettre au point et de contrôler des méthodes d'analyse pour la mesure des résidus d'herbicides dans différentes composantes de l'environnement et de mettre en application de telles méthodes dans des expériences en laboratoire et sur le terrain effectuées afin de déterminer le devenir et la persistance des herbicides dans les écosystèmes forestiers du Canada.

NEWFOUNDLAND AERIAL HERBICIDE SPRAY PROGRAM

by

G.K. ROSS

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 4 505 ha have been treated up to and including 1988.

Programme d'arrosages aériens d'herbicides à Terre-Neuve

G.K. Ross

Des essais (expérimentaux/semi-opérationnels) d'arrosage aérien d'herbicides sont effectués depuis 1984 dans le cadre des ententes forestières et en collaboration avec l'industrie des pâtes et papiers. Au total, 4 505 ha ont ainsi été traités de 1984 à 1988 inclusivement.

USE OF OPERATIONAL HERBICIDES IN NOVA SCOTIA

by

T.D. SMITH AND J. BURGESS

This is a brief discussion on the operational use of herbicides in Nova Scotia with a little information on operational and one experimental trial.

Utilisation opérationnelle d'herbicides en Nouvelle-Écosse

T.D. Smith et J. Burgess

On examine brièvement les utilisations opérationnelles d'herbicides en Nouvelle-Écosse et on fournit quelques détails sur une expérience effectuée.

SUMMARY OF 1988 FIELD AND LABORATORY RESEARCH REGARDING THE USE OF B.t. FOR CONTROL OF FOREST INSECT PESTS

by

KEES van FRANKENHUYZEN

Goals of the Applications Research Project at FPMI are to further improve the effectiveness of B.t. for spruce budworm control and to transfer the knowledge and experience gained from work with this species to other defoliating forest insect pests.

Compte rendu des recherches effectuées sur le terrain et en laboratoire en 1988 sur l'utilisation de *B.t.* contre des insectes forestiers nuisibles

Kees van Frankenhuyzen

Les objectifs de la recherche sur les applications à l'IRRF sont d'améliorer l'efficacité de *B.t.* pour la lutte contre la tordeuse des bourgeons de l'épinette et de mettre à profit les connaissances et l'expérience acquises de façon à mettre au point des applications pour d'autres insectes défoliateurs.

USE OF LECONTVIRUS AND SERTIFERVIRUS IN ONTARIO

by

J.C. CUNNINGHAM AND W.J. KAUPP

Lecontvirus is a nuclear polyhedrosis virus used to control redheaded pine sawfly, Neodiprion lecontei; it received full registration under the Pest Control Products Act in 1987. An emulsifiable oil formulation of Lecontvirus was supplied by FPMI to OMNR staff in seven districts and two forest product companies in 1988.

We are awaiting the outcome of our registration petition for Sertifervirus which was submitted in 1985.

Utilisation de lecontvirus et de sertifervirus en Ontario

J.C. Cunningham et W.J. Kaupp

Lecontvirus est un virus de la polyédrose nucléaire utilisé pour lutter contre le diprion de LeConte (*Neodiprion lecontei*); il jouit d'une homologation complète en vertu de la Loi sur les produits antiparasitaires depuis 1987. En 1988, l'Institut a fourni diverses quantités d'une formulation huileuse émulsionable de ce virus au personnel du ministère des Richesses naturelles de l'Ontario dans sept districts et à deux sociétés de produits forestiers.

Nous n'avons pas encore reçu de réponse à la demande d'homologation de Sertifervirus que nous avons présentée en 1985.

EXPERIMENTAL AERIAL APPLICATION OF DISPARVIRUS FOR CONTROL OF GYPSY MOTH IN ONTARIO

by

J.C. CUNNINGHAM, W.J. KAUPP, AND G.M. HOWSE

A Cessna Ag-truck fitted with 4 Micronair AU 4000 rotary atomizers was used to spray three plots (combined area of 64.0 ha) with Disparvirus, a nuclear polyhedrosis virus (NPV) product used for gypsy moth control.

A further three plots were selected as untreated checks. Gypsy moth egg mass densities in the spring of 1988 ranged from 1 430 to 8 520/ha in the six plots.

Arrosage aérien expérimental de disparvirus pour lutter contre la spongieuse en Ontario

J.C. Cunningham, W.J. Kaupp et G.M. Howse

Un Cessna Ag-truck équipé de quatre pulvérisateurs centrifuges Micronair Au 4000 a été utilisé pour traiter trois parcelles (superficie totale de 64,0 ha) au Disparvirus, virus de la polyédrose nucléaire utilisé pour lutter contre la spongieuse.

Trois autres parcelles, non traitées, ont été utilisées comme témoins. Au printemps 1988, les densités des masses d'œufs de la spongieuse variaient entre 1 430 et 8 520 à l'hectare dans les six parcelles.

INSECT GROWTH REGULATOR RESEARCH DURING 1987-88

by

ARTHUR RETNAKARAN

Insect Growth Regulators (IGRs) are biorational compounds that interfere with the normal growth and development of insects. There are several types of these IGRs currently being developed as control agents; chitin synthesis inhibitors or moult inhibitors, juvenile hormone analogs that prevent the last larval instar from pupating, and a new class of compounds called ecdysonoids that mimics the moulting hormone. All three types of compounds were tested in the laboratory and in the field and the salient features of the studies are described.

Recherche sur les régulateurs de croissance des insectes en 1987-1988

Arthur Retnakaran

Les régulateurs de croissance des insectes sont des substances biologiques qui gènent la croissance et le développement normaux des insectes. Plusieurs types de ces régulateurs sont à l'étude comme agents de lutte biologique: les inhibiteurs de la synthèse de la chitine ou inhibiteurs de la mue, les analogues d'hormones juvéniles, qui empêchent la nymphose après le dernier stade larvaire, et une nouvelle classe de composés, appelés «ecdysonoïdes», qui imitent l'hormone de la mue. Les trois types de composés ont fait l'objet d'études en laboratoire et sur le terrain; les grandes lignes de ces études sont présentées.

LABORATORY EVALUATION OF THE TOXICITY OF INSECTICIDES TO FOREST INSECT PESTS AND NON-TARGET INSECTS IN 1988

by

B.V. HELSON, J.W. McFARLANE, AND D.R. COMBA

This report highlights the major studies on the development of insecticides for forest insect control conducted by the insecticide toxicology project during the past year. This includes three new insecticides, alphaterthienyl, RH 5992 and RH 5849 which were evaluated against several forest pests.

Évaluation en laboratoire des effets toxiques d'insecticides sur les insectes-cibles et les autres en 1988

B.V. Helson, J.W. McFarlane et D.R. Comba

Ce rapport présente les faits saillants des principales études sur la mise au point d'insecticides qui ont été effectuées par l'équipe de recherche sur la toxicité des insecticides au cours de l'année dernière. Ces études ont porté notamment sur trois nouveaux insecticides, alphaterthiényle, RH 5992 et RH 5849, qui ont été évalués contre plusieurs insectes nuisibles.

EXPERIMENTAL APPLICATIONS OF DIPEL AND FUTURA B.t. FORMULATIONS AGAINST THE EASTERN SPRUCE BUDWORM IN NORTHWEST ONTARIO: A SUMMARY OF PRELIMINARY RESULTS

by

B.L. CADOGAN, B.F. ZYLSTRA, AND R.D. SCHARBACH

As the use of Bacillus thuringiensis (B.t.) to control lepidopterous forest pests expands, new and improved formulations of B.t. continue to emerge. These formulations are intended to enhance the pet control strategies of the forest managers. In 1988 five formulations were field tested to determine their respective efficacies against spruce budworm, Choristoneura fumiferana Clem.

Applications expérimentales de formulations de *B.t.* Dipel et Futura contre la tordeuse des bourgeons de l'épinette dans le Nord-Ouest de l'Ontario: Résumé des résultats préliminaires

B.L. Cadogan, B.F. Zylstra et R.D. Scharbach

Comme l'utilisation de *Bacillus thuringiensis* (*B.t.*) pour lutter contre les lépidoptères causant des dommages aux forêts se répand, des formulations nouvelles et améliorées continuent de voir le jour. Ces formulations sont destinées à améliorer les stratégies des gestionnaires forestiers face aux déprédateurs. En 1988, cinq formulations ont fait l'objet d'essais sur le terrain afin de déterminer leur efficacité contre la tordeuse des bourgeons de l'épinette (*Choristoneura fumiferana*) Clem.

PERMETHRIN SPRAY TRIALS AGAINST THE SPRUCE BUDMOTH, *Zeiraphera canadensis* IN MATAPEDIA, P.Q. 1988

by

BLAIR HELSON AND MICHEL AUGER

In 1988, we evaluated the efficacy of permethrin further by both aerial and ground applications timed to coincide with the initiation of egg hatch.

Pulvérisations expérimentales de perméthrine contre la tordeuse de l'épinette (*Zeiraphera canadensis*) à Matapedia (Québec) en 1988

Blair Helson et Michel Auger

En 1988, nous avons évalué de façon plus approfondie l'efficacité de la perméthrine dont les applications ont été faites par aéronef et au sol de manière à coïncider avec le début de l'éclosion des œufs.

RESEARCH STUDIES ON PHYSIOCHEMICAL ASPECTS OF PESTICIDE PERFORMANCE (CONDUCTED IN 1988)

by

A. SUNDARAM AND J.W. LEUNG

During 1988, the Pesticide Formulations Project at FPMI undertook one cooperative field study, one cooperative laboratory study, one field study using a mimic formulation, one laboratory study using *Bacillus thuringiensis* formulations and one laboratory study to examine the potential of certain polymeric adjuvants to bind glyphosate, thereby inhibiting (or reducing) the herbicidal effectiveness.

Études sur les aspects physiochimiques de la performance des pesticides (réalisées en 1988)

A. Sundaram et J.W. Leung

En 1988, le groupe de recherche sur la formulation des pesticides à l'IRRF, en plus de collaborer à une étude sur le terrain et à une autre en laboratoire, a réalisé une étude sur le terrain avec un produit imitant un pesticide, une autre en laboratoire avec des préparations de *Bacillus thuringiensis* et une autre encore en laboratoire sur la possibilité que certains adjuvants polymères se combinent au glyphosate et inhibent (ou réduisent) ainsi le pouvoir herbicide de celui-ci.

STUDIES ON THE ENVIRONMENTAL CHEMISTRY OF FORESTRY INSECTICIDES

by

K.M.S. SUNDARAM, R. NOTT AND J. BROKS

The 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. This report summarizes some of the achievements made in the research activities conducted during 1987/88.

Études du devenir chimique d'insecticides dans l'environnement forestier

K.M.S. Sundaram, R. Nott et J. Broks

Le groupe de recherche sur le devenir chimique des insecticides a deux grands objectifs: (1) étudier la distribution, la persistance, la toxicité et le devenir des insecticides pour usage forestier dans différentes composantes de l'environnement et (2) mettre au point des méthodes d'analyse permettant d'identifier et de mesurer les traces des résidus présents dans divers substrats forestiers. Un résumé des réalisations du groupe en 1987-1988 est présenté.

PROGRESS REPORT ON RESIDUAL EFFICACY AND DOSE TRANSFER MECHANISM OF DIPEL®12L SPRAYED AERIALLY AGINST SPRUCE BUDWORM AT BATHURST, DURING 1988

by

P.C. NIGAM AND S.E. HOLMES

This study determined (i) residual efficacy of Dipel®12L aerially atomized by Micronair AU4000 in coarse and fine droplets by using 30 BIU/ha in 1.1 L and 15 BIU/ha in 0.55 L/ha respectively, (ii) droplet deposits on needles, (iii) droplet characteristics and spectrum on webbing, (iv) dose transfer mechanism of active ingredient (A1) to feeding site, using video recording for larval and droplet interaction.

Rapport sur une étude à Bathurst en 1988 sur l'efficacité résiduelle et le mécanisme de transfert de la dose à la suite d'arrosages aériens de Dipel® 12L contre la tordeuse des bourgeons de l'épinette

P.C. Nigam et S.E. Holmes

On s'est penché sur: (i) l'efficacité résiduelle du Dipel® 12L appliqué par pulvérisation aérienne (Micronair AU4000) en grosses et fines gouttelettes à des doses de 30 x 10 UI/ha pour un débit de 1,1 L/ha et de 15 x 10 UI/ha pour un débit de 0,55 L/ha respectivement; (ii) le dépôt de gouttelettes sur les aiguilles; (iii) les caractéristiques des gouttelettes et leur spectre sur les toiles; (iv) le mécanisme de transfert de l'ingrédient actif au lieu de consommation, en utilisant des enregistrements vidéo de l'interaction larves-gouttelettes.

THE EXPERIMENTAL SPRAY PROGRAM AGAINST THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1988

by

R.J. WEST AND J.P. MEADES

The field efficacy provided by single applications of oil and water-based formulations of *B.t.* and an oil-based formulation of Dimilin, was determined. Applications of *B.t.* were made at various timings to further define the spray window during which control actions should be taken. Results of test applications of Dimilin made at bud break and shortly after larval hatch are given.

Le programme expérimental d'arrosages contre l'arpenteuse de la pruche à Terre-Neuve en 1988

R.J. West et J.P. Meades

On a étudié l'efficacité sur le terrain d'applications uniques de formulations de *B.t.* à base d'huile et à base d'eau ainsi que d'une formulation de Dimilin à base d'huile. Les applications de *B.t.* ont été faites à divers moments afin de mieux cerner l'intervalle au cours duquel les arrosages devraient être effectués. Les résultats des applications de Dimilin, qui ont été faites au moment de l'éclosion des bourgeons et peu après celle des larves, sont présentés.

RESEARCH ON THE BLACK ARMY CUTWORM IN NEWFOUNDLAND IN 1988

by

R.J. WEST AND D.S. DURLING

This is a status report of research work on evaluation of operational application of Ambush, food preferences of larvae, adult flight period and levels of parasitism of the black army cutworm.

Recherche sur la légionnaire noire à Terre-Neuve en 1988

R.J. West et D.S. Durling

Il s'agit d'un rapport sur les progrès des recherches sur l'évaluation des applications opérationnelles d'Ambush, les préférences alimentaires des larves, la période d'envol des adultes et le degré de parasitisme de la légionnaire.

INSECT GROWTH REGULATOR SPRAY TESTS AGAINST BALSAM WOOLLY APHID IN NEWFOUNDLAND IN 1988

by

W.W. BOWERS AND A. RETNAKARAN

Results in 1987 indicated that the insect growth regulator S-71639 (formally S-31183) significantly reduced the numbers of sessile nymphs. Accordingly, in 1988 research was directed to testing the effect of the compound on the egg and adult stadia of balsam woolly aphid.

Essais de pulvérisation d'un régulateur de croissance des insectes pour lutter contre le puceron lanigère du sapin à Terre-Neuve en 1988

W.W. Bowers et A. Retnakaran

Les résultats obtenus en 1987 ont indiqué que le régulateur de croissance des insectes S-71639 (anciennement S-31183) réduisait de façon marquée le nombre de nymphes sessiles. Par conséquent, en 1988, la recherche a été dirigée sur l'effet de ce composé sur les œufs et les stades adultes du puceron lanigère du sapin.

FIELD EXPERIMENT ON CONTROL OF SEEDLING DEBARKING WEEVIL, *Hylobius congener*, WITH NEMATODES

by

D.C. EIDT AND J.R. FINNEY-CRAWLEY

A field experiment was run in Nova Scotia to determine whether the seedling debarking weevil could be controlled with entomophilic nematodes, using the technique developed by Pye and Pye (Nematologia 31:109, 1985) for *Hylobius abietis*.

Expérience sur le terrain d'utilisation de nématodes pour lutter contre le charançon de l'écorce, (*Hylobius congener*)

D.C. Eidt et J.R. Finney-Crawley

Une expérience a été effectuée en Nouvelle-Écosse pour déterminer si le charançon de l'écorce pouvait être freiné par des nématodes entomophages en appliquant la technique mise au point par Pye et Pye (*Nematologia* 31:109, 1985) pour *Hylobius abietis*.

SUMMARY REPORT ON STUDIES OF PESTICIDE IMPACTS ON FOREST ECOSYSTEMS

by

S.B. HOLMES, K.N. BARBER, D.P. KREUTZWEISER AND R.L. MILLIKIN

Field studies by FPMI's Environmental Impact project in 1988 included post-treatment data collections in the Icewater Creek research area and the initiation of a study on the potential impact of *B.t.* spraying on non-target lepidoptera in jack pine plantations near Gogama, Ontario. A laboratory study investigating the sublethal effects of cholinesterase inhibiting forestry insecticides on the behaviour and reproductive activities of zebra finches was completed.

Rapport sommaire sur des études portant sur les incidences des pesticides dans les écosystèmes forestiers

S.B. Holmes, K.N. Barber, D.P. Kreutzweiser et R.L. Millikin

Les études sur le terrain du groupe de l'IRRF étudiant les incidences des pesticides ont comporté, en 1988, la collecte de données sur les incidences dans le secteur de recherche du ruisseau Icewater et la mise en œuvre d'une étude sur les incidences potentielles des arrosages de *B.t.* sur les lépidoptères non-cibles dans des plantations de pins gris près de Gogama, en Ontario. Une étude en laboratoire des effets sublétaux engendrés sur le comportement et les activités de reproduction de diamants mandarins par des insecticides forestiers inhibant la cholinestérase a été complétée.

SURVEILLANCE ENVIRONNEMENTALE DES PULVÉRISATIONS DE PESTICIDES AU QUÉBEC EN 1988

par

SYLVIE DELISLE, PIERRE-MARTIN MAROTTE, JEAN LEGRIS, JEAN CABANA

Le texte suivant résume les différents projets de surveillance et de suivi menés en 1988. Quelques résultats préliminaires y sont également présentés. L'analyse finale des résultats fera l'objet de rapports qui seront disponibles ultérieurement.

ENVIRONMENTAL MONITORING OF PESTICIDE SPRAYING IN QUEBEC - STUDIES CONDUCTED IN 1988

This paper summarizes the various monitoring activities carried out in 1988. It also presents some preliminary results. Reports on the final analysis of the results will be available at a later date.

16th Annual Pest Control Forum
November 15-17, 1988

Biorational Control Agents Program

E.S. Kondo

Introduction

The broad program rationale is to increase the number of options available to the forest manager for control of economically important insect pests. The broad value-at-risk is enormous when one considers that Canada accounts for 22% of all forest products traded in world markets and one-half of Canada's land mass 2.2 million sq. km is considered productive for supporting forest industry on a sustained basis. The forest resource contains a wood volume of about 24 billion m^3, of which 76% is coniferous and 24% is deciduous. Of this volume, 6% is overmature, 40% is mature, 37% is immature and 6% consists of regenerating areas and 11% is unclassified. Dramatic native pest outbreaks occur in the mature and overmature forests. Of course, the forest resource is the backdrop for a multibillion dollar tourist and outdoor recreation industry.

To provide a small perspective of the enormity of the problem and the value-at-risk let me give you one example. For 1986 the total estimated area of moderate to severe defoliation by spruce budworms, jack pine budworm, hemlock looper, forest tent caterpillar and gypsy moth was about 12 million hectares. This is only one group of forest pests. Each year on average approximately 2 1/2 million hectares of forest undergo some form of pest control operations.

The "National Forest Sector Strategy for Canada" endorsed by the Canadian Council of Forest Ministers in July 1987 states

> "It is recommended that all elements of the forest sector recognize that pesticides are among the legitimate means for effective forest management in specific areas, that their use continue to be regulated, and:
>
> - ensure that all pest management operations are ecologically and economically justified;
> - encourage development and use of effective alternative methods of pest control, including integrated pest management;
> - accelerate research into the environmental effects of pesticides; and
> - ensure that the process for registration of pesticides for forest use is not cost-prohibitive and is open to public scrutiny."

The Canadian Forestry Service's Strategic Plan for Research 1987 clearly states that "at the national level, the two national institutes will continue to focus on research of a more fundamental or methodological nature that is national or interregional in scope". It further states "biotechnology offers immense promise to increase forest yields through the development and mass propagation of genetically superior trees and to develop highly specific diagnostic and biological control techniques against forest pests", "Programs will be expanded in tissue culture and other micropropagation techniques for seedling production, and in biotechnological methods of insect and disease control."

Hence there are compelling reasons and mandates for continuation and expansion of the Biorational Control Agents program. However the current balance of resource allocation is as much as can be accommodated to address the biorational control agents R&D requirements without seriously jeopardizing the essential program requirements on the Chemical Control Agents and Environmental Concerns. This program is organized into 3 logical project groupings namely Microbial Control Agents, Biological Interactions and Physiological Mechanisms. The rationale for this grouping is to ensure optimum coordination and efficiency of resources while ensuring interaction with other Institute programs as necessary. More importantly these groupings provide a focus and work milieu to ensure a critical mass of scientists within their highly specialized area of expertise. I believe, that this is one of the reasons why this group of scientists have been so productive and successful over the years and have brought credit to FPMI and the CFS.

The details of the objective of each Project/study within the 3 program groups are contained in Appendix I. I will not go into the details unless there are specific questions from the Forum attendees.

Highlights of Current Major Achievements

I. Microbial Control Agents

(1) Bacterial Pathogens

- The primary focus continues to be optimization of *B.t.* against spruce budworms, new and/or improved *B.t.* products and expansion of *B.t.* use to other susceptible forest pests through coordination of the cooperative *B.t.* network BIOCIDE to accelerate research and development.

  - FPMI through contract with Dr. Paul Fast continues to provide scientific coordination and leadership. Approximately $49K has been obtained from the Federal biotechnology funding to support activities related to BIOCIDE.

- Ross Milne has virtually successfully completed his Masters educational program and will commence his Ph.D. program at University of Ottawa, Jan. 1989.

- FPMI through its involvement in BIOCIDE will participate in a $250K/year program to enhance B.t. effectiveness through the Centres of Excellence Network proposal on "Biotechnology Network in Forestry and Forest Products" if the proposal is accepted.

- Clarification and understanding of the interaction of B.t. with the target insect, the tree and environment continued; most notably spray droplets of various water-based formulation were highly susceptible to wash-off by rain while solar radiation contributed little to inactivation of B.t.

- Semi-operational ULV field trials have determined that undiluted application of B.t. is effective and a desirable approach to control gypsy moth.

- B.t. was not effective in control of Black Army Cutworm.

- Study of the mode of action of the B.t. toxin suggests there may be an "enhancing factor(s)" in susceptible cells.

(2) Fungal Pathogens

Investigations of entomogenous (insect pathogenic) fungi to control forest pests continued.

- *Entomophaga aulicae* pathology of spruce budworm was studied and propagation and storage methodology and techniques were devised.

- Isolation and identification of potential entomogenous fungi from spruce budworm larvae mortality in the Black Sturgeon area and from Black Headed budworm populations in B.C. continued.

(3) Virus Pathogens

The main focus here has been on the exploitation of the insect baculoviruses (Nuclear polyhedrosis virus NPV) in control of forest pests. They are highly host specific and they do not affect such beneficial non-target insects such as predators, parasites and pollinators. To date viruses which are the most promising candidates have been identified and developed to the registration stage.

- Registered viruses include: Lecontvirus for control of the red-headed pine sawfly, Virtuss, for control of Douglas-fir tussock moth; TM-Biocontrol-1, for control of Douglas-fir tussock moth.

- Registration petitions at Agriculture Canada include: Sertifervirus for control of European Pine Sawfly.

- Currently completing registration documentation; Disparvirus, for control of gypsy moth; Virtuss, for control of White Marked and Rusty Tussock moths.

The most promising candidates have been identified and developed. However, the search for more pathogenic viruses or strains will continue; a better understanding of viral epizootiology (spread of the virus in the target pest in nature) will improve use strategies; improved formulations and tank mixes may extend and enhance efficacy; and with newly developed techniques of recombinant DNA technology, it may be possible to alter the host ranges of viruses, enhance their virulence and decrease their susceptibility to UV inactivation. In these respects the Virus epizootiology and Virus Biochemistry studies have provided much information concerning the environmental build-up, persistence of baculoviruses, bioassays to determine infectivity, background work involving tissue culture work to allow an attempt to produce recombinants between the Alfalfa looper NPV and the spruce budworm NPV with a view of altering host range of both viruses, and characterization of various NPVs.

Significantly a working contact has been established with the Biotechnology Research Institute in Montreal to work towards DNA sequencing of spruce budworm NPV gene, producing ways to introduce foreign genes.

II. Biological Interactions

Studies included are insect tissue culture, immunochemistry and biological system analysis. The rationale for those studies is to develop the information/knowledge base required to successfully carry out other Institute projects. These studies are heavily linked to and work in close collaboration with a large number of Institute projects/studies, too numerous and complicated to list here in detail. *In vitro* Investigations of Insect Pathogens produces cell lines for study of control agents "outside" the living insect. Strain selection and genetic manipulations of insect viruses can be accomplished only in cell culture systems. Tissue cultures are important for chemical characterization and could well be very important in mass production of viruses for insect control. Immunochemistry is essential for identification and characterization of pathogens and their constituents such as toxic components. This study also investigates the mode of action of toxic components. Immunochemical techniques are used to identify modification to proteins made to pathogens involving increased virulence and efficacy arising from recombinant and somatic mutations.

Finally the Biological Systems Analysis study provides for modelling and analysis of the underlying biological systems and provides assistance in experimental design and methodology for interpretation and integration of results to all Institute projects. Highlights of current major achievements for the 3 projects contained here are as follows:

(1) Tissue Culture Investigations of Insect Pathogens

- Mr. G.F. Caputo successfully completed his first year residency requirements at Queen's University to obtain a M.Sc. in Insect Virology. Mr. Caputo is working on producing recombinant strains of spruce budworm NPV as a research project for his M.Sc. under supervision of Professor P. Faulkner.

- The "Lawn Assay" a cell culture bioassay for B.t. toxins was developed in collaboration with FP-10 K. van Frankenhuyzen. The cell assay is also used to study activation chemistry of B.t. toxins, their mode of action, and toxicity in laboratories in Canada and foreign countries.

- In collaboration with FP-40 W. Kaupp healthy and spruce budworm NPV infected spruce budworm cells were examined with an electron microscope and the cytopathology was characterized as being similar to that found in spruce budworm larvae.

- Studied in vitro the infectivity of viral pathogens, their replication and volume of production.

(2) Immunochemistry

- B.t. toxin mode of action studies suggest the toxin may act on spectific receptor(s) present in susceptible insects and cells. Preliminary work suggests that there is an "enhancing factor(s) in susceptible cells.

- Work continues to develop monoclonal antibodies to identify and isolate components of the B.t. toxin and virus variants.

- Advances have been made at understanding the nature and mode of action of B.t. toxin with immunochemical techniques.

(3) Biological System Analysis

- In pest damage assessment, exploratory analysis of spruce budmoth and spruce budworm impact data sets have been initiated and continues.

- In collaboration with FP-52 on jack pine cone crop damage a sampling procedure was developed and updating of the jack pine cone crop life tables continues.

- A prototype descriptive model of spruce budworm feeding on diet was completed and information gaps were identified.

- The second draft on testing large scale spruce budworm simulation model has been completed and is currently under review by authors.

- Modelled the influence of additives and temperatures on the physical properties of spray formulations.

III. Physiological Mechanisms

As knowledge of the physiological mechanisms associated with larval and pupal stages, mating and reproduction becomes more complete, so do the opportunities to identify critical physiological stages that can be controlled or manipulated to control economically important insect pests. The Institute has focussed on two potentially productive areas namely insect growth regulators and pheromones. Highlights of current major achievements for the two projects contained here are as follows:

(1) Insect Growth Regulators

- Dimilin field trials to control hemlock looper to date has not produced satisfactory operational expectation, although over 90% population control was achieved over time.

- Dimilin has been found effective in control of gypsy moth, Oak leaf shredder and white pine weevil. Data generated has been used to assist Pfizer in registration petitions for these 3 insects. Currently being evaluated by Agriculture Canada.

- In collaboration with FP-50 Blair Helson the efficacy of Rohm & Haas IGR RH 5992 and RH 5849 are being assessed. Preliminary studies of RH 5992 shows considerable promise against a range of forest pests.

- Preliminary investigations showed that several juvenile hormones and buprofezin reduced balsam woolly aphid populations.

(2) Pheromones

Pheromones are invaluable for detecting and monitoring fluctuations of pest populations. The information can be used for prediction of outbreaks and therefore essential for implementation of control strategies.

- Identification and/or laboratory or field tested pheromones of a number of insect pests including the budworm complex, shoot, seed and cone insects, Oak Leaf Roller, White Marked Tussock Moth, Large Aspen Tortrix, Oak Leaf Shredder.

- Research describing the mating behaviour of the white marked tussock moth and spruce budworm were published.

- An extensive monitoring study showed correlation between pheromone trap catches and larval and egg samples for the Large Aspen Tortrix.

Biorational Control Program
Project & Study Objectives

FP-10 Bacterial Pathogens. There are two constituent studies in the Project, FP-10-1, Chemistry of B.t., and FP-10-2, B.t. host interactions. The former, until his retirement in October, 1987, was led by Dr. Paul Fast, has investigated the chemistry and mode of action of B.t., with the goal of improving its efficacy by chemical characterization and modification. It is presently supported by three technicians and a contract researcher. The latter, under the leadership of Kees van Frankenhuyzen, and supported by one technician, deals with determination of the interaction of B.t. with the target insect, trees and the environment in order to optimize and expand the use of B.t. against defoliating forest insects.

FP-11 Fungal Pathogens. Under the leadership of Dr. David Tyrrell, and supported by two technicians, this project addresses the development of fungal pathogens as forest insect pest control agents, including the identification of virulent species, determination of their biology and physiology, formulation and application, and development of treatment strategies.

FP-13 Viral Pathogens. There are three constituent studies which addresses a continuum of problem areas in development of viruses as effective control agents. Dr. Basil Arif and Mr. Peter Jamieson, with a technical support position, determine the biochemical and biophysical properties of viruses, and their mode of replication, to examine the possibility of genetically manipulating them to improve their effectiveness. Dr. John Cunningham (Project Leader) and his technician determine their effectiveness against field populations of insects as a part of their registration for forestry use in Canada. Dr. Bill Kaupp, assisted by a technician, is involved in the elucidation of their role in regulating naturally-occurring insect populations as a means to determining their potential as control agents.

The second group, Biological Interactions, provides expertise in areas required to support other projects and develop innovative technology in cell culture, immunochemistry and biological systems analysis.

FP-20 In vitro. Investigation of Insect Pathogens, with Dr. Sardar Sohi and two technicians, develops cell lines and cell culture methods that can be used for the study of insect pathogens in controlled, in vitro systems, as well as the potential for their propagation in cell systems as opposed to in insects.

FP-22 Immunochemistry, with Dr. Anthony Pang and a technician, develops and applies immunochemical and serological techniques to the isolation and characterization of microbial pathogens.

FP-23 Biological Systems Analysis, with Dr. Rich Fleming and Mr. Tim Burns, develops and applies techniques in systems analysis and simulation modelling to the design, conduct, interpretation and synthesis of a broad range of experiments that cut broadly across Institute project organization.

FP-30 Pheromone Identification, with Dr. Gary Grant and two technicians, investigates the use of pheromones both as monitoring tools and for their potential for the direct intervention in, and disruption of, insect pest mating systems.

FP-31 Insect Growth Regulators, with Dr. Arthur Retnakaran and two technicians, develops insect control methods that capitalize on the fact that there are several insect-specific physiological systems that can be manipulated to provide control methods which are relatively target-specific and have limited non-target and environment side effects.

STUDIES CARRIED OUT BY THE CHEMICAL CONTROL AGENTS PROGRAM, FOREST PEST MANAGEMENT INSTITUTE - 1988

Report to The 16th Annual Forest Pest Control Forum

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November 1988

Summary of Activities for the Chemical Control Agents Program - 1988

Introduction

As an introduction to my summary for this year I would like to quote a recommendation from the July 1987 Canadian Council of Forest Ministers document - A National Forest Sector Strategy for Canada. This statement relates to the continuing controversy over the use of chemical pesticides associated with insect and vegetation management operations. It states in part -

> "that all elements of the forest sector recognize that pesticides are among the legitimate means for effective forest management in specific areas."

Likewise, The Canadian Institute of Forestry (CIF) document on the Use of Chemical Pesticides in Forestry, approved by the CIF Executive Committee in 1983 states in part:

> "The Canadian Institute of Forestry is aware that chemical pesticides are the major tools available today to reduce the losses caused by forest pests in an effective and economical way. It, therefore, supports responsible use of registered chemical pesticides in forestry practice."

Finally, the CFS Policy Statement on Forest Pest Management states in part:

> "The CFS promotes and supports the use of registered pesticides as a necessary requirement for forest management in situations where other approaches are not economically or logistically practicable or of sufficient effectiveness to achieve forest management goals."

Other forest sector organizations have developed similar statements in support of the judicious use of registered forestry pesticides.

These are all terrific statements worthy of our support. The problem is that they are not being lived up to. At the same time as the forestry sector makes these statements:

- May and Baker have withdrawn their registration package for Zectran forestry uses due to economic and political/social constraints of forestry pesticide use.

- Chemagro has been told by its parent company Bayer, that Matacil will no longer be manufactured, largely thanks to provincial government refusal in recent years to include this more environmentally acceptable chemical insecticide in budworm protection programs.

- fenitrothion rightly or wrongly, is on the hot seat with regard to avian and pollinator concerns and a reevaluation of its forestry use may be sought from Agriculture Canada by Environment Canada.

- permethrin research permits are denied in New Brunswick for spruce budmoth efficacy trials while at the same time this insecticide can be applied in the same province by aircraft to potato and other crops.

- Ontario once again refuses to consider research involving aerial application of chemical insecticides on Crown lands.

- Nova Scotia, Ontario and Quebec refuse to consider chemical insecticide treatments for budworm control and Newfoundland and New Brunswick state that they are committed to significant reductions in chemical insecticide use in their operational programs.

- Saskatchewan refuses to consider the use of herbicides as silvicultural tools for the control of competing vegetation, Quebec is limited to ground applications and Alberta only allows a few small forest sites to be treated for research purposes.

- the registration data packages for hexazinone herbicide products Velpar and Pronone have waited review in Environment Canada for over two years and there is no guarantee that full registration or registration for aerial uses will result when the review is complete.

- although regulatory reviews have been completed for additional forestry uses of Dimilin insecticide to allow general use for control of Gypsy moth and Forest tent caterpillar, a final registration decision is being delayed by the Pesticides Directorate at least until after a Discussion document is prepared which justifies any decisions for additional registrations.

All of these facts, when considered together, make supporting statements such as those described earlier appear rather pointless. We should all be very concerned about the forestry sector's lack of success in convincing decision-makers of the need for retaining all the pest control options within our grasp. However the forestry sector is great at talking among themselves and not so great at convincing others of their needs.

We should be concerned about the one-way road that forest pest management is being forced to take and the impact that this will have on our ability to provide effective pest protection. At FPMI we are equally concerned about how all of this is going to impact on the nature of research undertaken in the Chemical Control Agents Program and other areas of the Institute in future. This area will be the subject of considerable discussion at FPMI and we will be looking to adapt our activities to meet the challenges and constraints that are placed before us.

At this time I would like to summarize highlights of research for 1988 in the Chemical Control Agents Program.

FP-50 Insecticide Toxicology and Screening - Blair Helson

- research was initiated to determine the efficacy of RH 5992 and 5849 IGR's to a number of insect pests in cooperation with Art Retnakaran and Rohm and Haas.

- research on the efficacy of a naturally derived insecticide, alpha-terthienyl, was initiated cooperatively with Dr. Bill Kaupp of FPMI and John Arnasson of Ottawa University.

- a cooperative study to examine the efficacy of ground and aerial treatments of permethrin for spruce budmoth control was carried out successfully in Quebec with Que. EMR.

- cooperative drift bioassay research with Nick Payne and Somu Sundaram to validate a buffer zone model for permethrin and to determine fate and chemical behaviour in forest substrates was delayed because of unsuitable weather on the test site near Sault Ste. Marie and also initially because of refusal of N.B. officials to grant a provincial research permit for this insecticide.

- other toxicological studies were continued with E. hemlock looper, Gypsy moth, white pine weevil, *Hylobius congener*, cone beetles and also non-target insects.

FP-51 Insecticide Field Efficacy - Leo Cadogan

- 1988 was again an all *B.t.* research year. The efficacy of Dipel 64AF, 264 and 352 (64 AF, 96 LV, 128 LV) as well as Futura XLV and XLV-HP were tested against budworm in N. Ont. with disappointing results. Condor, a new *B.t.* product from Ecogen, was dropped from this year's program due to difficulties in obtaining a federal research permit.

FP-52 Plantation Pest Management - Jean Turgeon
Peter de Groot

- research was continued cooperatively with Dan Quiring of UNB to determine relative susceptibilities of white spruce families to spruce budmoth.

- research continued on the development of a pheromone-based monitoring system for budmoth in cooperation with Gary Grant.

- field studies are underway to identify the factors causing mortality in black and white spruce cones.

- cone life tables were completed for jackpine and the Ph.D. research of Peter de Groot on the biosystematics of *Conophthorus spp.* beetles continues.

FP-53 Herbicide Physiology - formerly Raj Prasad

- This was established as a separate project, elevated from study status in 1988. The research scientist Raj Prasad has left FPMI, having obtained a transfer to PFC in October. The position will be re-staffed at the RES level by April 1/89.

- research has continued both under greenhouse and small scale field conditions to determine the influence of drop size, volume and concentration, as well as the impact of herbicide adjuvants on weed efficacy and crop tolerance. Results of this work should lead to more effective, economical operational use strategies for silvicultural herbicides and part of these initial results formed the basis for field research on improved use of glyphosate by FP-54.

FP-54 Herbicide Field Efficacy - Phil Reynolds
Doug Pitt

- The improved use trial with glyphosate (Vision) referred to above was initiated successfully in N.B. in 1988 with the cooperation of NB DNR and CFS-M. The research will test under operational constraints, the benefits of smaller drop sizes in the effectiveness of aerial applications of Vision.

- site preparation trials in N.B. with Velpar L, Velpar ULW, Pronone 5G and 10G, Oust and Ally were continued post-treatment in order to monitor plant succession and crop growth response to these herbicides.

- results of Carnation Creek glyphosate research are being prepared for publication in a Workshop Proceedings.

FP-61 Pesticide Formulations - Alam Sundaram

- lab tests were initiated to determine adjuvant characteristics conducive to greater rainfastness of B.t. and also herbicide formulations. Herbicide work will be done initially with Vision and will form the basis of an M.Sc. thesis for Mr. John Leung, the project's technician.

FP-62 Pesticide Atomization and Dispersal - Nick Payne

- participated in cooperative research with Raj Prasad and U. of Guelph to determine the no effect level of glyphosate to non-target vegetation in order to estimate buffers required to protect streamside vegetation.

- research was also undertaken to measure meteorological conditions in atmospheric boundary layers at dusk and dawn.

- participation in the planned permethrin drift study was delayed due to weather.

FP-70 Environmental Impact - Peter Kingsbury (now vacant)
- Steve Holmes
- Rhonda Millikin
- Dave Kreutzweiser
- Kevin Barber

- Peter Kingsbury resigned from FPMI to pursue a career as a United Church Minister. The position will be staffed this year at a research scientist level.

- Steve Holmes successfully defended his M.Sc. thesis on the impact of fenitrothion-induced cholinesterase depression on survival and behaviour of songbirds.

- Rhonda Millikin defended her M.Sc. thesis on methods for sampling songbird populations and impact of an aerial application of fenitrothion on songbird behaviour near Sault Ste. Marie.

- post-treatment sampling of Icewater Creek continued to determine the impact of permethrin induced invertebrate losses on the behaviour and survival of trout populations.

- under the sponsorship of an OPAC grant to Sault College, Kevin Barber initiated a study on the impacts of B.t. to non-target lepidoptera and the potential of this food source loss to young grouse populations.

FP-71 Insecticide Chemical Accountability - Somu Sundaram

- permethrin environmental fate studies at Icewater Creek were completed but terrestrial studies near Thessalon, Ont. were delayed due to uncooperative weather.

- studies on leaching potential of Dimilin were completed but additional research at higher dosage rates will be required in support of additional registrations.

- methodology research was initiated for determination of systemic insecticides in conifer tissues in order to collaborate effectively in research for the control of seed and cone insect pests. Some of this research is being approached cooperatively with Peter de Groot of FPMI and also Rick West of NeFC.

FP-72 Herbicide Chemical Accountability - Dean Thompson

- Environmental fate research with glyphosate at Carnation Creek, B.C. has been completed and publications submitted.

- a cooperative study with Dow Chemical on the fate and persistence of trichlopyr (Garlon) in a N. Ontario watershed is near completion and will form an important component of a registration petition.

- a cooperative study with DuPont and Ph.D. thesis for D. Thompson has been initiated in N. Ontario for metsulfuron-methyl (Ally) in order to determine terrestrial and aquatic fate and behaviour for potential forestry registrations.

That summarizes highlights of accomplishments for the Program in 1988, some of this research will continue in 1989. As far as field trials planned for 1989 is concerned, not much has been finalized. We are very much interested in participating in cooperative trials or at the very least ensuring that duplication of research effort is minimized. Thus we encourage discussions at this Forum between FPMI scientists and other participants that could lead to a better understanding of everyone's plans for 1989 and even better, cooperative research opportunities.

STATUS OF ACTIVE MINOR USE PROGRAM SUBMISSIONS (H. Krehm, R. McNeil) November 1, 1988

SUB. #	ACTIVE INGREDIENT	HOST(S)	STATUS	LAST ACTION	B.F.
82-502	TRIFLURALIN	SASKATOON	08 EFFICACY & TOLERANCE	1988.07.11	1988.12.01
82-504	TRIFLURALIN	SWEET CLOVER SEEDLINGS	12 REGISTRANT	1988.10.18	1989.01.20
83-016	PERMETHRIN	MUSHROOMS	10 HEALTH & WELFARE	1987.07.10	1988.12.12
83-020A	TERBUFOS	COLE CROPS	12 REGISTRANT	1988.06.29	1988.11.30
83-020B	TERBUFOS	RUTABAGAS	14 SIRS	1988.05.25	REGISTERED
83-026	CHLORPYRIFOS	LENTILS	09 LABORATORY	1988.05.26	1988.11.30
83-504	CYANAZINE/MCPA	FORAGES	08 EFFICACY, TOL & RES	1988.06.29	1988.06.01
84-001	CHLOROTHALONIL	PEPPERS	09 LABORATORY	1988.07.15	1988.12.12
84-002	MANCOZEB + METALAXYL	LETTUCE (HEAD)	09 LABORATORY	1988.03.08	1988.12.12
84-003	CHLOROTHALONIL	ONIONS	10 HEALTH & WELFARE	1988.07.15	1988.12.12
84-006	PHOSMET	CELERY	14 SIRS	1988.05.25	REGISTERED
84-008	CYPERMETHRIN	LETTUCE	13 SIRS	1988.10.12	REGISTERED
84-009	CYPERMETHRIN	CARROT	11A CLOSED	1988.05.09	CLOSED
84-016	IPRODIONE	PLUMS	10 HEALTH & WELFARE	1987.09.08	1988.12.12
84-017	IPRODIONE	APRICOT	09 LABORATORY	1988.06.02	1988.12.12
84-022	METALAXYL	HOLLY	06 PESTICIDES	1988.07.15	1988.12.12
84-502	METOLACHLOR	COLE CROPS	08 RESIDUE TRIAL	1988.07.27	1989.01.30
85-007A	CHLORPYRIFOS	BRUSSELS SPROUTS	14 SIRS	1988.07.15	REGISTERED
85-007B	CHLORPYRIFOS	RUTABAGA	14 SIRS	1988.07.15	REGISTERED
85-009A	CARBOFURAN	CABBAGE	12 REGISTRANT	1988.08.18	1988.12.12
85-009B	CARBOFURAN	CAULIFLOWER	12 REGISTRANT	1988.08.18	1988.12.12
85-009C	CARBOFURAN	BROCCOLI	12 REGISTRANT	1988.08.18	1988.12.12
85-012	DISULFOTON	LETTUCE	12 REGISTRANT	1988.10.21	1988.12.12
85-016	MALATHION	LENTIL	12 REGISTRANT	1988.10.21	1988.12.12
85-017	CARBOFURAN	LENTIL	10 PESTICIDES	1988.10.28	1988.12.12
85-018	CARBOFURAN	SUGAR BEET	10 HEALTH & WELFARE	1988.07.20	1988.11.14
85-021	BENDIOCARB	GREENHOUSE CUCUMBER	11A SIRS	1988.10.27	CLOSED
85-023	CARBARYL	SAFFLOWER	09 LABORATORY	1988.10.04	1989.02.12
86-002B	BENDIOCARB	INTERIOR PLANTSCAPES	04 HEALTH & WELFARE	1988.09.12	1988.12.12
86-003B	DELTAMETHRIN	INTERIOR PLANTSCAPES	04 HEALTH & WELFARE	1988.09.12	1988.12.12
84-022	METALAXYL	HOLLY	06 PESTICIDES	1988.07.15	1988.12.12
86-004	METALAXYL	HOPS	08 RESIDUE TRIAL	1988.03.07	1988.12.12
86-007	TRIADIMEFON	SWEET CORN	04 HEALTH & WELFARE	1988.10.12	1988.12.12
86-008	CHLOROTHALONIL	SWEET CORN	09 LABORATORY	1988.07.15	1988.12.12
86-012	CARBATHIIN-THIRAM	SAFFLOWER	08 RESIDUE TRIAL	1988.05.13	1988.12.12
86-021	CHLORPYRIFOS	PICKLING ONION	10 HEALTH & WELFARE	1987.05.12	1988.12.12
86-022	COPPER OXYCHLORIDE	BLUEBERRY	12 REGISTRANT	1988.10.21	1988.12.12
86-023	CHLOROTHALONIL	PARSNIP	10 HEALTH & WELFARE	1988.10.13	1988.12.12
86-024	METHYL BROMIDE	EMPTY BEE EQUIPMENT	03 SIRS	1988.07.25	1989.02.12
86-025	OXAMYL	GREENHOUSE BEGONIAS	11A SIRS	1988.07.25	1988.11.14

86-500	DODINE	CONIFER SEEDLINGS	08 EFFICACY & TOLERANCE	1988.03.04	1988.12.12
86-503B	METRIBUZIN	ASPARAGUS (ESTABLISHED)	12 REGISTRANT	1988.07.18	1988.12.03
86-504	BROMOXYNIL	ONIONS (COOKING)	09 LABORATORY	1987.07.29	1988.11.15
86-509A	CHLOROXURON	POPLAR	13 SIRS	1988.10.28	1988.12.12
86-509B	CHLOROXURON	WILLOW	13 SIRS	1988.10.28	1988.12.12
86-511	TERBACIL	MINT	03 SIRS	1988.04.19	1988.11.30
87-001	IPRODIONE	CONIFER SEEDLINGS (NURSERY)	14 SIRS	1988.03.02	REGISTERED
87-002	CHLORPYRIFOS	CRANBERRY	11A REBUTTAL PERIOD	1988.07.26	1988.11.14
87-003	CHLOROTHALONIL	CRANBERRY	10 HEALTH & WELFARE	1988.07.15	1988.12.12
87-005	CYPERMETHRIN	CONIFER NURSERY SEEDLINGS	04 HEALTH & WELFARE	1988.10.18	1988.12.12
87-006	CHLORPYRIFOS	GARLIC	14 SIRS	1988.05.30	REGISTERED
87-108	ENDOSULFAN	GREENHOUSE PEPPER	10 HEALTH & WELFARE	1988.05.03	1989.01.30
87-109	ALDICARB	GREENHOUSE ORNAMENTALS	04 HEALTH & WELFARE	1988.10.12	1989.01.30
87-110	METHIDATHION	CHERRY TREE	09 LABORATORY	1988.07.21	1988.12.12
87-501A	SIMAZINE	PEACH TREE	12 REGISTRANT	1988.03.29	1988.11.15
87-501B	SIMAZINE	APRICOT TREE	12 REGISTRANT	1988.03.29	1988.11.15
87-501C	SIMAZINE	APPLE TREE	12 REGISTRANT	1988.03.29	1988.11.15
87-502A	TERBACIL	APPLE TREE	08 TOLERANCE	1988.04.20	1988.11.15
87-502B	TERBACIL	PEACH TREE	08 TOLERANCE	1988.04.20	1988.11.15
87-502C	TERBACIL	APRICOT TREE	08 TOLERANCE	1988.04.20	1988.11.15
87-503A	METRIBUZIN	CHERRY TREE	03 PESTICIDES	1988.03.29	1988.11.15
87-503B	METRIBUZIN	APPLE TREE	03 PESTICIDES	1988.03.29	1988.11.15
87-503C	METRIBUZIN	PEACH TREE	03 PESTICIDES	1988.03.29	1988.11.15
87-503D	METRIBUZIN	APRICOT TREE	03 PESTICIDES	1988.03.29	1988.11.15
87-504	CHLORPROPHAM + CYANAZINE	ONION	08 RESIDUE TRIAL	1988.05.03	1989.01.20
87-505	PROPYZAMIDE	LETTUCE	08 RESIDUE TRIAL	1988.07.27	1988.11.15
87-507	METRIBUZIN	PEA (PROCESSING)	12 REGISTRANT	1988.04.07	1989.01.20
87-509	GLYPHOSATE	STRAWBERRY	08 RESIDUE TRIAL	1987.09.29	1989.10.21
87-510	SETHOXYDIM	CRANBERRY	08 RESIDUE TRIAL	1987.09.29	1988.12.01
87-511	NAPROPAMIDE	CRANBERRY	11 PESTICIDES	1988.06.06	1988.11.15
87-512	DIPHENAMID	CONTAINER NURSERY STOCK	12 REGISTRANT	1988.08.04	1988.11.15
87-513	SIMAZINE	CONTAINER NURSERY STOCK	12 REGISTRANT	1988.04.20	1988.11.15
87-514	BROMOXYNIL	GARLIC	08 TOLERANCE	1988.07.11	1988.12.12
87-515	PHENMEDIPHAM	TABLE BEET	11 PESTICIDES	1988.09.19	1988.11.15
87-516	PHENMEDIPHAM	TABLE BEET	11 PESTICIDES	1988.09.19	1988.11.15
88-100	DIAZINON	GREENHOUSE PEPPER	11 PESTICIDES	1988.10.12	1988.12.12
88-101	FENBUTATIN OXIDE	GREENHOUSE PEPPER	08 RESIDUE TRIAL	1988.06.29	1988.12.12
88-102	SAFER'S INSECTICIDAL SOAP	GREENHOUSE PEPPER	12 REGISTRANT	1988.06.02	1988.12.12
88-103	BACILLUS THURINGIENSIS	GREENHOUSE PEPPER	12 REGISTRANT	1988.06.02	1988.12.12
88-104	ENDOSULFAN	APPLE TREE	04 HEALTH & WELFARE	1988.05.03	1989.05.10
88-105	ENDOSULFAN	SQUASH	04 HEALTH & WELFARE	1988.05.03	1989.05.10
88-106	ENDOSULFAN	MELON	04 HEALTH & WELFARE	1988.05.03	1989.05.10
88-107	ENDOSULFAN	PUMPKIN	04 HEALTH & WELFARE	1988.05.03	1989.05.10
88-108	CYPERMETHRIN	ONION	13 SIRS	1988.10.28	REGISTERED
88-109	CYPERMETHRIN	CABBAGE	13 SIRS	1988.10.12	1988.11.14
88-110	CYPERMETHRIN	CAULIFLOWER	13 SIRS	1988.10.12	1988.11.14
88-111	CYPERMETHRIN	BROCCOLI	13 SIRS	1988.10.12	1988.11.14
88-112	CYPERMETHRIN	BRUSSELS SPROUTS	13 SIRS	1988.10.12	1988.11.14
88-113	PARATHION	SWEET CORN	03 PESTICIDES	1988.07.18	1988.11.14
88-114	METHOMYL	SWEET CORN	13 SIRS	1988.10.12	REGISTERED

88-115	DIMETHOATE	CABBAGE	12	REGISTRANT	1988.06.07	1988.11.14
88-116	DIMETHOATE	CAULIFLOWER	12	REGISTRANT	1988.06.07	1988.11.14
88-117	DIMETHOATE	BROCCOLI	12	REGISTRANT	1988.06.07	1988.11.14
88-118	DIMETHOATE	BRUSSELS SPROUTS	06	PESTICIDES	1988.05.24	1988.12.12
88-119	NALED	GREENHOUSE ORNAMENTALS	04	HEALTH & WELFARE	1988.05.03	1989.05.10
88-120	NALED	GREENHOUSE CUCUMBER	04	HEALTH & WELFARE	1988.05.03	1989.05.10
88-121	NALED	GREENHOUSE TOMATO	04	HEALTH & WELFARE	1988.05.03	1989.05.10
88-122	METHOMYL	GREENHOUSE ORNAMENTALS	04	HEALTH & WELFARE	1988.10.12	1989.01.15
88-123	ACEPHATE	GREENHOUSE ORNAMENTALS	03	PESTICIDES	1988.02.18	1988.12.12
88-124	ACEPHATE	INTERIOR PLANTSCAPES	03	PESTICIDES	1988.09.12	1988.12.12
88-125	CHLORPYRIFOS	INTERIOR PLANTSCAPES	03	SIRS	1988.10.27	1988.12.12
88-126	FENBUTATIN OXIDE	INTERIOR PLANTSCAPES	03	PESTICIDES	1988.09.12	1988.12.12
88-127	PERMETHRIN	INTERIOR PLANTSCAPES	03	PESTICIDES	1988.09.12	1988.12.12
88-128	ENDOSULFAN	CUCUMBER	04	HEALTH & WELFARE	1988.05.03	1989.05.10
88-129	CYPERMETHRIN	CARROT	02	SIRS	1988.07.25	1988.11.14
88-130	CYPERMETHRIN + B. THURINGIENSIS	APPLE	12	REGISTRANT	1988.10.13	1988.12.12
88-200	IPRODIONE	RUTABAGA	08	RESIDUE TRIAL	1988.10.07	1988.11.14
88-201	METALAXYL	LETTUCE (HEAD)	08	RESIDUE TRIAL	1988.07.11	1988.12.12
88-202	METALAXYL	CARROTS	08	RESIDUE TRIAL	1988.07.11	1988.12.12
88-203	DICHLORAN	ONION	08	RESIDUE TRIAL	1988.07.12	1989.03.09
88-204	BENOMYL	RUTABAGA	08	RESIDUE TRIAL	1988.10.14	1988.11.14
88-205	THIABENDAZOLE	RUTABAGA	08	RESIDUE TRIAL	1988.10.07	1988.11.14
88-206T	BENOMYL + DICHLORAN	PEACHES	03	PESTICIDES	1988.10.12	1988.12.12
88-207T	BENOMYL + DICHLORAN	PLUMS	03	PESTICIDES	1988.10.12	1988.12.12
88-208T	BENOMYL + DICHLORAN	NECTARINES	03	PESTICIDES	1988.10.12	1988.12.12
88-301T	OXAMYL	CARROTS	03	PESTICIDES	1988.10.31	1988.12.12
88-401	ETHEPHON	GRAPE	03	SIRS	1988.08.27	1988.11.15
88-501	BENTAZON	ONION	12	REGISTRANT	1988.08.03	1989.01.15
88-502	CLOPYRALID	STRAWBERRIES	08	RESIDUE TRIAL	1988.05.25	1989.11.15
88-503	CLOPYRALID	STRAWBERRIES	10	HEALTH & WELFARE	1988.07.04	1989.01.20
88-504	SIMAZINE	CONIFERS SITE PREPARATION	12	REGISTRANT	1988.07.07	1988.12.12
88-505	PICLORAM/2,4-D	FORAGES GRASSES (SEEDS)	03	PESTICIDES	1988.03.29	1988.11.15
88-506	TRIFLURALIN	SAFFLOWER	12	REGISTRANT	1988.10.18	1989.01.20
88-507	CHLORSULFURON	BLUEBERRY (LOWBUSH)	08	RESIDUE TRIAL	1988.09.27	1988.11.15
88-508	TRIFLURALIN	FORAGE KALE	12	REGISTRANT	1988.10.18	1989.01.20
88-509	TRIFLURALIN	FORAGE RAPE	12	REGISTRANT	1988.10.18	1989.01.20
88-510	TRIFLURALIN	STUBBLE TURNIP	12	REGISTRANT	1988.10.18	1989.01.20

88-511	DICHLORPROP/2,4-D	BARLEY	03	PESTICIDES	1988.09.07	1988.11.15
88-512	DICHLORPROP/2,4-D	WHEAT	03	PESTICIDES	1988.09.07	1988.11.15
88-513	METOLACHLOR	LUPINS (SWEET WHITE)	03	PESTICIDES	1988.09.07	1988.11.15
88-514	METOBROMURON	LUPINS (SWEET WHITE)	03	PESTICIDES	1988.09.07	1988.11.15
88-515	LINURON	LUPINS (SWEET WHITE)	03	PESTICIDES	1988.09.07	1988.11.15
88-516	FLUAZIFOP-BUTYL	LUPINS (SWEET WHITE)	03	PESTICIDES	1988.09.07	1988.11.15
88-517	METRIBUZIN	LUPINS (SWEET WHITE)	03	PESTICIDES	1988.09.07	1988.11.15
88-518	GLYPHOSATE	BLUEBERRIES	03	PESTICIDES	1988.09.07	1988.11.15
88-519	TRIFLURALIN	CARROTS	12	REGISTRANT	1988.10.18	1989.01.20
88-520	TRIFLURALIN	SNAP BEANS	12	REGISTRANT	1988.10.18	1989.01.20
88-521	TRIFLURALIN	CAULIFLOWER	12	REGISTRANT	1988.10.18	1989.01.20
88-522	TRIFLURALIN	CABBAGE	12	REGISTRANT	1988.10.18	1989.01.20
88-523	TRIFLURALIN	RUTABAGA	12	REGISTRANT	1988.10.18	1989.01.20
88-524	TRIFLURALIN	TOMATOES	12	REGISTRANT	1988.10.18	1989.01.20
88-525	TRIFLURALIN	BROCCOLI	12	REGISTRANT	1988.10.18	1989.01.20
88-526	TRIFLURALIN	BRUSSELS SPROUTS	12	REGISTRANT	1988.10.18	1989.01.20
88-527	TRIFLURALIN	PEPPERS	12	REGISTRANT	1988.10.18	1989.01.20
88-528T	DIQUAT	LUPINS (SWEET WHITE)	02	SIRS	1988.10.13	1988.11.03

ACCEPTED FOR REGISTRATION UNDER THE MINOR USE OF PESTICIDES PROGRAM SINCE NOVEMBER LAST YEAR

H. Krehm, R. McNeil

November 1, 1988

80-516	Trifluralin	Sainfoin	Annual grasses and Broadleaf weeds	02.11.87
86-501	Trifluralin (Extension of Eastern/BC label to all Canada)	Asparagus	Annual Grasses and Annual Broadleaf Weeds	02.11.87
86-502	Trifluralin	Strawberry	Broadleaf weeds	02.11.87
86-506	Sethoxydim	Garlic	Grasses	02.11.87
86-507	Trifluralin	Siberian elm	Germinating Annual grasses and Broadleaf weeds	08.12.87
86-510	Trifluralin	Fall rye, Fall triticale, Winter Wheat	Weed control	11.12.87
83-020B	Terbufos	Rutabaga	Cabbage maggot and Flea beetles	25.05.88
84-006	Phosmet	Celery	Carrot weevil	31.03.88
84-008	Cypermethrin	Lettuce	Aster leafhopper	12.10.88
85-004	Methomyl	Brussels sprouts	Slugs	06.01.88
85-007A	Chlorpyrifos	Brussels sprouts	Cabbage maggot	15.07.88
85-007B	Chlorpyrifos	Rutabaga	Cabbage maggot	15.07.88
85-019	Methomyl	Greenhouse cucumbers	Western flower thrips	06.01.88
86-016	Methomyl	Strawberry	Slugs	06.01.88
86-503A	Metribuzin	Asparagus	Weed control	31.03.88
87-001	Iprodione	Conifer seedlings	Botrytis	04.03.88
87-006	Chlorpyrifos	Garlic	Onion maggot	30.05.88
88-108	Cypermethrin	Onion	Thrips	21.10.88
88-109	Cypermethrin	Cabbage	Thrips	(approved 12.10.88)
88-110	Cypermethrin	Cauliflower	Thrips	(approved 12.10.88)
88-111	Cypermethrin	Broccoli	Thrips	(approved 12.10.88)
88-112	Cypermethrin	Brussels sprouts	Thrips	(approved 12.10.88)
88-114	Methomyl	Sweet corn	Aphids	12.10.88

CPPA FOREST PROTECTION PROGRAM - 1988

J.P. Martel

- IN SUMMARY -

The Problem

In early 1983, responding to the herbicide confrontation in Nova Scotia and its broader implications, the Executive Board set up a Task Force to review the growing problems related to the use of pesticides in forestry. The Task Force report included a recommendation for the establishment of a Forest Protection Committee with the continuing task of promoting the industry's viewpoint on the need for improved forest protection. In addition to pesticides, the Committee is also concerned with other forest environmental issues such as the possible effects of air pollution on forest health and the impact of wildfires. However, in all aspects of the program, forest protection is considered to be one element in the larger context of sound forest management.

The Objective

The primary objective of the program is to help improve public understanding of the need for better forest protection and of the need to have the technology to accomplish the task. This goal is being achieved through the provision of public information and technical information materials for use by member companies in their programs, and for professional reference.

The Committee also directly represents the industry and promotes its viewpoints on regulatory, scientific and technical, and public affairs matters.

In its earlier stages the Committee concentrated on information needs and on building a constituency of the employees of member companies, and local communities. Recently, it has begun to communicate with wider audiences; to promote cooperative efforts within the industry and the broader forest sector, and to assume a more active role in policy and regulatory matters.

The Forest Protection Committee

The Committee is composed of member company professionals in the fields of woodlands management and public affairs. They meet three times a year to direct the program. One of these meetings is held in a location where important forest protection problems exist. As well as the on-site review of regional problems, this meeting also affords the Committee an opportunity to meet with local industry, political leaders, and the media. A second meeting is held in Ottawa and focuses on communication with regulators, political interests, and other organizations concerned about protection issues. The Committee is divided into several sub-committees which deal with specific sub-programs and projects.

The Program

There are several major aspects to the Forest Protection Program:

- -- the development and promotion of the industry's positions on pesticide use in forestry;
- -- the preparation of public affairs and educational materials for use by the industry and the public;
- -- the collection and distribution of technical and other factual information;
- -- the development and promotion of the industry's views on pesticide regulation, research and development;
- -- the cultivation and maintenance of networks of allies with complementary objectives;
- -- investigations into the effects of air pollution on forest health;
- -- reducing the damage to the forest from fire; and
- -- other forest environmental issues which might arise.

The following sections elaborate on activity in each of these areas.

1. Industry's Positions on Pesticides

The following position statements express the industry's views on pesticide use in forestry.

i) "The Use of Herbicides in Forestry"

ii) "The Use of Insecticides in Forestry"

2. <u>Public Affairs Projects and Materials</u>

The following materials are in circulation and available to member companies.

i) "Protecting the Forest Resource" -- an audio-visual presentation on the use and the safety of pesticides.

ii) "A Matter of Safety" -- a booklet on the regulation of pesticides.

iii) "The Esential Edge" -- an audio-visual explaining the need for pesticides in forestry.

iv) "Farming Canada's Forest: Forest Management and Silviculture" -- a publication which describes in detail the objectives and technology of forest management.

v) "Coming of Age" -- a video covering the same general subject matter as the publication of the same name.

vi) "Free to Grow" -- a poster to help convince management, mill and woodlands employees, visitors and the broader community of the need for better forest management. This is the second in the poster series.

vii) "Forest Resource Update" -- a periodic newsletter distributed widely across the country covering current forestry issues and topics of interest.

viii) "Forest Management Education Project" -- the development and distribution of forest management and forest protection education materials for elementary school children in the manner of and in conjunction with the People of the Forest Project.

ix) "Sylvester" -- a project in which individual companies can become involved directly with the public in local communities and urban areas. Seedlings are distributed to the public with instructions on how to plant, tend and protect the seedling. The accompanying message stresses the need to manage Canada's forests in a similar manner.

3. Technical and Other Factual Information

a) Technical Information

Reference materials of a technical nature are prepared and distributed to the forestry sector in fact sheet format for inclusion in a binder retained in forestry offices. This is a joint project with the Forest Pest Management Institute of the CFS. The following technical references are in circulation.

Herbicides:

i) Glyphosate -- a commonly used herbicide known as Vision (formerly Roundup).

ii) Hexazinone -- a herbicide with limited registration sold commonly as Velpar.

iii) 2,4-D -- a herbicide with a long history of usage in forestry, agriculture and home use.

iv) Triclopyr -- a forestry herbicide known as Garlon with valuable applications but not yet registered.

v) Herbicides Registered for Forest & Woodlands Management -- a listing of all registered herbicides with forestry usage.

vi) Other Herbicides Registered for Forest, Woodlands and Nursery (1) -- a summary information on amitrole, chloropicrin, methyl bromide, fluazifop-butyl, napropamide and dazomet.

vii) Other Herbicides Registered for Forest, Woodlands and Nursery (2) -- a summary information on fosamine ammonium, asulam, simazine, MSMA and 2,4,5-T.

In process;

vi) Planned target species and their control products.

Insecticides:

i) Fenitrothion -- an insecticide used primarily against spruce budworm.

ii) Bacillus Thuringiensis -- Bt is a bacterial insecticide used to control spruce and jackpine budworm and other insects.

iii) Nuclear Polyhedrosis Viruses -- NPV is a viral insecticide used to control Douglas Fir Tussock Moth and other insects.

iv) Diflubenzuron -- an insecticide used to control Gypsy Moth, and sold as Dimilin.

v) Aminocarb -- an insecticide used to control spruce budworm and commonly sold as Matacil.

vi) Insecticides Registered for Forest & Woodlands Management -- a listing of all registered insecticides with forestry useage.

In process;

vii) A review of less commonly used insecticides.

viii) Permethrin.

ix) Target insects and their control products.

<u>Others</u>:

i) A glossary of commonly used pest management terminology.

In process;

ii) Toxicity and Toxicology -- a review of terminology and factual information.

iii) Registration and Regulation of Pesticides -- a review of federal and provincial regulations of pesticide use.

b) <u>Other Information</u>

This category covers factual reference materials relating to accurate historical reviews of pest management situations or 'Case Studies'. A second category called 'Questions and Answers' gives factual replies to questions which might be asked of resource managers on protection issues.

<u>Case Studies</u>:

i) The Spruce Budworm Infestation of Cape Breton -- a history of the impact of the budworm on the forest, and the environmental and political battle which resulted in large timber losses in the province and particularly in Cape Breton.

In process;

ii) Budworm Management in New Brunswick -- the long and mainly successful history of budworm management in New Brunswick.

iii) The Mountain Pine Beetle in British Columbia -- a description of the impact of that insect on timber supply management.

<u>Questions and Answers</u>:

In process;

i) Forest Protection -- resource status and the need for more intensfied forest management and protection in Canada.

ii) Pest Management -- the need for effective and efficient pest management in forestry.

4. Regulation, Research and Development

The Committee supports the industry's endeavour to influence the development of more useful pesticides and to make its views known on regulation matters.

i) CPPA is represented on the CFS Forest Pest Management Institute's Advisory Committee. This is a body which advises the CFS on the research and development of pesticides for forestry use.

ii) A position paper stating the need and the means to improve the regulatory process governing the regulation of pesticides for forestry use.

iii) Submissions to and dialogue with the Pest Management Advisory Board of Agriculture Canada regarding the public consultation component of the regulatory process.

iv) Submissions to provincial governments in support of provincial trade associations and member companies. (Ex. A brief was presented to the Quebec government on the use of pesticides in the forestry environment.)

5. Networks and Allies

The Committee believes that it is very important for those with a mutual interest in forest environmental problems to work together. In support of this objective the Committee is involved in the following:

i) "Networks" -- the Committee has established a network within the industry to promote, facilitate and coordinate actions on forest protection issues. A broader group of forest sector interests are included in a network for communications purposes only. A special newsletter called "Communiqué" was developed for distribution of information on important forest protection issues.

ii) "Forest Resource Environment News" -- this intra-forestry sector newsletter provides information to industry and allies on current developments in forest protection related issues. The mailing list for this newsletter forms a list of individuals concerned with the issues.

iii) "Public Affairs and Forest Management: Pesticides in Forestry" -- a seminar was held on this topic and proceedings are available.

iv) "Preventing & Resolving Public Conflicts in Forest Management" -- a workshop sponsored by the Committee to help enable managers to deal with issues.

v) Committee members and staff are involved in the programs of other allied groups, provincial level programs, and federal efforts in issues management and public information programs.

vi) The Committee sponsors workshops with allies to develop common approaches, coordinate efforts and to communicate. Most recently a workshop was held titled, "Cooperation: Pest Management Issues".

6. <u>Air Pollution and Forest Health</u>

A sub-committee is engaged in investigating the problem of possible damage to the forest resource from long-range transported air pollutants (LRTAP).

Several initiatives have been taken:

i) "Acid Rain and the Canadian Forests" -- this position paper discusses the facts concerning the impact of air pollutants on the forest and the industry's views on research and pollution controls.

ii) The sub-committee meets with researchers to review the status of knowledge and ongoing research programs in Canada. It has visited dieback areas and research installations. The industry's position paper was prepared under the direction of the sub-committee.

iii) The sub-committee follows the scientific developments in the field, and has organized technical presentations for the industry.

iv) The industry is represented on the Canadian LRTAP Terrestrial Research Coordinating Committee.

v) Contacts have been made with U.S. forest industrial counterparts.

vi) An industry representative made a study tour of West Germany and southern Sweden to review the problem in those areas.

7. Fire Prevention

A position paper on this topic has been in wide circulation.

i) "Protecting the Forest from Fire"

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November 1988

OPERATIONAL HERBICIDE RESEARCH CONDUCTED BY FPMI IN 1988

Report to the 16th Annual Forest Pest Control Forum

Project FP-54-1 - Herbicide Applications

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OPERATIONAL HERBICIDE RESEARCH CONDUCTED BY FPMI IN 1988

FP-54-1 conducts operational conifer release and site preparation trials that are designed to evaluate the weed efficacy, crop tolerance, and crop growth response aspects of various forestry herbicides and herbicide use strategies. The following paper briefly outlines new and ongoing herbicide research that FP-54-1 has been involved with this past year.

New Operational Herbicide Research

This past summer, FPMI worked cooperatively with the New Brunswick Department of Natural Resources and Energy and the Canadian Forestry Service, Maritimes, to establish a trial designed to develop an improved-use strategy for VISION (glyphosate). The trial was conceived last May, after the cooperators attended a New Brunswick Spray Efficacy Research Group (NBSERG) meeting in Fredericton.

At this meeting, the fact that there exists no herbicide application technology, specific to forestry, was cited as a major concern. For example, in New Brunswick forests alone, more than 6 million dollars are being spent annually on VISION application with techniques adopted from agriculture - techniques that may not offer maximum efficacy at minimum cost. It was agreed that VISION is currently well established as being the most effective broad-spectrum herbicide available and significant cost savings may be realized by finding more effective and efficient methods of applying it.

Recent work with glyphosate suggests that efficacy can be improved through the use of small droplet sizes (200 to 350um) at low carrier volumes (47 to 35 l/ha) (Bode and Butler, 1982; Prasad and Cadogan, 1987; Prasad and Cadogan, 1988; Brunsdon, 1988). In this light, the trial conducted by FPMI this summer is designed to compare the efficacy and crop tolerance levels produced by the currently-used operational delivery system (D10-46 nozzle with a VMD of 750 um) to those produced by the AU5000 Micronair system (with a VMD of 250 um). A second objective of the trial is to define a reduced active rate, delivered with either system (D10-46 or Micronair), that would maintain or improve the current standard of efficacy and crop tolerance.

A randomized-block design with four replicates was used for the experiment. The four blocks that were chosen each have reasonably uniform raspberry cover throughout, gentle topography, similar site history, and black spruce crops. Block sizes range from 30 to 62 ha. Considerable effort went into the selection of these four blocks, including the examination of 21 blocks and the sampling and analysis of pre-treatment raspberry cover on 7 blocks. All of the blocks are located on Crown Land in New Brunswick; two approximately 90 km north of Fredericton, a third 18 km east of Edmunston, and a fourth 125 km north of Edmunston.

Each of the 4 blocks are subdivided into 9 treatment plots. These plots vary in size in order to take advantage of the terrain and are between 1.8 ha and 6.0 ha. Within each of the 9 plots, 25 subsamples have been systematically located along a transect that cuts across each plot diagonally. Each transect begins and ends at least 50 m <u>inside</u> the plot boundary to insure that sampling takes place well within the area planned to receive the calibrated dose. The subsamples are crop-tree centered, permanently marked, and consist of a 1-m sample radius, within which the percent cover of raspberry is estimated. The crop trees in the center of each subsample are rated on a scale of 0 (healthy) to 10 (dead). All pre-treatment data was recorded during July 1988.

Each of the four blocks contained the following 9 treatments:

1) D10-46 nozzles, 0.25 Kg ai/ha,
2) " " , 0.50 " " ,
3) " " , 0.75 " " ,
4) " " , 1.00 " " ,
5) AU5000 micronair, 0.25 " " ,
6) " " , 0.50 " " ,
7) " " , 0.75 " " ,
8) " " , 1.00 " " , and
9) untreated.

Two BELL 206B helicopters were used to apply these treatments, one equipped with micronaires, the other with the conventional nozzles. Both helicopters were flown by the same pilot, fitted with the same SIMPLEX spray system, and calibrated to deliver a total volume of 37.4 l/ha. Plots were clearly flagged on the ground so that the pilot was able to navigate accurately.

Treatment of the four blocks took place between September 4 and 10, 1988, all during early morning sessions. All 8 treatments were applied to each individual block during a single 2-hr spray session. Weather at the time of application was similar for 3 of the 4 blocks: winds light (0-3 kph), temperatures between 2 and 11 C, and RH between 88 and 100%. Due to limited budgets, 1 of the 4 blocks was treated in less than desirable conditions (winds 2 to 5 kph with occasional gusts to 10 and 20 kph) and the question remains as to whether or not its data will be usable. All treatments had a rain-free period of at least 18 hrs post application.

Since raspberry is the major competitor in N.B., efficacy is being measured by the relative change in pre and post-treatment cover of this species. Crop tolerance is being evaluated as the relative change in health of the crop trees planted on the treated areas.

To help verify the results obtained in this trial, residue and deposit sampling was conducted. Petri dishes, containing glass-fibre filter paper, were placed within every fifth subsample area in each plot (5 per plot) in order to estimate impingement of active ingredient on target foliage at the time of application. A second set of petri dishes, placed in the same locations as the first, were used to detect potential contamination from adjacent treatments. 3M paper (#729), was also placed beside the residue sample locations in order to provide droplet spectra data for each of the treatments.

The data generated in this trial will be analyzed with regression techniques, with the intention of illustrating any differences in effectiveness between the two systems. As well, dose-response curves will be generated for each system with the hope of defining a reduced active rate that will still meet management efficacy objectives. Since the active ingredient represents 70% of total treatment costs, any reduction in the amount of active that can be made through the use of smaller droplet sizes would mean tremendous cost savings. Further, the results of this trial will allow the planning of future research that will be designed to seek out further cost savings in the interacting effects of carrier volume, spray timing, adjuvants, and droplet size.

Ongoing Operational Herbicide Research

Currently, FP-54-1 has six active trials located across Canada. Four of these trials are located in New Brunswick, on J.D. Irving Ltd. freehold land in Black Brook, the fifth is located in Foleyet, Ontario, and the sixth is located at Carnation Creek, on the west coast of Vancouver Island.

The latest trial established at Black Brook was a June 1987 comparative study of VELPAR L (liquid hexazinone) and VELPAR ULW (ultra-low-weight, dry-flowable hexazinone). Aerial application of a single active rate (2 Kg/ha) was used for this comparison. First-season weed efficacy results were presented at the 1988 Northeastern Weed Science Society (NEWSS) meeting in Hartford, Ct. (Pitt et al., 1988a). Half of the experiment was planted one month after treatment, the other half was planted this past August. Repeat measurements were made on the crop and weeds this August, and crop tolerance and second-season weed efficacy data are planned for presentation at the 1988 Expert Committee on Weeds (ECW) and 1989 NEWSS meetings.

In 1986, a large-scale comparison of the site preparation herbicides VELPAR L, PRONONE 5G (5% granular hexazinone), and PRONONE 10G (10% granular hexazinone) was conducted at Black Brook. These herbicides were applied with ground-application equipment and the experiment was designed to compare several rates of each of the herbicides as well as spring vs fall soil application.

Also in 1986, along side of this VELPAR/PRONONE trial, a comparison of ALLY (metsulfuron-methyl) and OUST (sulfometuron-methyl) was established. Again, ground application equipment was used to apply several rates of each herbicide, but in this case, as spring soil and summer foliar applications.

For both of these 1986 trials, results of the spring applications were presented at the 1988 NEWSS meeting (Reynolds et al., 1988a; Reynolds et al., 1988b). Repeat measurements were made on the crop and weeds in these experiments this August, and results of the summer/fall applications and the comparison of the two application times are planned for presentation at the 1988 ECW and 1989 NEWSS meetings. Crop trees appear to show treatment-related growth differences this year and data will be analyzed and reported on later this winter.

The oldest FP-54-1 trial established at Black Brook is a 1984 site preparation experiment involving VELPAR L. The trial encompasses about 40 ha and involved the aerial application of 3 different active rates. Since 1985, the trial has yielded valuable weed efficacy data which was reported in the 1986 Proceedings of the NEWSS (Reynolds et al., 1986). In 1987, emphasis shifted toward the crop tolerance and growth response aspects of this study and some very positive treatment effects were illustrated (Pitt et al., 1988b). This tolerance and growth-response data was presented at the 1988 NEWSS meeting. In August 1987, half of the reps of this experiment were treated with VISION. Repeat measurements of the crop and weeds were made this August and future follow-up should provide some interesting site prep vs. site prep-and-release data.

Moving westward, to Ontario, an application of VELPAR L and PRONONE 10G was made near Foleyet, in the spring and fall of 1986. This experiment parallels the one conducted in N.B. during the same year (similar application equipment and design) but is providing data for lighter-textured soils than is the N.B. study. Weed efficacy, crop tolerance, and crop growth response data were collected this past September and will be analyzed and reported on later this year.

At Carnation Creek, where ROUNDUP (glyphosate) was applied to a 42-ha portion of Coastal watershed in September 1984, weed efficacy, crop tolerance, and crop growth response data were collected from 1985 through 1987. This data was presented at the Carnation Creek Herbicide Workshop, held in Nanaimo, B.C., last December (Reynolds et al., 1987). No measurements were conducted by FP-54-1 this field season.

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SUMMARY REPORT OF THE STUDIES ON HERBICIDES PHYSIOLOGY

[Project No. FP-53 - Herbicide Physiology]

Report to The 16th Annual Forest Pest Control Forum

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Summary Report of the Studies on Herbicide Physiology

Introduction

The aims of the Herbicide Physiology Study are to determine the toxicological and physiological properties of herbicides and their formulations and other chemicals on forest weed species and selected crop trees and for those that show potential for use, to provide possible dosage levels and use patterns for further field testing. This is accomplished by carrying out extensive studies in the greenhouse as well as under natural forestry situations employing small (field) plot techniques. Studies on the mechanisms of crop tolerance to herbicides/adjuvants are also conducted.

A. Greenhouse Studies

(i) Evaluation of Adjuvants on Herbicide Efficacy and Crop Tolerance

Spray adjuvants are a class of chemicals which, when added to herbicide formulations, modify and facilitate the effectiveness of the active ingredients. In so doing they reduce the cost of application and chemical burden in the environment. Two groups of additives (a) organic and (b) inorganic were investigated in the greenhouse. Employing seedlings of aspen, alder and white birch the effectiveness of 6 organic adjuvants Enhance, Ethokem, Frigate, LI-700, Triton-XR and Tween-20) and 1 inorganic adjuvant (ammonium sulfate) on efficacy of Vision @ 0.125 kg/180L/ha was investigated. Most of the organic adjuvants enhanced the effectiveness of Vision at low concentration (0.125 kg/ha) on greenhouse plants. Similarly the inorganic adjuvant (ammonium sulfate) also increased the effectiveness of Vision at low concentration (1.1 kg/ha) but the "burn-out" effects were short-lived.

(ii) Evaluation of Plant Growth Regulator (PGR) on Efficacy and Crop Tolerance

Chemical herbicides minimize competitive ability of forest weeds by killing or suppressing their growth. This results in browned-out areas which are aesthetically displeasing to the public. Plant growth regulators, on the other other, do not kill/brown the weeds, instead they retard the competitive ability by producing short/fewer roots and shoots.

The crop species (conifers) can thus, take advantage of this retardation and can outgrow the weeds. Thus, growth regulators offer a potential tool for weed management in the forests. A new compound, PRUNIT, has recently been developed by the Chevron Chemical Company, California and exhibits considerable growth regulator properties. Using a series of concentrations weed and crop species, it is proposed to investigate the potentials of PGR in the greenhouse.

B. Field Studies

(i) Effects of Adjuvants on Efficacy of Forestry Herbicides under Small Plot Conditions

As a followup to the previous year's work, the effectiveness of 6 adjuvants: Enhance, Ethokem, Frigate, LI-700, Triton-XR and Tween-20 was tested, this time with Vision at concentrations of 0.25 and 1.1 kg/180L/ha. The trials were conducted north of Thessalon, Ont. employing the small plot technique. Plots were arranged in a stand of trembling aspen using the randomized block layout with appropriate buffer zones and three replications. Application of treatments took place at the beginning of August, 1987. All adjuvants were applied at 0.5% v/v with two concentrations of Vision (0.25 and 1.1 kg/ha) by "solo" backpack hand sprayer. (An additional dosage for LI-700 of 0.25% v/v was also included in the series.) Evaluations were carried out after one year.

Results showed that none of the adjuvants enhanced the efficacy of glyphosate at the highest concentration (1.1 kg/ha) probably because adequate amount of adjuvants are already present in the commercial formulation (Vision). However, when the concentration of glyphosate was lowered to 0.25 kg/ha, Ethokem, Triton and Tween-20 showed significant differences in augmentation of glyphosate activity.

Effects of low volume rate of application of adjuvants (Ethokem, Enhance and Triton-XR) and glyphosate @ 30 L/ha were also investigated. The reason for this was that most aerial applications of Vision now rely upon smaller volume rates for efficacy.

Employing a low volume rate (30 L/ha) and a low concentration of glyphosate (0.30 kg/ha), the additive effects of Ethokem, Enhance and Triton-XR were investigated in the small plots at Constance Lake area. A Herbi (C.D.A.) type of sprayer using spinning disc nozzle was used. Preliminary results suggested that at low volume rates, none of the adjuvant, significantly enhanced the activity of Vision meaning thereby that adequate amount of innate adjuvants were already present in the formulation. Thus, there may not be any further need of adding adjuvant to commercial formulation of Vision at low volume rate of applications. There may be a need only when the volume rate is high or the weed species is hard to kill.

(ii) Collaborative Field Research

(a) No observable effects levels (NOEL) of Vision

To determine a suitable buffer zone of aerial application of Vision a collaborative research program involving the University of Guelph, FP-62 (Nick Payne) and the O.M.N.R. was continued under the aegis of COFRDA. Field plots of aspen and pincherry with red pine (north of Thessalon) were sprayed with different levels of Vision. Results obtained so far demonstrated that very low concentration of Vision (5, 10, 25%) do not affect efficacy under field conditions but the same concentrations affect the physiological processes in pin cherry. Hopefully a more sensitive pathway (Shikkimic and metabolism) is found to be most vulnerable to Vision and attempts are being made to study this.

HERBICIDE CHEMICAL ACCOUNTABILITY (1988)

[Project No. FP-72 - Herbicide Chemical Accountability]

Report to The 16th Annual Forest Pest Control Forum

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Herbicide Chemical Accountability (1988)

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 1987-88

Following the internal review (March, 1988) Herbicide Chemical Accountability (HCA) was redefined as an independent project (FP-72) and grouped under the environmental concerns section within the chemical control agents program. The project objectives as noted above are approached through two constituent studies:

a) Methodology Development (FP-72-1)

Glyphosate

Analytical methods developed and validated during 1986-87 served as the basis for a presentation to the Eastern Canada Pesticide Workshop and as a journal publication which is currently under review.

Triclopyr

Analytical methods made available through the DOW Chemical Company were adapted and validated for use in analysis of streamwater and sediment samples emanating from the cooperative Dora Creek environmental fate project. Further optimization of the methods including conversion to capillary column or megabore column separation have been initiated with the intention of a future publication dealing with analysis of triclopyr residues in forest environmental substrates.

Metsulfuron methyl

Development of a GLC-ECD method for metsufluron methyl residues in environmental substrates is in progress. Successful development of the method would allow specific detection of the parent compound at levels known to be phytotoxic and would be utilized to determine metsulfuron methyl residues in field samples emanating from the Nassau Township environmental fate research experiments.

b) Environmental Fate Research (FP-72-2)

Glyphosate - Carnation Creek, B.C.

Two papers were presented at the Carnation Creek Workshop, held in Nanaimo, B.C. in December of 1987. These presentations summarized the environmental fate research conducted as part of the overall Carnation Creek study. A comprehensive description of the research and resulting data was also written and submitted as two papers for incorporation into the workshop proceedings. Preparation of two journal manuscripts is currently underway and publication of this material in the scientific literature will mark the termination of this project. Data are to be used to address regional concerns both in B.C. and nationally.

Glyphosate - Thessalon, Ontario

Research on the correlation of various meteorological conditions with off-target drift of glyphosate has been completed. Results of this cooperative project (FP-62/72) are currently being prepared for a journal submission.

Glyphosate - Fredericton, New Brunswick

Research to investigate strategies for improved-use of glyphosate has been initiated by FP-54-1. The research involves the cooperation of FP-72 in determination of on-target deposit using artificial deposit collectors. Funding for the research was obtained in June 1988 and the field research was initiated in early September. Analyses of deposit collectors is ongoing and results will be incorporated into a future journal publication.

Triclopyr - Dora Creek, Ontario

A cooperative research trial investigating the environmental fate and impact of triclopyr in a boreal forest watershed was successfully initiated on DOMTAR freehold lands in August, 1987. FP-72 staff have assisted in site selection, protocol development, initial sampling and residue analyses for the project. Residue analyses for triclopyr as the parent butoxyethyl ester, the free acid and the major metabolite in aquatic substrates was completed by FP-72 laboratories in August, 1988. Results are to be incorporated into a journal publication scheduled for 1989 and will form a major portion of the environmental chemistry submission for silvicultural registration of GARLON 4.

Metsulfuron methyl - Nassau Township, Ontario

Metsulfuron is the latest 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 is currently ongoing. Laboratory experiments dealing with soil persistence and leaching are nearing completion. Field experiments to investigate the environmental fate and impact of metsulfuron methyl in the boreal forest region ecosystem were initiated in August 1988 on DOMTAR freehold lands west of Hearst, Ontario. Sampling of the field experiments is currently ongoing and scheduled for completion in August, 1989. Termination of the project including publication is expected in 1990-91.

Other Activities and Responsibilities

PRUF Program

Duties associated with direction of PRUF contracts for both hexazinone and glyphosate soil persistence studies have been terminated with the acceptance of the final report for these two contracts. Research relating to the investigation of glyphosate fate in edible berries was also completed and a final report accepted. A publication to be co-authored by the contractees (D.N. Roy and co-workers) and FPMI staff (Dean Thompson, Raj Prasad) is currently in preparation.

COFRDA Program

Supervision of a COFRDA contractee who conducted residue analyses on glyphosate within FP-72 laboratories was completed in May, 1988. A presentation of results was made by the contractee (V. Manniste-Squire) to a COFRDA panel and a written report submitted to the senior scientific authority (Dr. N. Payne, FP-62). Data will be utilized in modeling off-target deposit as it relates to non-target phytotoxicity.

Non-target Phytotoxicity Committee

The project leader (FP-72) accepted an invitation to participate in a cross-departmental committee established to define research needs, protocols and registration requirements for non-target phytotoxicity testing. One meeting of the newly established committee was held in June, 1988. A draft document detailing guidelines is being distributed to researchers, government and industry representatives for comment.

NEWFOUNDLAND
AERIAL HERBICIDE SPRAY PROGRAM
(Prepared by G.K. Ross, Director - Silviculture)

(Presented at Pest Control Forum, Ottawa, Nov. 15-16, 1988)
(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 93 000 hectares since 1975 and includes around 20 000 hecatres in plantations and 40 000 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 comercial 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 4 505 hectares have been treated up to and including 1988. In 1984, the Provincial Government required an environmental assessment under the Environmental Assessment Act. This assessment has been on-going since that time and was completed this year (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 Department of Forestry 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 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 45 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.

SUMMARY OF AERIAL HERBICIDE SPRAY - NEWFOUNDLAND 1984-88

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

TOTAL 1984-88 4505 ha

* S = Site prepation
P = Plantation release
C = Conifer release

Use of operational herbicides in Nova Scotia T.D. Smith and J. Burgess - Forest Protection.

The following is a brief discussion on the operational use of herbicides in Nova Scotia with a little information on operational and one experimental trial. In Nova Scotia data on the use of pesticides must be filed by the last day of the year. These data presented here are tentative and may be incomplete but do reflect the general magnitude of herbicide use in the Province.

Provincial scene:

There were 441 permits requested through the Nova Scotia Department of Environment. Both the Departments of Lands and Forests and Health advise Environment on the suitablity of the site for treatment. The 441 permits were for 994 different sites and an area of 18 563 hectares, of this area 798 ha were deleated.

Table 1. Operational use of herbicides in Nova Scotia, 1988

Method of Application	Herbicide Proposed Area (ha)			
	Princep	Velpar	Vision	Total
Aerial	0.00	13.30*	15 651.00	15 644.30
Ground (unspecified)	22.00	19.00	15.50	56.50
Ground Boom	60.10	127.40	633.00	820.50
Ground Hydraulic	44.00	273.30	1 356.50	1 673.80
Ground Mist Blower	0.00	0.00	277.21	277.21
Ground Back Pack	13.00	7.10	50.20	70.60
Total Area (ha)	139.10	440.10	17 983.41	18 562.61

* Experimental Use Only

Operalional use of herbicides on Crown Land by the Department of Lands and Forests:

Spraying was carried out in both the spring and the fall. In the spring two small areas were treated, ground, Velpar 0.4 ha @ 2.25 kg/ha and Princep 1.0 ha @ 6.3 kg per hectare. In the fall a total of 439.7 ha was aerially treated with Vision at a dose of 4.7 L/ha in an application rate of 45 L per hectare.

1988 SUMMARY OF HERBICIDE TREATMENTS IN NEW BRUNSWICK

Area Treated (ha)

Agency	Plantation Tending	Natural Release	Aircraft Fixed Wing	Aircraft Rotary Wing	Total
N.B.D.N.R.					
Crown Land	12256	7614	9448	10422	19870
Small Freehold	365	-	-	365	365
	12621	7614	9448	10787	20235
Large Freehold					
J.D. Irving	9500	5500	12000	3000	15000
Fraser	4200	1200	-	5400	5400
NBIP	820	80	900	-	900
	14520	6780	12900	8400	21300
TOTAL	27141	14394	22348	19187	41535

1. All herbicide treatments carried our aerially.
2. Only Vision used operationally at rates of 3.20L to 5.00L per hectare.
3. Total spray volumes (Vision + water) at 37 or 47 L/ha.

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SUMMARY OF 1988 FIELD AND LABORATORY RESEARCH REGARDING THE USE OF *B.t.* FOR CONTROL OF FOREST INSECT PESTS

[Project No. FP-10-2 - Bacterial Applications]

Report to The 16th Annual Forest Pest Control Forum

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November 1988

Summary of 1988 Field and Laboratory Research Regarding the Use of B.t. for Control of Forest Insect Pests

Introduction

Bacillus thuringiensis (B.t.) is now widely used for effective control of the eastern spruce budworm in Canada. Goals of the Applications Research Project at FPMI are to further improve the effectiveness of B.t. for spruce budworm control and to transfer the knowledge and experience gained from work with this species to other defoliating forest insect pests. The research program comprises three major components:

1. To obtain a thorough understanding of the interaction between foliar deposits, the target insects and the host tree as affected by post spray weather,

2. To ascertain the relative susceptibility of major forest insect pests to various strains of B.t. in order to assess control potential,

3. To quantify residual activity of currently used B.t. formulations in relation to weather conditions and to assess spray adjuvants to increase the foliage life of B.t.

During 1988 work was conducted in each of these areas and is summarized below.

1. B.t.-target insect-weather interactions

Earlier studies with B.t. incorporated into artificial diet indicated that temperature had no effect on the level of toxicity but that larval mortality progressed more rapidly with increasing temperature (Can. Ent. 119: 941-954). A similar effect of temperature was observed in assays with balsam fir foliage sprayed with 0.5, 2.0 and 5.0 droplets per needle (40-50 µm drops, Thuricide 32 LV). I also examined the effect of temperature on the exposure time required for ingestion of a lethal dose by larvae feeding on sprayed foliage. Groups of larvae were transferred to untreated diet after 1,2,3,5,7,9 and 14 days of feeding on foliage with 1.5 drops per needle at 13, 19 and 25°C. More than 50% of the larvae had ingested a lethal dose after an exposure of only one day, regardless of temperature. Experiments were repeated in 1987 at various droplet densities. These data suggest that temperature has very little effect on the probability that a larva ingests a lethal dose, provided that density and potency of the droplets are sufficiently high. The data also suggest that events most critical to spray efficacy occur within the first few days following spray application. Results are being prepared for publication in Can. Ent. in 1989.

2. Susceptibility of defoliators to *B.t.*

Laboratory bioassays are conducted continuously to assess the effectiveness of new *B.t.* products against various defoliating lepidopterans. These products are provided by industry and include recently discovered natural strains as well as genetically-engineered gene products (heat-killed preparations of *E. coli* and *Pseudomonas* with unaltered genes of existing *B.t.* strains). Relative susceptibility of eastern spruce budworm, western spruce budworm and jackpine budworm to HD-1 and NRD-12 was studied in diet bioassays and on sprayed foliage. Western spruce budworm was 5-10 fold more susceptible to both strains. Results are in press (J. Econ. Entomol.).

3. Residual toxicity of *B.t.*

Residual toxicity of Thuricide 48LV was studied on sprayed balsam fir seedlings placed outside in various enclosures, permitting full exposure to sun and rain and exposure to sun only (rain excluded). A control group was sheltered from both sun and rain. Residual toxicity on the foliage was determined by daily bioassay against spruce budworm larvae. The effectiveness of two stickers (3% RA1990, Monsanto and 3% Rhoplex, Rohm and Haas) was evaluated on exposed seedlings. Data analysis is not yet complete. However, under sunny conditions with very little rain (June trial) 50% of original activity remained after 5 days as compared with 1-2 days under rainy conditions (July trial). The two stickers did not substantially improve residual toxicity. Inactivation by sunlight does occur but has a relatively long-term effect. It appears that washoff by rain is more critical to the success of a spraying operation, especially in the first few days after application. Results were accepted for publication in J. Econ. Entomol. (in press).

1988 Field Study: ULV application of *B.t.* against gypsy moth

Current use of *B. thuringiensis* against gypsy moth involves application of diluted formulations in 6 to 9.5 L/ha. Recent experience with spruce budworm control indicates that efficacy of *B.t.* is improved by applying undiluted formulations in 1.5 to 2.5 L/ha. In 1987, we compared spray deposition in an oak forest canopy resulting from two volume application rates (1.8 versus 6.4 L/ha) and related spray deposits on the foliage to gypsy moth mortality in bioassays. The study was conducted in cooperation with C.J. Wiesner and C.M. Riley of New Brunswick Research and Productivity Council. Results were reported in detail in last year's report and have been submitted to Can. Ent. for publication in 1989. In 1988, a more extensive trial was conducted in cooperation with OMNR Pest Control Section, with the same objectives as in 1987. Dipel ~~8AF~~ 64AF was applied undiluted in 1.8 (30 BIU/ha) or 0.9 L/ha (15 BIU/ha) and diluted in 6.0 L/ha (30 BIU/ha), using Micronair AU4000 atomizers (Piper Brave). Sprays were applied at 60-80% leaf expansion when 10-50% of larvae were in third instar. Spray deposition was assessed by RPC or 15-25 trees/block in 3 blocks treated with 0.9 L/ha, 2 blocks treated with 1.8 L/ha, and 1 block treated with 6.0 L/ha. In one block of each treatment sampling was intensified to study deposition at upper, middle and lower canopy and to relate spray deposits to larval mortality in bioassays of sprayed foliage. In each of those blocks efficacy was also assessed in terms of pre- and post-spray egg mass counts and foliage protection. Preliminary results indicate similar spray deposition (5-10 droplets/cm^2) and larval mortality (45-50%) in the 1.8 and 6.0 L/ha treatments. In the 0.9 L/ha treatments spray deposits were lower (3-5 droplets/cm^2) and larval mortality was only 30%. In all blocks there was a decrease in spray deposition with increasing canopy depth. Defoliation in treated blocks ranged from 12-15% as compared with 30% in nearby untreated areas. Defoliation estimates were low because egg mass densities were generally low (1300-3000 egg masses/ha). Post spray egg mass data are not yet available. The data indicate again that undiluted application at 1.8 L/ha is at least as effective as diluted application at 60 L/ha, and that 0.9 L/ha may not be adequate to obtain the desired foliage deposits.

USE OF LECONTVIRUS AND SERTIFERVIRUS IN ONTARIO

Report to the 16th Annual Pest Control Forum

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USE OF LECONTVIRUS AND SERTIFERVIRUS IN ONTARIO

Lecontvirus is a nuclear polyhedrosis virus for control of redheaded pine sawfly, *Neodiprion lecontei*, which received temporary registration in 1983 and full registration under the Pest Control Products Act in 1987. An emulsifiable oil formulation of Lecontvirus was supplied by FPMI to OMNR staff in 7 districts and two forest product companies in 1988. The material was used in 5 of the 7 districts; 26 plantations with a combined area of 201.2 ha were treated (Table 1).

Table 1. Use of Lecontvirus in 1988 in Ontario

District	No of plantations treated	Total area treated (ha)
Bancroft*	12	66.2
Espanola**	3	29.8
North Bay	2	27.0
Parry Sound	4	5.2
Tweed	5	73.0

* Includes 4 plantations (26.0 ha) treated by Domtar Forest Products staff
** Includes 1 plantation (3.8 ha) treated by E.B. Eddy Forest Products staff

Shelf life studies are being conducted with another viral insecticide for sawfly control, Sertifervirus for European pine sawfly, *N. sertifer*. After 1 year storage at room temperature and at 2°C, there was major loss of activity of an emulsifiable oil suspension. On the other hand, a wettable powder formulation suffered no loss of activity after 1 year in storage. This experiment will be continued next year when formulations have been stored for 2 years. It is imperative that "Use by" instructions are followed on the Lecontvirus emulsifiable oil formulation label and it is not stored from one year to the next. We are evaluating the possibility of replacing the emulsifiable oil with a wettable powder formulation which will, of course, mean a revised label.

Lecontvirus will be available to OMNR and forest product company staff in 1989 and requests for material should be made to FPMI around April or May. Lecontvirus is formulated and shipped in early June.

We are awaiting the outcome of our registration petition for Sertifervirus which was submitted in 1985. There are very few requests for this viral insecticide because European pine sawfly is currently an insignificant pest. None was used in Ontario in 1988, although ornamental trees were treated in St. John's, Newfoundland. Requests to FPMI for material should be made as soon as possible as a Research Permit is required for this unregistered viral insecticide. A demonstrable need for this product should help accelerate the registration process.

EXPERIMENTAL AERIAL APPLICATION OF DISPARVIRUS FOR CONTROL OF GYPSY MOTH IN ONTARIO.

Report to the 16th Annual Pest Control Forum

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November, 1988.

Experimental aerial application of Disparvirus for control of gypsy moth in Ontario.

Summary

A Cessna Ag-truck fitted with 4 Micronair AU 4000 rotary atomizers was used to spray 3 plots (combined area of 64.0 ha) with Disparvirus, a nuclear polyhedrosis virus (NPV) product for gypsy moth control. Two applications, 3 days apart, were made when larvae were mainly in their first larval instar. The dosage for each application was 1.25×10^{12} polyhedral inclusion bodies (PIB)/ha, the emitted volume 10L/ha and the tank mix contained 25% (v/v) molasses and 6% (w/v) Orzan LS as a sunscreening agent. A further 3 plots were selected as untreated checks. Gypsy moth egg mass densities in the spring of 1988 ranged from 1,430 to 8,520/ha in the 6 plots.

A detailed assessment involved larval, pupal and fall egg mass counts, weekly records of the incidence of NPV-infected larvae in all 6 plots and defoliation estimates in treated and check plots. Pupal counts per metre of burlap trap were 5.8, 3.5 and 12.0 in treated plots, and 66.4, 58.3 and 60.9 in corresponding untreated checks. Defoliation of red oak was estimated at 14% in two of the treated plots compared to 82 and 90% in the corresponding check plots. The third treated plot suffered 46% defoliation which was attributed to oak leaf shredder, Bruce spanworm and forest tent caterpillar as well as gypsy moth; defoliation in the corresponding check plot was 31%. Peaks of NPV infection at 12 to 19 days post-spray reached 60.5, 84.9 and 48.7% of larvae infected in the treated plots and secondary peaks of 78.2, 65.2 and 37.1% were recorded at the onset of pupation 40 to 47 days post-spray. In the check plots, levels of naturally occurring NPV infection remained low until the onset of pupation when they increased rapidly reaching peaks of 27.1, 56.6 and 42.5% of larvae infected. Changes in egg mass density between spring and fall counts attributed to the Disparvirus treatment were corrected for natural changes in the check plots using a modified Abbott's formula and reductions of 84, 85 and 92% were recorded for the 3 treated plots.

Introduction

A gypsy moth nuclear polyhedrosis virus (NPV) product was registered by the USDA Forest Service under the name Gypchek in 1978. The label suggests a range of dosages from 5×10^{11} to 2.5×10^{12} polyhedral inclusion bodies (PIB)/ha. In 1979, Gypchek was used operationally in 6 states and a total of about 4,000 ha treated. However, Gypchek has not been used operationally since then, although experimental sprays have been conducted annually in the USA with a view to fine-tuning dosages and application strategies.

A spray trial was conducted in Ontario in 1982 with Gypchek supplied by USDA Forest Service staff. In 1985, the same strain of NPV was produced at the Forest Pest Management Institute (FPMI) and two plots treated in 1986, one with a double application giving a total of 5.4×10^{11} PIB/ha and the second with almost 10-fold that dosage at 4.4×10^{12} PIB/ha. The high dosage virtually annihilated the gypsy moth population.

In 1988, it was decided to conduct a replicated test with a double application of 1.25×10^{12} PIB/ha giving 2.5×10^{12} PIB/ha in total. It was felt that sound base-line data could be obtained with this dosage upon which future trials could be compared and evaluated. Also, this trial will provide efficacy data for a Canadian registration petition for Disparvirus which is currently being prepared. Presently Bacillus thuringiensis is the only agent used by OMNR staff for gypsy moth control in Ontario. Having only one pest management tool is not a sound strategy and it is highly desirable to have a second, environmentally acceptable and safe control agent for gypsy moth registered in Canada.

Plots and spray application

Three plots, numbered 1,2 and 3, were selected on private land in Lindsay district near the Ganaraska Forest Conservation area. Three check plots, designated A, B and C, were chosen in the same geographical locality as the treated plots. Treated and check plots were paired according to their locality and gypsy moth egg mass density. A description of the treated and check plots is given in Table 1.

Table 1. Description of plots.

Plot	Area (ha)	% Oak in plot	Spring egg mass numbers/ha
1	18.0	30	2470
2	21.0	50	2330
3	25.0	50	8500
Ck A	5.5	50	1430
Ck B	4.6	80	1750
Ck C	7.3	30	6670

To propagate gypsy moth NPV, larvae were infected, harvested, frozen and lyophilized. Lyophilized larvae plus 5% w/w silica powder were ground to a fine powder in an ultracentrifugal mill. This powder contained $7.25X10^9$ PIB/g and 12.0 kg were used to mix 700 L of spray for each application. The tank mix also contained 25% v/v molasses and 6% w/v Orzan LS, a lignosulphonate used as a sunscreening agent. Analysis of the tank mix verified that it contained $1.25X10^8$ PIB/mL. The FPMI Cessna Ag-truck fitted with 4 Micronair AU 4000 atomizers was used for both applications and, flying a 30m swath width, equipment was calibrated to deliver 10 L/ha. The first application was on the morning of May 26 and the second 3 days later on the morning of May 29. Meteorological conditions at the time of application are given in Table 2. Insect development, determined by head capsule measurement is given in Table 3. The leaves on red oak trees were expanded to about half of their full size at this time. Kromekote cards mounted on aluminum backings were placed in open areas at 15m intervals at right angles to the line of flight just prior to the applications. Results of the analysis of deposits on these cards are given in Table 4.

Table 2. Meteorological conditions during spray applications.

Date	Air temp(°C)	Ground temp(°C)	% RH	Wind speed km/h
26 May	5-9	5-11	85-91	6-10
29 May	15-17	15-16	91-94	2-4

Table 3. Larval development at time of application.

Plot	Application number	% 1st instar	% 2nd instar
1	1	98.9	1.1
	2	75.0	25.0
2	1	97.9	2.1
	2	58.2	41.8
3	1	96.2	3.8
	2	65.5	34.5

Table 4. Analysis of spray deposit on Kromekote cards.

Plot	Application number	NMD (μm)	VMD (μm)	D_{max} (μm)	Mean number of droplets/cm^2 (±S.D)
1	1	70	198	538	23.1±5.8
	2	66	212	529	91.7±18.1
2	1	55	206	477	26.4±8.2
	2	125	301	590	12.7±7.7
3	1	71	164	477	51.6±17.6
	2	76	236	711	32.3±12.6

Assessment

Egg mass counts were made on ten $10m^2$ (0.01ha) plots in each treated and check plot using methods established by Forest Insect and Disease Survey staff. At least 3 red oak trees were within the boundaries of each plot. All egg masses on tree trunks and branches in these plots were counted and 10 sub-samples taken of $1m^2$ areas on the ground where rocks, fallen tree trunks and other debris were closely examined for the presence of egg masses. Samples on the ground were multiplied by a factor of 10 and added to the numbers counted on standing trees giving the total for a 0.01 ha plot. This figure was then converted to the number of egg masses per hectare. Egg mass counts were made in early May before hatching commenced and the same plots were re-examined in late September, long after oviposition had finished. Great care was taken to distinguish between current egg masses and old egg masses.

Larval counts were made from 15 sites in each plot. These sites were distinct from the $10m^2$ plots used for egg mass counts which were intentionally left undisturbed. Two methods were used, the first for small larvae and the second for larger larvae when they reached fourth instar. For small larvae, 3 red oak, 46cm branch tips were collected at mid-crown at each sampling site using pole pruners fitted with a basket to prevent loss of larvae. Numbers of larvae and numbers of leaf clusters were counted and the mean number of larvae per leaf cluster calculated for each site. A pre-spray sample was taken followed by 3 post-spray samples at 5, 12 and 19 days after the first spray application. At this point larval counts on branches were discontinued because gypsy moth behavior changes around the fourth instar with larvae spending much of the time on branches and tree trunks while not actively feeding. In order to monitor populations of these larger larvae, burlap traps were attached to 3 red oak trees 1.5m from ground level at each of the 15 sites. The circumferences of the sample trees were measured and the larval counts converted to number per metre of burlap trap. Larvae in the traps were counted at 26, 33 and 40 days post-spray in all plots and check areas and also at 48 days post-spray in Plot 1 and Check A where insect development was slower. Larvae collected for population counts were retained for microscopic examination to determine incidence of NPV-infection (see below).

Pupal counts were made in the 10 undisturbed $10m^2$ plots used for egg mass counts. Burlap traps were attached 1.5m above ground to 3 red oak trees per $10m^2$ plot before larvae reached the fourth instar. Pupal counts were made at 48 to 56 days post-spray at these undisturbed sites and no pupae were removed so as not to influence the fall egg mass counts. Pupal counts were converted to numbers per metre of burlap trap.

Defoliation estimates were made on 10 red oak 46cm branches collected at mid-crown at each of the $10m^2$ plots used for egg mass counts. Leaves were examined individually, counts were made of petioles of leaves that were completely eaten and undamaged leaves were counted and removed. Partially eaten leaves were scored individually and an estimate made of the foliage consumed. A mean defoliation figure was then calculated for each branch.

Incidence of virus infection was established pre-spray and at weekly intervals post-spray in all treated and check plots. Larvae were collected at the 15 sites where larval counts were made and 15 larvae collected per site (225/plot). Larvae were placed in plastic petri dishes and taken to a mobile laboratory trailer where they were smeared on glass microscope slides. When more than 15 larvae were counted per site, only the first 15 were retained. When the number was less than 15, additional branch samples were taken until the target number was attained. Smears were stained with naphthalene black 12B and examined under oil immersion at 1200X magnification for the presence of PIBs. Smears were then scored positive or negative.

Results

Incidence of virus infection in the 3 treated plots and corresponding check plots is shown in Fig 1. Pre-spray levels of NPV-infection were very low and ranged from 0 to 1.1% of the larvae in the 6 plots. The actual spray deposit caused peaks of virus infection 12 to 19 days post-spray: 60.5, 84.9 and 48.7% of larvae were recorded as positive for PIBs in the 3 treated plots. Numbers of infected larvae then declined in the treated plots but increased again to secondary peaks of 78.2, 65.2 and 37.1% at the onset of pupation 40 to

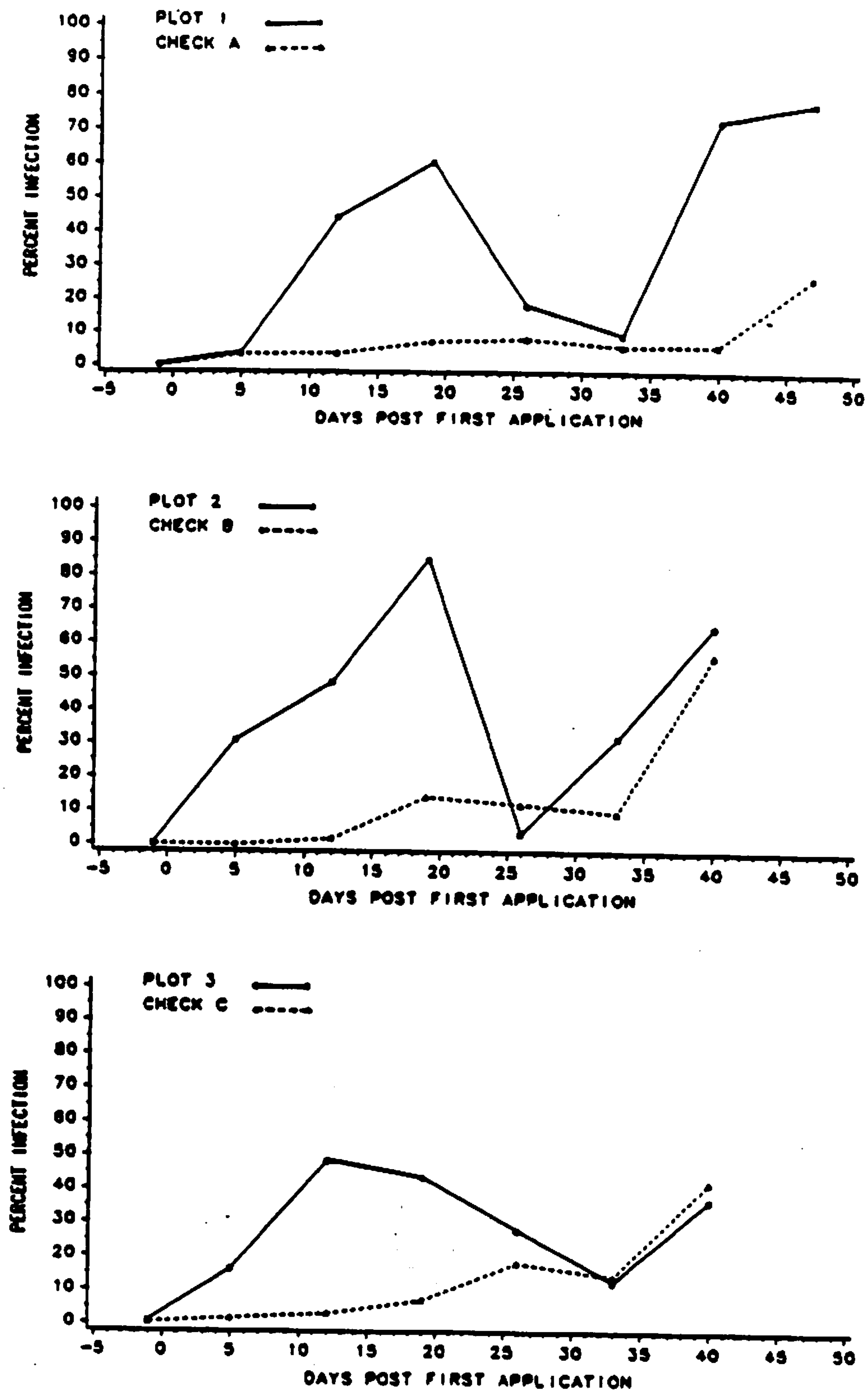

Fig 1. Incidence of NPV-infected larvae in plots treated with Disparvirus and in corresponding checks.

47 days post-spray. These secondary peaks are attributed to a combination of secondary infection due to virus released from larvae killed by the initial spray deposit and to infection from naturally occurring NPV. In the check plots, naturally occurring NPV infection levels remained low until near the onset of pupation when they reached peaks of 27.1, 56.6 and 42.5% of larvae infected.

Larval population counts are recorded in Table 5. The increase in numbers of larvae/leaf cluster between the pre-spray count and the first post-spray count in Plot 2 and check plots B and C may indicate that pre-spray samples were taken before migration of larvae from egg masses was complete. Thereafter a steady decline was noted in all plots and check areas with the declines being more severe in the treated plots. When the sampling technique was changed to burlap traps, populations were significantly lower in all the treated plots compared to their corresponding check plots.

Pupal counts from burlap traps in treated and check plots are shown in Fig 2. The mean numbers of pupae/m of trap in the treated plots, 5.8, 3.5 and 12.0, are significantly different from their corresponding check plots which had 66.4, 64.8 and 60.9 pupae/m of trap.

Defoliation estimates are shown in Fig 3. Plots 2 and 3 both with 14% defoliation were significantly different from corresponding check plots B and C which had 82 and 90% defoliation, respectively. However, there was no significant difference between Plot 1 with 46% defoliation and Check A with 31% defoliation . The heavier defoliation in Plot 1 compared to Plots 2 and 3 can be partly attributed to the presence of other defoliating insects including oak leaf shredder, Bruce spanworm and forest tent caterpillar, as well as gypsy moth.

Egg mass counts made in the fall are compared to the pre-spray counts made in the spring in Fig 4. Numbers of egg masses/ha increased in only one plot, Check A; decreases from spring to fall were recorded in all other treated and check plots. However, the reductions in egg mass numbers were much greater in the treated than check plots. There were no significant differences between spring egg mass counts in paired treated and check plots. There were significant differences between all three pairs of treated and check plots when fall egg mass counts were compared. Using a modified Abbott's formula, reductions in egg mass density, due to the application of NPV and corrected for naturally occurring population changes in the corresponding check plots, were calculated to be 84, 85 and 91% for the 3 treated plots.

Table 5. Larval population counts (±SE) in plots treated with Disparvirus and corresponding check plots.

	DAYS POST-SPRAY							
	-1	5	12	19	26	33	40	48
	Mean number larvae/leaf cluster				Mean number larvae/metre burlap trap			
Plot 1	0.26±0.06	0.18±0.03	0.13±0.03	0.01±0.01	5.3±1.4	5.7±1.6	10.6±6.3	3.6±0.01
Check A	0.20±0.11	0.12±0.02	0.16±0.04	0.05±0.02	51.1±9.3	34.5±7.5	25.7±6.4	50.2±0.1
Plot 2	0.02±0.02	0.23±0.03	0.07±0.02	0.03±0.01	8.0±1.9	9.8±2.3	5.3±1.2	-
Check B	0.26±0.04	0.43±0.06	0.38±0.08	0.11±0.03	15.7±2.9	31.1±3.3	32.9±4.8	-
Plot 3	0.35±0.08	0.24±0.05	0.15±0.03	0.11±0.01	6.9±2.5	10.9±3.7	6.3±2.3	-
Check C	0.33±0.04	0.73±0.12	0.56±0.11	0.29±0.05	11.7±1.7	52.9±3.9	71.7±7.3	-

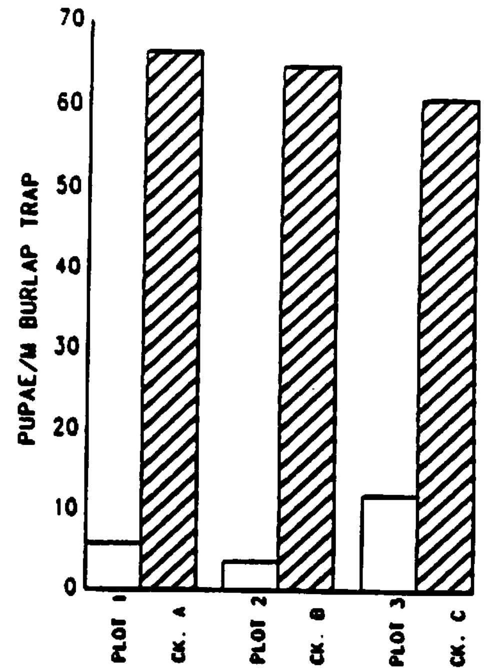

Fig 2. Number of pupae per metre of burlap trap in plots treated with Disparvirus and in corresponding check plots.

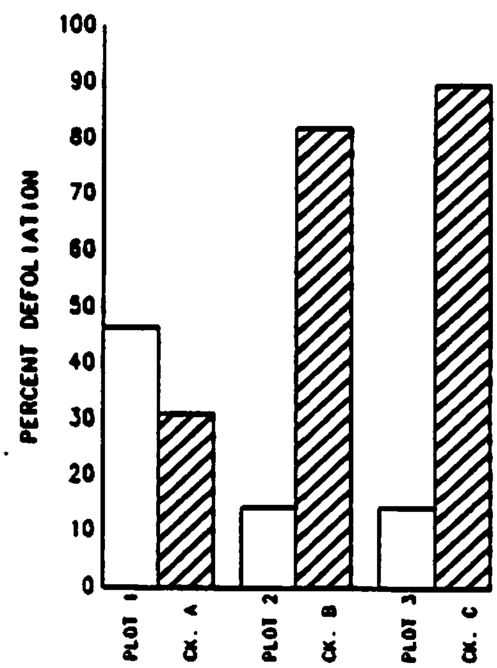

Fig 3. Estimates of percent defoliation of red oak in plots treated with Disparvirus and in corresponding check plots.

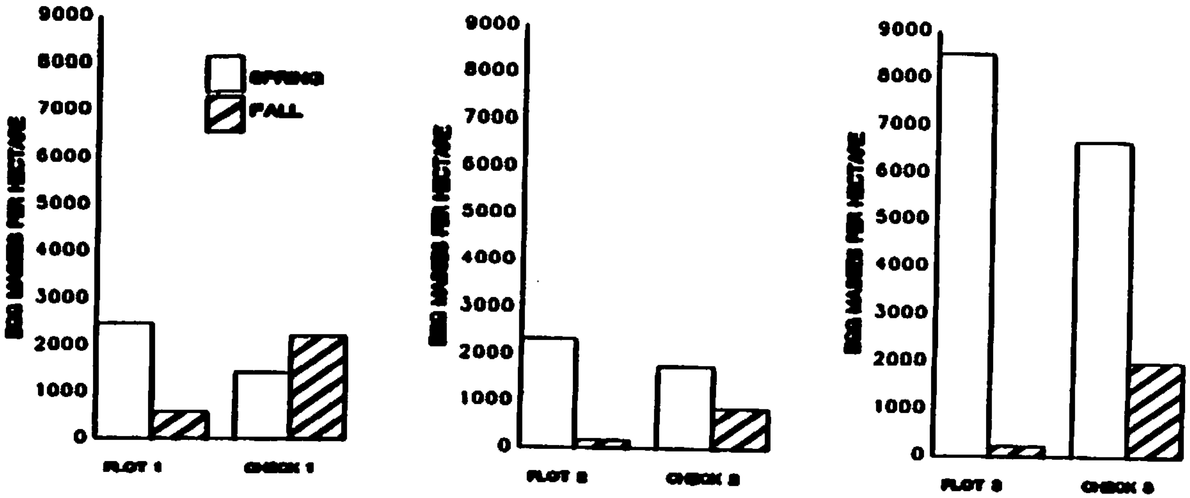

Fig 4. Spring and fall egg mass counts (number of egg masses/ha) in plots treated with Disparvirus and in corresponding check plots.

Discussion

Results were considered highly satisfactory and one has no hesitation in recommending a double application of $1.25X10^{12}$ PIB/ha for gypsy moth control provided the applications are on first and second instar larvae and are 3 to 4 days apart. Other studies at FPMI have shown most virus activity is lost after 4 days exposure to natural weathering on foliage. Two of the 3 replicated treatments gave almost identical results. Plots 2 and 3 paired with checks B and C. All 4 plots were fairly close together. Checks B and C were both heavily defoliated, larvae were stressed and incidence of naturally occurring NPV was higher in these check plots than in check plot A. Due to these factors, there was a considerable decline in egg mass density between the spring and fall counts. However, the egg mass counts were still significantly higher in these two check plots than in the treated plots. Defoliation of red oak at 14% was virtually negligible in Plots 2 and 3 and was extremely heavy in both the check plots. Plot 1 and Check A were about 12 km to the west of the other plots and about 2.0 km from each other. Results in these paired plots did not follow the same pattern; they were not as dramatic, but still quite acceptable. The fact that the treated plot was more heavily defoliated than the check plot was due to other insect species defoliating the oak in the treated plot. This was an unforeseen factor. The virus treatment caused a drop in egg mass density from 2,470/ha to 600/ha. This is a decline of 75.7% which puts the count well below the Ontario Ministry of Natural Resources figure of 1,200 egg masses/ha used as the threshold to include or exclude an area from a spray program. The population in check plot A, on the other hand, increased by 55.9% to 2,230 egg masses/ha.

Gypsy moth spray applications are difficult to assess compared to control operations on many other species of defoliating insects. Population densities of gypsy moth and the decision to treat or not treat an area are based on spring egg mass counts which may have little bearing on the subsequent larval population because of low egg viability and a low percentage hatch or because of migration of first instar larvae blown on silken threads from one area to another. Branch sampling and counting larvae, a technique used for most defoliating insects, is not particularly effective for gypsy moth larvae which do not spend all of their time on the foliage. Larval numbers may vary depending on the time of day, temperature and other weather conditions. Of course, branch sampling is not feasible after larvae reach the fourth instar and burlap traps are then used to estimate larval density. None of these methods are highly accurate, but they do give a good indication if populations are low, moderate or high. They are good survey tools upon which to base recommendations concerning control measures, but they are unsuitable for detecting small differences between different treatments. It is therefore imperative that as many replicates as possible are used when evaluating the efficacy of different dosages, formulations and application volumes of control agents on gypsy moth.

Naturally occurring NPV appears to be present in all gypsy moth populations surveyed in Ontario. The effects of this NPV are observed at the onset of pupation: when healthy larvae pupate, diseased individuals remain as larvae and eventually die. Naturally occurring NPV does not act soon enough to save any foliage, but it can cause population reductions as large or even larger than artificially disseminated virus. Naturally occurring NPV can have a profound effect on the evaluation of the efficacy of control agents and it should be monitored in treated and check plots.

Conclusion and recommendations

For Disparvirus to become an acceptable pest management tool in Ontario, it has to compare favourably with *Bacillus thuringiensis* (B.t.) and there has to be a commercial source for the virus. FPMI can produce Disparvirus for field trials, but is in no position to produce material for operational sprays. Presently, FPMI is negotiating with a French company called Calliope which has developed methods of mechanizing virus production. Hopefully, material will be available at a reasonable cost for field trials in 1989.

Considerably more testing of Disparvirus is required to develop acceptable use strategies with this virus. Single versus double applications should be tested; if a single application is satisfactory, use of virus is then preferable to B.t. Dosages between $2.5X10^{11}$ (too low) and $2.5X10^{12}$ PIB/ha (satisfactory, but expensive) should be tested. Also the application volume of 10L/ha is much higher than the 2L/ha or so used for B.t. applications. Tests should be conducted on reduced application volumes of Disparvirus. A registration petition for Disparvirus is currently being prepared using the USDA Forest Service toxicological data for Gypchek. It should be ready for submission sometime early in 1989. It may be possible to collaborate with American colleagues on improved use strategies for both Gypchek and Disparvirus. USDA Forest Service staff also tested double applications of $1.25X10^{12}$ PIB/ha in 1988 and obtained satisfactory results. The goals of the Canadian Forestry Service and the USDA Forest Service are the same.

This study was funded in part by an Ontario Pesticides Advisory Committee grant.

INSECT GROWTH REGULATOR RESEARCH DURING 1987-88

[Project No. FP-31 - Insect Growth Regulators and their Use in the Management of Forest Pests]

Report to The 16th Annual Forest Pest Control Forum

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Insect Growth Regulator Research During 1987-88

Introduction

Insect Growth Regulators (IGRs) are biorational compounds that interfere with the normal growth and development of insects. There are several types of these IGRs currently being developed as control agents. Chitin synthesis inhibitors or moult inhibitors are benzoylphenyl ureas and have been relatively well developed. To this class belongs Dimilin or diflubenzuron and its analogs. Juvenile hormone analogs are another class of IGRs that prevent the last larval instar from pupating. More recently a new class of compounds called ecdysonoids that mimics the moulting hormone have been introduced as IGRs. All 3 types of compounds were tested in the laboratory and in the field and the salient features of the studies are described.

Laboratory & Greenhouse Studies:

(i) S-31183 (S-71639): A juvenile hormone analog was tested for ovicidal activity against the spruce budworm along with several other JH analogs. While the effect could be clearly demonstrated in isolated egg masses, there was very little effect when sprayed on potted trees on which eggs had been laid. Larval effects, carry-over effects, effects on diapausing larvae - all indicated that this material will probably be of limited value in controlling lepidopterous pests of forests.

(ii) Dimilin-analogs: Several analogs of Dimilin that inhibit chitin synthesis were tested against a whole array of lepidopterous pests of forests. CGA-112913, CME 13406, Dow XRW3136, BASF 166-801, PH 60-51, PH 70-23 were all found to be a lot more active than Dimilin on most pests and further work is being conducted.

(iii) Ecdysonoids: Two new, non-steroidal agonists of ecdysterone (moulting hormone), RH-5849 and Rh-5992 have been introduced by Rohm and Haas. Within 24 h after ingestion, larvae attempted to moult and the pathological symptoms occurring at this stage lead to the mortality of the insect. These exciting new compounds are very active on most of the lepidopterous pests and work is underway.

Field Trials:

(i) Dimilin against hemlock looper in Newfoundland: Work was continued for a third year. Dr. R.J. West of NeFC was in charge of the operation. Control of the insect was demonstrated but the delayed effect resulted in less than anticipated foliage protection. Further work on optimizing the application is warranted.

(ii) Dimilin against the spruce budmoth: This work was conducted along with Dr. Luc Jobin of LFC and the Quebec Ministry of Energy and Resources. The results were quite disappointing.

(iii) <u>Dimilin against the white pine weevil</u>: This work was conducted in collaboration with Dr. Luc Jobin of LFC and Mr. Tim Gray of the Ontario Ministry of Natural Resources in Tweed. The ground spraying was conducted during fall and spring using different types of sprayers and formulations on 3 different tree species namely white pine, Scots pine and Norway spruce. Details of the spray regimin and results are shown in Table 1.

The results show that treatment with Dimilin is a viable method for controlling the white pine weevil. The dosages, volumes, equipment, tree species were all varied. This was mostly due to differences in tree numbers per unit area, branch density and tree-height. Therefore the comparisons between the treatments is not always valid. Certain broad conclusions, subject to confirmation are however possible. (1) Dimilin controls the weevil, (2) spring spraying appears to be better, (3) large volumes providing good coverage are more effective than low volumes, (4) ground spraying of trees above 3m high appear to work poorly and (5) doses above 300 g AI per ha in water or 7N oil gave good protection. Based on our success, especially in the absence of any other method available for white pine weevil control, we are planning to conduct field trials to optimize the various aspects of Dimilin application for controlling this insect.

(iv) <u>JH analogs against the Balsam woolly aphid</u>: This work is being continued in Newfoundland under the leadership of Dr. Wade Bowers. The results so far appear promising and further research is contemplated.

TABLE 1. Results of 1987-88, Dimilin Ground Spray Trials Against the White Pine Weevil

	Location & Area	Formulation & Dosage	Time of Application	Tree Species & Height	Damage
1.	Madoc, Ont. - 5.0 ha	Control	-	White pine, 2 m.	23%
2.	Madoc, Ont. - 1.9 ha	25% WP in water 263g AI in 158 L/ha	Fall, 1987	White pine, 2 m.	7%
3.	Madoc, Ont. - 6.0 ha	ODC-45 in 7N oil 500g AI in 500 L/ha	Spring, 1988	White pine, 2 m.	3%
4.	Kirkwood, Ont. - 1.0 ha	Control	-	Scots pine, 3 m.	47%
5.	Kirkwood, Ont. - 1.0 ha	25% WP in water 375g AI in 100 L/ha	Fall, 1987	Scots pine, 3 m.	12%
6.	Kirkwood, Ont. - 1.0 ha	25% WP in water 375g AI in 150 L/ha	Spring, 1988	Scots pine, 3 m.	2%
7.	Kirkwood, Ont. - 0.25 ha	SC-48 in water 500g AI in 40 L/ha	Spring, 1988	Scots pine, 3 m.	36%
8.	Kirkwood, Ont. - 0.25 ha	ODC-45 in '585' oil 500g AI in 40 L/ha	Spring, 1988	Scots pine, 3 m.	14%
9.	Beauceville, P.Q. - 0.8 ha	Control	-	Norway Spruce, 4.5 m.	40%
10.	Beauceville, P.Q. - 0.4 ha	25% WP in water 250g AI in 200 L/ha	Fall, 1987	Norway spruce, 4.5 m.	22%
11.	Beauceville, P.Q. - 0.4 ha	25% WP in water 250g AI in 200 L/ha	Spring, 1988	Norway spruce, 4.5 m.	36%
12.	St. Narcisse, P.Q. - 0.4 ha	Control	-	Norway spruce, 3 m.	21%
13.	St. Narcisse, P.Q. - 0.4 ha	ODC-45 in 7N oil 800g AI in 100 L/ha	Spring, 1988	Norway spruce, 3 m.	0%

LABORATORY EVALUATION OF THE TOXICITY OF INSECTICIDES TO FOREST INSECT PESTS AND NON-TARGET INSECTS IN 1988

[Project No. FP-50 - Insecticide Toxicology]

Report to The 16th Annual Forest Pest Control Forum

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Laboratory Evaluation of the Toxicity of Insecticides to Forest Insect Pests and Non-Target Insects in 1988

Introduction

This report will highlight the major studies on the development of insecticides for forest insect control conducted by the insecticide toxicology project during the past year. Three new insecticides, alpha-terthienyl, RH 5992 and RH 5849 were evaluated against several forest pests. Further experiments were undertaken to examine the relationship between Zectran residues in foliage and its residual toxicity to spruce budworm larvae. Studies were carried out on the relative toxicity of fenitrothion to different instars of eastern hemlock looper larvae and the contribution of different insecticide exposure routes to the toxicity of fenitrothion to looper larvae on balsam fir. The toxicities of different insecticides to gypsy moth larvae on treated oak leaf discs were also evaluated in 1988. Tests were continued on the evaluation of insecticides dips and sprays of conifer seedlings for debarking weevil control and the assessment of the potential of pyrethroids for white pine weevil control. Finally, a study to determine the persistence of new insect growth regulator, UC 84572 in comparison with Dimilin was completed this past year.

Alpha-terthienyl

Alpha-terthienyl is a naturally-occurring secondary metabolite from the plant family Asteraceae. It is highly toxic to mosquito larvae in the presence of sunlight or near UV light. In collaboration with W.J. Kaupp (FP-13-3) and J.T. Arnason, University of Ottawa, this phototoxic plant product is being tested to determine its spectrum of insecticidal activity to a wide range of forest insect pests and other miscellaneous insects in comparison with standard insecticides. To date, we have tested alpha-terthienyl by topical application against 15 species including 9 species of lepidoptera larvae, 4 species of sawfly larvae and 2 species of beetle adults. Some species of lepidoptera appear to be highly sensitive to this compound. A derivative of alpha-terthienyl has also been examined for its relative toxicity to some of these species.

RH 5992 and RH 5849

These are 2 novel, new insecticides discovered by Rohm and Haas Company. It has recently been reported that RH 5849 is an ecdysone-agonist which interferes with the moulting process. In collaboration with A. Retnakaran (FP-31), FP-50 has been comparing the toxicity of these compounds with standard insecticides to spruce budworm, eastern hemlock looper and gypsy moth larvae and determining their effects on feeding. Tests to date indicate that RH 5992 is very toxic to these species after exposure to treated foliage for 3 days, being as or more toxic than standard insecticides. Its contact toxicity also appears to be high. Mortality occurs more more slowly than with standard insecticides. However weakness of larvae is observed quite early and frass production is reduced substantially 3-5 days after treatment. With standard insecticides, frass production is reduced more quickly within 1-2 days after treatment. RH 5849 appears to be much less toxic than RH 5992 to these species.

Longevity of Zectran and its Metabolites

As reported previously, mexacarbate residues in white spruce foliage were found to decline rapidly to very low levels while mortality of spruce budworm larvae exposed to buds from the same trees continued much longer. A metabolite, methylformamidomexacarbate (not methylaminomexacarbate as reported in last year's report) is present in foliage at much higher levels for a longer period than mexacarbate. This collaborative study with K.M.S. Sundaram (FP-71) was continued during 1987-88 to confirm the types and levels of metabolites present on white spruce trees sprayed with Zectran, to determine if very low residues of mexacarbate are toxic to spruce budworm larvae and to determine if metabolites of mexacarbate are toxic to larvae. Methylformamidomexacarbate was again found to be the major metabolite detected in white spruce foliage. It was present throughout the 20-day experimental period at 13 to 50x the levels of mexacarbate after 3 days. Very low residues of mexacarbate were not toxic to spruce budworm larvae and could not account for the residual toxicity of Zectran sprays 3 days or more after treatment. The toxicity of 2 metabolites, methylamino- and methylformamidomexacarbate to spruce budworm larvae was determined by topical application and by exposure of individual larvae to single treated conifer needles. Methylaminomexacarbate was similar in toxicity to mexacarbate by both methods but this metabolite is not present at detectable levels beyond 1 day after treatment. By topical application, methylformamidomexacarbate was 50x less toxic than Zectran. However, it was only 7x less toxic on treated needles. This metabolite could account for at least some of the residual toxicity observed after 3 days.

Eastern Hemlock Looper

Further tests have confirmed that the toxicity of fenitrothion to first through fourth instar larvae is similar when larvae on balsam fir foliage are sprayed in the Potter's tower. Initial tests indicate that the primary route of exposure to fenitrothion is by ingestion and/or contact with deposits on foliage when larvae and foliage are sprayed together. Although larvae are probably exposed directly to the spray by this technique, the contact toxicity of fenitrothion to looper larvae is ca 3x less than its toxicity on treated foliage. Several insecticides including dimethoate, trichlorfon, malathion, acephate and carbaryl are currently being screened for their toxicity to eastern hemlock looper larvae.

Gypsy Moth

A bioassay method has now been developed to assess the toxicity of insecticides on treated oak leaf discs to untreated larvae. The order of toxicity of the insecticides tested to date was: permethrin >> mexacarbate= acephate = RH 5992 ≥ Sevin XLR > aminocarb > fenitrothion.

Hylobius congener

As reported last year, black spruce seedlings were dipped in aqueous solutions of 0.5% permethrin (Ambush 25% WP and Ambush 500EC), 2.5% chlorpyrifos (Dursban 4E), 2.5% fenitrothion (Sumithion 20F) and 1.0% lindane on September 3, 1987. Bioassays with debarking weevils 62 days after treatment demonstrated that all treatments were effective in preventing damage. On July 6, 1988, 309 days after treatment debarking weevils were exposed to another group of these treated seedlings which had been fully exposed to winter conditions. All treatments except Ambush 25% WP resulted in 100% weevil mortality and prevented any damage. In June 1988, red pine seedlings from Nova Scotia were also dipped and sprayed with aqueous solutions of permethrin, chlorpyrifos and fenitrothion for future bioassays with *Hylobius congener* adults.

White Pine Weevil

The toxicities of permethrin and methoxychlor to adult weevils are being compared by topical application and by exposure to twigs dipped in solutions of these insecticides. Permethrin was about 200x more toxic than methoxychlor by topical application. Tests on dipped twigs are in progress.

UC 84572

Last year we reported that a third trial was in progress at cool water temperatures to determine the persistence of UC 84572 in comparison to Dimilin in simulated aquatic pools using mosquito larvae for bioassays. This trial again confirmed that UC 84572 was more persistent than Dimilin and that the persistence of UC 84572 was longer under cool, cloudy conditions than in hot, sunny conditions experienced in a previous trial during June 1987.

Experimental Applications of Dipel and Futura B.t. Formulations Against Eastern Spruce Budworm in Northwest Ontario: A summary of Preliminary Results.

A Report to the 16th Annual Forest Pest Control Forum

(Ottawa, Ontario. 15th-17th November 1988)

B.L. Cadogan, B.F. Zylstra, R.D. Scharbach.

Project No. 51 Insecticide Field Efficacy

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These data are preliminary and must not be published nor cited without the permission of the Director, F.P.M.I.

Experimental Applications of Dipel and Futura B.t. Formulations against the Eastern Spruce Budworm in Northwest Ontario: A summary of Preliminary Results.

B.L. Cadogan, B.F. Zylstra, R.D. Scharbach

As the use of Bacillus thuringiensis B.t. to control Lepidopterous forest pests expands, new and improved formulations of B.t. continue to emerge. These formulations are intended to enhance the pest control stategies of the forest managers.

In the spring of 1988 five formulations were field tested to determine their respective efficacies against Spruce Budworm Choristoneura fumiferana Clem.

Dipel 8AF* (64AF) (16.8 BIU/l) is an aqueous formulation while Dipel 12L* (264) (25.2 BIU/l) and Dipel 16L* (352) (33.7 BIU/l) are emulsions whose advantages are purported to be their high potencies. Futura XLV** (14.8 BIU/l) and Futura XLV-HP** (High Potency)(26.4 BIU/l) are both aqueous formulations with the latter expected to exhibit extra advantages via its high potency.

Materials and Methods.

The trials were conducted in the Cedar Lake area, north of the town of Vermilion Bay in N.W. Ontario (Fig. 1). Seven

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* Abbott Laboratories, Chicago, Il.

**Chemagro Ltd, Mississauga, On.

50 hectare (1.0x0.5 km) blocks were established in an immature (softwood/hardwood) forest, five for the *B.t.* treatments and two as untreated checks. Seventy five balsam fir trees(*Abies Balsamea* L.)were randomly selected as sample trees in each block. The formulations were undiluted and were dyed with Erio Acid ZGN 250 dye(St Lawrence Analine, Brockville, On.) to facilitate droplet assessment.

The sprays were applied using a Cessna 188 Ag-Truck fitted with 4 AU 4000 rotary atomizers. Details pertinent to the spray application weather at the time of sprays, etc, are presented in Table 1. Methods relating to sampling, assessments, etc, are detailed in a previous report (Cadogan *et al* 1984.)

Results and Discussion

Deposit. Futura XLV-HP, Dipel 264L and Dipel 352L because of their viscous nature, required special attention to their pumping. Nevertheless, the deposit on Kromekote cards suggest that all five *B.t.* formulations atomized satisfactorily and the sample trees were, therefore, potentially exposed to good levels of deposit. The deposit data are summarized in Table 2. At the time of writing, the sizing of the drops was incomplete thus drop size spectra are not included in this report.

<u>Population Reduction and Defoliation.</u> Table 2 presents data relating to budworm population reductions and host tree defoliation. The results indicate that in this study, only Dipel 8AF suppressed budworm populations satisfactorily; that none of the population reduction in block 1 could be attributed to Futura XLV, whereas the "high potency" version reduced the budworm population by approximately 60 percent. Both of the "high potency" formulations (264 and 352) were only marginally effective in suppressing spruce budworm populations whereas the aqueous (64AF) formulation reduced the Budworm population by 84 percent.

Only an average of 12 percent of the balsam foliage was lost in the block treated with Dipel 64AF, while an average of 48, 47, 41, and 22 percent defoliation were recorded in the Dipel 264, Dipel 352, Futura XLV and Futura XLV-HP blocks, respectively.

These trials were conducted under very good conditions (the first 12 post spray days were sunny, warm and rain free), therefore, analysis are in progress to determine why the four <u>B</u>.<u>t</u>. formulations were that ineffective.

Table 1. Details Pertinent to the Application of Futura and Dipel. Vermilion Bay, Ontario. 1988

Treatment	Futura XLV (14.4 BIU/l)	Futura XLV-HP (26.4 BIU/l)	Dipel 8AF (16.8 BIU/l)	Dipel 12L (25.2 BIU/l)	Dipel 16L (33.7 BIU/l)
Spray Date (time)	31/05 (0521)	31/05 (0625)	31/05 (2127)	01/06 (0522)	01/06 (0803)
Applic. rate (BIU/Ha)	30	30	30	30	30
(l/Ha)	2.08	1.14	1.78	1.18	0.89
A/C[1] height above canopy (meters)	15-20	15-20	15-20	15-20	15-20
A/C speed (Km/h)	160	160	160	160	160
Emission rate (l/min)	24.4	13.7	21.4	14.3	10.7
Swath width (meters)	45	45	45	45	45
Atomizer type	AU-4000	AU-4000	AU-4000	AU-4000	AU-4000
Blade setting (RPM)	35(9175±64)	35(9375±104)	35(N/A)[2]	35(10200±678)	35(10487±510)
Weather at Spray Time					
Temperature (C)	19.6	21.3	25.8	19.7	23.7
R.H. (%)	92.1	90.0	80.6	91.9	78.2
Wind Speed (km/h)	4.4±1.2	4.0±1.0	4.4±1.2	2.9±1.5	7.0±1.9
Wind Direction (Az)	108	126	125	113	172
Block orientation (Az)	44	128	15	27	280
Atmospheric Stability	Strong Inversion	Strong Inversion	Strong Inversion	Strong Inversion	Very small Lapse

1. Aircraft used was a Cessna 188 Ag-Truck.
2. Not available.
3. Dipel 8AF=Dipel 64AF; Dipel 12L=Dipel 264; Dipel 16L=Dipel 352

Table 2. Spray deposit, spruce budworm population reductions and host tree defoliation following applications of undiluted Dipel and Futura XLV (B.t.) formulations. Vermilion Bay, Ontario. 1988

Treatment	Application rate/ha		No. of Samples	Spray Deposit (x ± SD)		Population Reduction: Larvae/46 cm branch (x ± SD)		Population Reduction: % corr. mortality[1]	% Defoliation
	BIU	l		drops/cm^2	l/ha	Prespray	Final post spray		
Futura XLV	30	2.08	75	3.1 ± 3.3	.870 ± .44	12.7 ± 7.2	5.7 ± 3.4	0	41 ± 27
Futura XLV-HP	30	1.14	75	6.4 ± 5.4	.795 ± .272	21.8 ± 12.4	3.9 ± 3.5	59	22 ± 17
Dipel 64AF (8AF)	30	1.78	75	8.2 ± 6.1	1.15 ± 1.96	13.9 ± 8.9	1.3 ± 1.6	86	12 ± 13
Dipel 264 (12L)	30	1.18	75	2.9 ± 2.8	.155 ± .137	16.4 ± 8.2	6.1 ± 3.6	46	48 ± 30
Dipel 352 (16L)	30	0.89	75	1.1 ± 1.1	.084 ± .113	17.4 ± 8.0	8.1 ± 5.0	60	47 ± 23
Check Block 1	N/A	N/A	75	N/A	N/A	15.2 ± 10.5	6.7 ± 4.8	56[3]	35 ± 18
Check Block 2	N/A	N/A	75	N/A	N/A	14.7 ± 7.7	10.2 ± 5.7	31[3]	67 ±24

1. B.t. population reductions corrected for natural mortality using Abbott's formula modified for asynchronous sampling.
2. High potency.
3. Not corrected for natural mortality.

PERMETHRIN SPRAY TRIALS AGAINST THE SPRUCE BUDMOTH, *Zeiraphera canadensis* IN MATAPEDIA, P.Q., 1988

[Project No. FP-50 - Insecticide Toxicology]

Report to The 16th Annual Forest Pest Control Forum

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Permethrin Spray Trials Against the Spruce Budmoth, *Zeiraphera canadensis* in Matapedia, P.Q. 1988

Introduction

In one 1984 trial, an aerial application of permethrin (Ambush 500EC) at 70g Al/ha by fixed wing aircraft at egg hatch was effective in reducing budmoth populations by 81% and limiting destruction of tree leaders to 9% (51% leader destruction in check plot). A single application of 35g AI/ha was less effective resulting in a 42% population reduction and 28% leader destruction (Helson, de Groot, Turgeon and Kettela 198 . Toxicity of insecticides to first instar larvae of the spruce budmoth, *Zeiraphera canadensis* Mut. and Free. (Lepidoptera: Tortricidae): laboratory and field studies Can. Ent. in final preparation). In 1988, we evaluated the efficacy of permethrin further by both aerial and ground applications timed to coincide with the initiation of egg hatch. The main objectives were:

1. To determine the effectiveness of a helicopter application of permethrin at 70 g AI/ha.
2. To determine the effectiveness of a double application of permethrin by helicopter at 35g AI/ha spaced 1-3 days apart.
3. To determine the effectiveness of single applications of permethrin at 35 and 70g AI/ha with a backpack mistblower.

Methods & Materials

The formulation of permethrin used in 1988 was Pounce® EC provided by Chemagro Ltd.

Aerial Applications:

A Hughes 269C helicopter equipped with boom and nozzles was used for the aerial applications. Aqueous mixes of Pounce containing 0.2% w/v Erio Acid Red Dye were applied at 5 ℓ/ha on the evening of May 20, 1988. The second application of 35g AI/ha was applied 24h later. The helicopter flew at 80 KMH, 10m above the ground along flagged flight lines 15m apart. Two, 2.5-2.8 ha plots in a white spruce plantation were treated at each rate and two additional plots in another plantation served as controls. One 15cm lateral branch from the upper crown of the tree was collected from 75 trees per plot, 3d. before treatment and again 2 weeks after treatment to determine larval population levels. Kromekote cards were hung vertically on 15 trees in each treated plot for spray deposit analyses.

Ground Applications:

A Solo Port 423 backpack mistblower fitted with a ULV nozzle was used to spray aqueous emulsions of Pounce on individual, 2-m-tall white spruce trees at an application volume of 20 ℓ/ha. The amount required per tree was calculated on the basis of a stocking density of 2500 trees/ha. Each tree was completely sprayed for 18-20 sec at flow rates of 24-26 ml/min. Thirty trees were treated at each rate on the morning of May 20, 1988. A group of 30 trees was sprayed with water only and another group was not treated. Branch samples were collected before and after treatment as for the aerial applications.

Leader damage appraisals on each of the sample trees were carried out during October 11-13, 1988.

Results and Discussion:

Based on day-degree accumulations and the number of eggs hatched on branch samples collected immediately preceding the treatments, the initiation of significant egg hatch occurred on the spray date, May 20.

In general, both the aerial and ground applications were effective in reducing larval populations and the number of damaged buds (Table 1). The population reduction in plot G was less than that in plot H even though these plots were in the same plantation and were both sprayed with 2x35 g AI/ha permethrin by helicopter within 15 minutes of each other. One major difference between these plots was the much lower prespray population density in plot G. The mistblower application of permethrin at 35g AI/ha appeared to be less effective than that at 70g AI/ha. However, larval populations were substantially lower after treatment in the plot treated with 35 g AI/ha than in the untreated plots and correspondingly fewer buds were damaged. A single application of permethrin at 70g AI/ha has consistently provided 80-90% larval control both by helicopter and by mistblower in this study and by fixed winged aircraft in a previous study in 1984.

Damage to leaders was reduced to below an index of one in all treated plots (Table 2). More trees were undamaged, fewer trees had broken leaders or destroyed apical buds and the leaders were longer in the treated plots than in the check plots. Similar levels of protection were achieved with helicopter applications of 2x35 g AI/ha, 1 day apart and 1x70 g AI/ha. With the mistblower applications, better protection was obtained with a single treatment of 70 g AI/ha than a single treatment of 35 g AI/ha. However the lower rate did prevent any destruction to the leaders and resulted in a satisfactory damage index.

Table 1. Permethrin (Pounce®) Trials Against the Spruce Budmoth, *Zeiraphera canadensis* in Matapedia, P.Q., 1988

Plot	Dosage g AI/ha	Larval Population ($\bar{x}$ no./branch) Pre	Post	% Population Reduction[1]	% Buds Damaged	% Reduction in Bud Damage
Helicopter						
G	2x35	1.8	2.0	51	13	66
H	2x35	6.7	1.1	93	10	73
I	1x70	5.4	2.0	84	10	73
J	1x70	7.5	2.2	87	9	75
L	Control	5.6	14.6	-	35	-
M	Control	7.4	14.5	-	39	-
Mistblower						
T	1x35	10.0	8.1	70	21	58
U	1x70	12.3	3.3	90	8	84
Y	Untreated Control	11.0	34.5	-	49	-
Z	Treated Control	13.1	31.3	-	50	-

[1]Corrected for population changes in the control plots by Henderson's method.

Table 2. Leader Damage to White Spruce Sample Trees in Permethrin Trials, Matapedia, P.Q., 1988

Plot	Dosage	# Trees	% Damage 0	1	2	3	Damage Index	Leader Length (cm)
Helicopter								
G	2x35	75	51	28	21	0	0.70	48.1
H	2x35	75	49	34	13	4	0.72	49.2
I	1x70	75	45	32	23	0	0.78	52.1
J	1x70	75	48	36	15	1	0.69	51.1
L	Control	75	20	29	40	11	1.42	27.4
M	Control	75	15	31	48	6	1.33	39.6
Mistblower								
T	1x35	30	37	33	30	0	0.93	37.2
U	1x70	14*	65	21	14	0	0.49	38.7
Y	Untreated Control	30	7	31	38	24	1.79	24.8
Z	Treated Control	30	7	20	43	30	1.96	24.7

*Identification Tags Missing on Remaining 16 Trees.
Damage Categories: 0 = no SBM damage, 1 = SBM scar on leader beyond 5 cm of apical bud, 2 = SBM scar within 5 cm 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 to .... t4 are the numbers of trees in each damage category. The goal of control measures is to reduce the damage index below 1.

RESEARCH STUDIES ON PHYSICOCHEMICAL ASPECTS OF PESTICIDE PERFORMANCE (CONDUCTED IN 1988)

[Project No. FP-61 - Pesticides Formulations]

Report to The 16th Annual Forest Pest Control Forum

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November 1988

Research Studies on Physicochemical Aspects of Pesticide Performance (Conducted in 1988)

Introduction

During 1988, the Pesticide Formulations Project at FPMI undertook one cooperative field study, one cooperative laboratory study, one field study using a mimic formulation, one laboratory study using *Bacillus thuringiensis* formulations and one laboratory study to examine the potential of certain polymeric adjuvants to bind glyphosate, thereby inhibiting (or reducing) the herbicidal effectiveness.

1. Investigation of the Use of Two Gay-Glo® Fluorescent Pigment Tracer Dyes for Assessing Droplet Size Spectra and Deposits of Bacillus thuringiensis and Dimilin® Formulations Following Aerial Application (A Cooperative Field Study with Newfoundland Scientists)

   Two oil-based *Bacillus thuringiensis* formulations, Dipel® 176 and Dipel® 264, one aqueous formulation, Futura ® XLV and two oil-based formulations of Dimilin®, were sprayed aerially at different dosage rates over conifer forests in Newfoundland for the control of Hemlock Looper. The formulations were mixed with Day-Glo® fluorescent pigment dyes to facilitate droplet detection on sampling surfaces. To determine the drop size spectra and drops per cm^2 at ground level, Kromekote® cards were used. Deposits on the balsam fir foliage were assessed by counting the number of drops per needle.

   The study is currently ongoing, and the data are being analysed. Nevertheless, the findings indicate that the Day-Glo dyes have the advantage of easier detection on sampling surfaces when compared to the conventional oil-soluble (Automate Red B, for oil-based formulations) and water-soluble (Erio Acid Red, for water-based formulations) tracer dyes. That is probably why more number of drops were detected on fir foliage and Kromekote cards in this year's spray trial, as compared to previous trials.

2. Influence of Spray Diluents on Physicochemical Properties, and Physical and Chemical Compatibility of Eight Oil-Based Tank Mixes of Aminocarb (A Cooperative Laboratory Study with FP-71)

   Matacil® 180F, a commercial flowable formulation of aminocarb, was diluted with carrier diluents to provide eight different oil-based tank mixes. The diluents included three vegetable oils, Dowanol® TPM (a glycol ether), kerosine and fuel oil (mixtures of aliphatic hydrocarbons), Cyclosol® 63 (a mixture of aromatic hydrocarbons) and a 50:50 mixture of canola oil and Cyclosol 63. The inter-relationships between physicochemical properties, solubility aspects, phase separation, resuspensibility of sediments, and chemical compatibility were investigated during storage for 96 h at 10°C.

Among the physicochemical properties studied, only viscosity and solubility played important roles in the physical compatibility of the tank mixes: high-viscosity diluents (vegetable oils) imparted high viscosity to the tank mixes and provided good suspensibility for the milled aminocarb particles present. The medium-viscosity diluent, Dowanol TPM, showed very high solubility for aminocarb and therefore, no phase separation problems were encountered. The two low-viscosity diluents, kerosine and fuel oil, posed some resuspensibility problems for the aminocarb particles. However, none of the diluents promoted lump formation or were chemically incompatible with aminocarb during the 96 h period.

The study indicated that, of the diluents tested, Dowanol TPM was the most desirable diluent for Matacil 180F, followed by the three vegetable oils. The two aliphatic hydrocarbon mixtures, kerosine and fuel oil, would be the least desirable diluents for forestry applications of aminocarb insecticide.

3. <u>Drop Size Spectra, Spreading and Adhesion; and Physical Properties of Eight Bacillus thuringiensis Formulations Following Spray Application Under Laboratory Conditions</u>

Three oil-based formulations, Dipel® 132, Dipel® 176 and Dipel® 264, and five aqueous formulations, Thuricide® 48LV, Thuricide® 64B, Futura® XLV, Dipel® 6AF and Dipel® 8AF, of <u>Bacillus thuringiensis</u> (B.t.) were sprayed undiluted at a dosage rate of 30 BIU per ha in a laboratory chamber using a spinning disc atomizer. The formulations were mixed with Day-Glo® fluorescent pigments to facilitate drop detection on sampling surfaces. Spray drops were sampled with Kromekote® cards and deposits were collected on glass plates. Drops were counted on balsam fir foliage of potted seedlings. Physical properties such as, viscosity, surface tension, volatility and pseudoplastic behavior, were determined for the formulations.

Spray drops of the three oil-based Dipel formulations were completely spread on Kromekote cards and fir foliage. The degree of spreading was influenced by viscosity and surface tension values. Drops of the five aqueous formulations were either totally spherical or hemispherical on all sampling surfaces, and the degree of spreading was related to surface tension and pseudoplastic behavior.

The data on drop size spectra indicated little influence from the physical properties of formulations. This is because of the differences in the application rates used. All the three oil-based Dipel formulations were non-volatile and provided 100% recovery of the spray volume on the glass plates. The four aqueous formulations, except the Thuricide 64B, provided lower percent recovery of the spray volume on glass plates.

4. <u>Investigation of the Potential of a Polymeric Adjuvant to Bind Glyphosate and Reduce Herbicidal Activity (A Laboratory Study)</u>

Five groups, A, B, C, D and E, of trembling aspen (<u>Populus tremuloids</u> Michx.) seedlings were treated as follows: group A with the Roundup® formulation containing ^{14}C-glyphosate [N-(phosphonomethyl) glycine] at a rate of 0.35 kg of active ingredient in 25 L per ha; group B with the same formulation but containing 0.05% v/v of a spray modifier adjuvant Nalco-Trol® II (a 30% emulsion of a polyvinyl polymer); group C with 0.05% of Nalco-Trol II alone in water; and group D with water only. Group E served as the control. The rate of uptake and translocation of glyphosate into the plant was determined by liquid scintillation counting and thin layer chromatography, using seedlings of groups A and B respectively. All the five groups of seedlings were maintained in the greenhouse for four weeks of observation, to assess height and weight increase and foliar browning. The data indicated that Nalco-Trol II did not affect the rate of uptake and translocation of glyphosate into trembling aspen. Seedlings belonging to group C, treated with Nalco-Trol II alone in water, exhibited a significant increase in height and weight, compared to those of groups D and E, indicating that the polymer has no potential in causing deleterious effects on plant growth. The reason for the enhanced growth is not clear and requires further investigation. The degree of foliar browning and plant injury was very similar in groups A and B, indicating that Nalco-Trol II did not inhibit (or reduce) the herbicidal activity of glyphosate.

The experimental aspects of this study were completed in 1986, but the data reduction, statistical treatment and other necessary calculations were carried out this year.

5. <u>Investigation of the Use of Day-Glo® Rocket Red T-13 for Droplet and Deposit Assessment on Artificial Samplers Following Aerial Application near the Sault Ste. Marie airport</u>

A water-based mimic formulation was prepared by mixing glycerol, triethyl phosphate, Atlox® 3409F, Rocket Red T-13 (a Day-Glo® fluorescent pigment dye) and water in the ratios of 3:1:1:1.5:143.5. This mixture was sprayed at an application rate of 5 L per ha (or at an emission rate of 60 L per min) over a plain land (8 ha or 400 m x 200 m), using a Cessna 188 aircraft equipped with 4 Micronair® AU5000 atomizers, on May 4, 1988 at 7:00 a.m. This spray mixture (called as "Mimic I") was then mixed with a polymeric adjuvant, Sta-Put®, and sprayed similarly on the same day but at 8:00 a.m. This spray mixture was called as "Mimic II". Artificial samplers used were balsam-fir shaped aluminum branch tips, live balsam fir branch tips, Kromekote® cards and glass plates.

The droplet data indicated that aluminum leaves received about 4 times more droplets than the live foliage. The average deposit recovery on glass plates was 50% for the spray mix "Mimic I" and 75% for "Mimic II". Droplet analysis on Kromekote cards are still in progress.

6. <u>Use of a Spray Chamber (the One Used Regularly for Testing Droplet Size Spectra and Deposit Recovery of Different Formulations) to Generate Rainfall of Different Intensity</u>

The spray systems that were present in the spray chamber were slightly modified to fit a 1056 Teejet nozzle which is now being used for generating raindrops of different sizes and rainfall of different intensity. This system is being used at present to investigate the rain-washing characteristics of deposits on target foliage following spraying of *Bacillus thuringiensis* and herbicide formulations with and without rain-protectants. These adjuvants are simultaneously tested for compatibility with the active ingredients, to ensure that any reduction in the active ingredient (after a rainfall) would not be due to incompatibility of the adjuvants for the particular active ingredients.

STUDIES ON THE ENVIRONMENTAL CHEMISTRY OF FORESTRY INSECTICIDES

[Project No. FP-71 - Chemical Accountability]

Report to The 16th Annual Forest Pest Control Forum

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Studies on the Environmental Chemistry of Forestry Insecticides

Introduction

The 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 1987/88.

Penetration, mobility, persistence and metabolic fate of implanted acephate (Acecaps®) 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. A cooperative research is in progress with the scientists in NeFC to evaluate the effectiveness of 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.

Sensitive, reliable and relatively simple analytical method for acephate and its major toxic metabolite, methamidophos present in spruce barks was developed first to monitor the persistence and fate of the chemical in treated trees. Ground bark samples were spiked with analytical grade acephate and methamidophos and extracted with ethyl acetate or acetonitrile by blending. The crude extracts were cleaned by silica gel or Nuchar® charcoal columns, eluted with ethyl acetate and analysed by gas chromatography-alkali flame-ionization detection.

Using the method, bark samples collected in the field, at intervals of time, and at different heights from the implanted site, were analysed. Correspondingly, damage assessments to cone and seed production, as well as residue levels in them are in progress. Preliminary data show that acephate has excellent penetration and xylem mobility with appreciable degradation to toxic metabolite, methamidophos. Further work is in progress and the project will be terminated in 1991. After fine tuning of the generated data, the methodology and biological evaluation parts will be published separately some time during the later part of 1991.

Fenitrothion deposits on simulated and live fir foliage following aerial spraying of two formulations

A cooperative research study was undertaken with FP-61 and scientists in NeFC to investigate the deposition patterns of a low and a medium volatile fenitrothion tank mix applied at two volume rates but at the same dosage level. The major findings are recorded below.

Fenitrothion was formulated in two spray media: one with a hygroscopic diluant Dowanol® TPM to provide a low-volatility spray medium (Fe-Dow); and the other with Cyclosol® 63 and stove oil to provide a medium-volatile spray medium (Fe-Cy-St). The former formulation, Fe-Dow, was sprayed at 210 g active ingredient (AI) in 0.4 L/ha and the latter formulation, Fe-Cy-St, at 210 g AI in 1.5 L/ha, over 30 ha blocks in a conifer forest in Newfoundland. A Piper® Pawnee aircraft equipped with six Micronair AU4000 atomizers was used for treatment. Spray deposits were collected at mid-crown level using foliar simulators made of aluminum. Live foliage was also sampled from the corresponding height. Droplet size spectra were assessed at ground level using Kromekote® cards and AI deposits were collected on glass plates.

Droplet density (droplets/cm^2) and AI deposit density (ng AI/cm^2) on the ground samplers showed lower values for Fe-Dow sprayed at 0.4 L/ha, than those for Fe-Cy-St sprayed at 1.5 L/ha. Droplet assessment on foliar simulators and live foliage showed much lower droplet density for Fe-Dow than for Fe-Cy-St. However, the AI deposit density was only slightly lower. The data indicated that, in forestry application of insecticides, volume rates less than 1.5 L/ha do show some potential, although the spray mixtures should have optimum physicochemical properties to provide a low-volatile medium and cause fine atomization under the conditions of forestry insecticide applications. Furthermore, a hygroscopic formulation has an added advantage of absorbing moisture from the environment during flight, so that spray droplets would likely absorb moisture under highly humid conditions and increase in droplet size, instead of decreasing, a phenomenon which would occur with a non-hygroscopic, volatile diluent.

Toxicity and metabolism of mexacarbate in freshwater crayfish under laboratory conditions

Adult crayfish (Orconetes limosus) were exposed to 0.1, 1.0, 2.5, 4.0, 7.5, 8.0, 8.5, 9.5, 15.0, 20.0 and 25.0 ppm of mexacarbate (4-dimethylamino-3,5-xylyl N-methylcarbamate, trade name - Zectran®) in water at 15°C under laboratory conditions. Behavioral abnormalities were noted at levels >1.0 ppm, but as the duration of exposure increased the animals recovered from these symptoms and behaved similar to those in the control group. Signs of acute toxicity and mortality were observed at concentration levels >2.5 ppm. The 96-h LC_{50} value was 8.8 ppm. Body weight depression was significant only in the three high dose groups (at 15, 20 and 25 ppm in water). The study was terminated at 144 h after treatment. The parent compound (M) and seven of its metabolites, viz., 4-methylformamido mexacarbate (MFM), 4-formamido mexacarbate (FAM), 4-methylamino mexacarbate (MAM), and 4-amino mexacarbate (AM), 4-dimethylamino-3,5-xylenol (DMAX), 4-methylamino-3,5-xylenol (MAX) and 4-amino-3,5-xylenol (AX), were detected in crayfish at 144 h after exposure. The primary metabolites detected were MFM and FAM which accounted for 30% and 20% respectively of the body residue. The other metabolites detected were low, and accounted only for about 9% of the body residue altogether. About 41% of the body residue was contributed by the parent material M. The bioconcentration factor of mexacarbate in crayfish was very low, about 0.58, as compared to those of about 2000 to 3000 reported in the literature for fenvalerate and permethrin in fathead minnows.

Cuticular penetration and *in vivo* metabolism of fenitrothion in spruce budworm

Oil and emulsion formulations of ^{14}C-fenitrothion were applied topically to fifth instar budworm larvae. Cuticular penetration and metabolic breakdown of the chemical were studied over a period of 300 min using thin layer chromatography and liquid scintillation counting. Rates of penetration and depletion of the external residue over time were determined (recovered by washing the treated insects with ethyl acetate). The quantity of fenitrothion penetrated was determined by macerating and extracting the tissues of washed insects with acetonitrile. Cuticular penetration of the chemical was higher for the oil than for the emulsion formulation. In addition to fenitrothion, demethyl fenitrothion, fenitrooxon, nitro-cresol and unidentifiable polar moieties were found in the insect washes and homogenates. Differences in amounts of the active material and its metabolites were found in the washes and homogenates depending on formulation type and rate of metabolism of the chemical over time. Demethylation of $-OCH_3$ group to -OH and P-O-aryl cleavage played major roles in the metabolic degradation of fenitrothion. The oxidation of P = S to P = O was apparent but the oxon levels were low and sporadic. No amino fenitrothion was found either in the insect washes or homogenates. Based on these findings, a tentative metabolic pathway of fenitrothion in budworm is proposed.

Volatilization of aminocarb, fenitrothion and mexacarbate from conifer (balsam fir) seedlings under laboratory conditions

The volatilization of three forestry insecticides, aminocarb, fenitrothion and mexacarbate from balsam fir seedlings was investigated over a 12 hr period after applying them as emulsions in a spray chamber at 140 g A.I./ha. Highest airborne residues were found after mexacarbate application (21.7 µg/L) and lowest after aminocarb spray (6.3 µg/L). The rate of volatilization of the chemicals decreased with time and was directly related to their vapor pressure. The most volatile insecticide was mexacarbate, while aminocarb was the least. About 30.3% of mexacarbate, 14.9% of fenitrothion and 9.4% of the aminocarb deposited initially on fir seedlings were lost within 12 hr by volatilization. More than 50% of the amount volatilized was lost within 1 hr. The initial and 12 hr postspray residue levels (µg/g, fresh wt.) found in fir were respectively 7.98 and 5.70 for aminocarb, 8.46 and 6.18 for fenitrothion and 7.32 and 0.69 for mexacarbate. Within the study period, aminocarb and fenitrothion were persistent, whereas mexacarbate was relatively labile.

Vertical mobility of diflubenzuron (Dimilin®) in clay and sandy loam forest soil columns under laboratory conditions

Diflubenzuron (DFB) [1-(4-chlorophenyl)-3-(2,6-diflurobenzoyl) urea] and its two formulations, Dimilin® WP-25 and Dimilin® SC-48, were applied separately at 17.23, 51.69 and 155.07 g of active ingredient (A.I.) (corresponding to 70, 210 and 630 g A.I./ha) to the top layers of columns (30 x 5.6 cm i.d.) packed with either sandy or clay loam forest soils. Water (1.251 L) equivalent to 50.8 cm of precipitation was allowed to leach through each column. After leaching, the columns were divided into 5 unequal segments and the DFB residues in soils were extracted and analyzed by high performance liquid chromatography (HPLC). Mobility of DFB was low and did not increase with dosage. At a deposit rate equivalent to 70 g A.I./ha, nearly all the residues were found within 2.5 cm of the top of the column. Mobility of DFB did not increase with dosage. Even at 630 g A.I./ha, only about 9% of the technical DFB, 7% of Dimilin SC-48 and 4% of Dimilin WP-25 moved below the 2.5 cm level in sandy loam. No residues were found below the 10 cm level or in the leachates in either soil type at all dosage levels. In addition to soil type, mobility of DFB was also influenced by the additives present in the formulation with technical DFB > Dimilin SC-48 > Dimilin WP-25.

Insecticide washoff from sprayed conifers by simulated rainfall

A major study to determine the foliar retention, persistence and wash-off potential of insecticides (fenitrothion) from foliage and their mobility to soil and groundwater has been initiated recently in cooperation with FP-61. The fate and stability of the chemical in balsam fir foliage, soil and water is examined as it is influenced by: 1) dosage of chemical 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, used for the simulation of aerial application of pesticides, has been modified to accommodate simulated rainfall. Veejet nozzles of varying orifice sizes have been examined under desired experimental conditions (by trial and error) to select three which give the best compromise between droplet size and intensity. The optimum droplet size range selected was 500-1500 μm for 5, 10 and 15 mm/h rainfall intensities. To study the runoff from the sprayed trees to the soil, the balsam fir trees are repotted into large pans with 5 cm of forest soil. The pans contained holes in the bottom to collect the groundwater during rainfall. Four fenitrothion formulations, used in operational sprays, and containing different types of adjuvants, will be sprayed on the trees at two dosage levels, viz; 140 and 280 g A.I./ha. The above conditions will be varied one at a time, keeping all others constant, to determine their influence on wash-off of the insecticide and accompanying mobility to soil and water. This on-going study will in due course be expanded to accommodate other insecticides and other parameters to examine critically the wash-off potentials of sprayed materials in forestry. If conditions and resources permit, the findings generated will be evaluated and tested under operational spray situations.

Progress Report on Residual Efficacy and Dose Transfer Mechanism of Dipel^{R}12L Sprayed Aerially Against Spruce Budworm at Bathurst During 1988

by

P.C. Nigam and S.E. Holmes

Report submitted to Sixteenth Annual
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November 15-17, 1988, pp. 23

PROGRESS REPORT ON RESIDUAL EFFICACY AND DOSE TRANSFER MECHANISM OF DIPEL^{R}12L SPRAYED AERIALLY AGAINST SPRUCE BUDWORM AT BATHURST DURING 1988

by

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INTRODUCTION

Bacillus thuringensis (*B.t.*) is becoming the material of choice for use against spruce budworm in North America. In order to increase its efficacy, competitiveness with chemicals and to reduce its application cost, highly concentrated formulations are being produced by different commercial companies and are tried neat at ultra ultra low volume rates with finer atomization. It is hypothesized that finer atomization will provide better coverage and the number of droplets reaching to the feeding site will increase, more dose per insect will be delivered due to high concentration at active ingredient (AI) per drop in neat formulation and finally the cost of application will be reduced.

This study was carried out with the new concentrated oil formulation, Dipel^{R}12L, developed by Abbott Laboratories. Experiments were carried out in cooperation with Mr. E.G. Kettela, Canadian Forestry Service - Maritimes (CFS-M), Forest Protection Limited (F.P.L.), Research and Productivity Council (R.P.C.) and Abbott Laboratories under the auspices of New Brunswick Spray Efficacy Research Group (NBSERG).

The objectives of this study were to determine (i) residual efficacy of Dipel^{R}12L aerially atomized by Micronair AU4000 in coarse and fine droplets by using 30 BIU/ha in 1.1 L and 15 BIU/ha in 0.55 L/ha respectively, (ii) droplet deposits on needles, (iii) droplet characteristics and spectrum on webbing, (iv) dose transfer mechanism of AI to feeding site, using video recording for larval and droplet interaction.

METHOD & MATERIAL

Plot Location and Description

The experiments were conducted at Bathurst, N.B., approximately 22 km west from Bathurst airport, Fig. 1. Three plots of 200 hectares were selected. Two plots were used for Dipel^{R}12L treatments and one was used as check (or control). Twelve trees were selected in each plot and 4 trees were assigned to each replication. There were three replications (Fig. 2-4). In each replication trees were assigned north, south, east and west aspect depending upon the side which had the most foliage for 45-cm branch samples (Fig. 2-4).

Aerial Application

The plots were sprayed with 30 and 15 BIU/ha Dipel^{R}12L and coded D1 and D2 respectively. Check or control plot was coded DC. The details of aerial application, formulation, weather and larval distribution and density is given in Table 1.

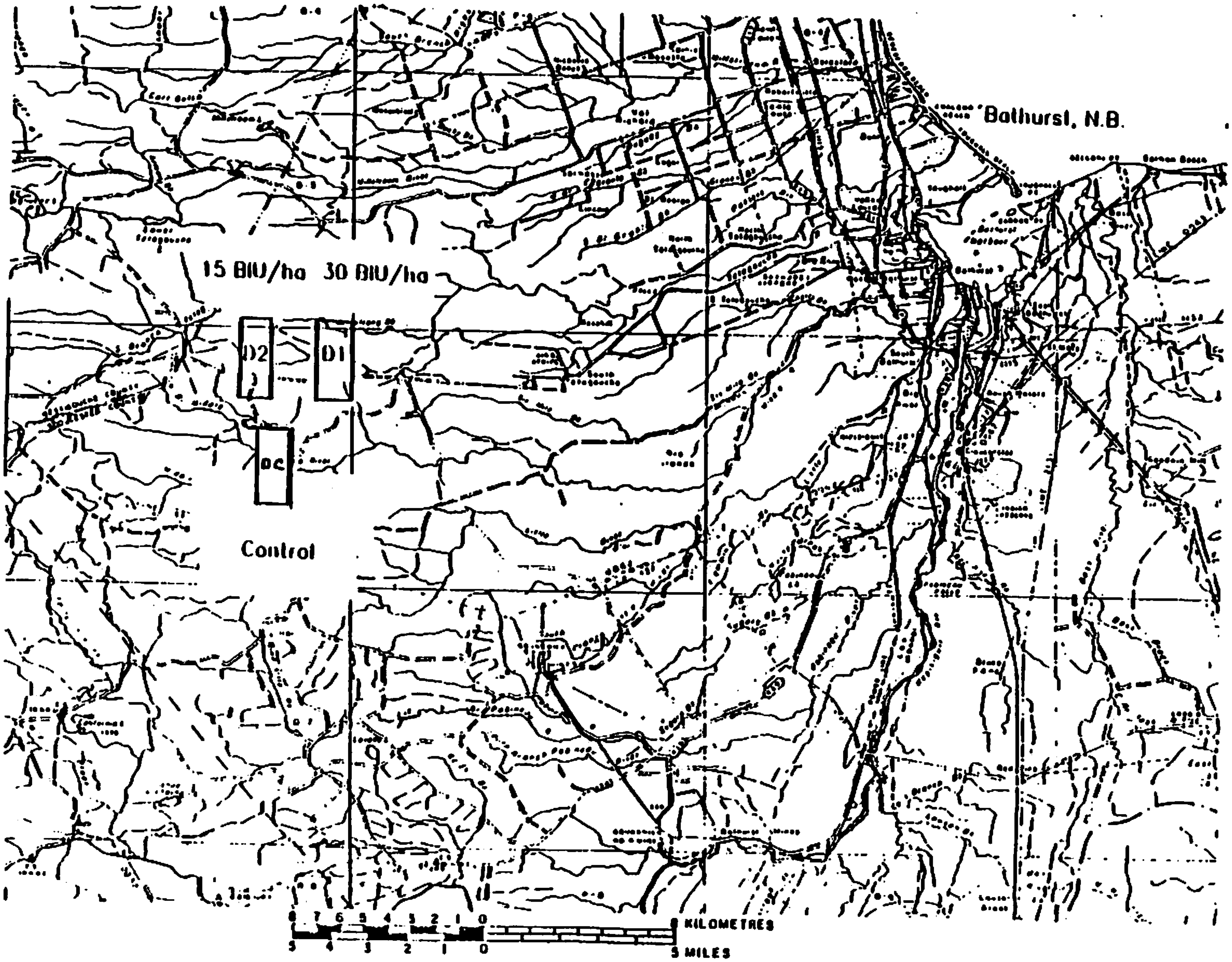

Fig 1: Location of treatment plots D1 and D2, sprayed with Dipel 12L at 30 and 15 BIU/ha respectively, and Control, west of Bathurst, N.B., 1988.

Fig 2 LOCATION OF TREES IN 1988 DIPEL 1 PLOT
(BATHURST, N.B.)

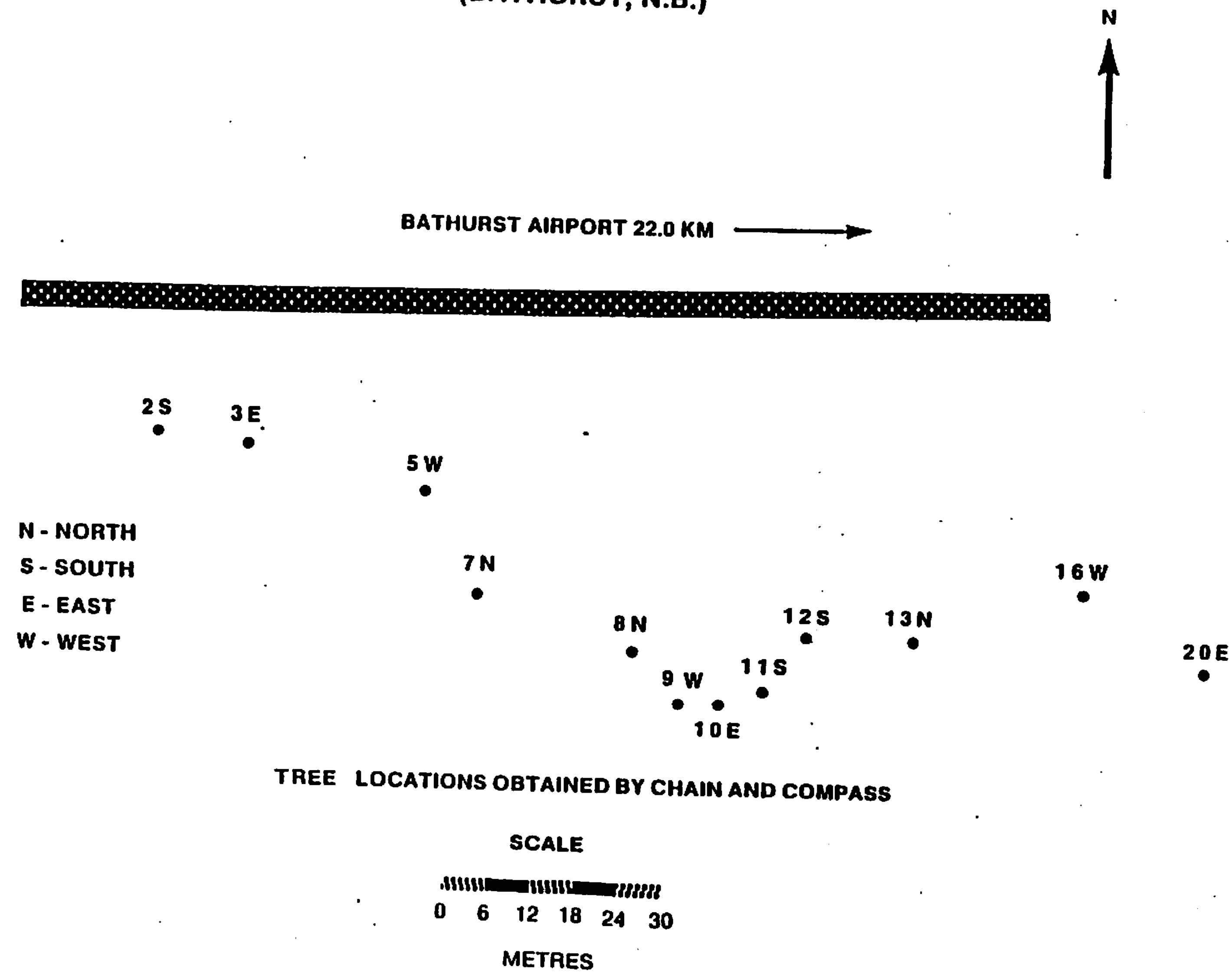

Fig 3 LOCATION OF TREES IN 1988 DIPEL 2 PLOT
(BATHURST, N.B.)

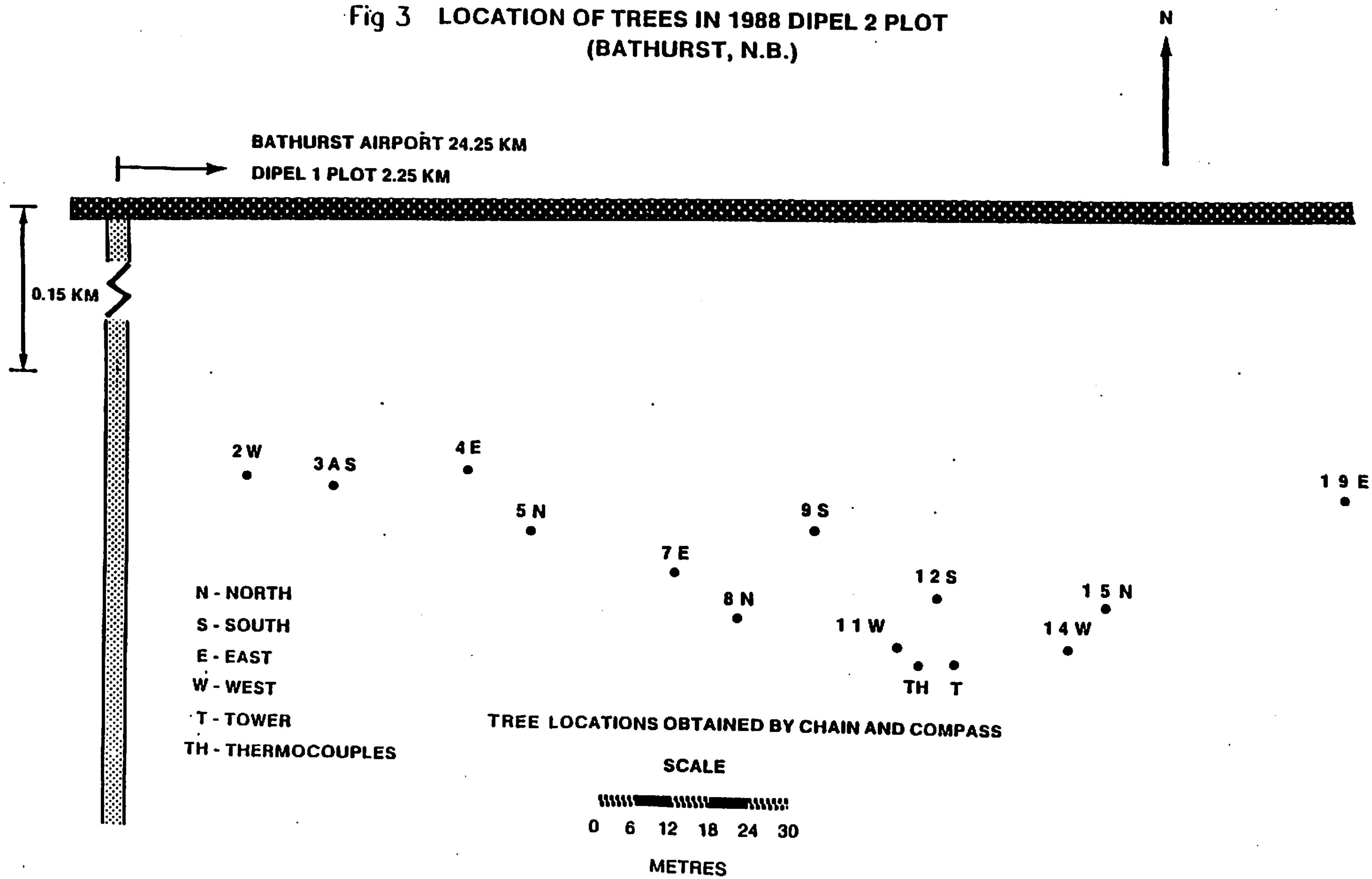

Fig 4 LOCATION OF TREES IN 1988 DIPEL CONTROL PLOT (BATHURST, N.B.)

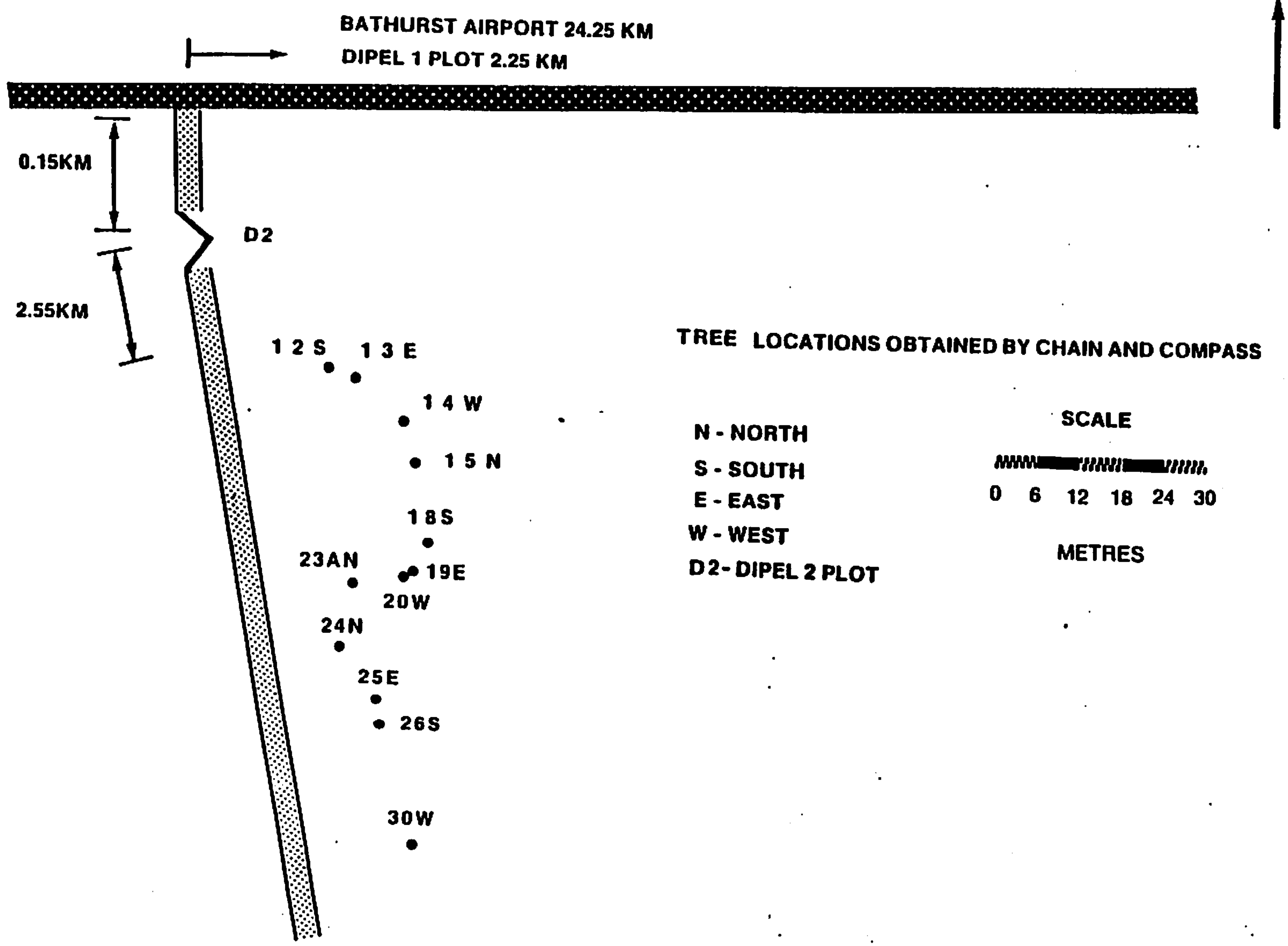

Table 1. Details of aerial applications of Dipel^{R}12L on plots D1 and D2, west of Bathurst, N.B., in June 1988.

	SPRAY BLOCK		
	D1	Parameters Common to D1 and D2	D2
Application Date/Time	June 11 1839-1910 h		June 11 2023-2045h
Aircraft		2 Cessna 188's, flying at 160 km/h at 15-25 m above canopy	
Atomization		4 Micronair AU4000 per aircraft, @ maximum rpms	
Dosage	30 BIU/ha		15 BIU/ha
Application Rate	1.1 L/ha (2.8 g/m)		0.55 L/ha (1.4 g/m)
Formulation	DIPEL 12L, oil base, neat	1.0% Day Glo Orange dye by weight	DIPEL 12L, oil base, neat
Surface Temperature	24°C		22°C
Canopy Temperature	22-23°C		20°C
Wind Speed	1.3-1.8 m/s (3-4 km/h)		0.8-1.7 m/s (2-4 km/h)
Wind Direction	Westerly		Southwesterly
Relative Humidity	28%		33%
	(June 9)		(June 10)
Larval Distribution	II III IV V VI		II III IV V VI
(% by instar)	1.0 12.5 84.6 1.9 0		0 4.1 81.2 13.5 1.2
Larval Density	8.6/45 cm branch tip		14.2/45 cm branch tip
Defoliation % (1987)			
Shoot Attack Rate % (1988)			
Control		(June 10)	
Larval Distribution		II III IV V VI	
(% by instar)		0.4 1.7 62.3 33.5 2.1	
Density		25.5/45 cm branch tip	

Table 2. Weather parameters for June 11-14, 1988 (day of application and post-spray sampling period), from instrumentation placed in plot D2, west of Bathurst, N.B.

Date	Julian Day	Temperature (°C)			Relative Humidity (%)			Wind Velocity (m/s)			Radiation Total (w/m²)	Total Rain (mm)
		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.		
June 11	163	15.10	4.48	23.75	48.92	26.06	87.90	1.44	0.00	3.61	137000	0.0
12	164	19.81	9.64	30.38	50.87	19.96	74.30	1.05	0.00	3.24	127000	0.0
13	165	17.15	7.15	24.33	56.14	32.60	89.10	1.13	0.00	2.52	134000	0.3
14	166	9.61	4.77	14.20	93.71	76.10	98.90	0.70	0.00	1.62	21144	6.1

Sample Collection and Storage

Foliage sampling was done for (i) bioassay of residues (ii) deposits on needles (iii) droplets on webbings and (iv) budworm behaviour and droplets interaction. Pre- and post-spray samples were collected from 12 trees of each plot (Fig. 2-4). Pre-spray samples were collected 48 h before spraying and post-spray samples within 1 h and 24 and 72 h after spraying. The sequence of sampling from 45 cm branch from each aspect was as follows:

First 4 shoots for behaviour and droplet interaction and 4 shoots for droplets on webbing were collected. If more shoots were available, samples for deposit on old and new needles and bioassay of residue were taken. If sufficient foliage was not present on the first branch, then a second branch was taken close to the first branch for deposit assessment on needles and for bioassay. The shoot samples for budworm behaviour and droplets interaction were approximately 3" in size and were put in styrofoam cups covered with clear plastic cups like lantern jars as shown in Figure 5.

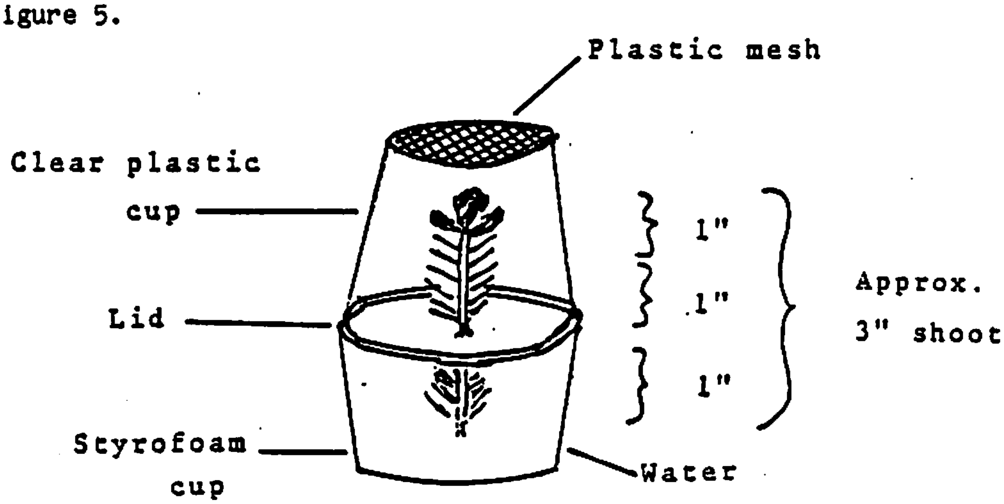

Fig. 5: Collections and storage of behaviour and droplet interaction and webbing deposit samples.

The lower portion of the shoot was inserted through a hole in the styrofoam cup lid. The bottoms of clear plastic cups were replaced with plastic mesh for aeration. Samples for droplet spectrum on webbing were processed similarly. Shoot samples for deposit on needles were approximately 3" in size and were kept in plastic cups upside down and shoots were secured by inserting into the lid. Precautions were taken to ensure that twigs stayed in the centre and did not touch the walls of the cup so that deposit was not smudged (Fig. 6).

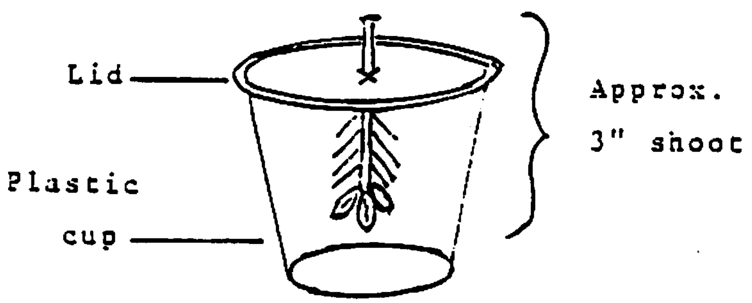

Fig. 6. Collection and storage of needles deposit samples.

Residue bioassay samples were kept in paper bags. Twenty- to twenty-five current year buds were collected from one branch; if sufficient shoots were not available then 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 or cold rooms at CFS-M laboratory. The samples were kept in shade in the field and refrigerator and freezer were used at the motel to keep samples as cool as possible. In the CFS-M laboratory samples were kept at the following temperature and humidity regimes: -

Sample type	Temperature (°C)	Humidity (% RH)
Residue bioassay	0	70-100
Needle deposit	-30	-
Webbing for droplets	0-5	70-80
Budworm behaviour and droplet interaction	0-5	70-80

Bioassay for Residual Efficacy

Bioassay of foliage for residual efficacy of 15 and 30 BIU/ha Dipel^{R} 12L spray was carried out using laboratory-reared IV instar larvae (L4). L4 were reared at CFS-M on artificial diet from hibernating L2 supplied by Forest Pest Management Institute, Sault Ste. Marie, Ontario. L4 were sorted from artificial diet cups and were kept on balsam fir foliage diet for 24 h before using for bioassay to acclimatize them for the change in diet. Each plot has 12 samples and ten L4 were used per sample. Theoretically total of 120 larvae per plot were released on pre-spray and post-spray samples, but the actual number in the first day mortality count varied from 113 to 120 due to cannibalism. Bioassay was done in 10 cm (115-117 ml) clear plastic No. D6 dishes, made by Canada Cup, Montreal. Approximately 10 buds were sub sampled from bioassay samples and were placed in the aerated dishes. A cotton ball was moistened with distilled water and placed in the dish for maintaining humidity. Foliage-acclimatized L4 larvae were released in these dishes for bioassay. The mortality observations were taken after 1, 3, 6 and 9 days of releasing the larvae and at adult emergence. Details of bioassay experiments are given in Expts 1 and 2 and Table 4.

Deposit Assessment

Particulate Day-Glow dye (1%) was suspended in Dipel^{R}12L oil formulation at Abbott's factory for deposit assessment. This is a fluorescent dye and excitation is done by U.V. light. Deposit data is of very preliminary nature due to lack of standard technique. An attempt was made to assess deposit on new and old needles and on webbing of spruce budworm microhabitant. Deposit assessment on old needle was done and new needle analysis is still pending. Webbing analysis is also of a preliminary nature as all samples were not analysed. Preliminary data is summarized in Table 5 and Figures 8, 9, 10 and 11. Details of needle and webbing deposit observation methods are not described in this report.

Budworm Larval and Droplet Interaction

In order to explain dose transfer mechanism of active ingredient (_B_._t_. crystals) to feeding site as larvae feed inside the buds on unexposed needles during the late L4 and early L5, video recording was done of affected and healthy larvae in their microhabitat using operating microscope and video recorder, etc. A preliminary analysis of data is done. Detailed analysis is in progress.

RESULTS

A tentative summary of results is a follows:-

1. Residual bioassay results are present in Tables 3-1, 3-2, 4 and Figure 7. There was no difference in larval mortality of 15 and 30 BIU treatments up to 9 days observation. Mortality at adult emergence in 1 and 72 h samples of 30 BIU was significantly higher than 15 BIU and mortality in 24 h samples of 15 and 30 BIU was not significantly different (Table 4).
2. Mean deposit counts of 1-year-old needles from 15 and 30 BIU plots were not significantly different (Table 5). Although 30 BIU plot shows a trend of more deposit on trees as compared to 15 BIU plot (Fig. 8 and 9), dye particle counts on tree No. 12 and 19 in 15 BIU plot are bringing mean deposit count closer to 30 BIU plot. Deposit count on 1-year-old needles does not reflect actual contamination of feeding site.
3. Analysis of droplet spectrum on webbing shows more smaller droplets in 15 BIU plot as compared to 30 BIU (Fig. 10 and 11). This deposit spectrum is more useful in evaluation of efficacy than deposit on 1-year-old needles.
4. Video observations showed that droplets were transferred from webbing to setae of the larvae and from setae to covered feeding site inside the developing buds by movement of contaminated larvae, because very few droplets reach directly to the needles inside the buds on which larvae feed at this stage.

Experiment 1 - DIPEL[R]12L Plot D1

Objective: To evaluate the toxicity of Dipel[R]12L, as residues on balsam fir foliage following aerial application at 30 BIU/ha, to laboratory-reared spruce budworm IV instar larvae.

Plan of Experiment:

Dosage	: 30 BIU/ha
Rate of Application	: 1.1 L/ha
Treatments	: Eight (4 weathering periods, 4 untreated checks) One larval population check on diet
Weathering Periods	: 1) Prespray (PS) 2) One hour after spray (1 h) 3) Twenty-four hours after spray (24 h) 4) Seventy-two hours after spray (72 h)
Replications	: 3
Number of Larvae per Treatment	: 120
Total Number of Larvae Utilized	: 120 x 8 = 960
Number of Larvae for Population Check	: 40 (Exp. 1 and 2 pooled)

Table 3-1

Weathering Period	Mortality After: 1 Day D/T	% Mort.	Corr. Mort.	3 Days D/T	% Mort.	Corr. Mort.	6 Days D/T	% Mort.	Corr. Mort.	9 Days D/T	% Mort.	Corr. Mort.	Adult Emergence D/T	% Mort.	Corr. Mort.
PS	1/118	0.9	0	1/118	0.9	0	2/118	1.7	0	4/118	3.4	0.8	27/118	20.3	0
1H	2/116	1.7	1.7	8/116	6.9	6.9	35/115	30.4	30.4	51/115	44.3	42.2	101/115	87.8	83.0
24H	0/120	0	0	2/118	1.7	0	32/116	27.6	24.7	51/114	44.7	40.0	91/114	79.8	72.6
72H	1/114	0.9	0.9	2/111	1.8	1.8	4/107	3.7	2.8	12/106	11.3	8.7	58/106	54.7	39.4
Pooled Pop. Check	0/40	0		0/40	0		0/40	0		0/40	0		0/40	0	
PS Control	1/116	0.9		1/116	0.9		2/115	1.7		4/113	3.5		29/113	25.7	
1H Control	0/114	0		0/113	0		0/110	0		4/109	3.7		31/109	28.4	
24H Control	1/113	0.9		2/112	1.8		4/103	3.9		8/103	7.8		27/103	26.2	
72H Control	0/114	0		0/113	0		1/103	1.0		3/103	2.9		26/103	25.2	

Note: Values of corrected mortality above may vary slightly from the mean values shown in Table 4 due to averaging in the latter.

EXPERIMENT 2 - DIPEL^{R}12L PLOT D2

Objective: To evaluate the toxicity of Dipel^{R}12L, as residues on balsam fir foliage following aerial application at 15 BIU/ha, to laboratory-reared spruce budworm IV instar larvae.

Plan of Experiment:

Dosage:	15 BIU/ha
Rate of Application:	0.55 L/ha
Treatments:	Eight (4 weathering periods, 4 untreated checks) One larval population check on diet
Weathering Periods:	1) Prespray (PS) 2) One hour after spray (1 h) 3) Twenty-four hours after spray (24 h) 4) Seventy-two hours after spray (72 h)
Replications:	3
Number of Larvae per Treatment:	120
Total Number of Larvae Utilized:	120 x 8 = 960
Number of Larvae for Population Check:	40 (Exp. 1 and 2 pooled)

<u>Table 3-2</u>

	Mortality After														
	1 Day			3 Days			6 Days			9 Days			Adult Emergence		
Weathering Period	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
PS	0/118	0	0	2/118	1.7	0.8	3/116	2.6	0.9	5/116	4.3	0.8	71/116	26.7	1.4
1H	2/114	1.8	1.8	11/114	9.6	9.6	31/114	27.2	27.2	44/114	38.6	36.2	80/114	70.2	58.3
24H	2/118	1.7	0.8	3/118	2.5	0.7	26/117	22.2	19.1	51/117	43.6	38.8	85/117	72.6	62.9
72H	0/116	0	0	3/115	2.6	2.6	9/114	7.9	7.0	22/114	19.3	16.9	47/113	41.6	21.9
Pooled Pop. Check	0/40	0		0/40	0		0/40	0		1/40	2.5		1/40	2.5	
PS Control	1/116	0.9		1/116	0.9		2/115	1.7		4/113	3.5		29/113	25.7	
1H Control	0/114	0		0/113	0		0/110	0		4/109	3.7		31/109	28.4	
24H Control	1/113	0.9		2/112	1.8		4/103	3.9		8/103	7.8		27/103	26.2	
72H Control	0/114	0		0/113	0		1/103	1.0		3/103	2.9		26/103	25.2	

Note: Values of corrected mortality above may vary slightly from the mean values shown in Table 4 due to averaging in the latter.

Table 4. Comparison of mean* corrected % mortalities ± standard errors of spruce budworm larvae on (n=12) field-collected foliage samples aerially sprayed with Dipel[R] 12, Bathurst, N.B., 1988.

Plot	Prespray Dosage	Weathering Period	n[+]	Mean Corrected % Mortality After		
				6 Days	9 Days	Adult Emergence
D1	30 BIU	Prespray	12	1.4 ± 1.0[k] (118)	2.2 ± 1.0[k] (118)	3.7 ± 2.2[k] (118)
		1 hour	12	30.4 ± 5.4[efg] (115)	42.2 ± 8.2[d] (115)	83.1 ± 4.6[a] (115)
		24 hour	12	24.8 ± 6.8[gh] (116)	40.3 ± 6.2[de] (114)	72.2 ± 6.1[b] (114)
		72 hour	12	3.3 ± 1.4[k] (107)	9.9 ± 3.9[kij] (106)	41.0 ± 6.5[d] (106)
D2	15 BIU	Prespray	12	2.3 ± 1.6[k] (116)	3.5 ± 2.3[k] (116)	6.9 ± 2.4[jk] (116)
		1 hour	12	27.5 ± 5.4[fgh] (114)	36.8 ± 5.8[def] (114)	58.8 ± 7.9[c] (114)
		24 hour	12	19.4 ± 4.6[hi] (117)	39.0 ± 6.4[de] (117)	62.9 ± 5.1[bc] (117)
		72 hour	12	7.5 ± 3.3[kj] (114)	17.4 ± 4.7[hij] (114)	25.8 ± 6.2[gh] (113)

[+] n=12 samples (represents 3 replications each containing 4 samples); 10 larvae per sample. Exact number of larvae is given in ( ).

* Means with the same letter are not significantly different as determined by Duncan's Multiple Range Test.

Note: For each weathering period corrected % mortalities of the 12 foliage samples were averaged in Duncan's test for comparison purposes; mean values may vary slightly from corrected % mortality values in Tables 3-1 and 3-2 due to averaging.

Table 5. Mean deposits of Dipel[R] 12L on balsam fir foliage and webbing of spruce budworm microhabitats collected in plots D1 (30 BIU/ha) and D2 (15 BIU/ha) near Bathurst, N.B., 1988.

Plot	D1	D2
Dosage (BIU/ha)	30	15
Foliage (year old)		
Number of deposits	419	361
Number of needles	730	729
Mean deposits/needle	0.57	0.49
Microhabitats (webbing)		
Number of droplets	20	35
Number of microhabitats	24	24
Range of droplet diameter (μ)	24 - 130	11 - 100
Mean droplets/microhabitat	0.83	1.46

Fig 7 : Mean corrected % mortality of spruce budworm larvae at 6 and 9 days and at adult emergence after releasing on balsam fir foliage treated with Dipel 12L aerially applied at 15 and 30 BIU/ha, and collected after 1, 24 and 72 hours of weathering, at Bathurst, N.B., 1988.

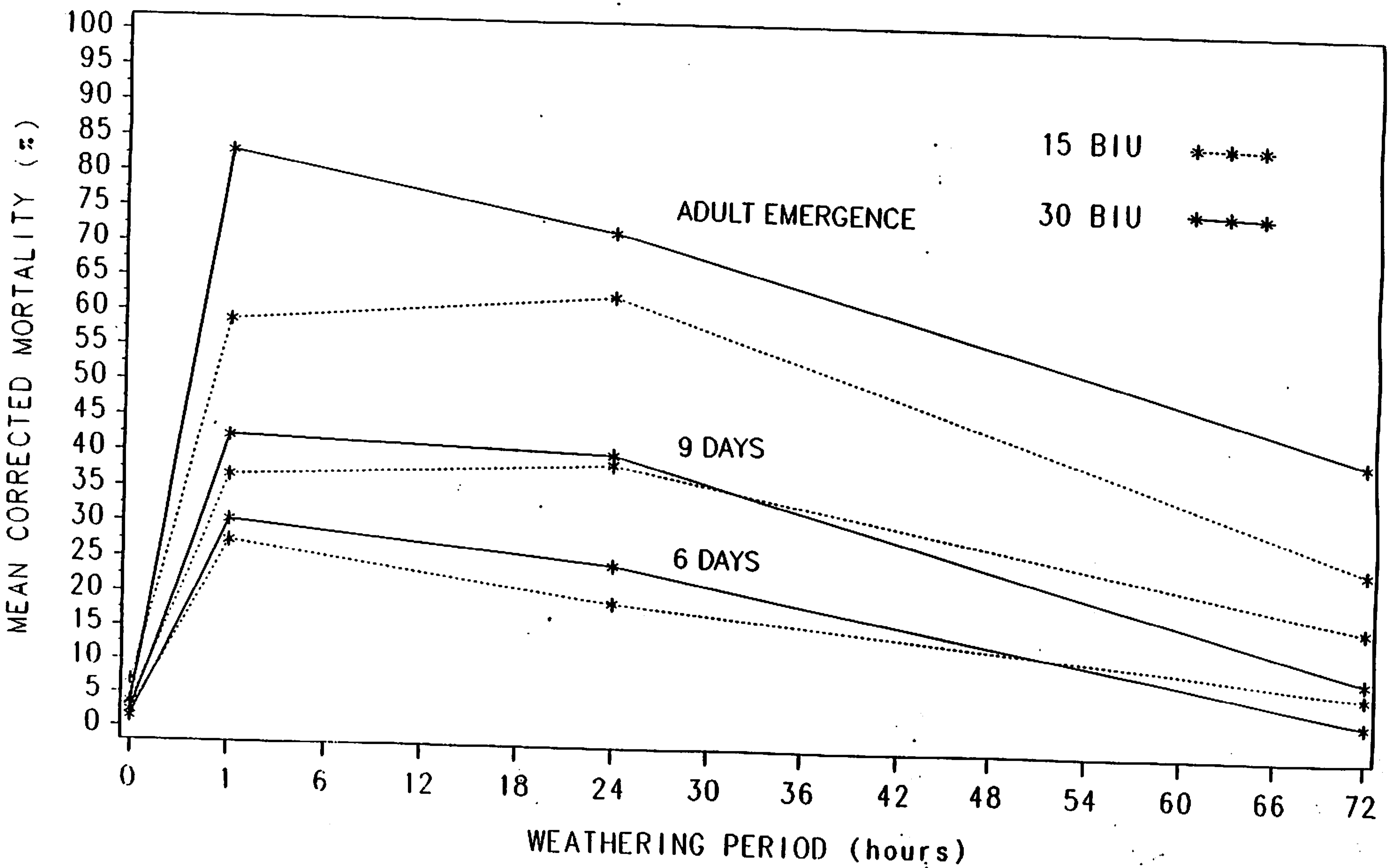

Fig 8: Mean density of Dipel 12L deposits on balsam fir needles of previous year's growth collected in Plot D1, aerially treated at 30 BIU/ha, Bathurst, N.B., 1988.

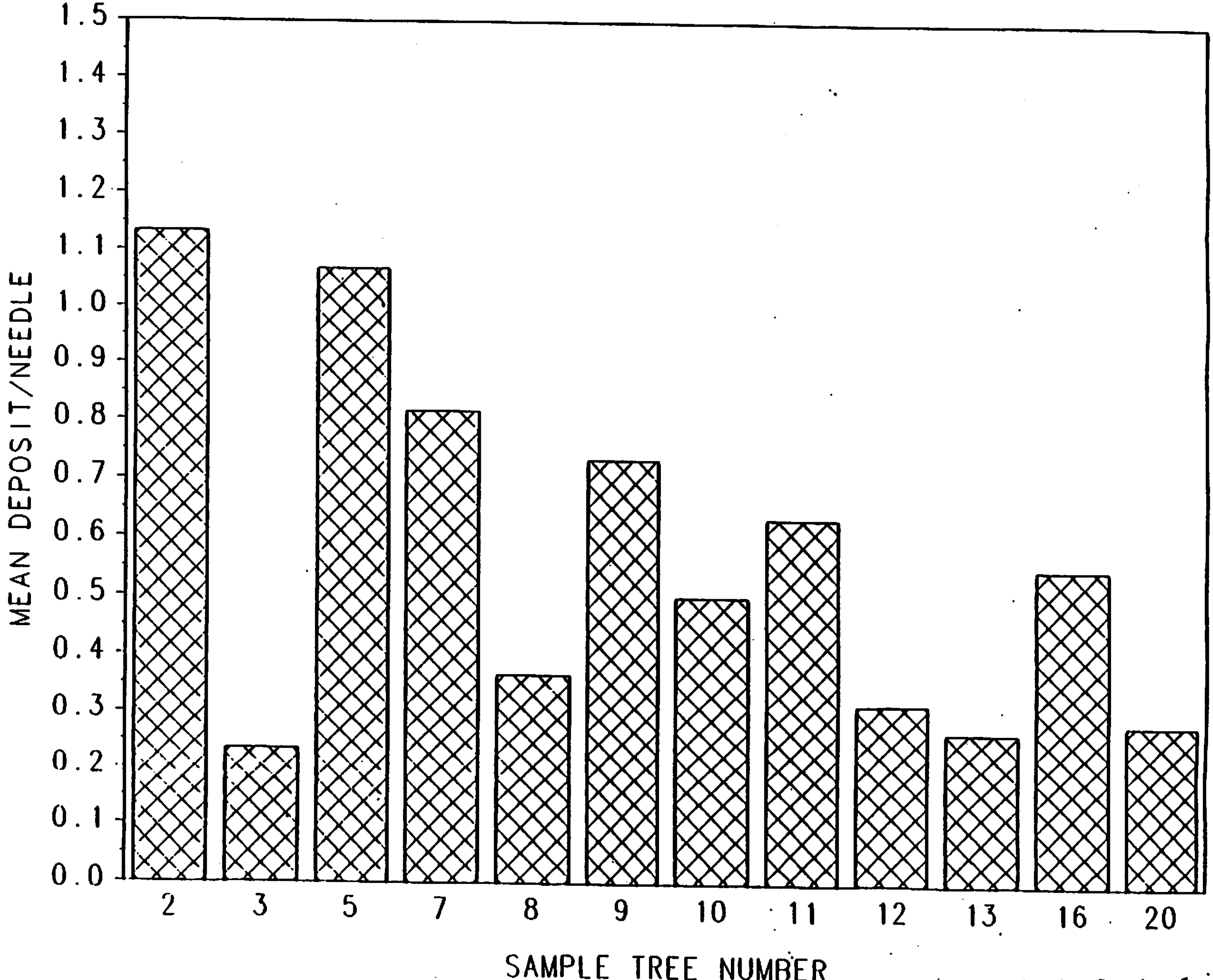

Fig 9 : Mean density of Dipel 12L deposits on balsam fir needles of previous year's growth collected in Plot D2, aerially treated at 15 BIU/ha, Bathurst, N.B., 1988.

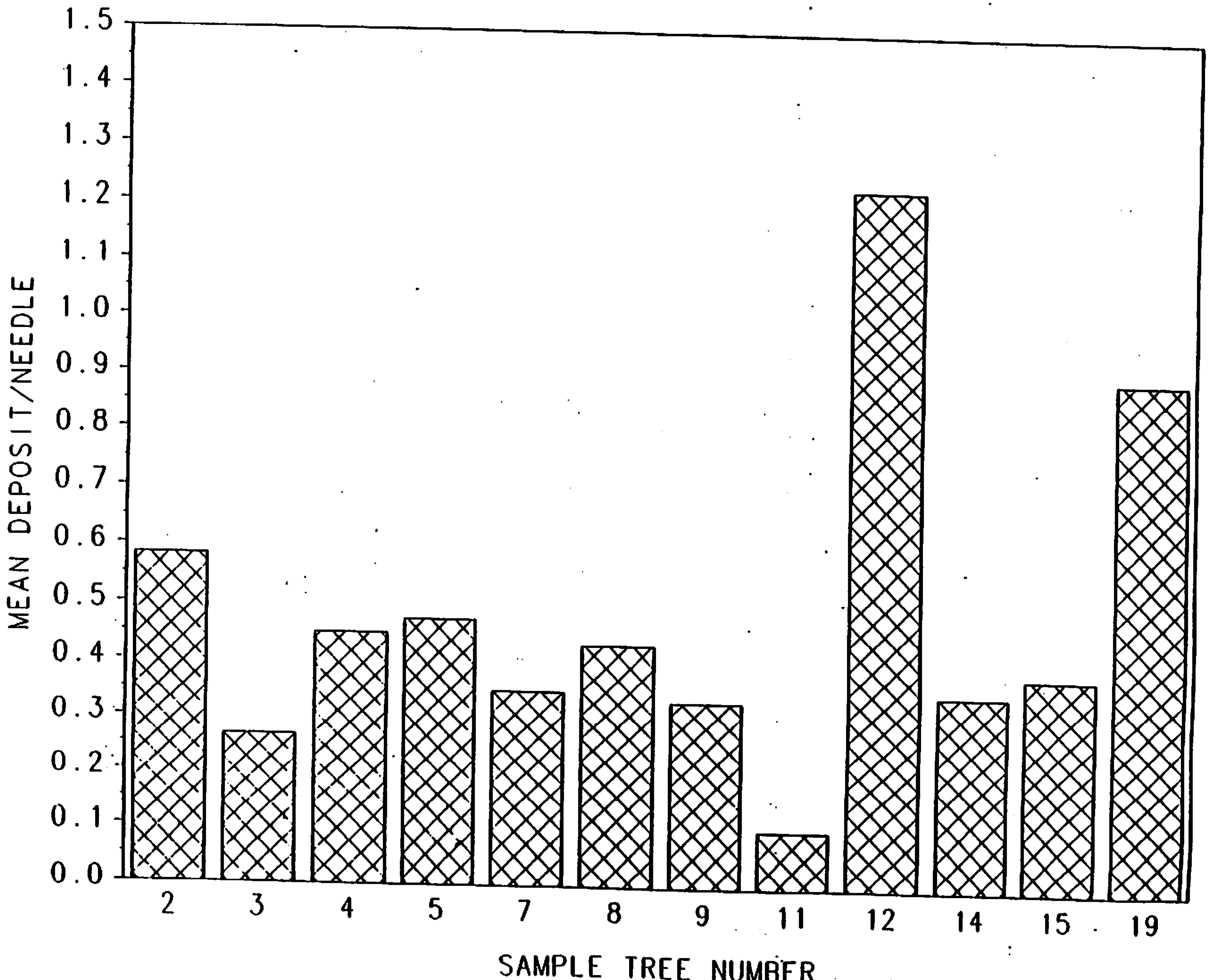

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Fig 10: Droplet spectrum observed on webbing of spruce budworm microhabitats on balsam fir in Plot D1 treated aerially with Dipel 12L at 30 BIU/ha, Bathurst, N.B., 1988.

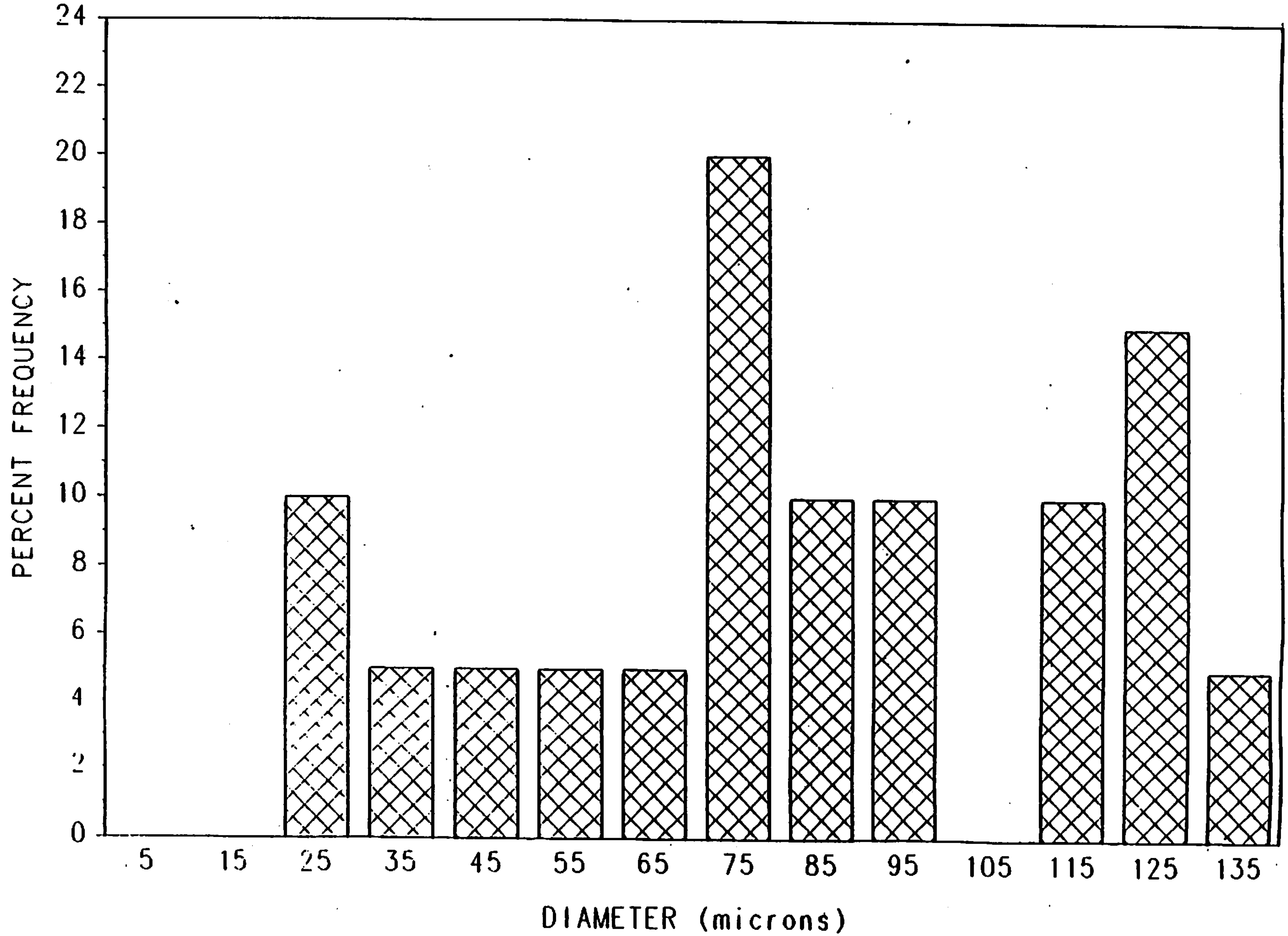

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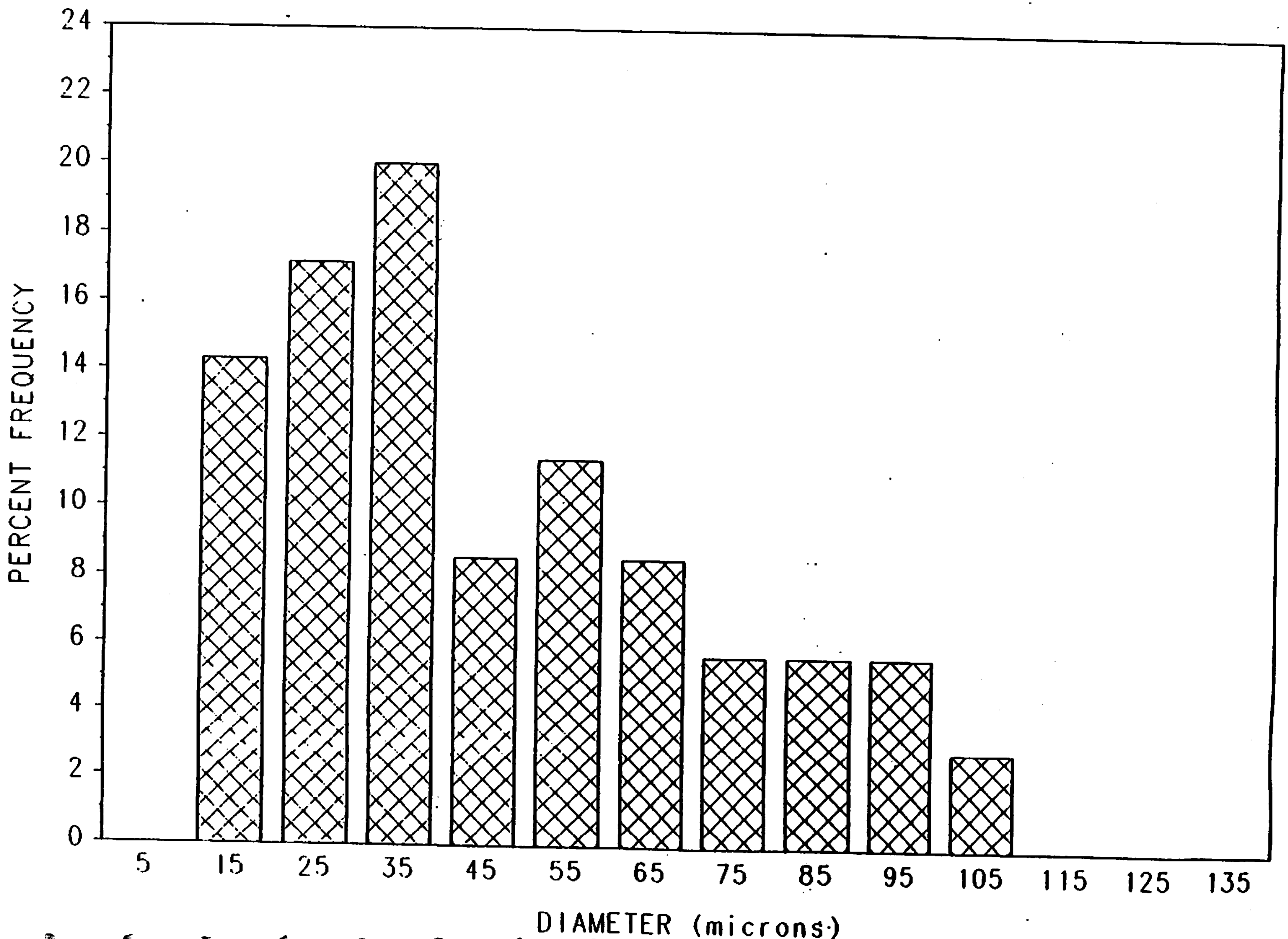
Fig 1 1: Droplet spectrum observed on webbing of spruce budworm microhabitats on balsam fir in Plot D2 treated aerially with Dipel 12L at 15 BIU/ha, Bathurst, N.B., 1988.



CONCLUSION

There was no difference in residual efficacy of 15 and 30 BIU spray formulations of Dipel^{R}12L as applied during these experiments. It appears finer droplets of 15 BIU formulation were causing more contamination of feeding site of larvae. These results were substantiated by data of Mr. E.G. Kettela on population survival and foliage defoliation, as 30 BIU gave 2.2% survival and 27% observed defoliation, while 15 BIU gave 0% survival and 23% observed defoliation in these experiments.

These results show a trend that 15 BIU give better efficacy than 30 BIU, but they are not significantly different. Dipel^{R}12L applied at 15 and 30 BIU gave similar efficacy for foliage protection and larval mortality under the experimental conditions in the field.

It appears cost of material and application can be reduced substantially by applying neat oil formulation of Dipel^{R}12L at 15 BIU with finer atomization.

THE EXPERIMENTAL SPRAY PROGRAM AGAINST THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1988

West, R.J. and J.P. Meades

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 15-17 NOVEMBER 1988

FORESTRY CANADA
NEWFOUNDLAND & LABRADOR REGION
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THE EXPERIMENTAL SPRAY PROGRAM AGAINST THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1988

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Forestry Canada
Newfoundland and Labrador Region

SUMMARY

Single treatments of Dipel at 30 and 40 BIU/ha when applied early provided acceptable reductions in larval numbers and prevented defolation by the hemlock looper. Later application provided less protection. Deposits of Dipel remained on the foliage despite heavy rain soon after application. The single application of Dipel 176 at 40 BIU/ha was more effective than that at 30 BIU/ha in reducing larval numbers when heavy rain fell within 3.5 h of treatment.

A single application of Futura XLV at 30 BIU/ha made when larval development was about 50% first instar and 50% second instar resulted in a delayed reduction in larval numbers but this was too late to provide acceptable foliage protection. Futura deposited well on the foliage.

Single treatments of an oil-based formulation of Dimilin applied when larvae were in their first instar reduced larval numbers but too late to provide acceptable foliage protection.

Mortality due to disease was widespread among late stage larvae throughout the Hawkes Bay area and this masked the effect of treatment. Abbott's formula was used to identify population reductions due to treatment.

A single application of B.t. at 30 BIU/ha made before 20% of the larvae have entered their second instar should adequately control low to moderate populations. In cases where larval populations are high and when weather following treatment is wet and cold, plans to make a second application within one week of the first should be considered.

OBJECTIVES

To determine the field efficacy provided by single applications of oil and water-based formulations of B.t. and an oil based formulation of Dimilin. To test applications of B.t. made at various timings to further define the spray window during which control actions should be taken. To test applications of Dimilin made at bud break and shortly after larval hatch.

Insecticides, Formulations, Dosage, Timing and Weather: Details of the applications are listed in Table 1.

Spray Plane and Equipment: The insecticides were emitted from four Micronair AU4000 nozzles mounted on a Grunnman AgCat aircraft. The plane flew 30 m swaths about 20 m above treetops at an air speed of 160 km/h.

Table 1. Details of applications.

Insecticide	Formulation*	Dosage/ha	Volume rate/ha	Larval dev't at time of application (L1:L2:L3)	Precipitation: Hours to next rain	6h acc (mm)	24h acc (mm)
B.t.	DIPEL 176	30 BIU	1.8 L	82:18:0	3.5	5.5	7.1
	DIPEL 176	30 BIU	1.8 L	29:71:0	7.5	0	0.9
	DIPEL 176	30 BIU	1.8 L	5:60:35	20.0	0	2.1
	DIPEL 176	40 BIU	2.4 L	82:18:0	3.0	5.5	7.1
	DIPEL 176	40 BIU	2.4 L	2:55:43	19.0	0	2.1
	DIPEL 264	30 BIU	1.2 L	90:10:0	46.0	0	0
	DIPEL 264	30 BIU	1.2 L	47:53:0	7.0	0	0.9
	DIPEL 264	30 BIU	1.2 L	5:71:24	5.5	0.2	7.9
	DIPEL 264	40 BIU	1.6 L	81:19:0	46.0	0	0
	DIPEL 264	40 BIU	1.6 L	3:58:39	5.0	0.3	7.9
	FUTURA XLV	30 BIU	2.1 L	33:67:0	6.5	0	0.9
DIMILIN	ODC 45	70 g ai	2.5 L	98:02:0	1.0	1.0	3.6
	ODC 45	70 g ai	2.5 L	99:01:0	30.0	0	0
	ODC 45	120 g ai	2.5 L	99:01:0	40.0	0	0
	ODC 45	120 g ai	2.5 L	82:18:0	6.0	0	6.4

*Formulations were applied undiluted from the drum with the exception of Dimilin which was mixed with Superior 70 oil. Tracer dyes were added to tank mixes at a concentration of 1% wt/vol. Day Glo Fire Orange was used for the oil-based formulations (Dipel and Dimilin) formulations. Day Glo Rocket Red was used in the application of Futura, a water-based formulation.

RESULTS

Weather

Weather was poor throughout the spraying period and caused postponement of the applications of Dimilin planned to be made at bud break. Rain occurred within 24 h of most applications. Conditions during the applications, however, were favourable.

Deposit (Table 2)

Deposit analysis to date is only for sprayed foliage. The materials applied deposited well. Generally there were one or more spray droplets/needle. The number of spray droplets/needle 48 h after application was not significantly reduced for the B.t. formulations but was significantly lower for Dimilin (only one application examined).

Table 2. Average number of spray droplets on current and year-old needles 1 and 48 h after application.

Formu-lation	A.I./ha	Date trt'd	1 h after application		48 h after application	
			Current	Year-old	Current	Year-old
DIPEL 176	30 BIU	2 VII	0.9	1.7	0.5	0.6
DIPEL 176	30 BIU	5 VII	0.8	1.0	3.7	4.6
DIPEL 176	30 BIU	14 VII	1.4	1.5	1.2	1.3
DIPEL 176	40 BIU	2 VII	0.9	1.4	0.9	1.0
DIPEL 176	40 BIU	14 VII	4.3	3.2	5.4	4.9
DIPEL 264	30 BIU	4 VII	2.9	3.4	2.6	3.1
DIPEL 264	30 BIU	5 VII	1.3	1.4	0.9	1.4
DIPEL 264	30 BIU	14 VII	2.7	2.6	2.5	2.1
DIPEL 264	40 BIU	4 VII	1.1	1.3	1.0	1.1
DIPEL 264	40 BIU	14 VII	3.4	3.2	3.6	3.2
FUTURA XLV	30 BIU	5 VII	1.1	1.5	2.5	3.5
DIMILIN ODC	70 g	22 VI	5.6	9.4	1.6	3.8
DIMILIN ODC	70 g	25 VI	1.4	1.8	-	-
DIMILIN ODC	120 g	24 VI	1.0	1.6	-	-
DIMILIN ODC	120 g	29 VI	1.2	1.6	-	-

Population reduction due to treatment (Table 3)

Post-spray samples were taken approximately 10 and 21 days after treatment for the plots sprayed early and 12 days after the plots sprayed late. Treatment plots were matched with check plots with similar pre-spray population densities in calculating reductions in looper numbers. Disease was widespread among late stage larvae and masked the effects of treatment. Abbott's formula was used to identify the mortality which occurred due to treatment.

Dipel: Reduction of larval numbers was generally 80% or better at the time of the first post-spray sample. An exception was the plot sprayed with Dipel 176 at 30 BIU/ha on 2 July. The very heavy rain which followed this application may have reduced efficacy. The reduction in the number of late stage larvae and pupae was excellent.

Futura: Larval reduction was only 22% 10 days after application but was 68% 21 days after treatment. The 0.9 mm of rain which fell within 24 h of application may have been a factor. Pupal reduction was excellent.

Dimilin: Control was poor at the time of the first post-spray evaluation, but there was good reduction in the numbers of late-stage larvae and pupae. There was better deposit and control of larval numbers at the lower dosage of 70 g ai/ha.

Table 3. Population reduction due to treatment following aerial application of insecticides.

Treatment	AI/ha	Date trt'd	Mean number of loopers sampled/tree: Pre spray	1st post spray	2nd post spray	Pupae	% population reduction: Red 1	Red 2	Pupal
DIPEL 176	30 BIU	2 VII	64	25	4	0	38	90	100
DIPEL 176	30 BIU	5 VII	152	8	1	0	85	96	100
DIPEL 176	30 BIU	14 VII	131	5	-	0	87	-	100
DIPEL 176	40 BIU	2 VII	52	6	3	0	83	91	100
DIPEL 176	40 BIU	14 VII	78	13	-	0	82	-	100
DIPEL 264	30 BIU	4 VII	69	8	5	0	81	89	100
DIPEL 264	30 BIU	5 VII	33	4	10	0	79	49	100
DIPEL 264	30 BIU	14 VII	123	18	-	0	68	-	100
DIPEL 264	40 BIU	4 VII	437	6	3	0	96	98	100
DIPEL 264	40 BIU	14 VII	44	5	-	0	80	-	100
FUTURA XLV	30 BIU	5 VII	284	56	11	0	22	68	100
DIMILIN ODC	70 g	22 VI	400	106	4	0	50	91	100
DIMILIN ODC	70 g	25 VI	133	60	9	0	38	88	100
DIMILIN ODC	120 g	24 VI	202	147	14	0	2	51	100
DIMILIN ODC	120 g	29 VI	806	223	3	0	12	98	100

Defoliation

Frequent heavy rains throughout July and early August washed off damaged foliage and this made defoliation assessment difficult. Furthermore mortality from disease in late stage larvae undoubtedly prevented additional defoliation. Thus there was not as an obvious contrast between treated and untreated areas as there was in 1987. Ground assessments of defoliation have been analyzed and are summarized in Table 4. Data from the aerial assessments are still being processed.

Dipel: Generally there was little defoliation and good protection of current and year-old foliage in the plots treated with early applications of Dipel. There was more defoliation in plots treated later.

Table 4. Ground evaluations of defoliation of current and year-old balsam fir in plots treated with B.t. or Dimilin (TRT), matched check plots (CK) and in areas bordering either side of the treated plots (BORD).

Treatment	(ai/ha)	Date trt'd	Mean defoliation/tree (%) TRT	CK	BORD1	BORD2	Foliage saved compared to CK	BORD
A. Current-year foliage								
DIPEL 176	30 BIU	2 VII	2	6	37	0	66	89
DIPEL 176	30 BIU	5 VII	0	10	62	7	100	100
DIPEL 176	30 BIU	14 VII	32	30	67	74	0	55
DIPEL 176	40 BIU	2 VII	0	6	1	0	100	100
DIPEL 176	40 BIU	14 VII	0	6	0	0	100	n/a*
DIPEL 264	30 BIU	4 VII	0	6	2	66	100	100
DIPEL 264	30 BIU	5 VII	1	6	46	50	81	98
DIPEL 264	30 BIU	14 VII	8	56	3	60	86	76
DIPEL 264	40 BIU	4 VII	0	38	58	17	100	100
DIPEL 264	40 BIU	14 VII	2	11	0	1	82	n/a*
FUTURA XLV	30 BIU	5 VII	55	82	56	46	34	0
DIMILIN ODC	70 g	22 VI	22	30	0	75	27	42
DIMILIN ODC	70 g	25 VI	8	6	0	7	0	0
DIMILIN ODC	120 g	24 VI	54	11	75	27	0	0
DIMILIN ODC	120 g	29 VI	47	38	45	57	0	9
Year-old foliage								
DIPEL 176	30 BIU	2 VII	8	1	33	0	0	52
DIPEL 176	30 BIU	5 VII	0	5	63	14	100	100
DIPEL 176	30 BIU	14 VII	27	20	48	62	0	52
DIPEL 176	40 BIU	2 VII	0	1	3	6	100	100
DIPEL 176	40 BIU	14 VII	0	1	0	0	100	n/a*
DIPEL 264	30 BIU	4 VII	0	1	2	59	100	100
DIPEL 264	30 BIU	5 VII	0	1	37	53	100	100
DIPEL 264	30 BIU	14 VII	14	34	2	46	57	38
DIPEL 264	40 BIU	4 VII	0	28	45	17	100	100
DIPEL 264	40 BIU	14 VII	6	5	0	1	0	n/a*
FUTURA XLV	30 BIU	5 VII	47	59	40	37	21	0
DIMILIN ODC	70 g	22 VI	28	20	0	79	0	28
DIMILIN ODC	70 g	25 VI	10	1	0	11	0	0
DIMILIN ODC	120 g	24 VI	49	5	80	23	0	4
DIMILIN ODC	120 g	29 VI	40	28	50	39	0	11

*not applicable because defoliation was too low in border areas to make a comparison.

Futura: Larval numbers were initially high in the plot treated with Futura and there was some defoliation prior to treatment. However, there was little difference in defoliation between the treated plot and the untreated bordering area. Foliage saved in comparison to the check plot was low.

Dimilin: There was only minimal foliage protection in the plots treated with dimilin.

Forestry Canada
Newfoundland and Labrador Region

November 1988

RESEARCH ON THE BLACK ARMY CUTWORM IN NEWFOUNDLAND IN 1988

West, R.J. and D.S. Durling

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM,
OTTAWA, 15-17 NOVEMBER 1988

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

RESEARCH ON THE BLACK ARMY CUTWORM IN NEWFOUNDLAND IN 1988

R.J. West and D.S. Durling
Forestry Canada
Newfoundland and Labrador Region
Canadian Forestry Service

Evaluation of operational application of Ambush:

Ambush 500 EC was applied by personnel from the Newfoundland Department of Forestry on 19 May at Abitibi Price's black spruce plantation at Journois Brook in western Newfoundland. The application was made at a rate of 140 ml in 45 L water/ha with a MB200SK Automatic Mistblower equipped with an AU5000-2 Micronair air blaster and mounted on a Tree Farmer C5D Porter. The number of larvae in 1 m^2 quadrats were counted on 19 May prior to the application of Ambush and again on 28 May. Five replicates of 6 quadrats each were examined in both the treated area and in an untreated check area. Damage to seedlings was evaluated 5 July in terms of the percentage of buds attacked, percentage of defoliation/seedling and leader growth. One hundred seedlings in each area were examined.

Larvae were essentially eliminated from the treated area within 10 days of the application of Ambush while numbers of larvae remained high and actually increased in the check area (Table 1). Sprayed seedlings had little damage and displayed good leader growth whereas the untreated seedlings were severely damaged (Table 2).

Food preferences of larvae:

Fifteen 50 m^2 circular plots in an untreated area at Journois Brook were used to identify food preferences of larvae on 30 May and 16 June. The five most common plant species in each plot were identified and ranked according to the amount of their coverage. The percentage of defoliation of each species was then estimated.

Fireweed, raspberry and birch were the most common plant species and all were severely defoliated. Other severely defoliated plants included red maple, elderberry, pearly everlasting, sorrel and mountain ash. The fruiting bodies of the hairy cap moss also were preferred. At the time of the first evaluation, there was less defoliation in the planted seedlings. However, at the time of the second evaluation nearly all the non-coniferous cover was defoliated and defoliation of the seedlings increased. There did not appear to be a preference for a particular non-coniferous species, but non-coniferous plants were preferred over black spruce seedlings.

Adult flight period:

A non-saturating trap (Multipher) baited with the black army cutworm lure (Raylo Chem., Alta.) was used at black spruce plantations at Journois Brook (10 traps) and St. Fintan's (5 traps). Traps were set up on 4 July and checked weekly until 18 October to determine the flight period.

Adults were caught from 11 July to 7 October indicating a lengthy flight period. Peak catch was between 9 August and 6 September.

Table 1. Effect of Ambush on larvae of the black army cutworm following an operational application at a black spruce plantation at Journois Brook, Newfoundland in 1988.

Treatment	Replicate	Number of larvae/m^2 ($\pm$ S.E.) Pre-spray	Post-spray
Ambush	1	44.0 $\pm$ 7.7	0.3 $\pm$ 0.2
	2	48.7 $\pm$ 6.7	0.2 $\pm$ 0.2
	3	0.5 $\pm$ 0.2	0
	4	24.7 $\pm$ 4.1	0.2 $\pm$ 0.2
	5	21.5 $\pm$ 4.7	0
	mean	27.9 $\pm$ 3.9	0.1 $\pm$ 0.1
Check	1	1.5 $\pm$ 0.8	35.0 $\pm$ 10.2
	2	0.3 $\pm$ 0.2	25.8 $\pm$ 2.5
	3	30.7 $\pm$ 5.6	43.3 $\pm$ 11.7
	4	46.8 $\pm$ 4.0	24.7 $\pm$ 4.3
	5	17.7 $\pm$ 6.9	34.2 $\pm$ 4.9
	mean	19.4 $\pm$ 3.7	32.6 $\pm$ 3.4

Table 2. Damage to black spruce seedlings by the black army cutworm at Journois Brook, Newfoundland in 1988.

Treatment	Percentage of buds damaged/seedling	Percentage of seedling defoliated	Leader growth (cm)
Ambush*	1.8	1.2	12.2
Buffer zone**	85.8	48.7	1.2

* 28 larvae/m^2 (19 May), 0.1 larvae/m^2 (28 May).

** 51.4 larvae/m^2 (28 May).

Levels of parasitism:

Approximately 200 larvae were collected each week from 29 May to 16 June from Journois Brook and St. Fintan's and reared either individually in 30 ml diet cups or in groups of 50 in plastic tubs. Birch foliage was supplied twice a week. The levels of parasitism were determined from the rearings.

Approximately 40% of larvae collected from St. Fintan's and 50% of those from Journois Brook were parasitized by either hymenopterous or dipterous species. Parasitism levels among the individuals that pupated were 1% or less. Specimens have been sent to BRI for identification and more parasites are expected to be reared over the winter.

Future Work

Control trials:

Steinernema sp., a cold-tolerant, soil-inhabiting entomogenous nematode native to Newfoundland will be tested in replicated ground trials in cooperation with Memorial University. Nematodes as control agents are environmentally acceptable and they can be aerially applied.

Other environmentally acceptable controls will be tested as they become available.

Recovery of seedlings attacked by the black army cutworm:

The seedlings monitored at Journois Brook in 1988 will be reexamined in 1989 to determine recovery after defoliation by the cutworm.

FIDS monitoring of adults:

FIDS monitoring of adults will increase in newly established plantations and in recently burned areas scheduled for planting. Results from the 1988 study indicate that adults should be monitored in August.

Identification of parasites:

Larvae will be collected and reared to further determine the complement of species parasitizing the black army cutworm in Newfoundland.

Forestry Canada
Newfoundland and Labrador Region

November 1988

INSECT GROWTH REGULATOR SPRAY TESTS AGAINST BALSAM WOOLLY APHID IN NEWFOUNDLAND IN 1988

Bowers, W.W. and A. Retnakaran

REPORT TO THE 16TH ANNUAL FOREST PEST CONTROL FORUM,
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INSECT GROWTH REGULATOR SPRAY TESTS AGAINST BALSAM WOOLLY APHID IN NEWFOUNDLAND IN 1988

by

Bowers W.W.[1] and A. Retnakaran[2]

In 1987, a cooperative project was initiated between the Newfoundland Forestry Centre and the Forest Pest Management Institute to assess the potential use of insect growth regulators (IGRs) against the balsam woolly aphid, Adelges piceae (Ratzeburg). Four IGRs were tested in 1987 in a small scale field trial at Bottom Brook, Newfoundland. Results in 1987 indicated that the insect growth regulator S-71639 (formally S-31183) significantly reduced the numbers of sessile nymphs. Accordingly, in 1988 research was directed to testing the effect of the compound on the egg and adult stadia of balsam woolly aphid.

Ten trees in each of four treatment groups were used in the spray trial. Individual trees were selected following a preliminary screening to detect trees with current aphid infestation. Within the study area each treatment group was spaced at least 10 m apart. Treatments included groups of 10 trees sprayed with 1.0%, 0.1% and 0.01% S-71639 as well as an untreated control group. Test materials were diluted with water and applied as aqueous sprays to the point of runoff from a backpack mist blower. Treatment effects were evaluated by pre- and post-spray branch sampling. For each of 40 trees, 1 branch sample was removed from the subapical crown and the second position node on the secondary twig examined for aphids. The node sample unit was chosen because most first instar nymphs settle, feed, and develop at first and second position nodes in the apical 3-year growth portion of a branch. At each node bud scales were removed and aphid stadia counted under 25 magnifications. The percent population reduction due to treatment effects was computed using Abbott's (1925) formula.

Figures 1 and 2 present the total numbers of eggs and adults before and after spray application. Numbers of balsam woolly aphid eggs and adults were reduced following application of the insect growth regulator. However, in contrast to sessile nymphs, the percent population reduction for eggs and adults is low and not considered acceptable for effective population control (Fig. 3). Greenhouse and laboratory experiments to investigate the biological effects of S-71639 are in progress.

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FIG. 1. S-71639 EFFICACY TRIAL AGAINST BALSAM WOOLLY APHID EGGS, CRABBS RIVER, NF, 1988

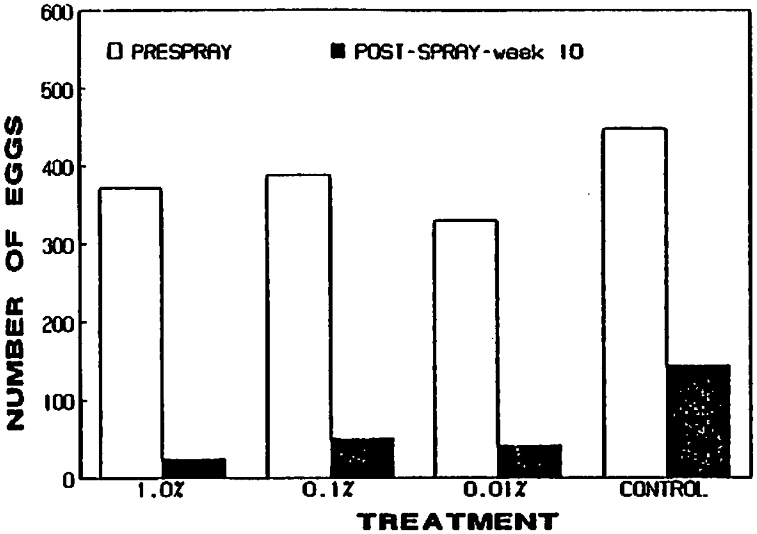


FIG. 2. S-71639 EFFICACY TRIAL AGAINST BALSAM WOOLLY ADULTS, CRABBS RIVER, NF, 1988

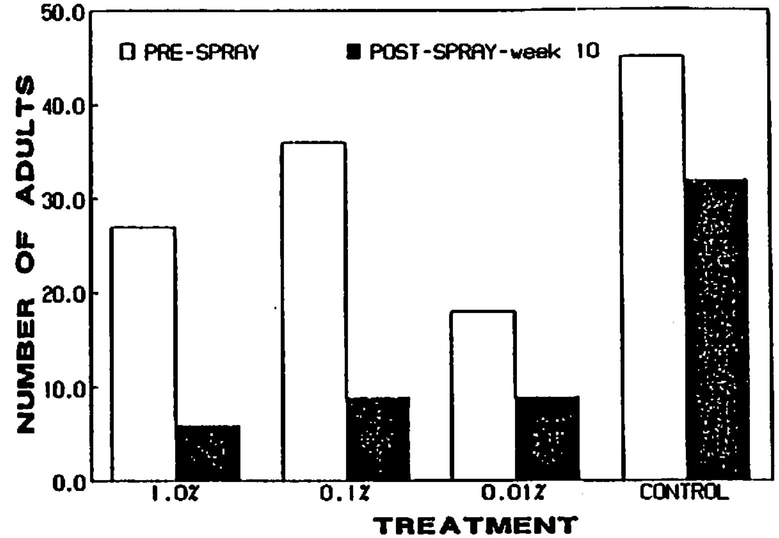
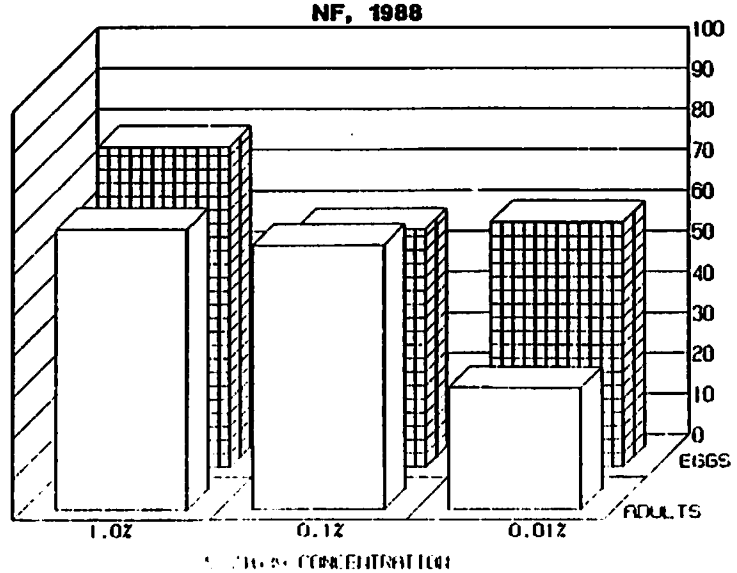


FIG. 3. S-71639 EFFICACY TRIAL AGAINST BALSAM WOOLLY APHID, CRABBS RIVER NF, 1988



FIELD EXPERIMENT ON CONTROL OF SEEDLING DEBARKING WEEVIL, *Hylobius congener*, WITH NEMATODES

D.C. Eidt, Canadian Forestry Service - Maritimes
and
J. R. Finney-Crawley, Memorial University of Newfoundland

A field experiment was run in Nova Scotia to determine if the seedling debarking weevil could be controlled with entomophilic nematodes, using the technique developed by Pye and Pye (Nematologia 31:109, 1985) for *Hylobius abietis*. The procedure was to dip the roots of trees in multipots in an aqueous suspension of the nematodes in the evening, and to plant the trees the next day. Rows of treated trees at each site were interspersed with rows of untreated trees and there was a buffer of untreated trees on each side. There was one site for each treatment and a control site, each separated from the others by at least one kilometer to avoid cross infection.

The results were not conclusive. At every treated site there was no difference between the control and the treatment which suggests no protection. Because the nematodes are mobile and can be carried about by the weevils, we are not surprised that there was no difference. There was less damage in all of the treatments than at the control site, which suggests a degree of control, but the odds are high, 20%, that any site will have the greatest damage. On the other hand, in the plot with the least damage, 350,000 *S. feltiae*/tree is a high dosage compared with that for the other species, and *S. feltiae* is the species that gave good results against *H. abietis*.

Bruce Pendrel had plots with cultural treatment on a similar site about 500m away from our high rate of *S. feltiae*. Comparison suggests our treatment reduced damage by more than 50%.

Because the nematodes are mobile, our treatments may have been diluted by the untreated trees on the sites. We postulate that greater damage protection would have resulted if all the trees at each site had been treated.

The experiment suggests another field trial next year, but only if entire planted areas are treated.

We acknowledge gifts of nematodes for experimental purposes from Phero Tech Inc., Vancouver, and Biologic Biocontrol Products, Research, Chambersburg, Pennsylvania. Field crews were provided by Scott Paper Company, New Glasgow, N.S. Bruce Pendrel, FIDS, advised us on details of the biology of the insect, helped us select the plot areas, and taught us his damage appraisal method.

Damage by *Hylobius congener* to red pine planting stock, roots of which were dipped in a suspension of entomophilic nematodes before planting.

Species	Nematodes per tree	Percentage of trees damaged: Amount of Girdling 25	50	75	100	Total	N
Control site 1	0	2	2	2	39	46	680
Control site 2	0	7	2	4	22	35	
Steinernema feltiae	35,000	2	3	2	33	40	768
	0	5	2	1	33	41	371
	350,000	1	1	1	12	15	703
	0	1	0	2	11	14	357
Steinernema bibionis	2,250	2	<1	2	13	17	565
	0	2	1	1	15	19	384
Heterorhabditis heliothidis	2,700	1	1	1	17	21	158
	0	2	0	1	17	20	223

FIELD EXPERIMENT ON CONTROL OF SPRUCE BUDMOTH,

Zeiraphera canadensis, WITH NEMATODES

D. C. Eidt, Forestry Canada - Maritimes

and

J. R. Finney-Crawley, Memorial University of Newfoundland

Three species of entomophilic nematodes were applied to the soil beneath white spruce trees just after fully grown larvae dropped to the ground to pupate. Because of a limited amount of material available, only two trees were treated at each rate for each species. To ensure that controls and treatments had similar budmoth populations, the areas under the trees were divided so that half was treated and half was not. The nematodes were applied as a measured amount of an aqueous suspension using a watering can. The treatments were applied in late evening to avoid rapid evaporation and desiccation of the nematodes.

The results indicate that *Heterorhabditis heliothidis* was not effective, but the dosage was small. *Steinernema bibionis* was effective even though the rate was low. *Steinernema feltiae* was effective at all rates, and increasingly so at increasing rates. On the control side of the trees, diminishing moth emergence with increasing dosage can be attributed to dispersing nematodes invading the control area.

These are results of a preliminary field test, and have no statistical validity. It is our intention to run a properly designed field experiment in 1989. We would also like to attempt a foliar spray against larvae under bud caps, depending on whether we can devise a formulation worth trying. Success depends on the nematodes surviving to seek and infect the larvae.

We acknowledge gifts of nematodes for experimental purposes from Phero Tech Inc., Vancouver, and Biologic Biocontrol Products, Research, Chambersburg, Pennsylvania.

Emergence of spruce budmoth adults, *Zeiraphera canadensis*, under trees where the ground was treated with entomophilic nematodes.

Species	Nematodes /m²	Emergence moths/0.5 m² Tree 1	Tree 2	Total	% reduction
Heterorhabditis heliothidis	0.1×10^6	25	7	32	-45
	0	9	13	22	
Steinernema bibionis	0.13×10^6	6	0	6	68
	0	16	3	19	
Steinernema feltiae	4×10^6	14	5	19	58
	0	31	14	45	
	20×10^6	2	3	5	83
	0	19	11	30	
	40×10^6	1	1	2	71
	0	4	3	7	

SUMMARY REPORT ON STUDIES OF PESTICIDE IMPACTS ON FOREST ECOSYSTEMS

[Project No. FP-70 - Environmental Impact]

Report to the 16th Annual Forest Pest Control Forum

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Summary Report on Studies of Pesticide Impacts on Forest Ecosystems

Field studies by FPMI's Environmental Impact Project in 1988 included post-treatment data collections in the Icewater Creek research area and the initiation of a study on the potential impact of B.t. spraying on non-target Lepidoptera in jack pine plantations near Gogama, Ontario. A laboratory study investigating the sublethal effects of cholinesterase inhibiting forestry insecticides on the behaviour and reproductive activities of zebra finches was completed.

Aquatic Studies

A post-treatment analysis of the 1987 permethrin injection into Icewater Creek was continued in 1988. The density and composition of the stream invertebrate community was monitored by stream bottom and artificial substrate sampling. An evaluation of treatment effects on stream benthos is in progress, including identification and quantification of invertebrate samples. Measurement of brook trout density, movement, population structure, and growth was continued through 1988 to assess long-term effects of the permethrin injection on brook trout and to continue the population dynamics data base.

An analysis of the short-term (to the end of 1987) response of the brook trout population to the insecticide treatment was completed. The insecticide, injected at a concentration sufficient to cause a massive disturbance of benthos, had a limited impact on the resident brook trout. The treatment resulted in large invertebrate drift increases and some depletion of benthos, but did not produce evidence of fish mortality or stress. The density, population age structure, movement patterns, and condition of brook trout were unaffected by the permethrin treatment. The growth rates of 0+ and 1+ age classes following the insecticide application were significantly lower than those of trout from the same age classes in pre-treatment years. This lower growth rate resulted in significantly smaller lengths of post-treatment trout compared to pre-treatment fish. The contribution of insecticide effects to this growth reduction is confounded by the unusually warm and dry field season of 1987. Temperatures in 1987 were above the averages of the pre-treatment years and water temperatures exceeded 22°C for extended periods through late June, July, and August. These temperatures are considered unsuitable for brook trout and were well above the optimum growth temperature of 13°C. This suggests that temperature stress may have contributed to the growth reductions. A significant reduction in the growth of trout collected during the same periods from a nearby control stream indicated that high temperatures were at least partially responsible for the reduced growth rate of treated fish. A replication of the treatment to measure the response of brook trout in the absence of temperature stress is tentatively scheduled for 1989 or 1990.

Terrestrial Invertebrate Studies

The 1988 field season was principally dedicated to initiating a study of the Lepidoptera associated with blueberry in jack pine plantations near Gogama, Ontario. Research carried out by Dr. J.F. Bendell and colleagues

(University of Toronto, Faculty of Forestry) suggests that aerial sprays of B.t. may adversely affect the survivorship of young spruce grouse chicks by reducing the availability of caterpillars in the shrub/herb layer. This is a rather uncommon natural situation whereby a bird species is restricted to foraging within a space that is nearly a two-dimensional surface and is readily defined as an area not targetted by the spray operation.

The research carried out by the Environmental Impact Project was supported by a grant from the Ontario Pesticides Advisory Committee. The first season's objectives were to become familiar with the caterpillars associated with the clearly dominant ground cover (Vaccinium augustifolium) by collecting larvae through the month of June (the critical feeding period for the spruce grouse chicks), and then rearing, identifying, and establishing laboratory cultures of as many species as possible. These determinations will facilitate a critical analysis of the crop contents of spruce grouse chicks to determine the relative contribution each may make to the diet of these birds. Eventually, feeding bioassays of B.t. will be run against a selection of these species to assist in determining the relative risk each suffers when exposed to this insecticide.

To date, there have been at least ten species of leafrollers (Tortricidae), at least eight species of loopers (Geometridae), at least nineteen species of noctuids (mostly cutworms), one abundant species of Gelechiidae, and three other species of Lepidoptera collected, most of which have been tentatively identified. Work is continuing with the rearing and identification. Currently, three species of tortricids are in culture, large numbers of diapaused eggs have been obtained from three species of geometrids and await the spring, and it is expected that cultures of at least five species of noctuid will be initiated variously with overwintering eggs, pupae or adults.

In addition to the above, some qualitative sampling of the insect fauna at the Icewater Creek research site was continued but on a much smaller scale. Some initial toxicity trials employing contaminated surfaces were conducted using fenitrothion against leafcutter bees in cooperation with FP-50.

Terrestrial Vertebrate Studies

Field studies conducted at Icewater Creek between 1983 and 1987 were the basis of an MSc thesis which was successfully defended by R.L. Millikin at U.B.C. in December 1987. The major objective of this study was to develop a new approach to monitoring insecticide impacts on forest songbirds. This approach utilized a variety of monitoring techniques including censuses and territory mapping of singing male birds to determine population trends, mist-netting to determine breeding condition, reproductive success and population structure of territorial species, and observations of colour-banded individuals to determine movement and behaviour patterns. Some of the methods used (particularly time-budgeting and mist-netting) could be adapted for use in operational monitoring programs. The method most commonly used in recent years for monitoring pesticide impacts (i.e. measurement of cholinesterase inhibition) does not directly address the questions of survival and reproduction in exposed birds. In this respect, the techniques developed in this study are superior. Censuses will be continued at Icewater

Creek for the next several years to measure of long-term population trends in the area.

Laboratory Toxicology Studies

A study of the effects of insecticide exposure on songbirds in the laboratory was completed in 1988. This study was supported in part by grants from the Wildlife Toxicology Fund, World Wildlife Fund Canada, and the Frank M. Chapman Memorial Fund, the American Museum of Natural History. In this study, patterns of brain and plasma cholinesterase inhibition, activity (as measured by frequency of hopping on perches) and reproductive success were monitored in groups of zebra finches given acute, oral doses of the organophosphate insecticide fenitrothion. In brief, the results were as follows: peak levels of brain cholinesterase inhibition of 50 to 70% were associated with behavioural effects which lasted up to 2 days; recovery of normal perch hopping activity was more closely paralleled by recovery of plasma cholinesterase activity than by brain cholinesterase activity; plasma cholinesterase activities were not significantly different from control levels 24 to 48 hr after administration of the insecticide; brain cholinesterase activity required 10 days or more to return to normal; cholinesterase inhibitions in the range of 50 to 70% had no demonstrable effect on reproductive success, although sample size may have been a limiting factor in these tests. A more detailed analysis of the data is presented in an MSc thesis which was successfully defended by S.B. Holmes at Queen's University in June 1988.

SURVEILLANCE ENVIRONNEMENTALE DES PULVÉRISATIONS
DE PESTICIDES AU QUÉBEC EN 1988

Rapport préparé pour le seizième colloque annuel
sur la lutte contre les ravageurs forestiers à Ottawa
du 15 au 17 novembre 1988

par: Sylvie Delisle
Pierre-Martin Marotte
Jean Legris
Jean Cabana

Gouvernement du Québec
Ministère de l'Énergie et des Resssources
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 que les produits utilisés soient sécuritaires pour la santé humaine et l'environnement.

Chaque année, le Service effectue un suivi dans l'environnement des insecticides pulvérisés par le ministère de l'Énergie et des Ressources (M.E.R.) dans sa lutte contre les ravageurs forestiers. Il réalise également le suivi des phytocides servant à l'entretien des plantations. Pour ce faire, il procède à l'échantillonnage de différents milieux ou organismes exposés aux pulvérisations.

Le texte suivant résume les différents projets de surveillance et de suivi menés en 1988. Quelques résultats préliminaires y sont également présentés. L'analyse finale des résultats fera l'objet de rapports qui seront disponibles ultérieurement.

A. PULVÉRISATIONS D'INSECTICIDES CONTRE LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE

Depuis deux ans, le M.E.R. utilise essentiellement 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 contiennent des spores pouvant persister, se reproduire et même s'accumuler lorsque les conditions sont favorables. Le S.E.E. juge donc nécessaire d'en évaluer la présence à court et à long terme. En ce sens, il réalise chaque année un programme d'échantillonnage. Le Service est aussi responsable du contrôle de la qualité des préparations de B.t.

En 1988, le programme de pulvérisations opérationnelles du M.E.R. couvrait une superficie de 192 073 hectares. Le Dipel^{MD} 132 a été utilisé sur 93% de cette superficie et le Futura^{MD} XLV sur le reste. Deux quadrimoteurs de type DC-4 et 12 monomoteurs de type Bull Thrush, Thrush 800 et AgCat ont réalisé les traitements à une dose de 30 M.U.I./ha.

Les détails concernant les traitements expérimentaux sont donnés plus loin dans le texte.

1. Persistance à long terme du B.t.

a) Sol forestier

- Thuricide^{MD} 48LV

En 1985, le M.E.R. établissait vingt-neuf stations de sol forestier à l'intérieur des aires traitées au Thuricide^{MD} 48LV. Depuis ce temps, les mêmes stations ont été échantillonnées chaque année afin d'étudier la persistance de ce produit. Au fil des ans, certaines stations ont cependant dû être abandonnées pour diverses raisons. En 1988, seize stations ont pu être échantillonnées. Le but de cette étude était de vérifier la présence après trois ans du Thuricide^{MD} 48LV dans le sol ainsi que l'augmentation des concentrations dans la partie minérale. Trente deux échantillons ont été analysés pour ce projet. Des résultats sont présentés au tableau 1.

- Dipel^{MD} 132

En 1987, le Ministère a étudié le comportement du Dipel^{MD} 132 dans le sol à la suite d'une pulvérisation aérienne. Étant donné l'absence d'observations sur le comportement à long terme de ce produit, le S.E.E. a voulu connaître sa persistance après un an. On désirait aussi évaluer le déplacement des spores de B.t. vers les horizons inférieurs et comparer les résultats avec ceux du Thuricide^{MD} 48LV.

Les mêmes stations, au nombre de dix-huit, ont de nouveau été échantillonnées en 1988. On y a prélevé trente-six échantillons de sol organique et minéral. Des résultats sont présentés au tableau 1.

b) Lacs

Le S.E.E. a effectué en 1987, des prélèvements de sédiments et d'eau en milieu lacustre deux mois après des pulvérisations de Dipel^{MD} 132. Ce projet comprenait l'échantillonnage de huit lacs situés à l'intérieur des aires traitées. Les résultats démontrent la présence de faibles concentrations lorsque le bassin versant des lacs est exposé aux pulvérisations.

En 1988, nous avons échantillonné les mêmes lacs afin d'y évaluer la persistance du produit après un an. L'échantillonnage de chaque lac comprenait cinq prélèvements de sédiments et trois d'eau. Le tableau 1 présente des résultats.

2. Persistance à court terme du Dipel^{MD} 132 dans le sol

Une étude réalisée en 1987 a révélé de très faibles quantités de B.t. dans le sol quelques jours après une application de Dipel^{MD} 132. Les concentrations sont inférieures à celles obtenues après un traitement au Thuricide 48LV. Ces résultats s'expliquent difficilement puisque les deux formulations contiennent la même quantité de spores par litre.

Une étude similaire a été réalisée en 1988, afin de vérifier le comportement à court terme du Dipel[MD] 132. Douze échantillons de sol organique ont été récoltés après des délais variant de un à trois jours. Des résultats se trouvent dans le tableau 1.

3. Suivi des produits expérimentaux

Les traitements expérimentaux en forêt sont essentiels dans le processus d'homologation de nouveaux insecticides. Le M.E.R. participe à certains projets afin de vérifier l'efficacité des produits et d'en étudier le comportement dans l'environnement. Deux des produits expérimentaux utilisés en 1988 par le Ministère, sont des formulations aqueuses à base de B.t.k.. Ils ont été mis au point par les compagnies C.I.L. et ECOGEN et correspondent au nom de E 492[MD] et de Condor[MD] AF.

a) E 492 (C.I.L.)

Au printemps de 1988, le M.E.R. a utilisé deux formulations de ce produit durant son programme de pulvérisations aériennes contre la tordeuse des bourgeons de l'épinette. Quatre secteurs forestiers ont été traités pour une superficie totale de 144 hectares. Un avion de type Piper Pawnee a réalisé le traitement à une dose de 30 M.U.I./ha.

Le S.E.E. a élaboré un programme d'échantillonnage conjointement avec la compagnie C.I.L.. Les milieux choisis sont le sol forestier et l'eau lotique. L'objectif premier de ce projet était de connaître le comportement du produit à court, à moyen et à long terme. De plus, on voulait comparer les résultats à ceux obtenus avec le Thuricide[MD] 48LV et le Dipel[MD] 132.

Pour ce projet, le S.E.E. a échantillonné seize stations de sol et un ruisseau. Des prélèvements ont été faits avant le début des opérations. Pour le sol, les récoltes suivantes ont eu lieu entre un et trois jours après l'application ainsi que trois mois plus tard. Le ruisseau a été échantillonné toutes les vingt minutes pendant les trois premières heures suivant la pulvérisation. Les récoltes suivantes ont eu lieu après un et quatre jours ainsi que deux mois

Tableau 1. Persistance à court et à long terme du <u>B.t.</u> - Résultats préliminaires

PROJET	MILIEU	PRODUIT	DÉLAI	MIN. - MAX.
persistance à long terme	sol org.[a]	Th. 48LV	3 ans	2,3 - 33,0 x 10^4 U.F.C.[c]/g
	sol min.[b]			N.D.[d] - 1,6 x 10^4 U.F.C. /g
"	sol org.	Dipel 132	1 an	N.D. - 28,0 x 10^4 U.F.C. /g
	sol min.			N.D. - 0,31 x 10^4 U.F.C. /g
"	lac-sédiment	Dipel 132	1 an	N.D.[e] - 0,62 x 10^4 U.F.C. /g
"	lac-eau	Dipel 132	1 an	0,001 - 0,18 x 10^4 U.F.C. /ℓ
persistance à court terme	sol org.	Dipel 132	1-3 jrs	1,1 - 21,0 x 10^4 U.F.C. /g

a. sol org.: organique
b. sol min.: minéral
c. U.F.C.: Unité formant des colonies
d. N.D. (sol) : non détecté < 0,1 x 10^4 U.F.C./g poids sec
e. N.D. (séd.): non détecté < 0,01 x 10^4 U.F.C./g poids humide

plus tard. Au total, quarante-huit échantillons de sol organique, trente-deux échantillons de sol minéral et treize échantillons d'eau ont été récoltés. Les mêmes stations seront de nouveau visitées au printemps de 1989.

b) Condor^{MD} AF (Ecogen)

Au mois de septembre de 1988, le Ministère, en collaboration avec la compagnie Ecogen, a réalisé une pulvérisation terrestre de Condor^{MD} AF. Ce traitement visait essentiellement à connaître le comportement du produit dans le sol organique et minéral.

Pour réaliser ce projet huit stations de sol forestier ont été traitées manuellement au moyen d'un pulvérisateur à air comprimé. La dose d'application était de 30 M.U.I./ha. Huit autres stations ont été traitées de la même façon avec du Dipel^{MD} 132 dans le but de comparer les résultats. Un premier échantillonnage a eu lieu avant la pulvérisation. Les récoltes suivantes se sont déroulées après 24 heures et 2 mois plus tard. Un total de quatre-vingts échantillons de sol organique et minéral ont été récoltés. Les mêmes stations seront de nouveau échantillonnées après neuf mois.

4. 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 quatorze espèces différentes de micro-organismes autres que le B.t. ont été identifiées (Tableau 2). Comme en 1987, on a détecté la présence d'entérocoques dans tous les lots de Dipel^{MD} 132. L'espèce Enterococcus faecium se retrouve dans les vingt-cinq lots, alors que l'espèce Enterococcus faecalis n'est présente que dans huit de ces lots. Rappelons qu'en 1987, ces deux espèces se retrouvaient dans chacun des 22 lots de Dipel^{MD} 132.

Les résultats du dénombrement des entérocoques révèlent des concentrations inférieures à 100 U.F.C./ml dans douze des vingt-cinq lots. Dans les autres lots, elles varient de 274 à 6700 U.F.C./ml, soit le même niveau que les concentrations détectées en 1987 (330 à 5400 U.F.C./ml).

Le laboratoire a surveillé le comportement des entérocoques dans trois lots de Dipel^{MD} 132 en vrac et dans un lot en baril. Un échantillonnage hebdomadaire a été effectué entre le 4 juin et le 18 juin 1988. Les résultats des dénombrements faits sur ces échantillons n'indiquent aucune croissance de ces bactéries dans ces quatre lots.

Notons qu'à l'exception des entérocoques, le laboratoire n'a détecté aucune des autres espèces indicatrices désignées par Agriculture Canada dans le cadre de son programme de surveillance. Ainsi, tous les lots de B.t. ont été approuvés et ont pu être utilisés en 1988.

Tableau 2. Microcontaminants retrouvés dans les lots de préparations homologuées de B.t. en 1988

Espèces retrouvées	Dipel 132[a] (%)	Futura XLV[b] (%)
Aspergillus niger	8[d]	0
Bacillus spp[c]	100	67
Corynebacterium spp	8	0
Enterococcus faecalis	32	0
Enterococcus faecium	100	0
Lactobacillus spp	52	33
Micrococcus spp	4	0
Staphylococcus epidermidis	4	0
Staphylococcus hominis	4	33
Streptococcus bovis	24	0
Streptococcus lactis diacetylactis	100	0
Streptococcus mitis	12	0
Streptococcus sanguis I	4	0
Streptococcus sanguis II	4	0

a) 25 lots
b) 3 lots
c) Autres que Bacillus thuringiensis et Bacillus anthracis
d) Chaque chiffre indique le pourcentage de lots contaminés par le micro-organisme

B. PULVÉRISATIONS CONTRE LA TORDEUSE DE L'ÉPINETTE

En mai 1988, le M.E.R. effectuait des pulvérisations expérimentales contre la tordeuse de l'épinette (Zeiraphera canadensis). Les traitements ont couvert une superficie totale de 35,1 hectares répartis sur dix plantations d'épinettes blanches. Les insecticides utilisés étaient le diflubenzuron (Dimilin^{MD}) et la perméthrine (Pounce^{MD}). Un hélicoptère Hughes 269C a réalisé les pulvérisations. Le diflubenzuron a été appliqué à des doses de 140 et 280 g/ha. Les traitements de perméthrine ont été réalisés à raison de 70 g/ha.

Étant donné l'éventualité de leur utilisation opérationnelle, le S.E.E. a voulu connaître le comportement de ces insecticides dans l'environnement. Pour ce faire, il a procédé à une évaluation du dépôt à la suite des pulvérisations. Il a aussi vérifié les concentration de diflubenzuron dans le sol et le feuillage.

Le Service a, par ailleurs, effectué un contrôle de la qualité des préparations utilisées.

1. Dépôt

Le S.E.E. a évalué le dépôt à six reprises pour chaque insecticide durant le programme expérimental. Lors de chaque traitement, cinq dispositifs comprenant un papier Kromekote^{MD} et une feuille d'aluminium étaient placés près de la tête des arbres. Les concentrations retrouvées, exprimées en pourcentage par rapport à la dose émise, ont varié de 44 à 83% pour le diflubenzuron et de 51 à 100% pour la perméthrine.

2. Sol et feuillage

Des échantillons de sol et de feuillage d'épinette blanche ont été prélevés à l'intérieur des plantations traitées au diflubenzuron. Par cet échantillonnage, le S.E.E. visait à évaluer la persistance à court et à moyen terme de l'insecticide.

Quatre stations de sol et de feuillage ont été respectivement échantillonnées pour cette étude. Une première récolte s'est déroulée avant le début des opérations. Les prélèvements suivants ont eu lieu entre neuf et seize heures après la pulvérisation ainsi que deux semaines et deux mois plus tard. Au total, vingt-quatre échantillons de feuillage et seize de sol organique ont été recueillis.

3. Contrôle de la qualité

Un total de neuf échantillons de bouillis ont été prélevés dans les réservoirs juste avant le début des traitements. Par cet échantillonnage, on voulait s'assurer que les produits utilisés contenaient la bonne proportion d'ingrédient actif.

C. 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 continué, en 1988, son suivi environnemental du glyphosate (Vision^{MD}) et de l'hexazinone (Velpar L^{MD}).

1. Glyphosate

À la suite de pulvérisations terrestres, 40 échantillons d'eau, 30 échantillons de sédiments et 60 échantillons de sol ont été récoltés. Lors des pulvérisations expérimentales par voie aérienne, le S.E.E. a réalisé une étude sur la quantification du dépôt et de la dérive à partir de trois types de capteurs: le plat de Pétri, la feuille d'aluminium et le papier Kromekote^{MD}. Pour ce dernier projet, environ 250 échantillons ont été récoltés.

En ce qui a trait à l'évaluation des résidus dans les composantes biologiques, la priorité a été accordée à la faune terrestre. Dix-neuf lièvres d'Amérique séjournant à l'intérieur ou à proximité des zones traitées ont été capturés. Des prélèvements de chair, de foie, de rein, de contenu stomacal, de fèces et d'urine ont été recueillis pour analyses ultérieures. De plus, des échantillons de chair, de rein et de foie ont été prélevés sur des orignaux et des chevreuils abattus à l'intérieur ou aux alentours des secteurs traités.

Quatorze prélèvements de fruits sauvages et trois de plantes aquatiques ont également été prélevés lors de ce suivi.

2. Hexazinone

Le suivi de ce produit a été moins important compte tenu de son utilisation limitée dans la province. Quelques prélèvements d'eau, de sédiments et de sol ont été réalisés. De plus, afin d'évaluer l'exposition des travailleurs, le S.E.E. a prélevé des échantillons d'air lors de pulvérisations effectuées avec des pistolets applicateurs.

3. Collaboration à d'autres études

En 1988, le Service canadien de la faune a réalisé une étude sur les impacts à long terme des phytocides sur les populations aviennes. Le S.E.E. a contribué financièrement à ce projet et a été impliqué dans certaines étapes de la réalisation.

D'autre part une entente de trois ans a été conclue avec le Centre de Toxicologie du Québec. L'objectif de cet accord est de déterminer l'exposition professionnelle des travailleurs forestiers aux pesticides utilisés opérationnellement en pépinières et en forêts.

Finalement, le S.E.E. effectue avec le Service de la régénération forestière un survol en hélicoptère des secteurs traités antérieurement afin de vérifier la qualité des pulvérisations.

ENVIRONMENTAL MONITORING OF PESTICIDE SPRAYING IN QUEBEC: STUDIES CONDUCTED IN 1988

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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 used do not pose a threat to human health or the environment.

Every year, the SEE conducts studies aimed at monitoring the insecticides sprayed by the ministère de l'Energie et des Ressources (MER) in the framework of the latter's forest pest control program. It also monitors the phytocides used for tending plantations. In conducting these studies, it samples environmental components or organisms which have been exposed to spraying.

This paper summarizes the various monitoring activities carried out in 1988. It also presents some preliminary results. Reports on the final analysis of the results will be available at a later date.

A. INSECTICIDE SPRAYING AGAINST THE SPRUCE BUDWORM

For the past two years, the MER has used mainly B.t.k.-based (*Bacillus thuringiensis* var. *kurstaki*) biological insecticides to control the spruce budworm (*Choristoneura fumiferana* Clem.). Several studies have shown that B.t.k. poses no threat to man, wildlife or the environment in general. However, insecticides made from this bacteria contain spores that may persist, reproduce and even accumulate under suitable conditions. The SEE has therefore decided that the short and long-term presence of these spores should be assessed. An annual sampling program has been implemented for this purpose. The SEE is also responsible for controlling the quality of B.t. formulations.

In 1988, the MER operational spray program covered an area of 192 073 hectares. Dipel^{TD} 132 was sprayed over 93% of the zone and Futura^{TD} XLV over the remaining 7%. Two four-engine DC-4 aircraft and 12 single-engine Bull Thrush, Thrush 800 and AgCat aircraft applied the insecticides at a dosage rate of 30 BIU/ha.

The results of various experimental treatments will be discussed later.

1. Long-term Persistence of B.t.

a) Forest Soil

- Thuricide™ 48LV

In 1985, the MER established 29 forest soil sampling sites in the areas treated with Thuricide™ 48LV. Since then, these sites have been sampled annually to assess the persistence of this product. Over the years, some sites have had to be abandoned, however, for various reasons. In 1988, the SEE was able to sample 16 sites. The aim of our study was to verify whether Thuricide™ 48LV was still present in the soil three years after treatment and whether there had been an increase in the concentrations of this product in the mineral layer. Thirty-two samples were analyzed during the study and the results are presented in Table 1.

- Dipel™ 132

In 1987, the MER studied the behaviour of Dipel™ 132 in the soil after aerial spraying. Since no research had been carried out on the long-term behaviour of this product, the SEE wanted to assess its persistence one year after treatment. It also wanted to evaluate the downward movement of B.t. spores in the soil and to compare the results with those of the

Thuricide™ 48LV study.

The 18 sites sampled in 1987 were sampled again this year. Thirty-six organic and mineral soil samples were collected. The results are presented in Table 1.

b) Lakes

In 1987, the SEE took sediment and water samples from a number of lakes two months after the area in which these lakes were located had been treated with Dipel™ 132. A total of eight lakes were sampled during the study. Low concentrations of this insecticide could still be detected in the samples from lakes whose watershed had been exposed to spraying.

The lakes were sampled again in 1988 to assess the persistence of Dipel™ 132 one year after spraying. Five sediment samples and three water samples were taken from each lake. The results are shown in Table 1.

2. <u>Short-term Persistence of Dipel™ 132 in the Soil</u>

During a study conducted in 1987, very small quantities of <u>B.t.</u> were detected in the soil a few days after Dipel™ 132 had been applied. The concentrations were, however, lower than those recorded after treatment with Thuricide^{TM} 48LV. These results are difficult to explain since both formulations contain the same amount of spores per litre.

A similar study was carried out in 1988 to determine the short-term behaviour of Dipel^{TM} 132. Twelve samples of organic soil were collected one to three days after spraying. The results of this study are shown in Table 1.

3. Monitoring Experimental Products

Treatments must be tested in the forest before new insecticides may be approved by Agriculture Canada. The MER is currently participating in projects aimed at measuring the effectiveness of certain experimental products and studying their behaviour in the environment. Two of the products used by the Department in 1988 are aqueous B.t.k.-based formulations. Developed by CIL and Ecogen Inc., these products are known as E 492^{TM} and Condor^{TM} AF.

a) E 492 (CIL)

In the spring of 1988, the MER used two formulations of this product during its aerial spraying program against the spruce budworm. Four

Table 1. Short and Long-term Persistence of B.t. - Preliminary Results

PROJECT	ENVIRONMENT	PRODUCT	SAMPLING DATE AFTER TREATMENT	MIN. - MAX.
long-term persistence	org soil[a]	Th. 48LV	3 years	2.3 - 33.0 x 10^4 C.F.U.[c]/g
	min. soil[b]			N.D.[d] - 1.6 x 10^4 C.F.U. /g
"	org. soil	Dipel 132	1 year	N.D. - 28.0 x 10^4 C.F.U. /g
	min. soil			N.D - 0.31 x 10^4 C.F.U. /g
"	lake-sediment	Dipel 132	1 year	N.D.[e] - 0.62 x 10^4 C.F.U. /g
"	lake-water	Dipel 132	1 year	0.001- 0.18 x 10^4 C.F.U. /l
short-term persistence	org. soil	Dipel 132	1-3 days	1.1 - 21.0 x 10^4 C.F.U. /g

a. org. soil: organic soil
b. min. soil: mineral soil
c. C.F.U.: colony forming units
d. N.D. (soil): not detected < 0.1 x 10^4 C.F.U. /g dry weight
e. N.D. (sed.): not detected < 0.01 x 10^4 C.F.U. /g wet weight

forest sectors covering a total of 144 hectares were treated. A Piper Pawnee aircraft applied the insecticide at a rate of 30 BIU/ha.

As a follow-up to spraying operations, the SEE has elaborated a sampling program in collaboration with CIL. Samples are taken in two types of environment: forest soil and lotic water. The primary objective of the program is to determine the short, medium and long-term behaviour of E 492™. The SEE also intends to compare the results of this study with those of the Thuricide™ 48LV and Dipel™ 132 studies.

To ascertain the behaviour of E 492™, the SEE sampled 16 soil sites and one stream during the spring and summer. An initial series of samples was taken prior to spraying operations. The soil sites were sampled again on two other occasions: one to three days and three months after treatment. In the stream, samples were collected every 20 minutes during the first three hours after spraying. Other samples were taken one day, four days and two months after treatment. In all, 48 organic soil samples, 32 mineral soil samples and 13 water samples were collected during the study. The same sampling sites will be studied again in the spring of 1989.

b) Condor™ AF (Ecogen)

In September 1988, the MER implemented a ground spraying program in collaboration with Ecogen Inc. The primary objective of the program was to determine the behavior of Condor™ AF in both organic and mineral soil.

During the study, eight forest soil sampling sites were treated manually with a pneumatic sprayer at a dosage rate of 30 BIU/ha. For comparative purposes, eight other sites were treated in the same manner with Dipel™ 132. An initial series of samples was taken prior to spraying operations. Other samples were taken 24 hours and 2 months after treatment. In all, 80 samples of organic and mineral soil were collected. These sites will be sampled again nine months after spraying.

4. Quality Control

Before implementing its operational spray program, the SEE microbiology laboratory sampled all B.t. lots. It also verified their insecticide efficacy and determined whether pathogenic species were present.

The insecticide efficacy of all the lots fell within the limits defined as acceptable on the label. In addition, more then 14 different species of micro-organisms other than B.t. were identified (Table 2). As in 1987, enterococci were detected in all Dipel™ 132 lots. The species <u>Enterococcus faecium</u> was found in all 25 lots, while <u>Enterococcus faecalis</u> was detected in only 8. It should be mentioned that, in 1987, both species were found in all of the 22 lots of Dipel™ 132.

The enterococci count revealed concentrations of less than 100 C.F.U./ml in 12 of the 25 lots. Concentrations in the other lots varied from 274 to 6 700 C.F.U./ml, or levels very similar to those detected in 1987 (330 to 5 400 C.F.U./ml).

The laboratory monitored enterococci behaviour in three bulk lots of Dipel™ 132 as well as in one barrel lot. Samples were taken once a week from June 4 to June 18, 1988. Counts of the number of enterococci in the samples did not reveal any increase in this bacteria in the four lots over that period.

It should be noted that, of the indicator species designated by Agriculture Canada in its monitoring program, enterococcus was the only species identified by the SEE laboratory. As a result, all the <u>B.t.</u> lots were approved and were able to be used in 1988.

Table 2. Microcontaminants Detected in *B.t.* Lots Approved in 1988

Species	Dipel 132[a] (%)	Futura XLV[b] (%)
Aspergillus niger	8[d]	0
Bacillus spp[c]	100	67
Corynebacterium spp	8	0
Enterococcus faecalis	32	0
Enterococcus faecium	100	0
Lactobacillus spp	52	33
Micrococcus spp	4	0
Staphylococcus epidermis	4	0
Staphylococcus hominis	4	33
Streptococcus bovis	24	0
Streptococcus lactis diacetylactis	100	0
Streptococcus mitis	12	0
Streptococcus sanguis I	4	0
Streptococcus sanguis II	4	0

a) 25 lots
b) 3 lots
c) Other than *Bacillus thuringiensis* and *Bacillus anthracis*
d) This figure indicates the percentage of lots contaminated by the micro-organism.

B. SPRAYING AGAINST THE SPRUCE BUDMOTH

In May 1988, the MER implemented an experimental spray program against the spruce budmoth (Zeiraphera canadensis). Spraying operations covered a total of 35.1 hectares, spread out over 10 white spruce plantations. The insecticides diflubenzuron (Dimilin™) and permethrin (Pounce™) were used during the program. They were applied by a Hughes 269C helicopter, at a dosage rate of 140 and 280 g/ha, in the case of diflubenzuron, and 70 g/ha, in the case of permethrin.

Since these insecticides might be used during operational spray programs, the SEE wanted to determine how they behaved in the environment. For this purpose, it assessed their deposition after spraying. It also measured diflubenzuron concentrations in the soil and foliage.

In addition, the SEE carried out quality control tests on the formulations used.

1. Deposition

The SEE measured diflubenzuron and permethrin deposits on six different occasions during the experimental program. During each treatment, five collectors containing Kromekote™ paper and a sheet of aluminum foil were installed near the crown of trees. These collectors detected concentrations which, when expressed as a percentage of the dosage rate, varied from 44 to 83% in the case of diflubenzuron and from 51 to 100% in the case of permethrin.

2. Soil and Foliage

Soil and white spruce foliage samples were taken in the plantations sprayed with diflubenzuron. The SEE wanted to assess the short and medium-term persistence of this insecticide.

Four soil and four foliage sampling stations were studied during the program. An initial series of samples was collected prior to spraying. Other samples were taken 9 to 16 hours, two weeks and two months after treatment. In all, 24 foliage and 16 organic soil samples were collected.

3. Quality Control

A total of nine formulation samples were taken from storage tanks just before the insecticides were applied. The purpose here was to ensure that the products contained the right proportion of active ingredient.

C. SPRAYING PHYTOCIDES ON PUBLIC LAND

To complete our knowledge of the behavior of the phytocides used in the forest environment by the MER and to validate the data collected to date, the SEE has continued to monitor glyphosate (Vision^{TM}) and hexazinone (Velpar L^{TM}) in the environment over the past year.

1. Glyphosate

Forty water, 30 sediment and 60 soil samples were taken following the implementation of a ground spraying program involving the phytocide glyphosate. During an experimental aerial spraying program, the SEE conducted a study aimed at quantifying the deposition and drift of this phytocide using three types of collectors: Petri dishes, aluminum foil and Kromekote^{TM} paper. A total of 250 samples were collected for this purpose.

In measuring the amount of residues present in biological components, the SEE focused its efforts primarily on land animals. Nineteen snowshoe hares living in or near the treated zones were captured. Samples of the animals' flesh, liver, kidneys, stomach contents, feces and urine were collected for subsequent analyses. Flesh, kidney and liver samples were also taken from moose and deer killed in or near the sectors where glyphosate had been applied. Fourteen samples of wild fruit and three samples of aquatic plants were also collected during this monitoring program.

2. Hexazinone

The hexazinone monitoring program was somewhat more limited than that carried out for glyphosate since hexazinone is not used very widely in Québec. Nevertheless, a few water, sediment and soil samples were taken. In addition, to determine the doses to which workers may be exposed, air samples were collected while this phytocide was applied with spotguns.

3. Collaboration in Other Projects

In 1988, the Canadian Wildlife Service conducted a study on the long-term impact of phytocides on bird populations. The SEE contributed financially to the project and was also involved at several stages during its implementation.

A three-year agreement has also been concluded with the Centre de Toxicologie du Québec to determine the extent to which forest workers are exposed to pesticides during their operational use in nurseries and forests.

In addition, to monitor the quality of spraying operations, the SEE carries out helicopter surveys in collaboration with the Service de la régénération forestière over sectors where phytocides have been applied in the past.

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 . 1 from each of 6 regional establishments . 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) - 1 par bureau régional (6) - 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/ 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.

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 four resolutions/statements were developed and ratified by over 80% of the attendees. The four issues were:

1. Be it resolved that the Forest Pest Control Forum express concerns with respect to the research, development, registration, and operational use of forest pest control products to the Canadian Council of Forestry Ministers with a request that the Council establish a Task Force to examine, with all stakeholders, a mechanism to address scientific, sociological, economic and political concerns that currently exist and to recommend practical means for the implementation of the National Forest Sector Strategy statement, "that pesticides are among the legitimate means for effective forest management in specific areas, that their use continued to be regulated...."

2. Be it resolved that the Forest Pest Control Forum recommend to the Chairperson of the Expert Committee on Pesticide Use in Agriculture, that a Forestry Coordinator be identified through Forestry Canada in order to ensure the collection of necessary data and coordination of subsequent requests for registrations of forestry pesticides under the minor use program.

3. Be it resolved that Agriculture Canada monitor the quality of *Bacillus thuringiensis* (*B.t.*) preparations used on operational spray programs conducted in Canada in order to ensure that acceptable levels of purity are maintained.

4. Whereas Plant Health Directorate of Agriculture Canada is to be congratulated for the development of a Gypsy Moth Policy, it nonetheless appears to have been made unilaterally without consultation with Provincial/Federal Forestry Agencies, and whereas these agencies have real concerns about the policy, be it resolved that the annual Forest Pest Control Forum request that Agriculture Canada consider this policy only to be a proposal open for negotiations with Provincial/Federal Forestry Agencies and that a revised policy be developed with input from these agencies by the end of 1989.

ISSUE STATEMENT
Forest Pest Control Forum
1988

Background

In the National Forest Sector Strategy for Canada sanctioned by the Canadian Council of Forest Ministers in 1987 the statement is made that:

> *"Much of Canada's forest is overmature and requires protection from fire, insects and diseases so that its inherent value can be utilized over time. Investments in new forests must be protected from hazards including competing weeds. Failure to invest in protection will jeopardize future benefits from the forest. Furthermore, the level of protection should be appropriate to the value of the resource and the level of investment in its management."*

In line with the preceding statement the recommendation is made in the strategy document.

> *"that all elements of the forest sector recognize that pesticides are among the legitimate means for effective forest management in specific areas...."*

In summary, the strategy document which received wide-spread approval by the forestry ministers, recognizes that our forests must be protected from destructive forest insect pests and competing vegetation, that forest protection is an integral component of intelligent forest management and that registered pesticides are legitimate tools of forest protection.

In a similar vein in its Policy Statement on the Use of Chemical Pesticides in Forestry approved by the Canadian Institute of Forestry in 1983 the CIF states that:

> *"The Canadian Institute of forestry is aware that chemical pesticides are the major tool available today to reduce the losses caused by forest pests in an effective and economical way. It, therefore, supports responsible use of registered chemical pesticides in forestry practices."*

Similarly, in its Policy on Forest Pest Management issued in 1985, the Canadian Forestry Service states that:

> *"The CFS promotes and supports the use of registered pesticides as a necessary requirement for forest management in situations where other approaches are not economically or logistically practicable or of sufficient effectiveness to achieve forest management goals."*

These are all strong statements highlighting the need for forest protection and supporting the judicious use of registered chemical pesticides to achieve forest protection objectives. Similar statements have been developed by other forest sector organizations.

All of these strategy and policy statements have been developed and promulgated over a period in which forestry's use of pesticides has been under attack by anti-pesticide activists. The statements have been aired in attempts to retain maximize the forest sector's options for the protection of the forest at a level *"appropriate to the value of the resource and the level of involvement in its management"* (National Forest Sector Strategy for Canada).

But these policies and statements are not having the effect intended. Where forestry use pesticides are concerned, the forest sector is surely losing the battle.

- Quebec, Nova Scotia and Ontario are limited to a single control option (B.t.) in control of forest insect pests now and, in Ontario, chemical insecticides cannot, even for research purposes, be applied to Crown Lands from the air.

- New Brunswick, which historically has used a variety of products in its protection operations against the spruce budworm is now more committed to B.t. as the control option.

- Matacil, an extremely efficacious and environmentally acceptable synthetic insecticide is no longer readily available.

- Zectran, an insecticide comparable or superior to Matacil is no longer under development for forestry use by the manufacturer because of poor market potential.

- Dimilin, an insect growth regulator which has U.S. registration and is particularly effective against the gypsy moth and other hardwood defoliators, is not yet registered in Canada despite vigorous attempts to gain registration over the years.

- To date, forestry has been unsuccessful in having Permethrin insecticide products registered for use via aerial application in the Woodlands category in spite of the fact that aerial agricultural uses are permitted.

- Fenitrothion remains the only synthetic insecticide in use against spruce budworm, jack pine budworm and hemlock looper in eastern Canada and its continued use is under question via a series of reviews recently completed by Environment Canada, Atlantic Region.

- No other new synthetic insecticides which the exception of a few candidate insect growth regulators are actively under development for use against the spruce budworm and other important forest insect pests.

- Herbicides, which are currenlty essential tools for ensuring successful forest regeneration on a number of forestry sites, are subject to the same constraints and issues that have reduced our insect control options to an unacceptable level. Herbicide registrations and operational uses are being severely restricted.

Increasingly, B.t. is replacing synthetic insecticides in forest protection operations. B.t. has many qualities that make it a very attractive option, however overreliance on a single product can have very negative effects where forest protection is concerned:

- B.t. is relatively effective against spruce budworm, jack pine budworm, gypsy moth and some other important lepidopteran forest pests, but it is not effective against other families of insect pests with great potential for forest damage.

- This continuing move towards B.t. to the exclusion of synthetic insecticides carries with it the perception that only B.t. or similar biologically-based insecticides can be used safely on our forests. We must in reality consider all environmentally acceptable options, whether naturally derived or synthetic.

- If uses of synthetic insecticides are ruled out for any single pest it will be tremendously difficult to reintroduce them when required to control a species against which B.t. is ineffective.

- B.t. is not immune from environmental criticisms or problems in applications as evidenced in 1987 when formulations were found to contain bacterial contaminants.

- Although B.t. has proven acceptable for control of medium to low budworm populations, we have little knowledge on how effective it will be during high populations or when populations which are currently in decline, begin to increase again due to natural population cycles.

While biological control is a desirable way to move in forestry whenever possible, this desire must be tempered by the knowledge that biological control agents (here, specifically, biologically-based insecticides) cannot be developed overnight. It has taken three and one-half decades of research and development to develop B.t. to the use pattern it now enjoys. And it has taken virtually the same length of time to get the only insect viruses registered in Canada against very specific insect pests. Should new pests assume importance in our emerging, high-value man-made forests and/or should atmospheric deposition and climate change make our natural forests susceptible to new pests, it will take several decades following their discovery to develop biological control techniques for them. In the interim particularly, and, very likely, as long as we have insect problems in our forests, we will have to depend to some degree at least on synthetic insecticides for essential forest protection operations. To believe anything else would be to do forestry and the forest sector great disservice which in turn will have a severe impact on those using and benefiting from the forest resource either directly or indirectly.

Issue Statement

If one were to boil this situation down into an Issues Statement for presentation to the Forest Pest Control Forum, perhaps it would read something like this:

> *"The forest sector in Canada is seriously constrained with respect to the range of registered pesticides (both insecticides and herbicides) that is available for essential forest protection operations. This situation must be improved to allow forest managers to manage this important renewable natural resource to the optimal benefit of all Canadians."*

Recommendation

It is recommended that the Forest Pest Control Forum bring this issue to the attention of the CCFM with a request to examine this issue and take what measures are required to rectify it. With respect to the latter, the Forest Pest Control Forum would be willing to assist the CCFM in establishing a Task Force to examine, with all groups with a stake in Canada's forest resource, the most appropriate courses of action to rectify the situation.

Steering Committee Members
Forest Pest Control Forum, 1988

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	G. Munro	H. Cerezke
Ontario	J. Churcher	G.M. Howse
Quebec	M. Auger L. Dorais	D. Lachance
New Brunswick	N.E. Carter	L. Magasi
Nova Scotia	T. Smith	L. Magasi
Newfoundland	H. Crummey	J. Hudak
FPMI		E. Caldwell E.S. Kondo (Chairperson)
PNFI		M. Power
FC Headquarters		B.H. Moody

RESPONSES TO 1987 FOREST PEST CONTROL FORUM RESOLUTIONS AND ISSUES

MAR 21 1988

Agriculture Canada

Food Production and Inspection Branch — Direction générale, Production et inspection des aliments

Pesticides Directorate
Ottawa, Ontario
K1A 0C6

Your file Votre référence

Our file Notre référence

March 15, 1988

834.2 DFB
834.2 VPR

Dr. Edward S. Kondo
Forest Pest Control Forum
Steering Committee Chairman
c/o Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Building
Hull, Quebec
K1A 1G5

Dear Dr. Kondo:

Thank you for your letter of December 15, 1987 to Dr. J.B. Morrissey regarding the review status of Dimilin (diflubenzuron) and Velpar (hexazinone) for use in forest sites.

The Pesticides Directorate has for sometime, been negotiating a review schedule with advisors in key departments, including Environment Canada. In the case of Dimilin, there was agreement that Agriculture Canada would prepare a Discussion Document on Dimilin for November 1988. This document will include a science review from each of the advisory departments and will, upon a signed release by the applicant, be provided to all interested parties.

We have recently learned that the review of the environmental data supporting forestry use of Dimilin is almost complete and that the review will be finalized by the end of March 1988. We are obliged to await the review by Environment Canada before commenting on forestry use, as this amendment is considered a significant and major use expansion.

.../2

Canada

In contrast to Dimilin which involved a major use expansion requiring a more thorough review, the Velpar review involves the review of supplemental environmental fate data. This information was requested by Environment Canada and the Canadian Forestry Service following their initial review for forestry use. Agriculture Canada, therefore, expected a quicker turnaround time, unfortunately other projects/assignments in Environment Canada have delayed this. We now understand that completion of the Velpar review will follow immediately that of Dimilin. We have also reconfirmed our interest in having this reivew completed fairly promptly, by virture of the attached letter to Environment Canada. In view of the concerns expressed re persistence/leaching of Velpar, we shall await advisor comments before commenting on the future status of Velpar.

Thank you for raising your concerns. Should the need arise, please do not hesitate to contact us again.

Yours sincerely,

(S.G. for Janet K. Taylor)

Janet K. Taylor
Director
Product Management Division

TAY:489
/sg

FEB
FEV 15 1988

Environment Canada / Environnement Canada

Conservation and Protection / Conservation et Protection

Ottawa, Ontario
K1A OH3

FEB
FEV 11 1988

Your file Votre référence

Our file Notre référence

Dr. Edward S. Kondo
Chairman, Steering Committee
Forest Pest Control Forum
c/o Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey
Hull, Quebec
K1A 1G5

Dear Dr. Kondo:

Thank you for your recent letter regarding Dimilin and Velpar which were discussed at the recent meeting of the Forest Pest Control Forum.

With respect to the submission supporting the registration of Dimilin the final required component of the database was received in March, 1987. These data are currently being evaluated by the Pesticides Division, Commercial Chemicals Branch and I anticipate that their evaluation will be completed by mid March of this year.

With respect to Velpar which was originally evaluated in 1983, the required database addressing the areas of concern identified in that original evaluation was received in December, 1987. This product will be scheduled for review and we anticipate that the review will be completed in 1988.

Finally I would like to address your concern regarding the perceived reluctance of Environmental Protection's representative to discuss the specific details of the evaluation of Dimilin and Velpar during the Issues Debate Session at the Fifteenth Annual Forest Pest Control Forum.

As you are aware, data submitted by a registrant for evaluation is considered by the registrant to be confidential business information. While our assessment of the data is made public at the time a decision is made (e.g. Discussion Documents) it is not our practice to discuss the specific details of the database with anyone other than the registrant and/or the regulatory authority until the evaluation has been completed. Therefore it is my view that the pesticide officer who attended the forum acted quite properly under the circumstances.

Canada

While I appreciate your desire to expedite the early registration of these pesticide products, it is Environment Canada's responsibility to conduct comprehensive evaluations of the potential adverse environmental impact of these same products. I assure you that these evaluations are conducted as quickly and expeditiously as possible.

Thank you for sharing your concerns with me.

Yours sincerely,

Lorette Goulet
Assistant Deputy Minister

c.c. G. Munro
J.B. Morrissey

MAR 16 1988

Office of the Minister
of the Environment

CANADA

Cabinet du ministre
de l'Environnement

MAR 11 1988

Mr. Edward S. Kondo,
Chairman,
Steering Committee,
Forest Pest Control Forum,
c/o Canadian Forestry Service,
Place Vincent Massey,
351 St. Joseph Boulevard,
Hull, Quebec.
K1A 1G5

Dear Mr. Kondo,

Thank you for the letter that you and Mr. Geoffrey Munro sent to the Honourable Tom McMillan on 15 December, 1987, regarding Environment Canada's ongoing review of the insecticide fenitrothion. The Minister has asked me to reply to you on his behalf. I regret the delay in my response.

As you correctly point out, there are three aspects to the Department's current review of the use of the insecticide fenitrothion in forestry: avian, pollinator and aquatic impacts. There seems to be some misunderstanding, however, regarding the mechanics of the pesticide review process within the federal pesticide registration system.

The responsibility for regulating the use of pesticides in Canada rests with the federal Minister of Agriculture and his provincial counterparts. The federal Minister of the Environment is responsible for providing advice about the environmental risks associated with these products, including the possible impacts on wildlife. Reviews of specific pesticides and related problem issues are continually ongoing within the Department.

In the case of fenitrothion, the aim of Environment Canada's review is to advise the Minister of Agriculture as to whether there is a need to accelerate the re-evaluation of its registration status. Although there is an orderly pesticide re-evaluation process, the pesticide review system is flexible to accommodate new scientific findings such as evidence of significant human health or environmental impacts.

.../2

Ottawa, Canada K1A 0H3

It is Agriculture Canada's responsibility to weigh the benefit of the product under review against the identified risks. If the results of Environment Canada's internal review indicate that the environmental risks of fenitrothion are serious, the Department will advise the Minister of Agriculture accordingly. Mr. McMillan is confident, however, that whatever action the Agriculture Minister chooses to take, there will be ample opportunity for the forestry sector to outline the benefits of fenitrothion.

I have sent a similar letter to Mr. Geoffrey Munro so that he, too, may be aware of the above.

Your interest in this matter is very much appreciated.

Yours sincerely,

Holly Martel
Special Assistant

FEB
FEV 15 1988

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

DEPARTMENT OF FOREST RESOURCES AND LANDS

Office of the
Deputy Minister

P.O. Box 4750
St. John's, Nfld.
A1C 5T7

February 3, 1988

Mr. Edward S. Kondo
Forest Pest Control Forum
Steering Committee Chairman
c/o Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Building
Hull, Quebec
K1A 1G5

Dear Mr. Kondo:

Your letter of January 19, 1988 on the subject of insecticide registration so as to have alternatives for budworm control refers.

I appreciate the opportunity to lend my support to the Forest Pest Control Forum on this matter. Your correspondence is timely since the local Federal/Provincial Joint Research Committee recently met in St. John's and the subject of insecticide registration and alternative insecticides was an important part of our agenda.

In Newfoundland's case, as you are probably aware, we do not presently have a budworm problem. We do, however, have a hemlock looper problem and the issues associated with the availability of alternative insecticides to fenitrothion, which is the only fully registered chemical product for looper control, are basically the same. We are very concerned that pressure from environmental groups may leave us without an adequate control measure for looper before other reasonable alternatives are developed and registered.

This Department in conjunction with the Canadian Forestry Service has since 1985 been looking at alternatives to fenitrothion for hemlock looper control. This research has not been limited to Bacillus thuringiensis (B.t.) but has included Matacil, Dimilin and several new formulations of fenitrothion. The idea behind this research is to enhance the registration process where applications have been made to Agriculture Canada by manufacturers. The results from some of these experiments in terms of control have been disappointing but we will continue our work in 1988. I have to admit that the most positive results so far have come from the higher potency formulations of B.t. (namely Dipel 176 and 264). We have not, however, given up on Dimilin and there is a proposal to look at Zectran (mexacarbate) if we get some indication from May and Baker that they might pursue the registration of this product in Canada.

I feel this gives you a good indication of where the Newfoundland Department of Forestry stands on the issues you raise. I wish you well in your pursuit of these matters.

Yours sincerely,

R.D. PETERS
Deputy Minister

c.c. Mr. Geoffrey Munro
Issue Debate Chairman

Nova Scotia

Department of Lands and Forests

Deputy Minister

PO Box 698
Halifax, Nova Scotia
B3J 2T9

902 424-4121

Our file no:

February 10, 1988

Mr. Geoffrey Munro
Forest Pest Control Forum
Issue Debate Chairman
c/o Manitoba Natural Resources
300-530 Kenaston Blvd.
Winnipeg, Manitoba
R3N 1Z4

Dear Mr. Munro:

Your letter of January 19, 1988 outlining the recommendations of the Fifteenth Annual Forest Pest Control Forum is acknowledged.

I thank you for forwarding these recommendations on behalf of the Forum held in November 1987.

The utilization of registered insecticides in this Province will be within the framework of the Forest Policy of Nova Scotia. I have enclosed a copy of the policy for your reference. You will note (pp. 5) that the policy recognizes forest protection as the keystone of sound forest management.

Yours sincerely,

John Mullally

Enclosure

cc: Edward S. Kondo, Chairman

Gouvernement du Québec
Ministère de l'Énergie
et des Ressources

Le sous-ministre associé aux Forêts

Québec, le 7 avril 1988

Mr. Edward S. Kondo
Chairman
Steering Committee
Forest Pest Control Forum
Canadian Forestry Service
351, boul. Saint-Joseph
Place Vincent Massey Building
Hull, Québec
K1A 1G5

SUBJECT: Forest Pest Control Forum
Bordereau #2346

Mr. Kondo,

Our position concerning the recommendation developed and ratified by over 80% of the attendees at the Issues Debate session of the fifteenth Annual Forest Pest Control Forum is the following:

On a forester point of view, I understand that the more "Tools in the box" we dispose to control forest pest problems the more robust is our position regarding forest management. On an other hand the use of pesticides (chemical or biological) in Quebec requires an impact study, and eventually public hearings, when applied aerially over more than 600 hectares. Moreover, the final decision belongs to the cabinet: so there is more than our personnal good will to take such a decision.

The actual situation in Quebec is that Bt is the only material accepted to control the Spruce Budworm; this leaves us in a very poor position if the product, for a reason or an other, becomes no more available or if its cost rises up dramatically.. I recognise that the situation should be improved and if provincial authorities dont show interest for alternative materials, those will soon disappear from the market.

/2...

200, chemin Sainte-Foy, Québec, QC (Canada), G1R 4X7 - Tél. (418) 643-3987 - Télex 051-2274

Mr. Edward S. Kondo

Meanwhile, I do beleive that there is in a near future major improvements to come from the new generations of Bt (more concentrated formulations, new natural strains generated through sorting or strains improved through genetic manipulations) that because of their relatively broad spectrum (effective against most lepidoptera) and their general acceptance from the public will down the line worth the efforts invested. Within that perspective though, I agree with you that tuning our efforts is a must.

GILBERT G. PAILLÉ

c.c.: Mr. Geoffrey Munro

MAR 28 1988

Manitoba

Deputy Minister of
Natural Resources

Room 112
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

March 24, 1988.

Geoff Munro,
Issue Debate Chairman,
Forest Pest Control Forum,
c/o Manitoba Natural Resources,
300 - 530 Kenaston Blvd.,
Winnipeg, Manitoba.
R3N 1Z4

Dr. Ed Kondo,
Chairman, Steering Committee,
Forest Pest Control Forum,
c/o Canadian Forestry Service,
351 St. Joseph Boulevard.,
Place Vincent Massey,
Hull, Quebec.
K1A 1G5

Dear Sirs:

Thank you for your letter of January 19, 1988 outlining the concerns of the Forest Pest Control Forum. At the outset, I would like to say how pleased I am that the Forum has taken on this new role and grown beyond the sole function of information exchange. I am sure that the forum participants will be interested to know that as a result of the issue debate session and the subsequent recommendations, this topic became an agenda item at the Deputy Ministers' recent meeting in Edmonton that was held in conjunction with the CCFM Research and Development Symposium.

As far as the recommendation itself is concerned, I am pleased to advise you that in Manitoba we always review all pest control options that are available to us before initiating a control program. Our forest pest control programs involving the use of pesticides have never been large by Eastern Canadian standards but we do have a history of using both chemical and biological pesticides.

I can assure you that it is my intent that Manitoba continue to review all forest pest control options, including chemical and biological pesticides as well as alternate strategies such as silvicultural techniques, altered harvesting patterns, etc., before initiating any operations. Again, I support your initiatives and look forward to hearing the results of your efforts.

Yours truly,

Dale F. Stewart,
Deputy Minister.

MAR 8 1988

Province of British Columbia

OFFICE OF THE DEPUTY MINISTER

Ministry of Forests and Lands

Parliament Buildings
Victoria
British Columbia
V8W 3E7

February 29, 1988

File: 720-2

Forest Pest Control Forum
c/o Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Building
Hull, Quebec
K1A 1G5

Attention: E. S. Kondo, Chairman
Steering Committee
G. Munro, Chairman
Issue Debate Committee

Gentlemen:

Thanks very much for your letter of January 19, 1988, concerning the status of the insecticide mexacarbate.

Although potential use of this product would most likely be very small and/or intermittent in British Columbia, I support the Forum's general desire to ensure application of environmentally-acceptable materials fully registered for use in Canadian forest management. The shrinking list of available materials, and the limitations of the B.t. alternative, are well known to us.

As a result, I believe the Forum's recommendation concerning registration of an array of approved and available pesticides is both valid and timely.

We believe mexacarbate to be an acceptable option and potential choice if required in British Columbia.

Sincerely,

B. E. Marr
Deputy Minister

FEB
FEV 25 1988

Alberta
FORESTRY, LANDS and WILDLIFE

Office of the Deputy Minister

Petroleum Plaza, South Tower, 9915-108 Street, Edmonton, Alberta, Canada T5K 2C9 TWX 037-3507 403/427-3552

February 11, 1988

Mr. Edward S. Kondo
Chairman, Forest Pest Control
Forum Steering Committee
C/O Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Building
HULL, Quebec
K1A 1G5

and

Mr. Geoffrey Munro
Issue Debate Chairman
Forest Pest Control Forum
C/O Manitoba Natural Resources
300 - 530 Kenaston Blvd.
WINNIPEG, Manitoba
R3N 1Z4

Dear Sirs:

I very much appreciated receiving your January 19 letter recommending active support for the registration of the insecticides mexacarbate and aminocarb. Although these insecticides have not been used operationally in Alberta, we agree with the recommendation.

I would like to take the opportunity to thank you for the excellent work you are doing with respect to registration of those pesticides which are proven to be safe and effective in forestry operations.

Yours truly,

F.W. McDougall
Deputy Minister
Forestry, Lands & Wildlife

cc: Mr. C.B. Smith,
Assistant Deputy Minister
Alberta Forest Service

Mr. Murray Anderson
Head, Range Management Section
Forest Land Use, AFS

FEB FEV 10 1988

May & Baker Canada Inc.

M&B May & Baker

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January 28, 1988

Forest Pest Control Forum
Steering Committee
Chairman
Edward S. Kondo
c/o Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Building
Hull, Quebec
K1A 1G5

Forest Pest Control Forum
Issue Debate Chairman
Geoffrey Munro
c/o Manitoba Natural Resources
300-530 Kenaston Blvd.
Winnipeg, Manitoba
R3N 1Z4

Dear Sirs:

Thank you for your recent letter summarizing the recommendations from the Issues Debate Session of the 15th annual Forest Pest Control Forum.

I noted with particular interest the recommendation encouraging May & Baker Canada to "actively pursue forestry registration" for Zectran (mexacarbate) insecticide.

As you are probably aware, May & Baker Canada, as part of the international Rhone Poulenc group, recently purchased Union Carbide's agricultural products division. In Canada, we purchased a production facility and all the products being sold or developed by Union Carbide Canada. Zectran is one of the products that was being developed by the former Union Carbide team in Canada.

The challenge of bringing two major chemical companies together has created a number of product opportunities. Unfortunately, the process has also resulted in some hard decisions being made regarding the future of other products.

In reviewing the future of individual products, we have considered such factors as:

1. The product's efficacy in controlling target pests.
2. International brand management strategies.
3. The product's safety to non-target insects, users the general public and the environment.
4. Influence of environmental lobbyists on specific market sectors.

5. Production costs vs. expected market returns.

6. The likelihood of commercial sales.

We are very pleased with the efficacy of Zectran. The product has consistently proven to be an excellent insecticide for control of spruce budworm. Independent research done by personnel at the Forest Pest Management Institute has confirmed the results that our own in-house product development teams have obtained.

Unfortunately in today's regulatory climate numerous other factors must be considered when deciding to commercialize a product. It is with regard to these other factors that we are not encouraged by the future of Zectran.

A number of factors including limited world demand, high estimated production cost, poor likelihood of commercial sales and strong negative influence of environmental pressure groups have all combined to indicate a poor future for Zectran.

Since we have a limited number of resources available, we have reluctantly chosen to place our emphasis in developing plant protection products for other Canadian market sectors.

Therefore I regret to inform you that future development and registration of Zectran in Canada is being stopped.

I realize this decision will be hard for your members to accept. However I ask for your understanding of the factors that we have considered in making our decision.

Thank you again for expressing your interest in Zectran.

Yours truly,

MAY & BAKER CANADA INC.

David Havers

D.R.O. Havers
Vice-President
General Manager
Agrochemicals

DEPUTY MINISTER
NATURAL RESOURCES AND ENERGY
NEW BRUNSWICK

SOUS-MINISTRE
RESSOURCES NATURELLES ET ÉNERGIE
NOUVEAU-BRUNSWICK

P.O. BOX (C.P.) 6000, FREDERICTON, NB E3B 5H1

FEB FEV 25 1988

842 01 0001

February 8, 1988

Dr. Edward S. Kondo
Forest Pest Control Forum
Chairman, Steering Committee
Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Bldg.
Hull, Quebec
K1A 1G5

Mr. Geoffrey Munro
Forest Pest Control Forum
Issue Debate Chairman
Manitoba Natural Resources
300 - 530 Kenaston Blvd.
Winnipeg, Manitoba
R3N 1Z4

Dear Sirs:

Thank you for your letter of January 19, 1988, in which you provide recommendations from the 1987 Forest Pest Control Forum Issues Debate Session. Not surprisingly, the points you raise are viewed very seriously here in New Brunswick where the continued use of pesticides (especially chemicals) in forestry has become an annual component of forest management.

The New Brunswick government has recently announced that a 50:50 chemical/B.t. use pattern will be followed in the 1988 budworm protection plan and that further reductions in chemical use will be phased in over time. In other words, whereas the government prefers to see biological pesticides increase in use, it has not totally ruled out the option of chemicals as certain other jurisdictions apparently have done.

At the technical level I have been advised of the relative merits of both aminocarb (Matacil) and the unregistered mexacarbate (Zectran). Nevertheless, we are of the opinion that it is the manufacturers' prerogative to pursue or retain registration of its products. There is a risk in doing business and government makes no guarantees in this particular matter. One thing is certain, however, and that is without proper registration, Government will use none of these products. The onus therefore rests with the manufacturing sector to (a) provide a safe, reliable, and efficacious registered product, and (b) make it available at acceptable cost.

In summary, we would encourage the pesticides industry to maintain and pursue the registration of chemical and biological insecticides. The Government of New Brunswick is committed to long-term forest protection but can give no guarantee of market security for any one particular pesticide or to the pesticides industry in general.

Thank you for bringing these crucial issues to our attention and I hope that my comments will help to direct future developments within the pesticides industry.

Yours truly,

BRYAN J. WALKER

NC:ces

c. c. - R. Redmond
D. MacFarlane

MAR 1 1988

Yukon
Renewable Resources
Box 2703, Whitehorse, Yukon Y1A 2C6
(403) 667-5811 Telex 036-8-260

Our File: PP1/WJK1
Your File: 7003-2

88 02 16

Forest Pest Control Forum
Steering Committee
Chairman
Edward S. Kondo
c/o Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Building
Hull, Quebec
K1A 1G5

Gentlemen:

Thank you for your letter of January 19, 1988 regarding eastern spruce budworm control agents, B.t., fenitrothion and aminocarb.

As I am sure you can appreciate, eastern spruce budworm is not a concern in the Yukon. In fact, the use of pesticides in the Yukon is extremely limited, compared to provincial usage, and there is no chemical control of forest insects.

Due to our limited experience with this issue we are unable to take a position on the conference recommendation.

However, let me express my appreciation for your consideration in consulting us, and I offer my best wishes for your endeavors in this area.

Yours truly,

W.J. Klassen
Deputy Minister
Renewable Resources

PRINCE EDWARD ISLAND

Department of Energy and Forestry
P.O. Box 2000, Charlottetown
Prince Edward Island, Canada
C1A 7N8

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FEB FEV 16 1988

OFFICE OF THE DEPUTY MINISTER

February 3, 1988

Mr. Edward S. Kondo
Forest Pest Control Forum
Steering Committee Chairman
c/o Canadian Forestry Service
351 St. Joseph Blvd.
Place Vincent Massey Building
Hull, Que.
K1A 1G5

Dear Mr. Kondo:

This will acknowledge your letter of January 19 outlining recommendations emanating from the issues Debate Session of the Forest Pest Control Forum held in November, 1987.

I have no problem with the outlined recommendations which have been ratified by over 80% of those participating in the Session.

Yours sincerely,

Doug Cameron
Deputy Minister

/mb
cc: Mr. Geoffrey Munro
Issue Debate Chairman

Agriculture
Canada

Food Production and Inspection Branch | Direction générale, Production et inspection des aliments

Ottawa, Ontario
K1A 0C6

Your file Votre référence

Our file Notre référence

FEB
FEV 15 1988

Mr. Edward S. Kondo
Forest Pest Control Forum
Steering Committee Chairman
c/o Canadian Forestry Service
Place Vincent Massey Building
Hull, Quebec
K1A 1G5

Dear Mr. Kondo:

This letter is in response to your letter of December 15, 1987 concerning gypsy moth in Nova Scotia and New Brunswick.

I would like to take this opportunity to point out the activities that are being carried out in the two above mentioned provinces by Agriculture Canada:

1. Yearly, in conjunction with the Canadian Forestry Service, the region is surveyed for gypsy moth with the intention of detecting new populations and delineating the area of infestation.

2. There is an active public relations program being carried out at campgrounds in the generally infested area and with moving companies who may transport outdoor household articles from infested to non-infested areas. Copies of these brochures are enclosed for your information.

3. In past years, Agriculture Canada helped out New Brunswick with a control program that was jointly agreed to by both New Brunswick and Agriculture Canada. In 1987 Agriculture Canada contributed $10,000 towards a control program in Charolette County of New Brunswick.

4. There has never been a control program supported by the province of Nova Scotia.

Canada

....2

As part of the Domestic Program a network of provincial plant health advisory boards is being recommended. Given this forum the plan is to enter into cooperative agreements with each province on a pest management strategy for specific pests. Such an agreement with the province of Nova Scotia on Gypsy Moth would be a perfect example of what could be used as a model for other provinces and other pests.

I trust this clarifies the situation.

Sincerely yours,

Réal Roy
Director General
Plant Health Directorate