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Report of the Twentieth Annual Forest Pest Control Forum

Government Conference Centre, Ottawa, Ontario

November 17-19, 1992

Rapport du vingtième colloque annuel sur la répression des ravageurs forestiers

Centre des conférences du Gouvernement, Ottawa (Ontario)

Du 17 au 19 novembre 1992

Not for publication / Ne pas diffuser

Forestry Canada Forêts Canada

Canada

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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 se déroule sous l'égide de 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)
March 1993 / Mars 1993

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List of Attendees

Liste des personnes présentes

United States Forest Service
Bob Bridges, Washington, D.C.
Dan R. Kucera, Broomall, PA

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

Nova Scotia Department of Natural Resources
Eric Georgeson, Truro

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

Service de la protection contre les insectes et maladies, Ministère des Forêts
Louis Dorais, Québec
Michel Auger, Québec
Clément Bordeleau, Québec

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

Department of Natural Resources Manitoba
R. Westwood, Winnipeg

J.D. Irving Limited
B. Brundsdon, Saint John

SOPFIM
Jacques Bégin, Québec

N.B. Forest Protection Ltd.
D. Davis
P. Amirault

N.B. Research and Productivity Council
Charles Wiesner

Spray Efficacy Research Group (SERG)
H.J. Irving, Fredericton

Université Laval
Madeleine Chagnon

University of Ottawa
Clifford Beninger, Ph.D. Student

Environment Canada
Ian Nicholson, Pesticides Division, Ottawa

Deloitte & Touche Management Consultants
Marvin Stemeroff, Guelph

Canadian Wildlife Service
Bruce D. Pauli, Hull

Agriculture Canada
D. Watler, Plant Health Division, Ottawa
R. Favrin, Plan Health Division, Ottawa
E. Dobesberger, Plant Health Division, Ottawa
M. Dawson, Plant Health Division, Ottawa
T. Caunters, Pesticides Directorate, Ottawa
D. Rothwell, Pesticides Directorate, Ottawa
Gil Flores, Pesticide Directorate, Ottawa
J.E. Irvin, Pesticides Directorate, Ottawa
Janick Lorion, Research Program Service, Ottawa
A. Pucat, Diagnostic Services Division, Ottawa
Al Schmidt, Biosystematics, Ottawa
Peter Perrin, Pest Management Alternatives Office
Ivo Krupka, Pest Management Secretariat

Forestry Canada
Dave Winston, Victoria
A. Van Sickle, Victoria
H. Cerezke, Edmonton
L. Magasi, Fredericton
P.C. Nigam, Fredericton
J.E. Hurley, Fredericton
John Sweeney, Fredericton
Bruce Pendrel, Fredericton
D. Lachance, Ste. Foy
Bill Cheliak, Sault Ste. Marie
G.M. Howse, Sault Ste. Marie
J. Meating, Sault Ste. Marie
B.V. Helson, Sault Ste. Marie
D.B. Lyons, Sault Ste. Marie
John Cunningham, Sault Ste. Marie
E.T. Caldwell, Sault Ste. Marie (Chairperson)
Craig Howard, Sault Ste. Marie
Chris Sanders, Sault Ste. Marie

Forestry Canada (Cont'd)

M. Abou-Zaird, Sault Ste. Marie
Gary Grant, Sault Ste. Marie
S. D'Eon, PNFI
W. Bowers, St. John's
R. West, St. John's
Les Carlson, Ottawa
Peter Hall, Ottawa
W.A. Sexsmith, Ottawa
S. Holmes, Ottawa
F.C. Pollett, Ottawa (Chairperson)
B.H. Moody, Ottawa (Secretariat)

NOTICE OF 1993 MEETING

The Twenty-first Annual Forest Pest Control Forum

will be held in

Sussex Room, 1st Floor

Government Conference Centre

2 Rideau Street, Ottawa

November 16, 17, 18, 1993

(8:30 a.m. - 5:00 p.m.)

Avis de la réunion de 1993

Le vingt et unième colloque annuel

sur la répression des ravageurs forestiers

aura lieu dans le

Salon Sussex, 1e étage

Centre de conférence du Gouvernement

2, rue Rideau, Ottawa

du 16 au 18 novembre 1993

(de 8:30 h à 17:00 h)

Agenda

Twentieth Annual Forest Pest Control Forum

Government of Canada Conference Centre

2 Rideau Street
Sussex Room, 1st Floor
Ottawa, Ontario

November 17, 18, 19, 1992
8:30 a.m. - 5:00 p.m.

Tuesday, November 17

Session I - Introduction

8:30 - 9:00

1.1 Introductory Address
- Dr. Fred Pollett, Director General, Science & Sustainable Development Directorate, FC

1.2 Remarks and Introductions
- B.H. Moody, Forum Secretary

Session II - Forest Insect and Disease Status and Control Operation Summaries
- B.H. Moody/E. Kettela (Session Chairpersons)

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

	Pest Conditions FIDS Report	Control Operation Summary	
2.0	B.C. & Yukon G. Van Sickle	G.A. Van Sickle for B.C.	
2.2	Prairies - H. Cerezke and Northwest Territories	R. Westwood	- Manitoba - Saskatchewan - Alberta
2.3	Ontario - G. Howse	T. Scarr	- Ontario
2.4	Québec - D. Lachance	SOPFIM J. Bégin	- Québec - Québec

2.5	Maritimes - L. Magasi	N. Carter D. Davies E. Georgeson L. Magasi	- New Brunswick - New Brunswick - Nova Scotia - P.E.I.
2.6	Newfoundland - W. Bowers	H. Crummey R. West	- Newfoundland
2.7	United States - D. Kucera, H. Trial (Report Only)		
2.8	Other		
2.8.1	Report from the Pheromone Trapping Working Group - R. West		

10:00 - 10:15	-	Coffee
10:15 - 12:00	-	Session II Forest Insect and Diseases Status and Control Operation Continues
12:00 - 1:00	-	Lunch
1:00 - 3:00	-	Session II Continues
2:00 - 2:30	-	Biocontrol agents - regulatory guidelines, Agriculture Canada Proposal - Gil Flores
3:00 - 3:15	-	Coffee

Session III -

3:15 - 4:00	Vegetation Management Summaries - E. Caldwell (Session Chairperson)
3.1	Round-the-table regional summaries of vegetation management problems and control operations - provincial and regional Forestry Canada representatives British Columbia, Prairies, Ontario, Québec, Maritimes, Newfoundland, United States.
3.2	General Discussion

Session IV -

Issues Debate, Chairperson - Richard Westwood

4. Discussion and debate on selected items.

NOTE: Forum members should ensure that issues/recommendations for debate are properly documented and submitted to the Forum Secretary before the Forum so that these can be discussed at the Steering Committee meeting the day prior to the Forum.

Session V -

Research, Environmental Monitoring and Other Reports
E. Caldwell (Session Chairperson)

5.1 Procreation and propagation : The Bare Fax on Viruses
- Bill Cheliak

5.2 Use of Lecontvirus
- John Cunningham

5.3 Aerial spray trials with different formulation of gypsy moth virus
- John Cunningham

Wednesday, November 18

Session V - Continues

8:30 - 10:00 **Research, Environmental Monitoring and Other Reports**
- E. Caldwell (Session Chairperson)

5.4 Integrated Pest Management - Forestry Canada, Maritimes

5.5 Pest research and control programs in Pacific and Yukon Region
- Dave Winston

5.6 Effectiveness of B.t. formulations under laboratory condition against spruce budworm larvae
- P.C. Nigam

5.7	Natural products for forest insect pests - Blair Helson
5.8	Status of the spruce budworm pheronome trapping network - Chris Sanders
12:00 - 1:00	LUNCH
1:00 - 3:00	Session VI Research, etc. continues
5.9	Competition between three strains of steinernematid nematodes under laboratory and field conditions - Rick West, D. Durling & T. Vrain
5.10	Insect and Disease Research Direction in the USDA Forest Service - Bob Bridges
5.11	Other Research Papers
Session VI -	
	Pest Management Regulatory Considerations - Errol Caldwell (Session Chairperson)
6.1	Implementation Plan for the Revise Federal Pesticide Regulatory System - Ivo Krupta/Geraldine Graham
6.2	The Pest Management Alternatives Office (PMAO) as seen by AC - Peter Perrin
6.3	The Pest Management Alternatives Program - FC - Craig Howard
6.4	Support Program for Pesticide Minor Use - Douglas Rothwell
3:00 - 3:15	Coffee Break
3:15 - 4:00	Pest Management Regulatory Considerations Continues

6.4	Update on Fenitrothion Re-evaluation - Steve Holmes
6.5	Economic Benefit Assessment of Spruce Budworm Control; Communications Plan - Marvin Stemeroff
6.6	Gypsy Moth Policy - Marcel Dawson
6.7	The Status of Agriculture Canada role in protecting Canada's forests from introduced pests - Agriculture Canada
6.8	Other

WORKSHOPS

Monday, November 16, Conference Centre, 2 Rideau Street

- Forest Protection Technology Committee
  - G. Howse (Chairperson)
  8:30 a.m. - 5:00 p.m. - Sussex Room

- Pheromone Trapping Working Group
  - R. West (Chairperson)
  1:00 p.m. - 5:00 p.m. - Room 207

- Pest Control Forum Steering Committee
  - B.H. Moody/R. Westwood (Chairpersons)
  7:00 p.m. - 9:00 p.m. - Sussex Room

Thursday, November 19, Conference Centre, 2 Rideau Street

- Forest Pest Management Caucus
  - J.R. Carrow (Chairperson)
  9:00 a.m. - Sussex Room

- Semiochemical/Pheromone Working Group
  - Gary Grant (Chairperson)
  8:30 a.m. - 12:30 p.m. - Room 202

- Seed Orchard IPM Working Group
  - P. de Groot (Chairperson)
  9:00 A.M. - Room 207

- FIDS Heads Meeting
  - B.H. Moody (Chairperson)
  1:30 p.m. - 5:00 p.m.

<u>Friday, November 20, Conference Centre, 2 Rideau Street</u>

- FIDS Heads Meeting (closed session)
  - B.H. Moody (chairperson)
  8:30 a.m. - 3:00 p.m.

<u>NOTE</u> 1) Other workshops can be scheduled if required. Please inform the Secretary of requirements.

2) Time allotment per session is not firm and may vary.

Ordre du jour provisoire

Vingtième Forum annuel sur la répression des ravageurs forestiers

Centre de conférences du gouvernement du Canada

2, rue Rideau
Salle Sussex, 1er étage
Ottawa (Ontario)

Les 17,18 et 19 novembre 1992
8 h 30 à 17 h 00

Le mardi 17 novembre

Séance I - Ouverture

8 h 30 - 9 h 00
1.1 Allocution d'ouverture
1.2 Observations et présentations
- B.H. Moody, secrétaire du Forum

Séance II - État des populations d'insectes et des maladies des arbres et résumés des activités de lutte
- B.H. Moody/E. Kettela (présidents de la séance)

9 h 00 - 10 h 00 - Table ronde au cours de laquelle les chefs régionaux du RIMA présenteront un rapport récapitulatif sur tous les ravageurs d'importance et les représentants des provinces résumeront les activités de lutte menées sur leur territoire. Les présentations ne devront pas excéder 15 minutes.

Rapports des chefs du RIMA		Résumés des activités de lutte	
2.0	C.-B. & Yukon G. Van Sickle	G.A. Van Sickle pour la C.-B.	
2.2	Prairies et Territoires du Nord-Ouest H. Cerezke	R. Westwood	- Manitoba - Saskatchewan - Alberta
2.3	Ontario - G. Howse	T. Scarr	- Ontario

2.4	Québec - D. Lachance	SOPFIM J. Bégin	- Québec - Québec
2.5	Maritimes - L. Magasi	N. Carter D. Davis E. Georgeson L. Magasi	- Nouveau-Brunswick - Nouveau-Brunswick - Nouvelle-Écosse - Î.-P.-É.
2.6	Terre-Neuve - W. Bowers	H. Crummey	- Terre-Neuve

2.7 États-Unis
- D. Kucera
  H. Trial (rapport uniquement)

2.8 Autres

10 h 00 - 10 h 15 - Pause-café

10 h 15 - 12 h 00 - Suite de la séance II

12 h 00 - 13 h 00 - Déjeuner

13 h 00 - 15 h 00 - Suite de la séance II

15 h 00 - 15 h 15 - Pause-café

Séance III -

15 h 15 - 16 h 00 Résumés - Activités de gestion des végétaux
- E. Caldwell (président de la séance)

3.1 Rapport de l'Association canadienne de gestion des végétaux -Bob Campbell/E. Caldwell

3.2 Résumés sur les problèmes de gestion des végétaux et les activités de lutte - représentants des provinces, de Forêts Canada (Régions de la Colombie-Britannique, des Prairies, de l'Ontario, du Québec, des Maritimes et de Terre-Neuve) et des États-Unis

3.4 Discussion générale

Séance IV -

Débat sur certaines grandes questions
- président, Richard Westwood

4.0 Discussion et débat sur certaines questions

REMARQUE : Les participants doivent s'assurer que les questions/recommandations qui seront débattues sont bien documentées et sont présentées suffisamment tôt au secrétaire, de manière à ce qu'elles puissent être examinées à la réunion du Comité directeur la journée précédant la tenue du Forum.

Séance V -

Rapports sur la recherche, la surveillance environnementale et autres sujets
-E. Caldwell (président de la séance)

5.1 Virus : production et transmission
-Bill Cheliak

5.2 Utilisation du Lecontvirus
-John Cunningham

5.3 Essais de pulvérisation aérienne avec différentes formulations du virus de la spongieuse
-John Cunningham

Le mercredi 18 novembre

Séance V - Suite de la séance

8 h 30 - 10 h 00 Rapports sur la recherche, la surveillance environnementale et autres sujets

5.4 Lutte intégrée contre les ravageurs - Forêts Canada, Maritimes
-E.G. Kettela

5.5 Recherche des ravageurs et contrôle des programmes dans la région du Pacific et du Yukon
- Dave Winston

5.6	Évaluation, en laboratoire, de l'efficacité des formulations de B.t. dans la lutte contre les larves de la tordeuse des bourgeons de l'épinette -P.C. Nigam
5.7	Produits naturels pour la lutte contre les insectes ravageurs -Blair Helson
5.8	Pièges à phéromones pour la tordeuse des bourgeons de l'épinette - Mise à jour -Chris Sanders
12 h 00 - 13 h 00	DÉJEUNER
13 h 00 - 15 h 00	Suite de la séance V
5.9	Utilisation des nématodes dans la lutte contre les ravageurs - Mise à jour -Rick West
5.10	Direction de la recherche sur les insectes et les maladies au sein du USDA Forest Service -Bob Bridges
5.11	Autres rapports de recherche

<u>Séance VI</u> -

	<u>Considérations sur la réglementation</u> -Errol Caldwell (président de la séance)
6.1	Plan de mise en oeuvre de la nouvelle réglementation fédérale sur les pesticides -Ivo Krupta/Geraldine Graham
6.2	Le Bureau des nouvelles méthodes de lutte antiparasitaire tel que vu par l'AC -Peter Perrin
6.3	Le Programme sur les nouvelles méthodes de lutte antiparasitaire - Forêts Canada -Craig Howard

6.4	Programme de soutien pour les pesticides à emploi limité -Jean Hollebone
15 h 00 - 15 h 15	Pause-café
15 h 15 - 16 h 00	Considérations sur la réglementation - suite
6.4	Réévaluation du fénitrothion - Mise à jour -Steve Holmes
6.5	Évaluation des avantages économiques associés à la lutte contre la tordeuse des bourgeons de l'épinette; plan de communication -Marvin Stemeroff
6.6	Politique sur la spongieuse -Marcel Dawson
6.7	Rôle d'Agriculture Canada dans la protection des forêts canadiennes contre les ravageurs introduits -Agriculture Canada
6.8	Autres considérations

<u>ATELIERS</u>

<u>Lundi 16 novembre, Centre de conférences, 2, rue Rideau</u>

- Comité des techniques de protection des ressources forestières
  - G. Howse (président)
    8 h 30 - 17 h 00 - salle Sussex

  - Groupe de travail sur les pièges à phéromones
  - R. West (président)
    13 h 00 - 17 h 00 - pièce 207

- Comité directeur du Forum sur la répression des ravageurs forestiers
  - B.H. Moody/R. Westwood (présidents)
    19 h 00 - 21 h 00 - salle Sussex

Jeudi 19 novembre, Centre de conférences, 2, rue Rideau

- Caucus sur la lutte contre les ravageurs forestiers
  - J.R. Carrow (président)
    9 h 00 - salle Sussex

- Groupe de travail sur les écomones/phéromones
  - Gary Grant (président)
    8 h 30 - 12 h 30 - pièce 202

- Groupe de travail sur la lutte intégrée contre les ravageurs des plantations
  - P. de Groot (président)
    9 h 00 - pièce 207

- Réunion des chefs du RIMA
  - B.H. Moody (président)

Vendredi 20 novembre, Centre de conférences, 2, rue Rideau

- Réunion des chefs du RIMA (à huis clos)
  - B.H. Moody (président)
    8 h 30 - 15 h 00

REMARQUES

1) D'autres ateliers peuvent être ajoutés au besoin. Veuillez informer le secrétaire de vos besoins.

2) La durée des séances n'est pas inflexible et pourrait être modifiée.

Summary of Opening Remarks

Twentieth Annual Forest Pest Control Forum

November 18, 1992, 8:30 a.m.
Sussex Room, 1st Floor
Government Conference Centre, Ottawa

Dr. Fred Pollett, Director General, Science and Sustainable Development Directorate, Forestry Canada opened the Forum by welcoming delegates and members. He then brief the members on the Green Plan activities especially: 1. Decision Support Systems - Coordinator, Murray Strome, PNFI, 2. Biomonitoring - Coordinator, Denis Lachance, LFC and 3. Integrated Pest Management - Coordinator, Errol Caldwell, FPMI.

Through the Green Plan Partners in Sustainable Development of Forests Program, Forestry Canada will contribute almost $60 million over six years to the Model Forest Program. Funds will be used only to promote, develop, and implement new methods of sustainable and integrated forest management including pest management.

The Government, in partnership with provinces and industry in the major Canadian forest regions, evaluated 50 model forest proposals in their search for 10 that would best reflect the ecological diversity of the country. The 10 Model Forests include representation from eight provinces: British Columbia and Ontario have two sites each and one site each in Alberta, Saskatchewan, Manitoba, Quebec, New Brunswick and Newfoundland. The total area covered is about 6 million ha, more than the total forest area of many European countries. Forestry Canada will provide scientific and financial support to its partners in the program, the land owners and the land managers.

Forestry Canada is also involved in creating International Model Forests based on the following criteria:

- the overall goal is an international network
- respecting local needs and values in defining sustainable development
- Canada's role in initiating the process ($10 million)
- establishing the Model Forests concept in developing and developed countries
- twining and technology transfer

Several countries have expressed interest in the Model Forest including the USA, Mexico, Guatemala, Belize, Australia, and various countries in southeast Asia.

Dr. Pollett is also on the Board of Directors of Insect Biotech Canada, one of 15 Networks of Centres of Excellence funded by the Government of Canada, which has completed a very successful second year of operation. The focus of the research program is the application of biotechnology to develop new environment friendly methods to control insect pests of economic importance to Canada.

Twenty-nine researchers in eleven universities and three government laboratories including FPMI are involved in a coordinated and integrated research program which also involves eight companies active in the insect pest control business.

Résumé du mot d'ouverture

Vingtième Forum annuel sur la répression des ravageurs forestiers

18 novembre 1992, 8 h 30
Salle Sussex, 1er étage
Centre de conférence du gouvernement, Ottawa

M. Fred Pollett, directeur général des Sciences et du Développement durable, Forêts Canada, ouvre le Forum en souhaitant la bienvenue aux délégués et aux membres. Il donne ensuite quelques informations sur les activités du Plan vert, notamment : 1. Systèmes d'aide à la décision - coordonnateur, Murray Strome, IFNP; 2. Biosurveillance - coordonnateur, Denis Lachance, CFL; 3. Lutte intégrée - coordonnateur, Errol Caldwell, IRRF.

Par le truchement des partenaires du Plan vert dans le Programme pour le développement durable des forêts, Forêts Canada investira près de 60 millions de dollars, sur six ans, dans le Programme des forêts modèles. Les fonds ne serviront qu'à la promotion, à la mise au point et à la mise en oeuvre de nouvelles méthodes de gestion intégrée et durable des forêts, y compris la lutte dirigée.

Le Gouvernement, de concert avec les provinces et les industries des principales régions forestières du Canada, a évalué 50 projets de forêts modèles afin d'en trouver 10 qui refléteraient la diversité écologique du pays. Les 10 forêts modèles retenues représentent 8 provinces : Colombie-Britannique et Ontario (chacune deux) et Alberta, Saskatchewan, Manitoba, Québec, Nouveau-Brunswick et Terre-Neuve (chacun une). Elles couvrent 6 millions d'ha, soit plus que la superficie forestière totale de plusieurs pays européens. Forêts Canada aidera scientifiquement et financièrement ses partenaires du Programme, les propriétaires fonciers et les gestionnaires de terrains.

Forêts Canada s'occupe aussi de la création de forêts modèles internationales selon les critères suivants :

- l'objectif global du réseau international;
- le respect des valeurs et des besoins locaux pour la définition du développement durable;
- le rôle du Canada dans la mise en branle du processus (10 millions de dollars)
- l'introduction du concept des forêts modèles dans les pays industrialisés ou en développement;
- le jumelage et le transfert de technologies.

Plusieurs pays ont manifesté de l'intérêt pour les «forêts modèles», notamment les États-Unis, le Mexique, le Guatemala, le Belize, l'Australie et divers autres en Asie du Sud-Est.

M. Pollett est également membre du conseil d'administration d'Insect Biotech Canada (IBC), un des 15 réseaux de centres d'excellence financés par le gouvernement du Canada. IBC vient de terminer avec éclat sa deuxième année d'activité. Le programme de recherche porte d'abord sur l'utilisation de la biotechnologie dans la mise au point de nouvelles méthodes écologiques de lutte contre les insectes ravageurs qui ont une incidence économique importante pour le Canada.

Vingt-neuf chercheurs de onze universités et de trois laboratoires, dont l'IRRF, participent à un programme coordonné et intégré de recherche auquel sont aussi associées onze entreprises oeuvrant dans le domaine de la lutte contre les ravageurs.

Abstracts/Résumés

Région du Pacifique et du Yukon - 1992
État des projets expérimentaux de lutte contre des insectes et des maladies d'importance et de la recherche sur la gestion des végétaux

G.A. Van Sickle et D. Winston

Le document présente la situation de plus d'une vingtaine d'insectes et de maladies des arbres ayant causé des dommages d'importance dans les régions du Pacifique et du Yukon en 1992 ainsi que certaines prévisions pour 1993. Il porte notamment sur les populations grandissantes de la tordeuse bisannuelle de l'épinette, de la tordeuse de l'épinette, du dendroctone du Douglas, de la chenille à houppes du Douglas, de la chenille à houppes rousses, de l'arpenteuse de la pruche de l'Ouest, de la tordeuse occidentale de l'épinette, de la tordeuse à tête noire, de la livrée des forêts et de la tordeuse du tremble qui ont causé des dégâts importants, ainsi que sur le déclin de la tordeuse des bourgeons de l'épinette, de la légionnaire noire, du pourridié rhizinéen et de l'arpenteuse grise de l'épinette.

Parmi les recherches en cours et les essais de lutte contre certains de ces insectes et maladies, mentionnons les essais de confusion des mâles de la chenille à houppes du Douglas à l'aide de virus et de phéromone, les essais de *B.t.k.* pour lutter contre la tordeuse occidentale de l'épinette, la mise au point et l'étalonnage de systèmes de pièges à la phéromone pour lutter contre l'arpenteuse de la pruche de l'Ouest, des essais pour déterminer la vulnérabilité de l'arpenteuse de la pruche de l'Ouest au nématode du pin et à ses éventuels vecteurs; la classification des risques d'infestation par le dendroctone du pin ponderosa et le dendroctone de l'épinette, des essais de sélection pour l'obtention de plants résistant aux charançons des pousses terminales et à la rouille vésiculeuse du pin blanc ainsi que la mise au point de mycoherbicides à des fins de gestion de la végétation.

Région du Nord-Ouest
Problèmes entomologiques et pathologiques d'importance en 1992

H. Cerezke et collab.

Le présent rapport résume les données sur l'état actuel des problèmes entomologiques et pathologiques d'importance dans la région du Nord-Ouest en 1992. Les données recueillies sur les différents insectes et maladies nous proviennent en grande partie des organismes forestiers provinciaux du Manitoba, de la

Saskatchewan et de l'Alberta, ainsi que du ministère des Ressources renouvelables des Territoires du Nord-Ouest. Les données sur les lieux de capture de spongieuses mâles nous ont été fournies par Agriculture Canada.

Insectes et maladies des arbres au Manitoba

A.R. Westwood, Y. Beaubien, L. Christianson, L. Matwee, K. Knowles, I. Pines et R. Khan

Le présent rapport résume la situation des insectes et des maladies des arbres au Manitoba en 1992 et traite notamment de la tordeuse des bourgeons de l'épinette, de la tordeuse du pin gris, de l'étude de pins gris résistant à la rouille-tumeur globuleuse, du faux-gui, des chancres des tiges de pins rouges et gris, de l'évaluation des ravageurs dans la parcelle-échantillon permanente, de la maladie hollandaise de l'orme, des maladies des arbres et du relevé de 1992 des insectes et des maladies dans les forêts régénérées.

La tordeuse des bourgeons de l'épinette, la tordeuse du pin gris et la spongieuse en Ontario en 1992

J.H. Meating, G.M. Howse, T. Scarr et H.D. Lawrence

Une défoliation modérée à grave par la tordeuse des bourgeons de l'épinette a été cartographiée sur quelque 9 595 762 hectares en 1992, soit une augmentation de 529 981 hectares par rapport à 1991. Les résultats des relevés des masses d'oeufs révèlent que l'infestation continuera vraisemblablement de gagner du terrain dans les districts de Hearst et de Wawa et que de nouveaux îlots de défoliation pourraient apparaître dans la région du Nord-Ouest et dans le sud de l'Ontario en 1993.

La superficie totale défoliée par la tordeuse du pin gris en 1992 a augmenté pour atteindre 158 704 hectares, comparativement à 133 618 hectares en 1991. La majeure partie du territoire défolié se trouvait dans les régions du Nord-Est et d'Algonquin et les relevés révèlent que l'infestation devrait gagner du terrain dans ces régions en 1993.

L'infestation de la spongieuse, qui sévissait sur quelque 347 415 hectares en 1991, a diminué de façon spectaculaire en 1992 pour n'atteindre plus que 34 460 hectares. Aucune donnée sur les masses d'oeufs n'est disponible cette année; les populations devraient toutefois rester faibles en 1993, mais pourraient peut-être gagner du terrain le long de la lisière principale du foyer d'infestation.

En 1992, le ministère des Richesses naturelles de l'Ontario a annulé toutes les opérations de lutte aérienne, mais élabore actuellement des plans pour reprendre les programmes de pulvérisations contre la tordeuse des bourgeons de l'épinette en 1993.

Opérations de lutte de 1992 contre les ravageurs forestiers en Ontario et initiatives apparentées

Joe Churcher

Des programmes ont été proposés pour lutter contre la tordeuse des bourgeons de l'épinette, la tordeuse du pin gris et la spongieuse en Ontario. En raison de contraintes budgétaires, le ministère des Richesses naturelles a annoncé, le 13 février 1992, que ces programmes étaient annulés pour permettre de consacrer les 3,8 millions de dollars à d'autres programmes d'aménagement forestier plus prioritaires. C'est la première fois depuis 1967 qu'aucun programme de pulvérisation aérienne d'insecticides n'est mené dans la province.

Insectes et maladies des arbres au Québec en 1992

C. Bordeleau et D. Lachance

Ce rapport fait le bilan de certains problèmes entomologiques et pathologiques d'importance au Québec.

Dans la région du Québec, le relevé général des insectes et des maladies des arbres est effectué par le Service de la protection contre les insectes et les maladies (SPIM), Division de la protection, ministère des Forêts du Québec. L'unité du RIMA de Forêts Canada, région du Québec, est chargée de relevés spéciaux, de problèmes particuliers liés à la surveillance et à la réglementation de la quarantaine ainsi que de programmes de surveillance et de relevés d'envergure nationale.

Programme de lutte contre la tordeuse des bourgeons de l'épinette au Québec en 1992

Jacques Bégin, Alain Dupont et Alain Bélanger

Grâce à une réduction importante des populations prévues de la tordeuse des bourgeons de l'épinette, observée au début du printemps, l'ampleur du programme de lutte a été réduite pour ne toucher que 5 670 hectares. Il s'agit du programme le moins important depuis 1968, année où 1 390 hectares de plantations avaient été traités pour lutter contre cet insecte. Le programme ne visait que deux blocs de la région de la Côte Nord d'une superficie totale de 410 hectares. Le reste du programme s'est déroulé dans la région du Bas-Saint-Laurent-Gaspésie où 330 hectares de terrains privés et 4 390 hectares de terres publiques ont été traités au *B.t.*

Programme de lutte contre l'arpenteuse de la pruche au Québec en 1992

Jacques Bégin, Alain Dupont et Alain Bélanger

Au printemps 1991, une infestation de l'arpenteuse de la pruche (*Lambdina fiscellaria* Guen.) a été signalée dans le canton de Parke, à une trentaine de kilomètres au sud de Rivière-du-Loup, au Québec. Près de 2 000 hectares avaient été défoliés et des coupes de récupération avaient été prévues. Des peuplements de sapins et d'épinettes de près de 177 hectares ont été laissés sur pied comme ravages d'orignal afin de protéger les importantes ressources en gibier de la région. Compte tenu des populations élevées de l'arpenteuse prévues en 1992, la Fédération de la faune du Québec et le ministère des Loisirs, de la Chasse et de la Pêche (MLCP) ont confié à la SOPFIM le soin de protéger ces ravages. Les dix blocs traités avaient une superficie totale de 76 hectares et étaient situés assez proches les uns des autres.

Insectes et maladies des arbres dans les Maritimes en 1992

J. Edward Hurley et L.P. Magasi

Les notes techniques n[os] 268, 269, 270 et 272 de Forêts Canada - Région des Maritimes, ont fait état des problèmes entomologiques et pathologiques majeurs qui se sont produits dans la région des Maritimes en 1992.

Parmi les insectes et les maladies examinés plus en détail, mentionnons l'arpenteuse de la pruche, la tordeuse des bourgeons de l'épinette, la spongieuse, la livrée des forêts, la livrée d'Amérique, le porte-case du mélèze, le porte-case du bouleau, le puceron des pousses du sapin, la chenille à tente estivale, les enrouleuses du peuplier faux-tremble et les rouilles des aiguilles de sapin baumier. La sécheresse et des précipitations supérieures à la normale, combinées à des températures plus froides que la moyenne, ont touché le développement des insectes et l'état des arbres.

On a mené des opérations de lutte contre la tordeuse des bourgeons de l'épinette, le charançon de l'écorce et la maladie hollandaise de l'orme. Des essais ont été effectués contre un certain nombre d'insectes et de maladies, notamment la tordeuse des bourgeons de l'épinette, les tordeuses de l'épinette, la galéruque de l'orme et la brûlure des pousses Sirococcus. Les détails sur les activités de lutte seront présentés dans le cadre d'un autre volet du Forum sur les ravageurs forestiers. De plus, l'interdiction du transport de matériels de reproduction du mélèze à l'extérieur de la zone de quarantaine délimitée endigue la propagation du chancre du mélèze d'Europe.

Programme de protection contre la tordeuse des bourgeons de l'épinette au Nouveau-Brunswick en 1992

N. Carter et D. Lavigne

Le relevé aérien de la défoliation de 1992 a été entravé par de grands vents, de fortes pluies et même des averses de grêle. Par conséquent, il n'a pas été possible d'établir la superficie des catégories de défoliation légère, modérée et grave. Dans l'ensemble, seulement 84 300 hectares de défoliation détectable du haut des airs ont pu être cartographiés.

En 1992, le programme de lutte contre la tordeuse des bourgeons de l'épinette, mené par la Forest Protection Limited au Nouveau-Brunswick, a permis de pulvériser environ 236 675 hectares, soit 17,9 % de moins que les 288 150 hectares traités en 1991. De plus, la J.D. Irving Ltd. a traité 33 100 hectares de ses terrains en franche tenure, comparativement à 30 040 hectares en 1991.

L'arpenteuse de la pruche au Nouveau-Brunswick

N. Carter er L. Hartling

Le relevé de 1992, destiné à établir des prévisions, n'a pas permis de déceler les endroits des régions du Centre-Nord et du Nord-Ouest où les populations étaient importantes, mais a quand même révélé la possibilité qu'apparaissent des îlots de défoliation <u>éparpillés</u> sur quelque 5 600 hectares dans la région du Sud-Ouest, dans le comté de Charlotte. Le relevé aérien a confirmé qu'il fallait s'attendre en général à de faibles populations dans le Nord, soit environ 300 hectares près du lac Miller et près d'un millier d'hectares dans la région du Centre-Nord. Seulement 200 hectares de défoliation ont été détectés dans le comté de Charlotte (sur les îles en bordure de la côte) où l'infestation semble s'être effondrée. Aucun programme de protection contre l'arpenteuse de la pruche n'a été mené au Nouveau-Brunswick en 1992.

Insectes et maladies des arbres en Nouvelle-Écosse

E. Georgeson et R. Guscott

Le printemps tardif et froid semble avoir ralenti le développement des insectes en Nouvelle-Écosse en 1992. L'année a été plutôt tranquille et les populations d'insectes généralement faibles (l'exception la plus notable étant les pucerons). Le nombre d'insectes capturés dans des pièges lumineux était inférieur tout comme les appels reçus du public.

La tordeuse des bourgeons de l'épinette à Terre-Neuve en 1992

W.W. Bowers

Le développement de la tordeuse des bourgeons de l'épinette a été retardé de près d'un mois en raison du temps froid et humide qui a sévi pendant la majeure partie de juin et en juillet. Dans la vallée Codroy, dans le sud-ouest de Terre-Neuve, l'infestation s'est poursuivie en 1992 et 1 919 hectares de défoliation modérée et grave ont été signalés, comparativement à 2 251 hectares en 1991. Les superficies légèrement défoliées ont légèrement augmenté, passant de 500 hectares en 1991 à 721 hectares en 1992. La superficie totale infestée dans les forêts productives était de 1 990 hectares en 1992 et abritait 94 300 m^3 de bois, les trois catégories de défoliation confondues.

L'arpenteuse de la pruche à Terre-Neuve en 1992

W.W. Bowers

La superficie totale infestée par l'arpenteuse de la pruche a augmenté, passant de 4 870 hectares en 1991 à 9 808 hectares en 1992; la défoliation légère, modérée et grave atteignait respectivement 2 693, 1 790 et 5 325 hectares. De façon similaire, la superficie totale infestée dans les forêts productives a augmenté, passant de 3 042 hectares en 1991 à 5 625 en 1992, et renfermait 237 272 m^3 de bois, les trois catégories de défoliation confondues.

Le diprion du sapin à Terre-Neuve en 1992

W.W. Bowers

Dans la région de la baie d'Espoir, dans le sud de Terre-Neuve, les infestations qui avaient entraîné une grave défoliation en 1991, se sont effondrées en 1992. Par ailleurs, un foyer d'infestation de l'ouest de Terre-Neuve a légèrement gagné du terrain, passant de 800 à 1 256 hectares. Ce foyer comportait 723 hectares de défoliation grave et 533 hectares de défoliation légère. La superficie infestée dans les forêts productives de l'ouest de Terre-Neuve était de 1 134 hectares, comparativement à 800 hectares en 1991, et elle abritait 39 400 m^3 de bois, dans ces deux catégories de défoliation.

La tordeuse à tête noire à Terre-Neuve en 1992

W.W. Bowers

En 1992, l'invasion s'est poursuivie dans la péninsule Northern, mais la défoliation modérée et grave a brusquement diminué, passant de 12 400 à 3 757 hectares. De plus, la superficie légèrement défoliée a diminué, passant de 4 000 hectares en 1991 à 2 955 en 1992. Des secteurs à populations élevées de la tordeuse à tête noire se retrouvaient ici et là sur la presqu'île Avalon, mais aucune défoliation significative ne s'est produite. La superficie de forêt productive infestée atteignait 1 900 hectares dans les secteurs modérémenent à gravement défoliés et 2 637 hectares dans les secteurs légèrement défoliés, représentant 409 179 m^3 de bois, les trois catégories de défoliation confondues.

Piégeage à la phéromone à Terre-Neuve en 1992

W.W. Bowers et R.J. West

Des pièges à la phéromone ont été déployés à Terre-Neuve pour l'arpenteuse de la pruche, la tordeuse des bourgeons de l'épinette, la spongieuse et la livrée des forêts. Des papillons ont été capturés dans les pièges appâtés pour l'arpenteuse de la pruche et la tordeuse des bourgeons de l'épinette. Un seul papillon de spongieuse mâle a été capturé dans un piège de l'ouest de Terre-Neuve. Aucun papillon de la livrée des forêts n'a été capturé en 1992.

Chancre scléroderrien à Terre-Neuve en 1992

G.R. Warren et G.C. Carew

En 1992, trois nouveaux foyers d'infection ont été notés sur des pins noirs, tous dans la région de St. John's. Ces foyers d'infection se trouvaient sur le campus de l'Université Memorial, le long de Prince Philip Drive, où jusqu'à 10 % des pousses étaient infectées, le long de Portugal Cove Road, où jusqu'à 50 % des pousses étaient atteintes, et le long de Strawberry Marsh Road, où l'incidence de la maladie était faible.

Insectes et maladies des arbres aux États-Unis en 1992

Dan Kucera

Ce rapport traite des insectes et des maladies des arbres aux États-Unis, notamment des tordeuses des bourgeons de l'épinette, de la spongieuse, de la chenille à houppes du Douglas, de la livrée des forêts, de la tordeuse du pommier, des scolytes de l'écorce, du dendroctone de l'épinette, du complexe des squeletteuses de l'Ouest, du pourridié du cyprès de Lawson et d'autres insectes et maladies.

La spongieuse dans le Maine en 1992

Dick Bradbury

Les populations de la spongieuse sont restées à un niveau épidémique en 1992. Les relevés aériens ont permis de recenser 278 485 hectares de forêts qui avaient subi un degré quelconque de défoliation cette année. Ces dégâts ont surtout été observés dans la partie sud de l'État, dans les comtés de York et de Cumberland.

L'arpenteuse de la pruche dans le Maine en 1992

Henry Trial Jr.

D'après les données préliminaires du relevé aérien et des vérifications au sol effectuées jusqu'à maintenant, la superficie modérément à gravement défoliée oscillera probablement entre 100 000 et 200 000 acres, comparativement à 325 000 acres en 1991.

La mortalité des hôtes, attribuable aux ravages de l'arpenteuse, était beaucoup plus apparente en 1992. Dans de nombreux endroits, les arbres durement touchés par l'arpenteuse en 1991 n'ont pas produit de feuilles en 1992. À l'intérieur des terres, la mortalité ne frappait que la pruche, mais sur la côte, le sapin et l'épinette de nombreux endroits en ont été décimés. Plusieurs programmes de lutte ont été effectués en 1992 sur les terrains privés.

La tordeuse des bourgeons de l'épinette dans le Maine en 1992

Henry Trial Jr.

La Division de la gestion des insectes et des maladies des arbres du Service des forêts du Maine n'a pas détecté de populations larvaires significatives de la tordeuse des bourgeons de l'épinette en 1992, mais le nombre de larves individuelles, signalées lors du relevé général, et de sujets recueillis étaient à la hausse. Aucune défoliation attribuable à la tordeuse des bourgeons n'a été cartographiée au sol ou du haut des airs.

Utilisation du Lecontvirus en 1992

J.C. Cunningham

Quatre districts du ministère des Richesses naturelles de l'Ontario et une région du ministère des Forêts du Québec ont reçu une formulation de Lecontvirus. Au total, 28 plantations infestées par le diprion à tête rouge du pin gris, dont la superficie totale combinée atteignait 367 hectares, ont été traitées avec ce virus.

Application aérienne expérimentale de virus et de *Bacillus thuringiensis* pour lutter contre la spongieuse en Ontario

J.C. Cunningham et K.W. Brown

Au total, 19 parcelles, d'une superficie combinée de 355 hectares, ont reçu une double application aérienne du virus de la polyédrose nucléaire de la spongieuse. Quatre formulations ont été mises à l'essai; il s'agissait soit de Disparvirus, fourni par l'Institut pour la répression des ravageurs forestiers, soit de Gypchek, provenant du Service des forêts des États-Unis. Deux des formulations provenaient de la Cyanamid, la troisième d'Entotech, une filiale de Novo Nordisk Bioindustrials, et la quatrième était la formulation habituelle d'une consistance semblable à la mélasse. Trois autres parcelles, d'une superficie totale de 37 hectares, ont été traitées à l'aide d'une double application de Foray 76B, qui est une formulation de *Bacillus thuringiensis* produite par Novo. L'été a été frais et humide, comme d'habitude. La diminution de la densité des masses d'oeufs dans toutes les parcelles traitées était excellente et le nombre de masses d'oeufs de la parcelle témoin non traitée au printemps et à l'automne est resté inchangé. Toutefois, la défoliation des chênes était légère dans les parcelles traitées et dans les parcelles-témoins non traitées et aucune différence visible n'a pu être observée entre les parcelles.

Recherche sur les ingrédients et les propriétés physico-chimiques des formulations et leur influence sur l'efficacité des pesticides

Alam Sundaram et John W. Leung

Research studies on formulation ingredients and physicochemical properties, as related to pesticide performance

Alam Sundaram and John W. Leung

Études sur le devenir chimique des insecticides forestiers dans l'environnement

K.M.S. Sundaram, R. Nott et J. Curry

Les points saillants des principales études effectuées par le personnel du projet d'étude du devenir chimique des insecticides forestiers (Étude n° FP-7202) de l'Institut pour la répression des ravageurs forestiers en 1991-1992 sont présentés. Parmi les études examinées, mentionnons : 1) la répartition, le dépôt et la persistance de *Bacillus thuringiensis* (*kurstaki*) [*B.t.* (*k*)] dans un milieu forestier feuillu, (2) des analyses chimiques du RH-5992 provenant de diverses matrices forestières (aquatiques et terrestres) et formulations, (3) le devenir et la persistance du RH-5992 dans l'eau et les sédiments d'enceintes aquatiques après l'application de quatre doses différentes (70, 140, 360 et 600 grammes de matière active par hectare) et de solutions aqueuses non tamponées d'un pH de 4, 7 et 10, (4) le devenir et la persistance du RH-5992 dans le sol forestier et la litière et sur le feuillage de conifères (épinettes) après l'application de 35, 70 et 140 grammes de matière active/ha à l'aide d'un pulvérisateur à main à ultra bas volume (à disque tournant) actionné par un moteur à piles, et (5) la chimie de l'azadirachtin.

Application aérienne expérimentale de RH-5992 (Mimic 2F) en Ontario : sommaire des résultats préliminaires

B.L. Cadogan, A. Retnakaran, R. Scharbach, L. Smith R. Wilson et W. Tomkins

En 1992, des essais ont été effectués dans le nord-est de l'Ontario pour vérifier l'efficacité du RH5992 (MIMIC 2F) pour lutter contre la tordeuse des bourgeons de l'épinette

(*Choristoneura fumiferana*). Ce rapport présente les résultats préliminaires de ces études.

Efficacité d'un traitement unique au Futura XLV appliqué par hélicoptère pour lutter contre les larves de l'arpenteuse de la pruche dans des peuplements de sapins baumiers de Terre-Neuve en 1992

R.J. West

Le ministère des Forêts et de l'Agriculture de Terre-Neuve a effectué des opérations de pulvérisation par hélicoptère de Futura XLV, une formulation aqueuse de *Bacillus thuringiensis* (*B.t.*), du 6 au 11 août 1992 afin de protéger des peuplements éclaircis de sapins baumiers du secteur de Salmonier Line contre les dégâts causés par l'arpenteuse de la pruche (*Lambdina fiscellaria fiscellaria* (Guen.)).

À la demande du ministère des Forêts et de l'Agriculture de Terre-Neuve, Forêts Canada, région de Terre-Neuve et du Labrador, a évalué l'efficacité du traitement et le présent rapport fait état de nos constatations.

Évaluation des principaux paramètres influençant l'efficacité de pulvérisations opérationnelles de *B.t.* : Impact sur l'efficacité et répercussions sur les pulvérisations de *B.t.*

E. Kettela

Le *B.t.* et le fenitrothion sont des insecticides utilisés au Nouveau-Brunswick dans le cadre de programmes de pulvérisation contre la tordeuse des bourgeons de l'épinette. Une évaluation des opérations de pulvérisation effectuées en 1990 a révélé qu'il y avait encore un écart considérable entre l'efficacité relative du fénitrothion et du *B.t.*, le fénitrothion étant apparemment plus efficace. Des recherches antérieures ont montré que les principaux paramètres des pulvérisations, comme les conditions météorologiques, la hauteur de vol de l'aéronef, la température après le traitement et le dépôt du produit pulvérisé, ont une grande influence sur l'efficacité. Sur le plan opérationnel, les données sur ces paramètres et sur leur influence sur l'efficacité des pulvérisations à grande échelle sont rares. Afin d'améliorer le rendement du *B.t.* lors des opérations de pulvérisation, il est essentiel de comprendre les contraintes opérationnelles qui prévalent lors des applications pour améliorer l'utilisation de cet insecticide lors d'opérations de pulvérisations pour lutter contre la tordeuse des bourgeons de l'épinette.

Pièges à la phéromone de surveillance des fluctuations des populations de la tordeuse des bourgeons de l'épinette et de la tordeuse du pin gris

C.J. Sanders

Un réseau semi-opérationnel de pièges à la phéromone pour surveiller les populations de la tordeuse des bourgeons de l'épinette a été mis sur pied en 1985. À l'heure actuelle, plus de 500 parcelles d'échantillonnage permanent sont surveillées chaque année dans neuf provinces et six États. Les méthodes ont été normalisées et trois pièges Multi-pher sont maintenant déployés à hauteur de la tête, à 40 m de distance.

Après transformation logarithmique, les corrélations avec d'autres paramètres de la population sont bonnes, r^2 atteignant jusqu'à 80 % par rapport aux estimations des masses d'oeufs (L^2), et peuvent servir à définir les secteurs où une défoliation est à prévoir.

Toutefois, ce réseau devrait principalement permettre de surveiller les tendances des populations et de détecter très tôt des infestations imminentes. Les analyses à cet égard viennent de débuter.

Recherche sur la gestion intégrée des ravageurs dans les vergers à graines

Jon Sweeney et Garvice Gesner

La plupart de nos travaux portent sur l'élaboration de méthodes de prévision et de lutte contre les pertes de graines causées par des mouches granivores de l'épinette, *Strobilomyia neanthracina* et *S. appalachensis*, dans les vergers à graines d'épinettes ainsi que sur des méthodes de lutte. Ce rapport fait état de certains faits saillants de nos travaux en 1992-1993.

Concurrence entre trois souches de nématodes de la famille des Steinermematidae en laboratoire et sur terrain (1992)

R.J. West, D.S. Durling et T.C. Vrain

La légionnaire noire est un ravageur forestier occasionnel des nouvelles plantations établies dans des secteurs ravagés par des feux de friches ou soumis à un brûlage dirigé. La légionnaire noire se prête bien à un programme de lutte à l'aide de nématodes, car elle se trouve généralement dans les 5 cm supérieurs du sol lorsqu'elle ne se nourrit pas et devrait y être vraisemblablement exposée à de jeunes nématodes infectieux. Le programme de lutte pourrait consister à pulvériser une solution contenant des nématodes ou à incorporer des nématodes dans les mottes avant de transplanter les plants en récipients dans des endroits vulnérables aux attaques de la légionnaire.

Trois souches de *Steinernema* sp., soit *S. carpocapsae* "All" (BIOSYS, Palo Alto, Californie), *S. carpocapsae* "Umea" (BIOLOGIC, Willow Hill, Pennsylvanie) et *S. feltiae* L1C, ont été évaluées en laboratoire et sur le terrain en 1992.

Utilisation de nématodes entomopathogènes dans la lutte contre les ravageurs forestiers

D.C. Eidt, S. Zervos et C.A.A. Weaver

Des essais de lutte expérimentale contre la tordeuse de l'épinette, le charançon de l'écorce, le charançon noir de la vigne et la galéruque de l'orme à l'aide de nématodes entomopathogènes se sont poursuivis. Un nouveau projet sur l'arpenteuse tardive a été entrepris.

Orientation des activités de recherche sur les insectes et les maladies des arbres du USDA Forest Service

J. Robert Bridges

Le Service de recherche sur les insectes et les maladies des arbres (FIDR) du USDA Forest Service mène un vaste programme de recherche sur les insectes et les maladies. Ces dernières années, nous avons tenté d'élargir la portée de notre programme pour mieux comprendre les insectes et les organismes phytopathogènes dans les écosystèmes forestiers et nous tentons même d'y inclure des arthropodes et des microorganismes utiles.

Plusieurs tendances influeront sur les approches auxquelles aura recours la recherche. La sensibilisation grandissante du public aux ressources naturelles et les préoccupations à l'égard de questions environnementales influenceront le type d'outils de répression des ravageurs forestiers qui seront acceptables. On continuera de nous réclamer des données sur les insectes et les maladies et sur leur impact et leurs influences sur les écosystèmes ainsi que sur l'impact des mesures que nous prendrons pour atténuer les pertes causées par ces organismes. La demande de données scientifiques fondées permettant de prendre des décisions d'ordre politique continuera également d'augmenter à l'avenir. La foresterie est en voie de se tourner vers le modèle environnemental pour gérer ses ressources naturelles. Nous avons assisté à coup sûr à un tel changement au Service des forêts dont le chef a annoncé récemment que les forêts nationales seraient gérées en fonction des écosystèmes. Cette philosophie guidera l'aménagement des forêts publiques du pays et influera également sur nos activités de recherche dans un avenir prévisible.

En matière de recherche, nous voulons mettre l'accent sur la lutte biologique. Nous définissons en termes très généraux la lutte biologique pour inclure une multitude d'approches biologiques, soit les parasites et les prédateurs, les phéromones, les pesticides microbiens, la mise au point de variétés résistantes, etc. Nous avons déployé des efforts considérables de recherche dans ce domaine auparavant, mais nous sommes toutefois d'avis que nous n'avons pas abordé adéquatement les problèmes. Nous nous proposons de mettre l'accent sur la recherche en biotechnologie.

Nous élargissons également la portée du programme du FIDR pour inclure les arthropodes et les microorganismes qui ne sont pas considérés comme des ravageurs. Le FIDR, dans une lettre qui lui était adressée il y a deux ans par le chef adjoint du Service de la recherche, se voyait confier le mandat d'un secteur de recherche qui incluait la recherche sur les grands rôles écologiques des insectes et des microorganismes dans les écosystèmes forestiers. Ainsi, nous devons établir quels microorganismes et insectes se retrouvent dans les sols forestiers et la rhizosphère et arriver à comprendre les rôles qu'ils y jouent. Lorsque leurs rôles sont utiles, nous devons trouver des moyens de les utiliser et d'améliorer leur action. Les rôles écologiques d'insectes et de microorganismes, comme des symbiotes et des agents du cycle des éléments nutritifs, de la décomposition, de la détoxification, etc., en feraient également partie. Il faut mieux connaître ces organismes et comprendre leur rôle pour conserver des forêts productives et en santé et un environnement sain.

I. Forest Insect and Disease Status and Control Operation Summaries/Renseignements d'actualité sur les insectes et les maladies des arbres et résumés des activités de répression

PACIFIC AND YUKON REGION - 1992

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

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ABSTRACT

The status of more than 20 economically significant forest pests in the Pacific and Yukon Region in 1992 is presented with some forecasts for 1993. These include the increasing levels of two-year cycle budworm, spruce and Douglas-fir beetles, Douglas-fir and rusty tussock moths, western hemlock looper, and European gypsy moth. Continuing populations of mountain pine beetle, western budworm, blackheaded budworm, forest tent caterpillar and large aspen tortrix caused significant damage; eastern budworm, black army cutworm, rhizina root disease, and grey spruce looper declined.

Current research and control trials of some of these pests include: virus and pheromone confusion trials against Douglas-fir tussock moth; Btk trials against western spruce budworm; development and calibration of a pheromone trapping system for western hemlock looper; testing of susceptibility of western hemlock to pinewood nematode and its potential vectors; hazard rating for mountain pine beetle and spruce beetle; screening for resistance to terminal weevils and white pine blister rust; and development of mycoherbicides for vegetation management.

SUMMARY OF IMPORTANT PESTS

The pest conditions reviewed are those most likely to be of interest to participants. Equally significant in terms of losses, but not included, are several forest diseases such as root rots, dwarf mistletoes, stem decays, rusts and cankers. These are perennial and fluctuate little from year to year and do not warrant annual surveys. Controls for such diseases are most practical and economical as preventive treatments, when combined with stand management practices during the harvest-regeneration phase or juvenile stand tending. Also not included are nursery and regeneration losses, the impact of pests of young stands, 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 & Yukon Region in 1992, the reader is referred to "Forest Pest Conditions in British Columbia and Yukon" by Forestry Canada's Forest Insect and Disease Survey, published annually by the Pacific Forestry Centre, Victoria, B.C.

Mountain Pine Beetle

The beetle is the most damaging forest insect in British Columbia. The area and volume of mature lodgepole pine and some western white pine killed by the beetle decreased 10% from 1991, with more than 8330 active infestations over more than 46 100 ha from the International border to northeast of Prince Rupert. This is more than one and a half times the area burned by forest fires in British Columbia in 1992 (27 000 ha). The volume lost (2.3 million m^3) represents about 10% of the lodgepole pine annually harvested in British Columbia.

Active infestations continued throughout the six forest regions in British Columbia. Recently killed mature pine mapped during 1992 aerial surveys increased in the Kamloops Forest Region over 21 000 ha, up 10% from 1991 and in the Vancouver Region up by half at 775 ha. In the Cariboo Forest Region infestations which started in 1987 near Chilko Lake, increased slightly to 425 ha. Declines occurred in the Prince George Region, down 10% at 8500 ha, and in the Nelson and Prince Rupert regions down 25% at 11 000 ha and 4400 ha, respectively.

Infestations along the British Columbia-Alberta border and in Glacier and Yoho National Parks were generally at low levels for the seventh consecutive year; however, pockets of recently-killed pine were 25% more numerous in Kootenay (320) and Glacier (30) national parks. No new mountain pine beetle-killed pine (faders) were located in aerial surveys in Mt. Robson Provincial Park, near Valemount and west of Jasper National Park; however, about 500 recently attacked baited trees are to be cut and burned in a continuing control operation which started in 1985.

There was little or no mortality of overwintering broods region-wide in 1991-92, which resulted in increased populations for flight and attack in July 1992. The frequency of new attacks on mature lodgepole pine in 16 previously infested stands cruised in three forest regions averaged 16%. These ranged from 6% in the Prince Rupert Forest Region to an average of 30% at 9 sites in the Nelson Forest Region.

Increased numbers of mature western white pine were killed by mountain pine beetle in the northern part of the Kamloops Forest Region and adjacent parts of the Prince George Forest Region. Other bark beetles including western pine beetle, red turpentine beetle, lodgepole pine beetle and pine engraver beetle, were less common than in the previous three years in parts of the Kamloops and Nelson regions. Attacks by ambrosia beetles were also less widespread in the western part of the Nelson Region and northwest of Fort St. James.

Salvage of beetle-killed and adjacent susceptible pine continued as a priority in many beetle-infested Timber Supply Areas, particularly in the Kamloops and Nelson forest regions. More than 30,000 commercially produced semiochemical baits have been used in 1992 by the B.C. Forest Service and the forest industry for beetle management (P.M. Hall, BCFS, Victoria, personal communication).

Spruce Beetle

The area and volume of mature white and Engelmann spruce killed by spruce beetle in British Columbia increased 10%, to 50 000 ha. This followed three consecutive years of population increase mainly due to windthrow occurring in overmature stands periodically since 1985. Most of the infested spruce mapped in aerial surveys occurred in more than 1300 separate infestations in mixed alpine fir-spruce stands southeast of Prince George to north of Mackenzie. As in 1991, the largest areas were in recent windthrow and standing mature spruce in the Chunamen, Blackwater, and Phillips creeks drainages west of Williston Lake, and to a lesser extent near Carp and Weedon lakes and in the Parsnip and McGregor river drainages. Infestations increased fivefold in the Kamloops Region to 1655 ha. Most of these were expansions of older infestations in 10 patches west of Lillooet and 7 patches east of Barriere.

Surveys in recent windthrow in parts of the Cariboo, Kamloops and Nelson regions, including over 700 ha in Bowron Lake Provincial Park, found very little 1992 attack. Less than 1% of the trees surveyed at 15 sites following a major blowdown in 1990 in the Park were very lightly attacked, and pose little threat to mature stands in 1993. Small numbers of scattered blowdown were newly infested this year along the Haines Road and in the Kispiox and Morice river drainages in the Prince Rupert Forest Region, but pose no immediate threat.

Budworms

About 345 000 ha of mixed age-class Douglas-fir in four forest regions were defoliated by western budworm, down about 10% from 1991. Defoliation intensities also declined, being light on 72% of the area, with 27% moderate and 1% severe; compared with 28%, 59% and 13%, respectively, in 1991. There were more than 645 separate areas of infestations, 15% less than in 1991.

Still, areas of expansion occurred near Pemberton in the Vancouver Region totaling 21 135 ha, up fourfold from 1991. For the first time in recent years defoliation occurred in the southern part of the Cariboo Region, over 100 ha west of Clinton, and in the East Kootenay over 300 ha east of Skookumchuck. Areas of decline included the Okanagan Valley with 107 000 ha (down from 184 000 ha), the North Thompson, Adams and Shuswap river drainages. There was little change in the western Nelson Region and north of Grand Forks at 4000 ha.

Mortality of late-instar larvae at 17 locations in three regions averaged 28% nuclear polyhedrosis virus (NPV) diseased (range 0 to 90%), down slightly from 31% in 1991. An entomopathogen, *Beauvaria* sp., was isolated from larvae in one collection in which 1% were killed. Tachinids and hymenopterans were present in 10% (range 3-22%) of the larvae at all 17 sites, but were too few to effectively reduce populations.

The average number of egg masses collected by FIDS at 41 infested stands in three regions were 80% less than in 1991, indicating a population decrease in all three regions. Defoliation is forecast to be light at

22 of the sites, mostly in the Thompson and Okanagan drainages in the Kamloops Region, moderate at 16, severe at only one and none at the remaining two sites.

Budworm-infested Douglas-fir totaling about 35 000 ha in five forest districts in the Kamloops Forest Region were sprayed aerially with Bacillus thuringiensis var. kurstaki, by the British Columbia Forest Service. This followed applications in 1991 over a total of 3000 ha near Westwold and Pillar Lake between Vernon and Kamloops. Control was considered successful at all sites, except at Gun Lake west of Lillooet where applications were delayed.

A study to improve and calibrate detection methods for western budworm continued in 1992. Adult males were monitored in four regions at 11 sites with a history of budworm outbreaks but still low populations. Up to 800 larvae/tree were collected per beating (3 branches on 25 trees/plot) and up to 1093 male adults were caught in a total of 54 traps. The data indicates increasing populations with the potential to lightly defoliate stands in 1993.

Current foliage of white spruce, and to a lesser extent alpine fir, was lightly defoliated by eastern spruce budworm over 139 000 ha west, southeast and north of Fort Nelson and extending into Yukon and Northwest territories. This is 40% less than in 1991 and two-thirds less than a peak of 398 0000 ha in 1990. The lightly defoliated branch tips and upper crowns were barely visible from the air.

Two aerial applications of Bacillus thuringiensis var. kurstaki, to protect mature spruce seed production stands and adjacent young stands near Fort Nelson, were completed by the British Columbia Forest Service. Six blocks totaling 570 ha at four locations were treated with B.t. (Dipel (R) 132). Treatment of the area in 1988, 1990 and 1991 were moderately successful. Defoliation is forecast to be light in 1993 near these seed production stands. This is based on an average of 29 new egg masses (range 11-47) per square metre sample of foliage collected by the B.C. Forest Service.

Defoliation of alpine fir and spruce forests by 2-year-cycle spruce budworm was generally light over more than 410 000 ha in 468 infestations in four forest regions. This is the largest infestation since the 1960s, and up significantly from 1991 when defoliation covered 34 350 ha in 104 separate infestations in three regions.

Mature 'on-cycle' budworm defoliated high elevation alpine fir and white spruce in the Prince George Region, over 112 000 ha in about 100 patches southeast of Prince George, near McBride and north of Fort St. James. This was up from 15 000 ha mostly near Fort St. James in 1991. In the Ospika River drainage north of Mackenzie, defoliation was very light over about 8000 ha where it was mapped for the first time in 1989. In the Cariboo Region, mostly light defoliation covered about 160 000 ha in the Willow River drainage, up from 3250 ha in 1991. In the Kamloops Region, defoliation increased to over 144 000 ha mostly west of Clearwater and to a lesser extent near Vernon and Penticton. Defoliation was severe on 5000 ha, moderate on 96 000 ha, and light on 43 000 ha, up from a total of only 6775 ha in 1991. Light defoliation covered 3400 ha in the East Kootenay part of the Nelson Forest Region, up from 1525 ha in 1991.

Immature 'off-cycle' budworm lightly defoliated stands over 600 ha west of Kimberley and, to a lesser extent, in two stands west of Radium in the Nelson Forest Region.

Adult male 2-year-cycle budworm populations continued to be monitored in four regions to improve identification and calibrate methods to detect budworm populations in fir-spruce forests. An average of 148 male adults/trap) were collected in 54 non-sticky traps at 10 sites in three regions. Larval sampling was discontinued in 1992 based on preliminary results of previous years data. Forecasts for defoliation, based on overwintering egg mass samples, indicate populations with the potential to very lightly defoliate new shoots at six sites in the Kamloops Region and at two sites in the eastern part of the Nelson Region in 1993-94.

Western Hemlock Looper

Severe defoliation of mostly old growth western hemlock by the looper occurred in 533 patches, totaling 186 000 ha in the northern parts of the Nelson and Kamloops forest regions and the eastern part of the Cariboo and Prince George regions. Most was adjacent to high-use traffic corridors and recreational areas north of Revelstoke and Clearwater, east of Prince George to McBride and near Quesnel Lake east of Williams Lake. This resulted in numerous concerns being expressed by the public and other land users on the survival of the conspicuous, severely defoliated stands. The area of defoliation is up from 235 patches totaling 54 000 ha in four forest regions in 1991. Significant expansions occurred: up threefold to 88 000 ha in the Kamloops Region, a fourfold increase to 22 750 ha in the Cariboo Region, and in the Nelson Region over 47 250 ha up from 8225 ha in 1991. Tree mortality and top-kill of mature hemlock are being monitored.

Defoliation is forecast to continue in 1993, based on the numbers of eggs laid in 1992. An average of 146 eggs per sample (100 grams of lichens/site) were extracted at 18 sites in three regions. This indicates severe defoliation at 14 sites, moderate at 2 and light at the remainder, all at or near previously defoliated stands. Egg parasitism averaged 38% (range 10-68%) at 10 sites in the Kamloops Region and 14% (range 0-51%) at 12 sites in the western part of the Nelson Region, but was less than 5% at sites in the Cariboo (4) and Prince George (5) regions and in the eastern part of the Nelson Region (3). Parasitism was highest at sites where high populations occurred for two or more years, but is considered still too low to significantly reduce populations.

Larval mortality averaged 10% (range 0-23%) at 23 sites in three regions, mostly caused by Hymenoptera and to a lesser extent by Diptera. Additionally, about 14% (range 0-72%) of the larvae at 17 sites were dead from pathogens, mostly entomophthoracae.

A cooperative study between Forestry Canada and Simon Fraser University was initiated to develop a pheromone trapping and forecasting system for the western hemlock looper. Larval sampling (FIDS standard three-tree beating samples), defoliation severity, pupae, trapping of male adults using four different dosages, and overwintering egg populations were assessed at 27 sites with a history of looper activity in the Cariboo (3), Kamloops (7), Nelson (9) and Vancouver (8) forest regions. Results will be available later this year.

Grey spruce looper

Looper populations in western hemlock in the western part of the Nelson Forest Region west of the Arrow lakes collapsed without any further defoliation this year. This followed defoliation over 4550 ha in 1991 and 1370 ha in 1990, the first year of the infestation. The collapse was mostly caused by naturally occurring pathogens, *Entomophaga* sp. and *Paecilomyces* sp., which averaged about 72% at four sites in 1991. Damage assessments found tree mortality averaged 46% (range 14-78%) of the trees at three of five previously defoliated stands. Tree mortality resulted from at least one year of severe defoliation. Populations are not expected to continue in 1993.

This was the first major outbreak by this pest in the Pacific and Yukon Region since 1961, when a minor infestation occurred in hemlock stands near Terrace.

Western Blackheaded Budworm

Blackheaded budworm moderately defoliated alpine fir and white spruce over about 1000 ha at Bare Loon Lake near Chilkoot Pass in the northwestern part of the Prince Rupert Region, for the second consecutive year. Populations declined at Kinaskan Provincial Park south of Dease Lake, where stands over 10 ha were lightly defoliated last year. Populations in the eastern part of the region remained endemic following their collapse in 1990. Increasing populations in the eastern part of the Nelson Region very lightly defoliated hemlock near Golden and Crawford Bay in association with western hemlock looper.

Populations on the Queen Charlotte Islands and northern Vancouver Island remained low following their collapse in 1989 and 1990, respectively.

Douglas-fir Tussock Moth

Douglas-fir were defoliated in more than 50 patches totaling 1870 ha in the Kamloops Forest Region. Defoliation was severe over about 400 ha and moderate over the remainder. This followed population increases starting in 1989 and defoliation of Douglas-fir trees in eight forest sites, totaling 135 ha west of Kamloops in 1991. Most patches were west of Kamloops to Spences Bridge, and near Hedley in the southern Okanagan. Ornamental Douglas-fir and spruce in urban areas of Kamloops, Vernon, Kelowna, and Penticton were defoliated, some for the fifth consecutive year. Small groups of hedgerow and ornamental Douglas-fir near Abbotsford, Chilliwack, and Clearbrook in the Vancouver Region were defoliated for a third year. There was no defoliation near Grand Forks in the western part of the Nelson Region, where the number of male adults increased threefold in 1991.

The number of male adults in pheromone-baited sticky traps placed in Douglas-fir stands with the greatest historical frequency of outbreaks declined very slightly following six consecutive years of increases. About 4191 adult males were trapped in 115 of 120 traps at 20 permanent monitoring sites in the Kamloops and Nelson regions. This is 1% less than in 1991 when 4250 males were caught in 106 traps at 19 sites, and indicates that defoliation of Douglas-fir will continue in 1993 in or near stands defoliated this year. However, reduced numbers of egg masses in surveys at 23 sites indicate little or no defoliation at 14 sites mostly in the Okanagan, light at 4 sites, moderate at 3 and severe at only 2, near Kamloops and Cache Creek.

Numbers declined in the western part of the Nelson Region, where 54 male adults were trapped in six traps at Christina Lake Golf Course, and 30 at Rock Creek. This is down from 378 and 65 males at each of the two locations, respectively, in 1991. No males were caught in 10 traps adjacent to treated areas near Chilliwack, Abbotsford and Clearbrook in the Fraser Valley, where an average of 12 males were trapped in 10 traps in 1991.

An additional 2195 male adults were trapped in 36 of 43 single traps (average 61/trap) located by FIDS for detection purposes, about one km apart in 43 areas in the Kamloops Region. An additional 14 traps in 14 areas near Winfield and Kelowna, and 17 traps at 17 sites in the Nelson Region, were all negative. A further 5150 male adults were trapped at 186 locations (average 28/trap/location) in the Kamloops Region monitored by the B.C. Forest Service, down from a peak of 6176 at 163 locations in 1991 (average 38/trap), the third year of trapping. These data indicate a slight population decline.

Cooperative interagency viral (NPV) treatments of increasing populations were carried out by the B.C. Forest Service and Forestry Canada at five sites totaling 700 ha (range 5-250 ha) in three forest districts in the Kamloops Forest Region. Post-spray observations in control areas found a population reduction due to infection by a residual virus. Results will be available later.

Larval populations at four sites sampled in two regions were reduced by an average of 75% (range 25-96%), mostly by residual viral infection. This compares with an average reduction of one-third (range 8-64%) in 1991.

Rusty tussock moth

White spruce, alpine fir, lodgepole pine, alder and other deciduous shrubs were moderately defoliated over more than 13 000 ha in five drainages east of Prince George. Defoliation of the current year's foliage was most common on spruce of all age classes in mixed conifer-deciduous stands. This was the first recorded infestation of this pest in the Prince George Forest Region, and the largest recorded in the Pacific and Yukon Region. Total defoliation of new spruce shoots was common and widespread, with occasional top stripping of up to two metres on understory trees. Conifer seedlings and deciduous shrubs, particularly thimbleberry, were moderately defoliated in logged sites along the north and east arms of Quesnel Lake in the Cariboo Region. This followed population increases in 1991. Defoliation is not expected to be significant in 1993, based on the very small numbers of overwintering egg masses, and the historical evidence is that the few infestations documented in the region normally have been of short duration.

Larch Casebearer, Sawfly, Looper

Larch casebearer populations in western larch stands in southeastern B.C. increased slightly for the third consecutive year. Trace, light, and occasionally moderate defoliation occurred, particularly on regeneration, in previously infested parts of the host range in the Nelson Forest Region and adjacent areas in the western part of the Kamloops Forest Region. Defoliation was generally trace or light in the West Kootenay, similar to last year and slightly less than in 1990. Populations increased slightly overall for the second consecutive year in the East Kootenay near Creston, but declined near Cranbrook. Defoliation was most noticeable on regeneration near Moyie and Canal Flats, and light defoliation of mature trees was common near Lumberton, Kitchener and Creston. Light defoliation continued near Sicamous in the Kamloops Region, where it was recorded for the first time in 1990. Small patches of trace to light defoliation, with some moderate, were again common from near Oliver north to Cherryville in the Okanagan, and near Silver Star Provincial Park east of Vernon.

At most of the 18 long-term parasite release study sites in the Nelson Region and two in the adjacent Kamloops Forest Region, defoliation was trace to generally light. This was similar to 1991 at 10 plots in the West Kootenay, but discoloration of understory and open-growing trees was more common at sites from Castlegar west to Anarchist Mountain.

Parasitism of casebearer pupae from 11 sites in the Nelson Forest Region averaged 34% (range 14-72%), similar to 1991. Parasitism by the introduced *Chrysocharis laricinellae* (Ratzberg), present at all 11 sites, averaged 10% (range 2-32%), up 8%. Parasitism by *Agathis pumila* averaged 9% at 7 of 11 sites, similar to 8% in 1991, and none at the remainder. Parasitism by the native *Spilochalcis* sp. averaged 10% (range 0-40%) at five sites. Since the biological control program against larch casebearer was initiated in 1966, more than 15 000 specimens of *Chrysocharis laricinellae* (Ratzburg) or *Agathis pumila* (Ratzburg) have been released. No releases have made since 1987, and additional releases are not anticipated.

Larch sawfly populations in most previously defoliated larch stands in southwestern British Columbia and southwestern Yukon declined to endemic levels. However, exotic larch near Maple Ridge in the Vancouver Region were defoliated, some for the fifth consecutive year, and the crown of a weeping larch at Butchart Gardens near Victoria was defoliated for the first time.

Larch looper populations in western larch in the West Kootenay in the Nelson Forest Region remained endemic following their collapse in 1991. The collapse was attributed in part to larval parasitism in 1990 which averaged 32% with 15% parasitism of cocoons.

Black Army Cutworm

Cutworm populations generally remained at low levels for the third consecutive year, following a significant decline in previously infested areas in interior British Columbia in 1989. However, new feeding mostly on fireweed and other herbaceous growth occurred at 9 of 14 sites in the Prince Rupert Region. The numbers of male adults caught at these sites in 1991 ranged from 289 to 1167. There was no defoliation at the five remaining sites, where numbers of males ranged from 148 to 326 in 1991. Very light new feeding on recently planted Douglas-fir and lodgepole pine seedlings occurred over about 40 ha at a site north of Canim Lake in the eastern part of the Cariboo Region, the first damage in the region since 1988. There was no new feeding damage reported in the Prince George and Nelson forest regions, however, 12% of the spruce seedlings stripped by cutworms in 1991 were dead this year at a site west of Radium in the East Kootenay.

Declines in larval populations in 1991 were attributed to natural factors, mostly from infection by disease such as *Verticillium* sp., *Fusarium* sp., and *Paecilomyces*. Only 8% were parasitized then, mostly by Diptera.

Cutworms pose a threat to seedlings in 1993 plantings in sites slash-burned in 1992, where the numbers of male adults in pheromone-baited non-sticky traps exceeded a threshold of 600 or more per site. This occurred at only 9 of 86 sites trapped in five regions. Seven of the sites were southeast of Prince George and two in the eastern part of the Prince Rupert Region, the highest (750) near Stoner. A comparison of two lures at 17 sites in the eastern part of the Prince Rupert Region found a total of 5568 male adults (average 328, range 22-847) in 17 dry "Multipher" traps baited with "RPC" lures, 14% more than in traps baited with "Raylo" (average 282, range 12-471).

Rhizina Root Disease

Fruiting bodies of Rhizina root disease were present only in very low numbers for the second consecutive year in parts of the Nelson and Prince Rupert forest regions. Seedling mortality associated with fruiting bodies averaged 11% (range 2-20%) in three of 10 sites in the western part of the Nelson Forest Region, and less than 1% at one of 17 sites in the eastern part of the Prince Rupert Region.

Fruiting bodies were found in three of four previously burned areas in the western part of the Prince Rupert Region, and in one of 17 sites in the eastern part of the Region. Planting in 1992 was delayed at most of those sites due to the presence of fruiting bodies in 1991. Less than 1% of the seedlings were infected at only one previously infected site planted this year in the western part of the Region and at a single site in the eastern part. Fruiting bodies were present in eight of 24 sites surveyed in the Nelson Forest Region, and were associated with 1-20% (average 11%) of the seedlings at four sites.

Pinewood Nematode

New surveys in 1992 were conducted to obtain data for a possible exemption of western hemlock from a ban on non-kiln dried exports to the European Community. A temporary deferral (derogation) of the ban was to expire December 1992, but has been extended to mid-1993 for some countries.

Freshly cut logs from healthy standing cedar (5-10), hemlock (25), and lodgepole pine (25) were placed at each of eleven sites with active woodborer populations in six forest regions in late May to early June. These logs (about 625) are currently being measured, peeled, assessed for woodborers and chips extracted to determine the presence of nematodes. About 62% of the samples contained nematodes Rhabditae, Tylechidae and Dorylaimidae, but only 4%, which were all pine, contained pinewood nematode. About 53% of the pine bolts which were severely attacked and 12% of the hemlock bolts, usually very lightly attacked, contained *Monochamus* spp.

Additionally, about 2300 hemlock logs were examined at 24 dry land sorts or log decks throughout British Columbia. Only 22% of the logs had evidence of current or old insect activity. Several different woodborers (e.g. *Melanophila drummondi*, *Xylotrechus longitarsus* and *X. leptura*) were identified from 16% of the logs, but none were *Monochamus* which can potentially vector pinewood nematode. None of the 112 insect-affected wood samples extracted contained pinewood nematode, although 34% of the samples did contain other insect or fungal associated nematodes (Rhabditae, Tylenchidae, Dorylaimidae). Ambrosia beetle attack was found in 10% of the logs at 13 sites. These were mostly *Trypodendron lineatum*, although some coastal samples were *Gnathotrichus*. With more than 70% of the logs examined classed as "green", it is obvious that log inventories are being carefully managed and older logs with higher chances of being attacked by insects reduced.

Previously, samples have been examined from 2000 dead or dying trees, logs, low grade boards, and potential vectors collected from across British Columbia and Yukon Territory since 1980. Only six individual predisposed pine trees at widely scattered locations contained this nematode.

Gypsy Moth

Following the first capture of the Asian biotype of gypsy moth in 1991, the number of sticky traps monitored throughout British Columbia in the fifteenth year of a cooperative program with Agriculture Canada (Plant Health), Forestry Canada - FIDS, and the B.C. Ministry of Forests, was doubled to about 16 000.

In 1992 about 159 males and 3 females (of the introduced European strain) were trapped at 26 locations in British Columbia. These were mostly near Vancouver at Richmond (61 males, 3 females), Burnaby (10), Hope (14), and Salt Spring Island (14). This compares with about 59 males trapped in 18 areas in 1991 and was the highest number trapped in B.C. since 221 were trapped at Kelowna in 1987. None were the Asian strain which had been trapped in two areas in Vancouver in 1991. Within the 1992 treated area only one trap at West Vancouver was positive and it was of the European strain, based on DNA analysis at Pacific Forestry Centre. None were caught where aerial and ground applications of B.t. were completed in 1990 or 1991 on Vancouver Island near Victoria International airport, Colwood, Parksville and Courtenay.

Male moths were caught for the fourth consecutive year in West Vancouver (1), Vancouver (6), and North Saanich (1), and for the third consecutive year at Coquitlam (2) and Comox (7). Catches were made for the second consecutive year at Saltspring Island (14), Langley (1), Surrey (5), Aldergrove (2) and Richmond (61 + 3). New catches were made at New Westminster (3), Burnaby (10), Chilliwack (1), Langley (1), Harrison Hot Springs (1), Hope (14), Whiskey Creek near Coombs (8), Nanaimo (4), View Royal (1), East Saanich (10), Oak Bay (1), Mayne Island (1), and at provincial parks at Okanagan Lake (1), Kawkawa near Hope (1), Sasquatch near Harrison (1), and Porteau Cove near Squamish (1).

Catches of 25 males of the Asian strain in Vancouver in 1991 prompted aerial (18 800 ha) and ground (850 ha) applications of *Bacillus thuringiensis* var. *kurstaki* (Btk., Foray 48B) in late April to mid-May in an apparently successful eradication effort. Treatment costs totalled $6.3 million.

The captures at Okanagan Lake, Kawkawa, Sasquatch and Porteau Cove provincial parks were in four of 278 traps set out by FIDS in 238 forested recreation areas in national and provincial parks, commercial campgrounds, near military bases, and north coast ports.

European Pine Shoot Moth

The shoot moth is established in localized urban areas including Victoria to Courtenay, the lower mainland of British Columbia, and the Okanagan Valley. However, the areas have not increased in number and there is no evidence of shoot moth populations in native pines in this region.

Special surveys of Christmas tree plantings (particularly Scots pine) initiated in the Pacific and Yukon Region this year to detect the pine shoot beetle *Tomicus piniperda*, were negative. These followed the recent introduction of this pest into North America in Ohio and five Lake States.

Balsam Woolly Adelgid

Adelgid populations were found on recently dead and dying mature amabilis fir in a 1-ha pocket on Lasqueti Island in the Strait of Georgia east of Qualicum. This was the first record of the adelgid on the Island, but still within the quarantine zone in southwestern British Columbia. The BWA Regulations were recently revised by an Order-in-Council under the Plant Protection Act. The revision included changes to the quarantine zone which was expanded to include recently discovered infested areas of the mainland and islands.

Tent Caterpillars

Defoliation of trees and shrubs by forest tent caterpillar declined in areas near Prince George and in the northern part of the Kamloops Forest Region and collapsed in the Peace River area, but increased near McBride and in the Cariboo Region. More than 230 locations covering 47 325 ha were defoliated, down overall from 113 000 ha last year.

Northwest and south of Prince George, declining populations defoliated trembling aspen over 11 500 ha, down from over 80 000 ha in 1991. In the Peace River area, populations collapsed following eight years of defoliation and a decline to 4830 ha in 1991. Near McBride, the area of defoliation increased to 26 patches totaling 9700 ha, up from 6500 ha in 1991 the third year of the infestation. Defoliation in the Cariboo Region increased overall by more than half to 25 000 ha in 146 pockets in the eastern part of the region, but declined slightly near Quesnel. There was a six-fold decline in the Kamloops Region to 1125 ha in the North Thompson River Valley, in the fourth consecutive year of defoliation. Populations in the Nelson Region remained endemic following their collapse in the East Kootenay in 1990.

Based on egg samples from 16 areas in two regions, defoliation of trembling aspen, cottonwood and other deciduous trees and shrubs is forecast to increase near McBride and east of Williams Lake, but decline in most infested stands near Prince George and east of 100 Mile House.

An average of 10 new egg masses per tree (range 1-22), were counted at four sites near Prince George and four near McBride. This is up from an average of two in 1991, 17 in 1990 and 38 in 1989. Defoliation is forecast to be only light near Prince George but increase to severe near McBride; none is forecast to occur in the Peace River area. An average of 19 egg masses per tree (range 0-44) were counted at eight sites in the Cariboo Region. Counts greater than 10 masses per tree usually result in severe defoliation. Larval mortality from parasitism and disease averaged 59% (range 27-91%) at eight sites in two regions. This was up from less than 5% last year, but overall is considered still too low to significantly reduce populations in 1993.

Northern tent caterpillar populations in the western part of the Prince Rupert Region declined significantly due to late frost in May. Defoliation (mostly of cottonwood) declined to 1160 ha, down from 4260 ha in 1991, the third year of the outbreak. Defoliation was only very light in patches in the Skeena River Valley and in Terrace. Based on the small numbers of new egg masses at four locations, defoliation is forecast to be very light in small patches in 1993 near Terrace. Small patches of alder were severely defoliated over about one hectare in Strathcona Provincial Park on Vancouver Island. This was the first infestation in southwestern B.C. since 1986, and based on the high populations is likely to continue in 1993.

Large aspen tortrix

Defoliation of trembling aspen by the tortrix was widespread in the Prince George Region and Yukon Territory, in some areas for the fifth consecutive year. In the Prince George Forest Region defoliation in 89 separate patches totaled 24 000 ha, up from 18 000 ha in 1991. Defoliation was mostly light and moderate from Mackenzie to Fort Ware. None occurred along the Alaska Highway from Fort St. John to Pink Mountain and west of Fort Nelson at Steamboat Mountain, where damage was common in 1991. In the Yukon Territory, patches of moderate and severe defoliation covered an estimated 10 000 ha near Carcross, Tagish and Bennett Lake, and on south-facing slopes along the Alaska Highway west of Jakes Corner.

High numbers of parasite eggs on tortrix larvae collected near Carcross and Tagish are currently in rearing. Previous outbreaks usually collapsed due to parasitism after three years. Larval parasitism mostly by Hymenoptera was 27% and pupal parasitism 21%. Remoteness precluded assessments of populations in outbreaks in the Prince George Region.

Cone and Seed Pests

In 1992, 13 coastal seed orchards were surveyed. The most common pests included Cooley spruce gall adelgid which lightly infested about 10% of the Douglas-fir in five orchards, all the trees in an additional two orchards and 20% of the Sitka spruce in four orchards. Balsam woolly adelgid lightly infested about 2% of the amabilis fir in five orchards and 30% of the trees showed evidence of gouting from previous years attacks. Green spruce aphid lightly infested 1% of the trees at one orchard. Hemlock woolly adelgids moderately infested 70% and 40% of the western hemlock at two orchards. Douglas-fir needle midge lightly infested 10% of the Douglas-fir in five orchards. Douglas-fir cone worms lightly infested cones in 2% of the trees at five orchards and mined under the bark of stems on 10% of the trees at one orchard and 7% at a second orchard. There was no evidence of significant damage to trees at three interior seed orchards.

RESEARCH AND EXPERIMENTAL CONTROL PROJECTS

In 1990 Pacific and Yukon Region undertook significant changes to the forest health research programs. All programs were changed to reflect the development of fully integrated forest pest management strategies, with primary emphasis on biological and silvicultural control methods. The development of decision support models also received high priority.

Three programs were developed to reflect these new thrusts: Integrated Insect Management, Biological Control of Forest Pathogens and Biological Control of Forest Weeds. In addition, a new program on silvicultural systems was developed to work closely with all three programs looking at the effect and interaction of modified harvesting practices and other silvicultural practices on the environment and forest health. Current research strategies had a strong foundation as a result of our existing research at the time.

Since our repositioning in 1990, a number of new initiatives have been undertaken as well as the successful integration of several existing projects into our new strategic directions. Exciting progress has been made in several of these projects. Most prominent is the development of a revolutionary new theory on host resistance to spruce weevil.

INTEGRATED INSECT MANAGEMENT

Research at Pacific & Yukon Region concentrates on bark beetles, defoliators and terminal weevils.

Bark Beetles

The primary bark beetles are mountain pine beetle and spruce beetle. Biological management methods under investigation for mountain pine beetle concentrated on the manipulation of a competitor species, *Ips pini*. Pheromones are used to concentrate the mountain pine beetle and then to increase levels of the secondary beetle in the attacked trees, which reduces the success of the mountain pine beetle. Preliminary results in 1992 were encouraging in terms of reducing pine beetle survival. Work on spruce beetle is focused on the analysis of more than 10 years of accumulated data to determine beetle development and survival, in relation to windfalls and harvesting practices, natural enemies, competitors, and climatic factors.

A study on silvicultural approaches to beetle management is being done in cooperation with the Silvicultural Systems Research Program at Pacific Forestry Centre. The effects of selective harvesting and fertilization of lodgepole pine stands on the amount of attack and mortality caused by the mountain pine beetle are being evaluated. Three experimental areas have been selected in susceptible stands. Spacing treatments (check, 4-metre and 5-metre spacing) were applied in each area. Fertilizer will be applied next year to selected blocks. Stands will be monitored annually for beetle attack.

Development of a decision support system for mountain pine beetle management is being undertaken as a component of the Green Plan Decision Support System network. The system will integrate knowledge of pest and stand dynamics, impact on the resource, and management strategies. In 1992, the Invermere Forest District was selected as the system development site and support and participation in the project were obtained from all levels of the Ministry of Forests. The system framework has been developed and components identified. Development has begun on some of the necessary models (population dynamics, spread and impact) and the beetle susceptibility and risk rating system has been completed.

Defoliators

Current studies within the Integrated Insect Management group at Pacific and Yukon Region concentrate on developing management approaches for Douglas-fir tussock moth, western spruce budworm, and western hemlock looper. Damage appraisal studies have been undertaken in relation to both western and eastern spruce budworms.

Use patterns for the nuclear polyhedrosis virus (NPV) for tussock moth and evaluation of the effectiveness of pheromone confusion for control of this insect continued. Blocks treated in 1991 with NPV had only trace or nil defoliation in 1992, while tussock moth populations in the control blocks increased approximately three-fold. In 1992, in conjunction with continuing operational application of NPV by the B.C. Forest Service to treat new epicenters of tussock moth, approximately 300 ha were treated experimentally with alternating swaths of NPV treatment at the registered dosage, and no treatment swaths. This was to determine if treatment costs could be reduced through reliance on viral spread between swaths. By the end of the larval development, viral infection in the experimental block was widespread and virtually the same as in operational blocks treated with total coverage; however, the epizootic developed more slowly than in the operational blocks.

Pheromone confusion trials against tussock moth continued for the second year. A total of 12 ha (six by ground, six by air) were treated with beads impregnated with the traditional tussock moth attractant. Evaluation of the results is continuing, however, indications are very promising.

Trials with Btk were carried out against western spruce budworm in conjunction with an operational program. Three 50-ha plots were treated twice with 30 BIU/ha, about 30 minutes apart, to determine if higher than currently registered dosages would provide more acceptable levels of protection. Deposit was judged to be poor; results are being evaluated.

Damage caused by the western spruce budworm is being monitored throughout the course of the outbreak, utilizing permanent sample plots. Data has been incorporated into a budworm impact model which will be interfaced with the PROGNOSIS model. Work continues in conjunction with the B.C. Forest Service to calibrate the PROGNOSIS model and impact data to British Columbia conditions.

Pacific & Yukon Region is participating in the Green Plan budworm network for eastern spruce budworm, through impact assessment of the budworm on white spruce in the boreal forest. Also, the current western hemlock looper outbreak is the largest ever recorded in British Columbia. This resulted in an increased interest in its population dynamics and control. An NPV recovered and isolated from the western hemlock looper has been propagated in the eastern hemlock looper at FPMI for small-scale ground testing in B.C. Some limited trials of Btk are also contemplated for 1993. Studies have been initiated to determine stands susceptible to outbreaks and to develop more reliable sampling methods for forecasting.

Terminal Weevils

Terminal weevils, particularly Pissodes strobi on sitka, white and Engelmann spruce, continue to be the most important pest of spruce regeneration in the province. Research at Pacific and Yukon Region is concentrating on aspects relating to the identification and quantification of tree resistance to weevil attack.

Damage appraisal studies continue to determine levels of damage compared to degrees of observed weevil resistance in identified resistant spruce families. Existing impact data has been developed into the SWAT (Spruce Weevil Attack Trial) model that estimates commercial yield at rotation age of stands infested by weevils at various intensities over varying numbers of years. This model is currently being integrated with the TASS (Tree and Stand Simulator model) of the B.C. Ministry of Forests for use by forest managers.

During the past two years, a team led by Dr. T. Sahota has been evaluating weevil resistance by sitka spruce based on the monitoring of weevil attack and development versus terminal shoot elongation among provenances on differing sites. Dr. Sahota has developed a new hypothesis that could lead to a major breakthrough in identifying one of the mechanisms for weevil resistance and could provide a rapid screening tool to identify weevil resistant stock for propagation. This will be a major step in the development of a breeding program that will allow expanded, low risk, use of spruce in coastal and interior forests.

A journal publication has now been submitted describing the research supporting this hypothesis. It could have major spin-off to other insects and hosts as it dramatically challenges traditional feeding theory, yet research is fully supporting it.

During the next two years a major network of scientists and operational specialists (from Pacific and Yukon Region, Simon Fraser University, University of British Columbia, B.C. Forest Biotechnology Centre, FPMI and B.C. Ministry of Forests) is being assembled to further develop this research and incorporate it into the B.C. Ministry of Forests and industry breeding programs.

BIOLOGICAL CONTROL OF FOREST PATHOGENS

The pathology program is focused on 3 key strategic areas: white pine blister rust, root diseases and nursery diseases.

White Pine Blister Rust

Western white pine trees of British Columbia once provided a major source of timber, as well as being a primary component of coastal and southern interior forests. A cooperative research program (Forestry Canada, B.C. Ministry of Forests and the United States Forest Service), established in 1985, has been developing a tree breeding strategy and program to produce rust resistant tree seedlings. Since then, the coastal white pine blister rust resistance program has located 300 candidate trees for testing. Seedlings of most have been inoculated with blister rust and will be observed for five years. Resistant seedlings from difficult to infect families and those with latent or slow growing cankers will be used in seed orchards. The interior white pine blister rust program is following a similar, but slower, pattern. Unique protein patterns in the bark have been correlated with resistance. Analysis of ribosomal nucleic acid has revealed three unique patterns within the blister rust pathogen, but these are randomly distributed throughout its range in B.C.

During the past year, disturbing reports of new occurrences of blister rust in New Mexico, North and South Dakota have caused us to examine the possibility of external threats to our success. This could include such worrisome events as a new strain having evolved or the bridging of eastern blister rust into western North America. Pacific and Yukon Region and the U.S. Forest Service will be undertaking special examinations of spore material and virulence in 1993 and 1994.

Root Disease

Forest managers in B.C. have finally started to realize the significant impacts of root rots on forest survival and growth, especially in second growth forests. To address this, research is continuing on the following.

1. Effects of selection harvesting on infection and mortality by Armillaria root disease (*Armillaria ostoyae*). Root infection in undisturbed stands varied from about 10% to 90%. Harvesting of diseased trees increased the amount of inoculum, resulting in increased infection and mortality among residual trees. This study is continuing as it is critical to the debate on modified harvesting technologies.

2. Effects of precommercial thinning on infection and mortality by Armillaria, Phellinus and Tomentosus root diseases.

3. Pushover harvesting for control of laminated (Phellinus) root disease.

4. Use of red alder, alone and with conifers, for regenerating sites infested by *Phellinus weirii*.

5. Control of root diseases by destumping and use of alternate species. A 25-year-old trial has shown that stump removal or planting of alternate rows of resistant and susceptible species controls Armillaria and Phellinus root diseases.

6. Resistance of western larch to Armillaria ostoyae. This work is being done by a graduate student.

7. Pattern and rate of development of Armillaria root disease in Douglas-fir plantations in B.C. interior.

8. Pathology of red alder including decay fungi in living trees, entry courts, cull factors and rate of decay of logs.

Forest Nursery Survey and Research

The Pacific and Yukon Region's Nursery Pest Clinic has received 221 multi-sample requests for 1992. Due to unseasonably hot weather, hypocotyl and root rots caused by Fusarium were the most common diseases at most of the nurseries. Pythium, Sirococcus and Botrytis problems were lower than normal, also due to the warm, dry weather. Storage molds and Keithia blight of western red cedar were significant new problems. Identification of seedlots with high Fusarium levels and analysis of seed cleaning techniques for Fusarium continued.

Over 480 000 two-year-old spruce were lost in storage due to the fungus Septonema. In the past, this disease may have been prevented with a prestorage fungicide spray used routinely for Botrytis. With the implementation of cultural control recommendations made by Pacific Forestry Centre, Botrytis pre-storage sprays have been eliminated. Subsequently, Septonema proliferated during the normal seedling thawing phase. Research by the Pacific and Yukon Region Pest Clinic has produced a method of identifying Septonema on stock to be lifted for storage. Also, effective fungicides have been identified which can protect infected stock. The Pest Clinic has implemented a monitoring program at the request of nurseries which will determine when and if sprays are necessary.

Keithia blight (Didymascella thujina) has caused significant losses in outplanted western red cedar, consequently, a zero tolerance to this disease was implemented by plantation foresters resulting in losses of one million 2-year-old cedar. With the financial assistance of the B.C. Ministry of Forests and support from several nurseries, a multifaceted research program was initiated to identify, understand and control this disease. Experiments on seedling density, nitrogen nutrition, irrigation techniques, container size, types of effective fungicides and application times, and identification of the environment for spore dispersal and infection, have all been started.

Work continued on relating nursery practices (e.g. size of seedling growing cavities) to the incidence and severity of seedling root rots. A study on gray mould disease dealt with defining the onset and abundance of senescent needles (infection courts for the pathogen), as related to nursery practices such as sowing density.

Computer Assisted Nursery Pest Diagnosis

A computer system to assist nursery staff in diagnosing and managing insect and disease problems has been developed. The system is based on a technology known as hypermedia, which permits the user to move through a complex information base of text and graphics at the click of a mouse button. An expert system is included to assist the user in reaching the most appropriate information on which to base the diagnosis, leaving the final decision in human hands. This decision support model has been developed for a PC and has been distributed for use at several British Columbia nurseries. It has enjoyed considerable success and has been adapted for other locations.

RESEARCH BY FOREST INSECT AND DISEASE SURVEY

Disease Diagnostics

Dr. Brenda Callan, using ELISA (enzyme linked immuno sorbent assay) as an advanced diagnostic technique, has demonstrated for the first time that a xylem-inhabiting bacterium, *Xylella fastidiosa*, is present in leaf scorched big leaf maple. This helps to clarify that the damage is not caused by acid rain. Additional electron microscopy studies are in progress. As well as providing the disease diagnostics for the Forest Insect and Disease Survey, Dr. Callan has also undertaken a 4-year Memorandum of Understanding with the B.C. Forest Service to produce a checklist and reference manual for diseases of native and hybrid poplars.

Historical Hazard Rating for Budworm

FIDS is continuing development of GIS as a reporting and analysis tool. Historical records of western budworm dating from 1909 to 1992 and involving more than 480 maps have been brought into one common data base in our ARC/INFO Geographical Information System (GIS). Programs in this Historical Hazard Rating System enable examination of map areas of virtually any scale and time period to be examined by the user. Multi-year analysis and links to ecological maps will be completed shortly. This system also provides a basis for analysis of other pest data sets.

Pests of Young Stands (POYS)

In 1991 and 1992, young stands treated through the Forest Resource Development Agreement were examined for insects and diseases in a forest health survey. About 250 stands, or 9% of those within the Silvicultural History Record System which had been recently treated, are assessed each year. Although pest occurrence was noted at most sites, only half the sites had serious pests. This was usually at low levels with less than 10% of the trees affected by pests causing mortality, deformity, or long-term growth loss. The data base is providing an overview of pest problems and a basis for treatment recommendations for pest management. A statistically based sampling design, a review of sampling methodology for forest health surveys, and a SAS program for analyzing the POYS data have been completed, and a contract has just been issued for "Model development to forecast effects and impacts of selected forest pests as a basis for management".

ARNEWS/LRTAP

Contract or funded support involve "Foliar analysis and database structure for ARNEWS in the Pacific Region", "Lichen biomonitoring for ARNEWS in B.C. forests", and "An interactive computer-based training system for defoliation estimation".

Asian Gypsy Moth

In response to the urgent threat created by the finding of the Asian gypsy moth, Pacific and Yukon Region initiated several research projects to provide the essential background scientific information for diagnostic evaluation and life history strategies. Current research activities include:

1. Development of the first Canadian laboratory for mitochondrial DNA identification of gypsy moths trapped in British Columbia during 1992.

2. Within an approved quarantine rearing facility, determining the viability of egg masses discovered during quarantine inspections of vessels.

3. Determination of the ability of the Asian and European races of gypsy moth to hybridize (egg masses from reciprocal crosses have been produced, rearing of F1 hybrids and backcrosses are planned).

4. Scanning electron microscopy of eggs of Lymantria species from the Russian Far East to allow definitive identification of species detected during quarantine inspections (at least two species have been recovered from vessels in Canada and the United States).

5. Determination of the incidence of premature eclosion of egg masses of Asian gypsy moth.

6. Cooperative research on Asian gypsy moth phenology, mating behaviour and response to lights and pheromones in the Russian Far East.

7. Collaborative evaluation of potential nuclear DNA markers to provide a more definitive method of identification of the origin of trapped moths. In addition the efficacy of the Asian gypsy moth spray operation on larvae was assessed through bioassay feeding studies conducted under quarantine (in cooperation with Dr. I. Otvos).

Lygus bug

Activities include a cooperative research study to determine the distribution and phenology of Lygus bug species attacking conifer seedlings in nurseries across the province.

Garry Oak Pests

Two insects, the jumping gall wasp and the oak leaf phylloxeran, continued to cause increasingly severe and widespread damage to Garry Oak throughout southeast Vancouver Island and the adjacent Gulf Islands in 1992. This has resulted in major public concern about this environmentally sensitive and threatened oak, and unprecedented funding of cooperative research by B.C. municipal governments.

In April 1992, two graduates and one biology coop student began investigating pest biologies, parasite/predator complexes, and host resistance. Progress to date includes defining much of the basic life cycles of both the jumping gall wasp and oak leaf phylloxeran; identification of seven species of parasitoids and one predator of the jumping gall wasp; and assessment of seedling susceptibility to oak leaf phylloxeran damage. These studies are being funded through a joint Green Plan and core municipalities/Capital Regional District cost sharing agreement.

Biological Control of Forest Weeds

Research efforts in this program have concentrated on the screening and testing of naturally occurring fungi and bacteria for effectiveness on controlling woody shrubs and grasses.

Chondrostereum purpureum was demonstrated to be a viable pathogen of several hardwood brush species and was shown to be relatively uniform worldwide, making it feasible to request consideration of registration over a broad geographic range. Formulation was initiated to develop commercially attractive and industrially useful products.

The bacterial metabolite BIALOPHOS^R was shown to be an effective control agent of several weed species in initial greenhouse testing. More detailed field testing will be initiated in 1993.

One fungus (Nectria PFC-082) was identified to be both highly virulent and quite dependable as a biological herbicide for alder. The bioagent (PFC-082), the formulation strategy and a newly-designed combined wounding/inoculation device, were entered into preliminary patent processing.

Research to control salal (*Gaultheria shallon*) was suspended except for an extensive Canada-U.S.A. source provenance test. Initial differences among seed collections are evident after two years.

The combined fungus - rhizobacteria testing for biocontrol of the grass, *Calamagrostis canadensis,* in the Peace River area, is producing results after only one year with discovery of a new species of fungus and evidence of a natural allelopathic chemical. In addition, Pacific Forestry Centre provided major capital funding for the MIDI gas-chromatograph and analyzer which utilizes patterns of endogenous lipid content in the development of bacterial identification software libraries. To our knowledge, this is the first use in forestry of this technology.

NORTHWEST REGION

STATUS OF IMPORTANT FOREST PESTS CONDITIONS

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STATUS OF IMPORTANT PESTS

This report summarizes information on the current status of important tree damaging pests in the Northwest Region in 1992. Information gathered on the distribution of pests, their levels of abundance and of the various applications of management strategies applied within the region was contributed directly by staff of the Forest Insect and Disease Survey, as well as by various regional clientele whose names are listed as contributors. Information on the status of gypsy moth within the region was provided by Agriculture Canada.

Spruce budworm (*Choristoneura fumiferana*)

Spruce budworm infestations were reported in all three Prairie provinces and in the Northwest Territories, mostly within the same areas as reported in 1991. There was a general decline in size of outbreak in Manitoba and the Northwest Territories. Infestations in Saskatchewan increased substantially, while in Alberta, the areas of infestation remained similar to last year but the intensity of defoliation was much reduced (see attached Map and Table). Overall, the total area defoliated in the Northwest Region was 345,906 ha, up slightly from last year.

Summary of areas of mostly moderate-to-severe defoliation by spruce budworm during 1989 to 1992

Year	Alberta	Saskatchewan	Manitoba	Northwest Territories
1989	85,850	34,650	58,016	98,600
1990	109,150	18,780	18,985	113,625
1991	141,000	15,600	30,000	130,000
1992	142,650	87,000	26,256	90,000
% change ('91-'92)	+1	+458	-14	-31

Within the three Prairie provinces, most of the aerial and ground survey detection, monitoring and population and damage assessments are now conducted by the respective provincial forestry staff.

Aerial spray programs with the biological insecticide, *Bt* var. *kurstaki*, were conducted over three forest districts in Alberta (35,100 ha) and over 7,734 ha within the Weyerhaeuser Canada Ltd. lease in Saskatchewan. This was the third operational control with *Bt* in Alberta, and the first in Saskatchewan. Additional control strategies being applied include salvage harvesting, re-scheduling of areas and containment (ie., making use of adjacent nonhost stands and swamp areas).

Pheromone baited traps were deployed in Alberta and Saskatchewan by provincial forestry staff to monitor spruce budworm populations, and deployed by FIDS for the eighth consecutive year in Manitoba. In addition, intensive egg-mass sampling by Manitoba Natural Resources staff suggest, except for ~~as do the~~ pheromone trapping results, that there will be a general decrease in budworm population in 1993 in the southeast part of the province and in the Duck Mountains.

Aspen defoliators:

Forest tent caterpillar (*Malacosoma disstria*)
Large aspen tortrix (*Choristoneura conflictana*)
Aspen leaf beetles (*Chrysomela* spp.)

Populations of these defoliators declined in all areas in 1992, and were present only in relatively small infestation patches. In Alberta, most of the light to severe defoliation occurred in the central part of the province, and was contributed by the forest tent caterpillar and large aspen tortrix. In Saskatchewan, small patches of light-to- moderate defoliation occurred throughout the central part of the province and was due mostly to the large aspen tortrix. In Manitoba, the total area of aspen forests defoliated was 51,150 ha, a decrease of about 28% over 1991. Egg-band surveys to forecast forest tent caterpillar populations were conducted by Manitoba Natural Resources and FIDS in Manitoba and suggest a further reduction in 1993.

Bark beetles:

Mountain pine beetle (*Dendroctonus ponderosae*)
Spruce beetle (*Dendroctonus rufipennis*)
Douglas-fir beetle (*Dendroctonus pseudotsugae*)

Infestations of the **mountain pine beetle** remained very low at all locations in Alberta and in southwestern Saskatchewan. Monitoring for the beetle was carried out by the two provinces using semiochemical baits. Mountain pine beetles were trapped at three baiting locations in southwestern Alberta and have raised concern that new infestations may arise.

Surveys conducted by Alberta Forest Service in northwestern Alberta indicate a **spruce beetle** outbreak extending over 4.000 ha of mature white spruce forests. An average of 10% of trees in this area is estimated to be recently killed by the beetle. Some salvage harvesting in localized areas has been scheduled and other strategies including the felling of trap trees and deployment of semiochemical tree baits are being tested for population reduction.

The **Douglas-fir beetle**, now in the second year of outbreak, caused mortality of over 200 Douglas-fir trees in Jasper National Park.

Dutch elm disease (*Ophiostoma ulmi*)

This disease was of concern in both Manitoba and Saskatchewan and was detected at three new locations in Saskatchewan. Intensive surveys, control projects and public awareness programs are in place.

Gypsy moth (*Lymantria dispar*)

Agriculture Canada increased its effort in monitoring with pheromone traps for potential introduction of the gypsy moth into the Prairie provences. No moths were trapped in Alberta or Saskatchewan, but positive catches were made at two locations in Manitoba; at Birds Hill Provincial Park and at Shilo. These are presumed to be the European strain.

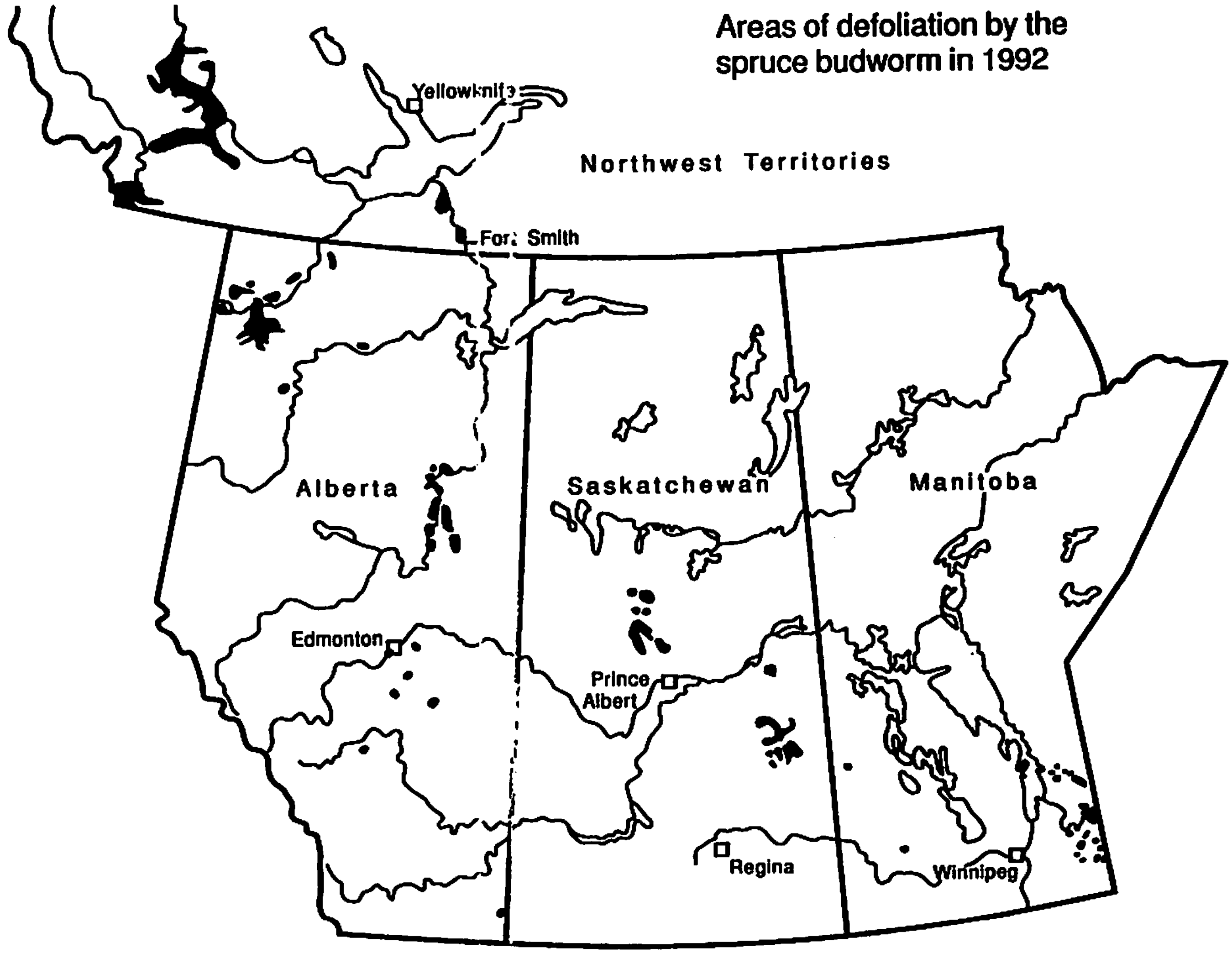
Surveys of aspen stand conditions

Surveys were initiated in 1992 within trembling aspen forests in the three Prairie provinces to monitor for the incidence of insects, diseases, other damage agents, defects and mortality. Ages of stands sampled varied widely from less that 20 years to over 80 years. The data were pooled from all sites and summarized by province (see attached table). Top dieback, tree mortality, and a stem-staining fungus (*Peniophora polygonia*) of aspen were all significant factors in all three provinces.

Young stand surveys

Young coniferous stands, including genetic plantations, seed orchards and various other planted or natural sites were surveyed in the three Prairie provinces for incidence of insects, diseases, and various abiotic agents affecting tree growth and mortality. No unusual pests were encountered.

Areas of defoliation by the spruce budworm in 1992



Summary of incidence (%) of important insects, diseases, and condition of trembling aspen surveyed in provincial Permanent Sample Plots (PSP's) in 1992

Damage agent or tree condition	Alberta	Saskatchewan	Manitoba
No. sites sampled	11	9	18
Tot. trees sampled	1301	684	979
Defoliator incidence[a]: *Choristoneura conflictana* *Malacosoma disstria*	8.2	33.6	11.5
Poplar borer *Saperda calcarata*	0.4	4.8	1.1
Armillaria root rot *Armillaria* sp.	<1.0	<1.0	3.6
Hypoxylon canker *Hypoxylon mammatum*	4.6[b]	6.9[b]	1.0
False tinder conk *Phellinus tremulae*	6.0	3.4	5.5
A stem-staining fungus *Peniophora polygonia*	20.2	6.4	8.0
Top dieback[c]	7.8	9.9	6.9
Dying and dead trees	15.6	38.3	22.2
Other[d]	39.9	11.5	20.8

[a] Levels of defoliation varied widely from trace to moderate or severe and was due mostly to large aspen tortrix, *C. conflictana.*

[b] Values may be slightly overestimated since some apparent infected trees may have been inaccurately diagnosed.

[c] Top dieback = partial mortality of shoots and branches in the upper crown.

[d] Other includes frost cracks, mechanical injury, partial girdling by hares or other animals, etc.; and major defects such as forked stems, severe lean, broken top, twisted stem, etc.

FOREST PESTS IN MANITOBA

PREPARED FOR THE

20TH ANNUAL FOREST PEST CONTROL

FORUM

NOVEMBER 17-19, 1992

OTTAWA

Presented by:

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Spruce Budworm

The spruce budworm, Choristoneura fumiferana, infestation in eastern Manitoba decreased in size in 1992. Approximately 26,000 ha of white spruce/balsam fir forest suffered moderate to severe defoliation within the Abitibi-Price Forest Management License, Nopiming, Whiteshell and Hecla Island Provincial Parks. A small localized infestation, (approx. 200 ha) continued in Duck Mountain Provincial Park in western Manitoba.

Based on defoliation predictions derived from the 1991 egg mass survey there was no budworm suppression program in 1992. The 1992 egg mass survey indicated that there would continue to be a slight population decline throughout much of eastern Manitoba. Light defoliation is predicted for much of the Abitibi-Price Forest Management License and Nopoming Provincial Park. Moderate defoliation is expected in the northwest portion of Whiteshell Provincial Park, along the Winnipeg River. Defoliation in the southern Whiteshell at Falcon Lake and Westhawk Lakes is expected to be light. The Duck Mountain infestation is expected to be moderate to severe.

A detailed survey and analysis was carried out 1991 and 1992 of spruce/fir forest loss to spruce budworm in the Abitibi-Price Forest Licence area. Spruce budworm vulnerable stand types, over an area of 27,447 ha were rated from the air as follows:

1. Extensive mortality	106 ha
2. Moribund, not likely to recover	2,008 ha
3. Severe defoliation, likely to recover	9,270 ha
4. Nil or light damage	16,063 ha

To determine volumes in budworm vulnerable stands, a ground survey was done using Manitoba forest inventory temporary plot procedures combined with a damage assessment of plot trees. Gross merchantable volumes derived from the ground cruise were compared to pre-outbreak inventory volumes to estimate the losses to spruce budworm. At the present time 15% (242,385 cu. m.) of the spruce/fir component within the budworm vulnerable stand types has been lost to spruce budworm. Continued stand decline will increase the loss to approximately 18% (295,623 cu. m.) over the next two to three years.

Moisture Content of White Spruce defoliated by Spruce Budworm

In 1991, Abitibi-Price Inc. reported that budworm defoliated white spruce, in eastern Manitoba, had a moisture content below the minimum of 45% required for their pulping process. A study was conducted to investigate the moisture levels of mature and over mature white spruce scheduled for salvage harvest due to spruce budworm impact.

Approximately 100 trees were randomly selected from the affected area and placed in one of two size and four defoliation classes. Heartwood and sapwood moisture content and % dry weight was measured in disks cut at 2.5 and 5.0 m intervals from small and large trees respectively.

Regardless of the degree of defoliation, all sampled living trees contained more than the minimum level of 45% moisture for pulping purposes. Spruce trees killed by spruce budworm had an average overall moisture content level of 48%. Moisture content varied within individual trees and depended on size and height. For severely defoliated trees moisture content was generally above 45% in stem sections greater than 30 cm in diameter and less than 45% in sections less than 30 cm in diameter, regardless of tree size.

Jack Pine Budworm Pheromone Study

Since the 1983-1985 outbreak, Jack pine budworm, (Choristeneura pinus pinus), populations in Manitoba have remained at endemic levels throughout the province. Monitoring for the adult males of Jack pine budworm began in 1985. This procedure is being evaluated as a supplemental technique to branch collection and assessment to evaluate endemic population levels. Budworm populations at twelve locations are being monitored throughout Manitoba.

Three concentrations of pheromone lure were evaluated from 1985 to 1988. Based on comparative results from these evaluations, beginning in 1989, the 0.03 microgram concentration of pheromone lure has been evaluated in two trap types (Pherocon 1C and Multipher). In 1992 total number of adult males captured increased slightly at three locations (Shilo; Moose Lake and Kississing Lake, Manitoba). Adult male captures remained low at all other locations in the province. Defoliation assessments and egg masses counts at all trap locations continue to indicate very little Jack pine budworm activity, as suggested by the low adult captures.

The following table shows the total male moth captures for the 0.03 microgram concentration per location for each trap type since 1985:

TRAP TYPE	1985	1986	1987	1988	1989	1990	1991	1992
Pherocon[1]	2060	419	229	323	391	179	74	160
Multipher	699[2]	40[3]	10[2]	23[3]	59[4]	47[4]	34[4]	106[4]

1. 12 sites sampled
2. 2 sites sampled
3. 3 sites sampled
4. 12 sites sampled

Statistical analysis has shown there is no significant difference between traps in the numbers of male captures. Male staminate buds have been assessed on collected branches from all 12 locations since 1985. The staminate buds indicate the level of male flowering that will occur in the collection areas in the following year. Jack pine budworm larva are known to feed on pollen before consuming new foliage. Current research has not fully determined the link (if any) between presence of pollen and level of larval survival. The following table illustrates the levels of male flowering averaged over trap locations since 1986.

	1986	1987	1988	1989	1990	1991	1992
% staminate buds	4	9	15	72	26	37	61

Jack pine budworm populations have remained at very low levels since 1986 and are predicted to remain low in 1993. In addition to pheromone trapping, Jack pine budworm, populations have been monitored via egg mass sampling at 29 other sites throughout the province. Assessment of 1992 data indicates that populations will continue to remain low in 1993, corroborating moth capture data.

<u>Western Gall Rust Resistant Jack Pine Study</u>

A cooperative project between Forestry Canada and Manitoba Natural Resources began in 1988 to identify superior Jack pine families, in an established pedigreed seed orchard, for relative resistance to western gall rust. The primary objective was to incorporate rust resistance into the ongoing Jack pine breeding program in Manitoba. Development of techniques for assessing host response to western gall rust infection are necessary. To date, reliable methods for inoculating and rating young Jack pine seedlings for susceptibility have been developed. All families have been surveyed for natural gall rust infections in the family test plantations at Stead, Marchand and Lonesand, Manitoba. Preliminary results from the field survey and greenhouse inoculated first-cousins indicate great genetic variability within the families.

Of interest is the mechanism and inheritance of western gall rust resistance. Controlled crosses between and within field resistant and field susceptible families were conducted at all three family test plantation areas in 1992. Cones were collected from the Stead plantation during the winter of 1991 and the resulting seed sown and seedlings inoculated with Manitoba field-collected western gall rust spores at Forestry Canada, Edmonton. During 1992 sampling was carried out in seven stands containing previously identified resistant Jack pine families. Seed from cones collected from these families was sown at the Pineland Nursery, Manitoba. The young seedlings were inoculated with field-collected western gall rust spores. Initial assessment showed significant levels of infection in most test trees. Assessments are ongoing. Results from these trials will be compared to those of other family tests.

Dwarf Mistletoe

A systematic, comprehensive aerial survey for lodgepole pine dwarf mistletoe, (*Arceuthobium americanum* Nutall ex Englemann), on Jack pine, (*Pinus banksiana* Lamb) was carried out to assess the severity and nature of infection over an area of 29,000 square kilometres in Manitoba during 1991. Ground surveys were carried out to confirm the presence of dwarf mistletoe and to quantify the volume present in infested areas. Approximately 140,000 ha of mature jack pine types were covered during the aerial survey; 12,000 ha or 9% of this area was infested. Dwarf mistletoe has a significant impact on productivity in the jack pine forests of central Manitoba. This volume loss was expressed as a percentage of the net operable Jack pine volume of the surveyed forest management units and ranged as high as 20% for one forest management unit. In conjunction with Dr. F.A. Baker, Utah State University, a loss simulator model is being produced to predict stand level impacts prediction of timber volumes over the life of the stand. Current activities also include development of an operational decision support system to assist in field management and an indepth economic analysis of the overall impact on the forest resource.

White Spotted Sawyer

Due to the large areas in Manitoba that were burned in the 1989 forest fire season there now exists extensive stands of fire killed brood material for the White Spotted Sawyer, *Monochamus scutellatus*. Based on the two year life cycle, massive adult emergences have occurred in both 1991 and 1992. Severe adult feeding has been observed on the periphery of many harvest blocks. Extensive tree mortality has been recorded in many areas of the province, often up to 30 meters from cut block edges. Jack pine has been the most severely attacked. Log decks and slash piles are acting as major attractants for beetles searching for breeding sites.

Pest Assessment of Permanent Sample Plots (P.S.P.'s)

Since 1986, the Silviculture Section of the Manitoba Forestry Branch has placed permanent sample plots in recently established plantations of the major tree species. Plots are maintained by species and take into account the different types of planting techniques and silvicultural site preparation methods. Forest Protection has established a survey regime within the Silviculture plots to relate pest damage and occurrence with growth and yield results.

The permanent sample plots are circular 50 m^2 plots arranged in a grid pattern across part of each plantation, at a density of one plot per hectare for the selected area. Similar to tree measurements, damage and causal pests will be assessed every 3 years of growth from age 3 until age 21.

In 1992, a second assessment of the 1986 P.S.P's was conducted. These included 25 plantations or 203 P.S.P.'s with White spruce, Black Spruce, Red pine, and Jack pine as the planted tree species. Data from this sampling program is being entered into the recently developed MNR, Forest Protection - Renewed Forest Pest Survey program. The data will be used to investigate pest occurrence on different tree ages, effects of site preparation and pest impact on growth and yield.

Dutch Elm Disease - 1992

The annual Dutch Elm Disease surveillance program commenced in June 1992. This survey program encompassed 43 cost-sharing communities as well as 7 buffer zone municipalities around the City of Winnipeg, all of which represent the focus of Dutch Elm Disease (DED) management program. Under the terms of the provincial program, the Province of Manitoba and the communities cost-share DED control activities such as sanitation pruning, basal spraying with chlorpyrifos and replacement planting. The province is responsible for the survey of diseased and dead elm trees within cost-sharing communities, except the City of Winnipeg. The province is also responsible for removal of infected elms from all cost-sharing communities except those of Brandon and Winnipeg.

Cool summer weather delayed the onset of disease symptoms by approximately three weeks in 1992, making it necessary to extend the survey season into mid-September. The overall incidence of DED was lower in Manitoba in 1992, primarily due to the cool, wet weather. Other factors contributing to less disease incidence were less elm bark beetle activity; trees taking longer to display disease symptoms; and a significant increase in available soil moisture levels (reducing stress loads on trees caused by previous drought years).

The range of the disease moved northward in Manitoba to the town of Swan River (172 km north of the 1991 infection limit - Riding Mountain National Park). The disease was found along the Carrot River in east-central Saskatchewan, but aerial survey of the Carrot and Saskatchewan Rivers in western Manitoba failed to show disease incidence.

During the 1992 provincial survey, 7,521 elms were marked for removal. Of this total, 1,073 trees were diagnosed as having DED while the remaining trees were classified as hazards i.e. decadent to the point that they were capable of supporting elm bark beetle breeding activity. In the City of Winnipeg 5,847 trees are slated for removal, 1,149 of which were diagnosed as having DED and the remaining classified as hazards. Other major urban centres with disease included Brandon, Portage La Prairie, Morden, Winkler, Dauphin, Steinbach and Selkirk.

River areas continue to have high levels of DED, especially along the Red and Assiniboine Rivers. The Boyne River near Carman and the Souris River in southwestern Manitoba remain extensively infected. Overall levels of DED dropped or remained the same as 1991 levels within most communities with cost-sharing programs. Less than two percent of elms in Winnipeg and Brandon were infected with DED.

From June 1, 1991 to May 31, 1992 the Provincial DED Sanitation crews removed 11,566 diseased and hazard elms.

European Elm bark beetle monitoring

Presently the native elm bark beetle is the major vector of Dutch Elm Disease in Manitoba. A few smaller European elm bark beetles, *Scolytus multistriatus*, have been captured in the City of Winnipeg each year since 1977. Monitoring for this species outside of Winnipeg began in 1982. Only two specimens of the European elm bark beetle have been captured in baited pheromone traps since rural monitoring began. Both were collected in 1989. No European elm bark beetle adults have been collected in rural traps since 1989.

1992 Renewed Forest Pest Survey

A Renewed Forest Pest Survey to determine occurrence and distribution of major pests causing main stem deformity, growth loss and/or mortality in high-value renewed stands and highly productive sites was implemented in 1987. The majority of renewed stands older than 5 years were surveyed in Abitibi Price Forest Management License (FML) in the Eastern Region in 1992.

A Renewed Forest Pest Survey Computer System has been developed which processes information regarding occurrence and distribution of major pests and resulting damage in renewed forests. Province of Manitoba RFMIS (Regional Forest Management Information System) codes have been incorporated into the database for compatibility with the Forestry Branch GIS system.

Since 1988, 243 renewed forest stands covering 7,126 ha have been surveyed in the Province of Manitoba. In 1992, 45 renewed stands, totalling 1,043 hectares and ranging from 4 to 11 years old were surveyed in the eastern region of the province. Four plantations (67.3 ha) were surveyed in the Agassiz Provincial Forest, and forty-one stands (975.7 ha) were surveyed in the Abitibi Price FML.

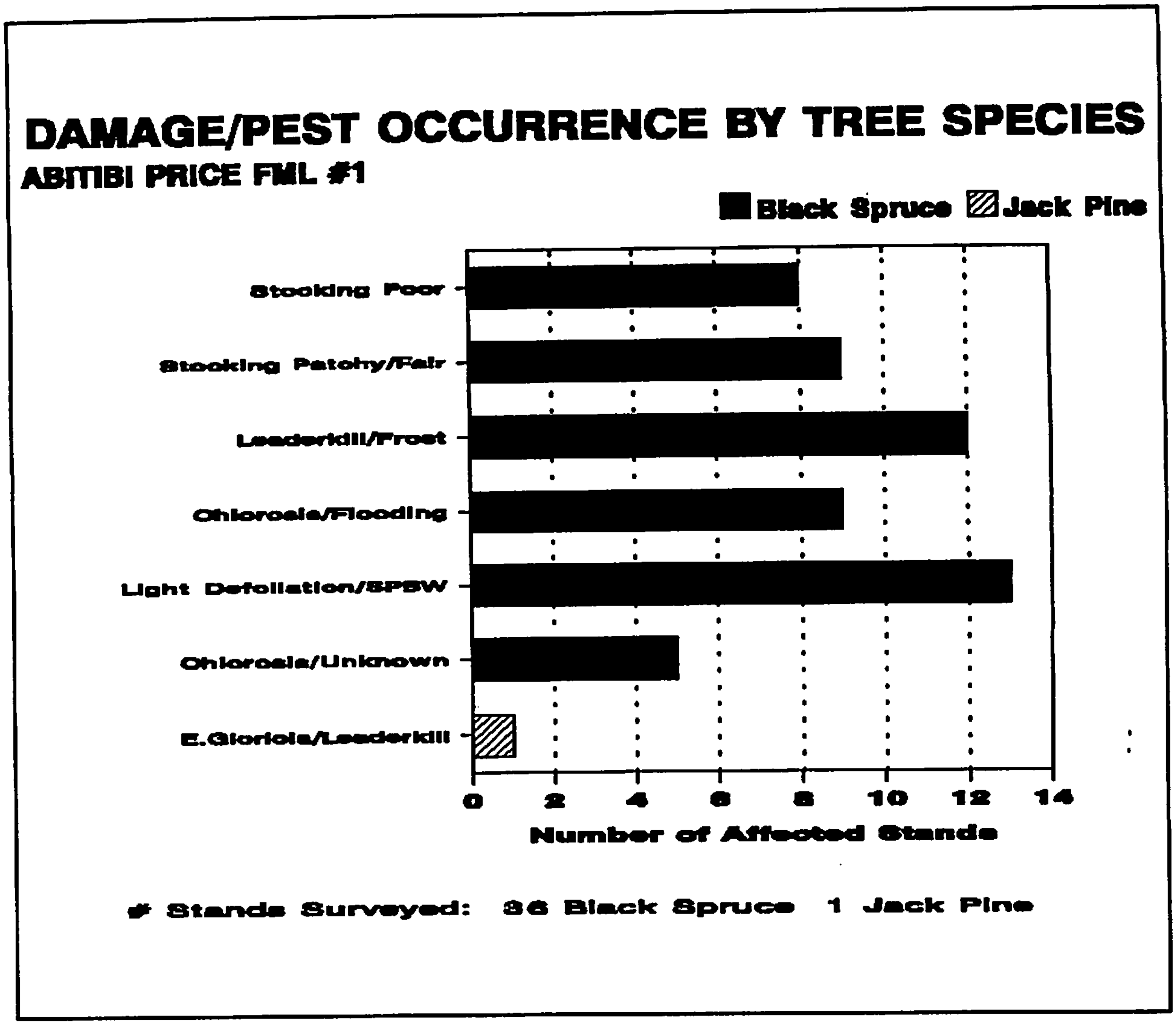
Many surveyed black spruce stands in the Abitibi Price FML are experiencing problems with stocking, heavy competition, and poor height growth due to competing vegetation (marsh grass and sedges) and a high water table following harvest (Figure 1). Height in surveyed black spruce stands ranged from <0.5m to 2.5m, averaging 0.5m to 1.0m overall. Flooding problems in 7 black spruce stands resulted in chlorosis and stunted growth. An additional 5 black spruce stands had chlorosis problems (unknown cause). Other noteworthy problems included spruce budworm, which occurred in small numbers causing little damage in 13 black spruce stands and frost damage causing twig dieback, lost leaders and double leadering. Of interest, paperpots were found intact on several 10 year old trees.

Eastern pine shoot borer *(Eucosma gloriola)* was found extensively in some jack pine stands located in Abitibi Price FML, causing lost leaders. In Agassiz Provincial Forest 2 white spruce and 2 black spruce plantations were surveyed. Height growth in both stands was fair to good, with good stocking and moderate to high competition. Browse causing lost leaders occurred on the tamarack larch and balsam fir in these stands.

Forest Tree Diseases

In 1988, during routine plantation surveys in Sandilands Provincial Forest, severe stem cankering was detected in Jack pine (20 to 22 years old) and Red pine plantations (18 to 32 years old). Substantial mortality centres have developed in some cases, indicating the disease has been present for a number of years. Field inoculations of fungi isolated from cankered samples into Jack and Red pine were carried out at three different periods during the summer of 1991. Host tree reactions, including canker development, has become very visible on Red pine inoculated with both *Ceratocystis minor* and *Sphaeropsis sapinea* and on Jack pine inoculated with *Sphaeropsis sapinea*. Retrieval of the fungi is planned for the fall of 1993.

Also in 1988, during routine plantation surveys in Sandilands Provincial Forest, a tip dieback condition was discovered in a 32 year old Red pine plantation. The condition occurred in fairly discrete infection centres with a gradient from lightly infected trees on the periphery to chronic infection, sometimes causing tree mortality, towards the interior. Since 1988, the disease has been discovered on Red pine of various age groups (9 - 35 years old) and occasionally on Jack pine in Agassiz and Belair Provincial Forests. Samples collected from the dead buds and browned tips were cultured and identified by Dr. R. A. Samson of the Centraal Bureau Voor



Schimmel Cultures in Holland as *Rhizosphaera kalkhoffii Bub.* This organism is commonly known to cause premature death and needle loss on spruce in North America. Known pine hosts include Austrian, Japanese black, Mugo, Eastern white, and Himalayan white. It also causes a significant needle blight of Japanese red pine in Japan. Field inoculation trials will be carried out using *R. kalkhoffii Bub.* cultures on Red pine in an attempt to mimic the tip dieback damage.

SPRUCE BUDWORM, JACK PINE BUDWORM AND GYPSY MOTH IN ONTARIO, 1992[1]

- Outbreak Status 1992
- Forecasts 1993
- Spraying Operations 1992 and 1993

by

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[1]Report prepared for the Annual Pest Control Forum, Ottawa, November 17-19, 1992.

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SPRUCE BUDWORM

Outbreak Status 1992:

In 1991, moderate-to-severe defoliation was mapped over some 9,065,781 ha in Ontario. Most of this occurred in northern Ontario, but sacttered pockets of defoliation were detected in districts along the North Channel and at a few locations in southern Ontario.

Egg-mass surveys conducted that summer indicated that significant changes were not likely to occur in 1992. Some expansion along the northern boundary in Red Lake and Sioux Lookout districts was expected along with some eastward expansion of the infestation in Hearst District. Populations appeared to be building in the Algonquin Park infestation and new pockets of defoliation were possible in parts of southern Ontario. The egg-mass data indicated that populations, and consequently defoliatin rates, would likely decline in parts of Thunder Bay and Nipigon districts.

1992 was a difficult year to map spruce budworm defoliation in much of Ontario. Cool, wet conditions throughout the summer resulted in a prolonged feeding period and heavy rain removed red foliage from trees earlier than usual. Despite this, however, some 9,595,762 ha of moderate-to-severe defoliation was mapped (Fig. 1, Table 1). This was an increase of 529,981 ha from 1991.

As predicted, in 1992 the infestation expanded to the north in Red Lake and Sioux Lookout districts and to the east and southeast in Hearst and Wawa districts respectively. Increases were also detected in Fort Frances, Ignace, Geraldton and Moosonee districts. Defoliation declined along the southern edge of the outbreak in Dryden, Atikokan and Thunder Bay districts as well as in the southern portions of Nipigon and Terrace Bay districts. Small pockets of severe defoliation were mapped near Sault Ste Marie in Sualt Ste Marie District and in Blind River District near Thessalon. Numerous small pockets were detected in Espanola and Sudbury districts. In southern Ontario, the infestation in Algonquin Park District more than doubled in size to 26,900 ha. Small pockets of defoliation persisted in white spruce plantations in Huronia and Maple districts. Approximately 10 ha of a white spruce plantation in the Larose Forest, Cornwall District was defoliated.

Forecasts for1993:

In 1992 budworm egg-mass samples were collected from locations throughout Ontario. A comparison of egg-mass densities from 366 locations sampled in 1991 and 1992 shows an overall decline in densities of 14% (Tables 2). This is the third consecutive year that the overall average egg-mass density has decreased.

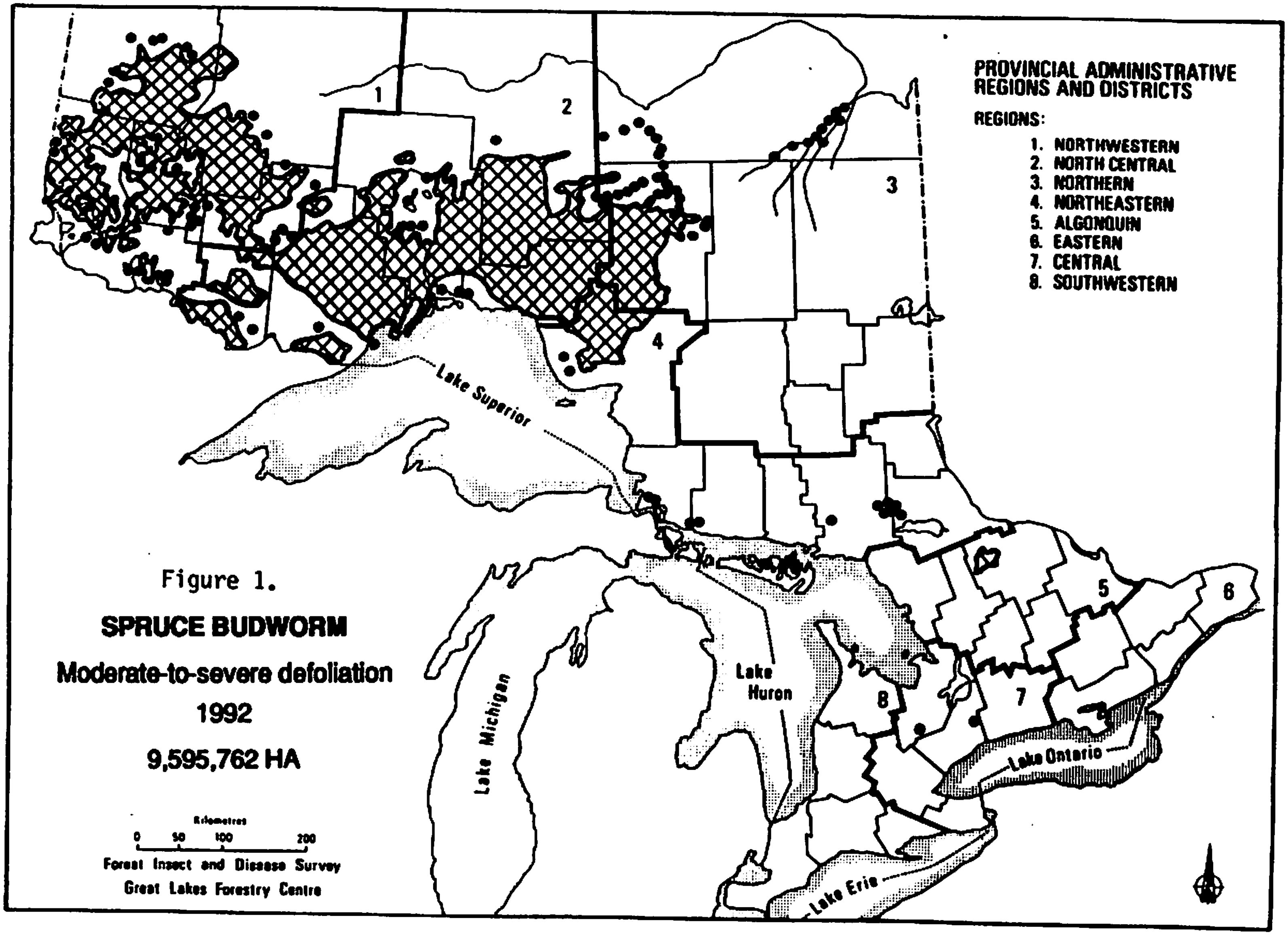

Figure 1.

SPRUCE BUDWORM

Moderate-to-severe defoliation

1992

9,595,762 HA

Regionally, changes in egg-mass density were quite variable. In the Northwestern Region, there was little overall change in egg-mass densities. In 1993, spruce budworm populations should remain high enough to cause moderate-to-severe defoliation throughout most of the areas affected in 1992. Significant expansion in this region is not likely, but new pockets of defoliation may appear in the southern portion of Fort Frances District.

In the North Central Region, there was an overall decrease in egg-mass densities of 30%. Some decrease in the level of defoliation may occur in 1993 and there may be a further reduction in the infestation in parts of Thunder Bay and Nipigon districts. The average egg-mass density for the region indicates that much of the area defoliated in 1992 will be affected again in 1993.

A small overall decrease in egg-mass density was recorded in the Northern Region and, with the exception of Hearst District, populations remain low throughout the region. In Hearst District, the infestation is not expected to expand dramatically in 1993. Areas defoliated in 1992 will likely suffer further defoliation in 1993.

Spruce budworm populations have increased significantly in most districts in the Northeastern Region and results of the egg-mass survey indicate that this trend will continue in 1993. Expansion of the areas defoliated in 1992 is probable and new pockets of defoliation may appear in 1993.

In southern Ontario, the infestation in Algonquin Park should continue and may possibly expand in 1993. New pockets of defoliation may appear in and around the park, especially to the east of the area currently affected. Despite the overall decline in egg-mass densities in southern Ontario, additional areas of defoliation may be detected in 1993.

Spraying Operations 1992:

In 1992, the Ontario Ministry of Natural Resources (OMNR) planned to conduct aerial spraying operations against the spruce budworm over some 30,000 ha in northern Ontario. The program was intended to protect commercial forests and high value areas such as parks, seed production areas and plantations. However, on February 13 1992, OMNR cancelled the program in order to reallocate the funding to other high priority initiatives in its forestry program. The budworm program is planned to be resumed in 1993 but details are not available at this time.

Table 1. Gross area of moderate-to-severe defoliation by the spruce budworm in Ontario from 1990 to 1992.

Region District	Area of moderate-to-severe defoliation (ha) 1990	1991	1992
Northwestern			
Dryden	815,547	700,085	494,680
Fort Frances	6,720	39,830	81,696
Ignace	314,071	351,536	410,436
Kenora	859,395	865,468	686,697
Red Lake	228,747	299,329	755,095
Sioux Lookout	523,344	589,537	687,630
	2,747,824	2,845,785	3,166,234
North Central			
Atikokan	410,377	550,264	339,782
Geraldton	493,011	1,146,368	1,327,419
Nipigon	1,087,868	1,403,210	1,024,715
Terrace Bay	761,251	1,081,938	992,254
Thunder Bay	1,273,723	1,861,617	1,474,555
	4,026,230	6,043,397	5,158,725
Northern			
Hearst	6,392	120,770	826,301
Moosonee	0	2,360	11,205
	6,392	123,130	837,506
Northeastern			
Blind River	0	0	170
Espanola	0	0	85
North Bay	0	10	1,545
Sault Ste Marie	0	0	795
Sudbury	0	70	1,280
Wawa	0	41,716	452,498
	0	41,796	456,373

5Table 1. Gross area of moderate-to-severe defoliation by the spruce budworm in Ontario from 1990 to 1992. (cont'd.)

Region District	Area of moderate-to-severe defoliation (ha) 1990	1991	1992
Algonquin			
Algonquin Park	2,815	11,640	26,900
Central			
Huronia	0	9	12
Lindsay	0	2	0
Maple	0	4	2
	0	15	14
Eastern			
Cornwall	0	0	10
Southwestern			
Wingham	0	18	0
Total (Ontario)	6,783,261	9,065,781	9,595,762

Table 2. Comparison of spruce budworm egg-mass densities in the regions of Ontario in 1991 and 1992.

OMNR Region	Number of locations common to 1991 and 1992	Average egg-mass density per 9.29 m^2 1991	1992	Change (%)
Northwestern	108	324.1	320.7	-1
North Central	145	358.9	252.1	-30
Northern	48	65.2	52.9	-19
Northeastern	41	84.9	185.9	+119
Southern Ont.	24	139.9	110.4	-21
Total	366	266.5	230.0	-14

Outbreak Status 1992:

The total area of moderate-to-severe defoliation increased to 158,704 ha in 1992 compared to the 133,618 ha mapped in 1991 (Fig. 2, Table 3). Large increases in the extent of defoliation occurred in the Northeastern and Algonquin regions whereas the infestation in the Northwestern Region virtually collapsed .

Forecasts for 1993:

Egg-mass surveys indicate that there will probably be an expansion of the area of defoliation in the Northeastern Region, particularly in the districts of Blind River, Espanola, and Sudbury (Table 4). Defoliation will probably continue in the Parry Sound District although 1993 will be the fourth year of infestation and collapses are to be expected. Expanded infestations will likely occur in the Pembroke Disstrict.

Generally, low populations of jack pine budworm are expected in the Northwestern Region although the odd scattered pocket of defoliation will likely occur.

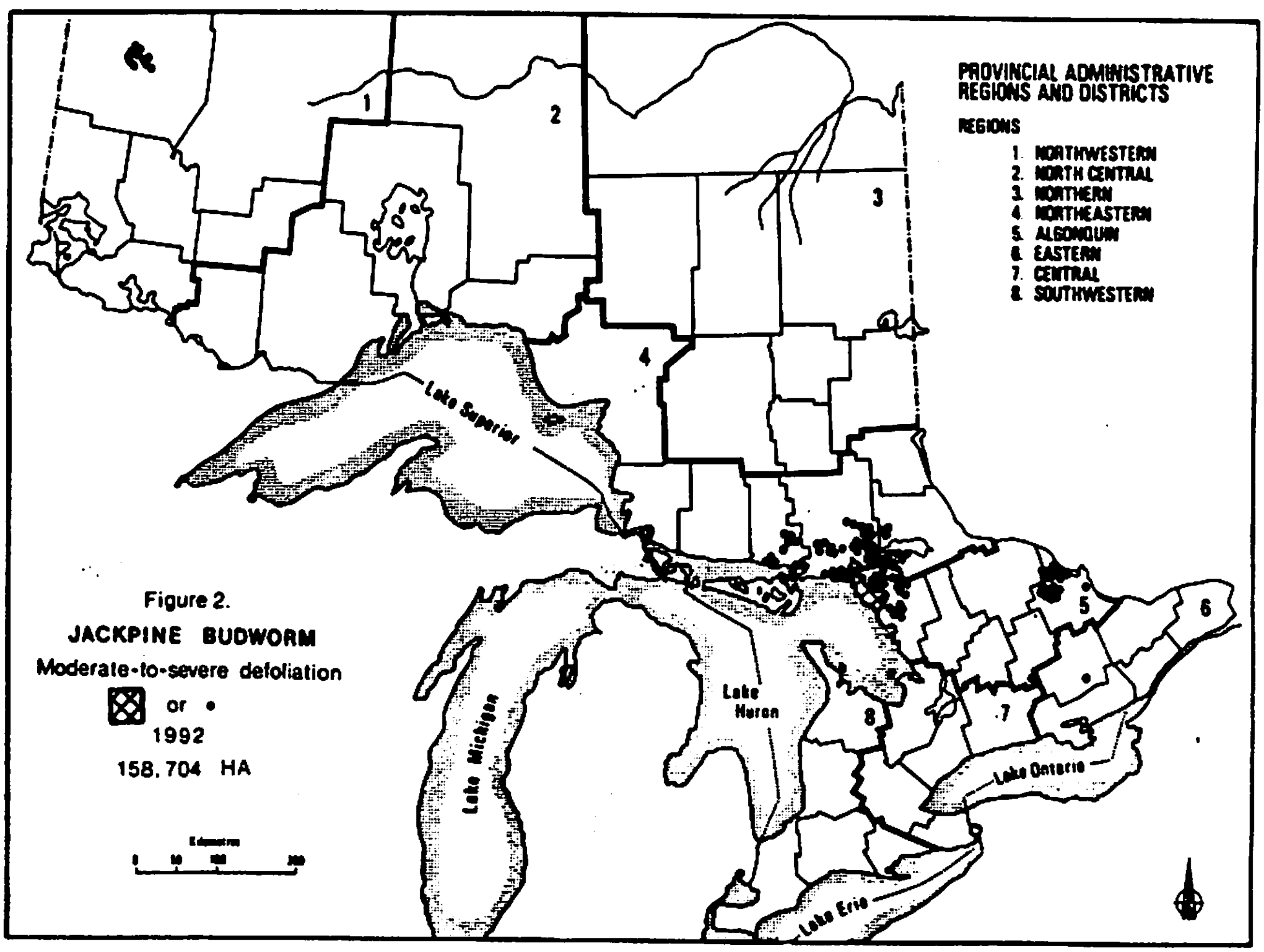

Figure 2.
JACKPINE BUDWORM

Table 3. Gross area of moderate-to-severe defoliation in Ontario by the jack pine budworm from 1990 to 1992.

Region District	Area of moderate-to-severe defoliation (ha)		
	1990	1991	1992
Northwestern			
Ignace	0	1,721	0
Red Lake	655	69,903	693
Sioux Lookout	10	20	0
	665	71,644	693
North Central			
Thunder Bay	0	870	0
Northeastern			
Espanola	0	810	9,500
North Bay	0	290	15,896
Sudbury	0	8,708	50,849
	0	9,808	76,245
Algonquin			
Algonquin Park	0	0	465
Bancroft	0	20	30
Parry Sound	29,660	51,276	78,034
Pembroke	0	0	2,704
	29,660	51,296	81,233
Eastern			
Tweed	0	0	533
Total *(Ontario)*	30,325	133,618	158,704

Spraying Operations 1993:

The OMNR planned to spray some 3,000 ha of infested forest near Metionga Lake, Thunder Bay District, North Central Region in 1992. This was cancelled in February, 1992 along with the spruce budworm and gypsy moth spraying planned for 1992. At this point a program is planned for 1993 but figures are uncertain.

Table 4. Comparison of jack pine budworm egg-mass densities by region, Ontario, 1991 and 1992.

OMNR Region	Number of locations common to 1991 and 1992	Total Egg-masses 1991	Total Egg-masses 1992	Change (%)
Northwestern	18	79	9	-89
North Central	11	62	3	-95
Northern	19	4	3	-25
Northeastern	40	83	151	+82
Southern	26	242	165	-32
Total	114	470	331	-23

GYPSY MOTH

Outbreak Status 1992:

Surveys conducted in the fall, 1991 indicated that gypsy moth populations would decline throughout much of the 347,415 ha infested that year. Aerial surveys conducted in 1992 revealed that the infestation had indeed declined dramatically (Fig. 3, Table 5). A total of 34,460 ha of moderate-to-severe defoliation was mapped in 1992. Most of the decline occurred in the Algonquin and Central regions where widespread infestations in 1991 were reduced to scattered small pockets in 1992. Defoliation was mapped in 15 districts in 1992 compared to 21 districts in 1991. Increases in infestation size were observed in several areas. The infestation in Tweed District, Eastern Region increased form 1,085 ha last year to 7,217 ha this year . In the Northeastern Region, pockets of defoliation first detected in 1991 expandecd substantially in 1992, affecting 3,502 ha in Sudbury and Espanola districts.

Forecasts 1993:

Support for gypsy moth egg-mass surveys was not available in 1992. Therefore, predictions for 1993 are based soley on historical trends and speculation. If the historical record of gypsy moth outbreaks in Ontario is any indication, populations in 1993 should remain relatively low throughout most of the areas affected by this pest. The exception may be in areas along the leading edge, particularly in the Northeastern Region where the areas of moderate-to-severe defoliation could continue to expand next year. The buildup of gypsy moth populations in Tweed District may be the first indicator of another round of defoliation in southern Ontario.

Spray Operations 1992:

In 1992, OMNR had planned to treat some 32,000 ha in southern Ontario to protect stands from gypsy moth defoliation. Originally, OMNR had planned to discontinue the private-land spraying program at the end of 1992, but the program was cancelled along with the budworm spray programs in February, 1992. There are no plans to conduct a spray program against the gypsy moth in 1993.

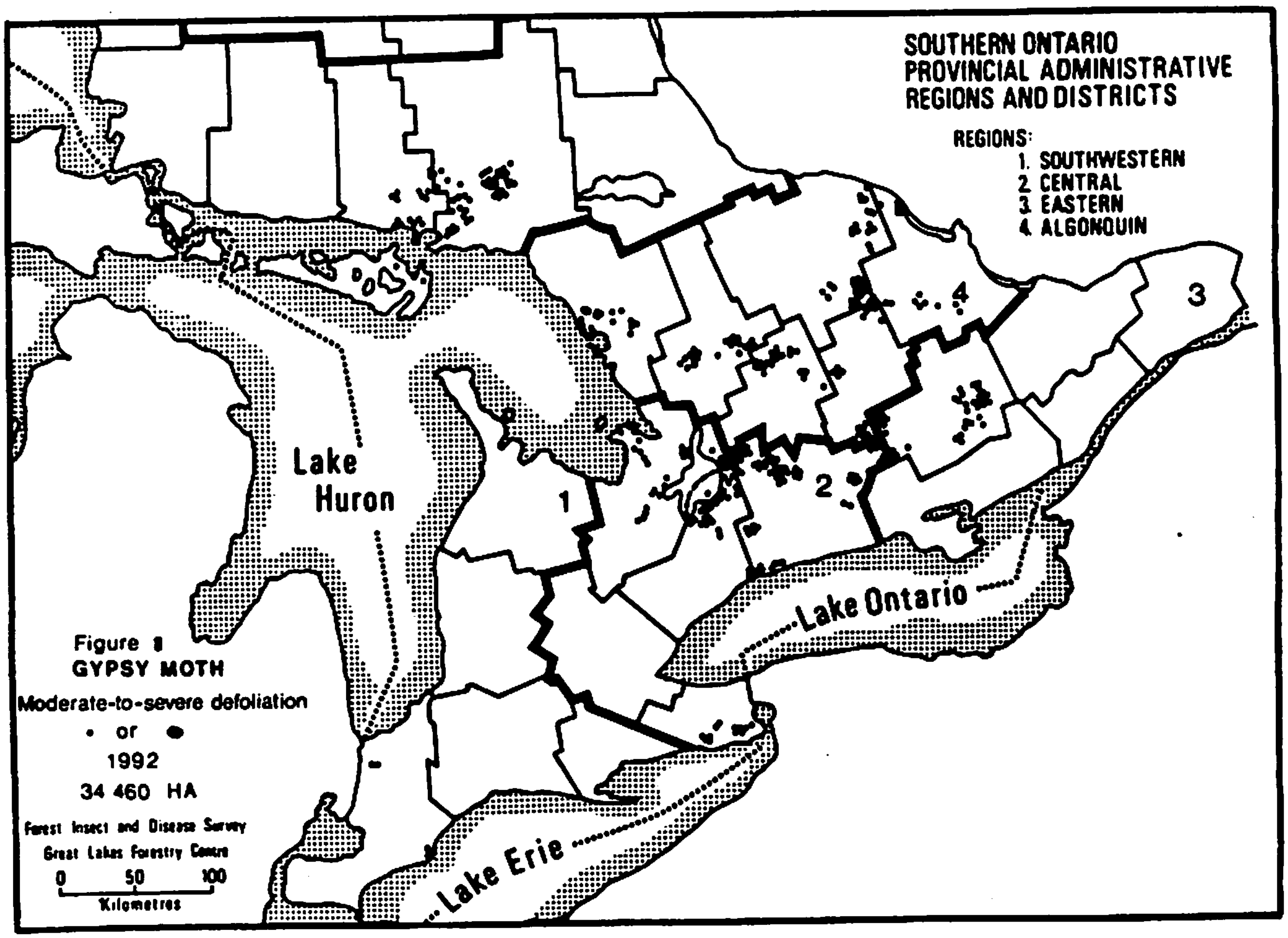

Figure 8
GYPSY MOTH
Moderate-to-severe defoliation
• or ●
1992
34 460 HA

Table 5. Gross area (ha) of moderate-to-severe defoliation by the gypsy moth in Ontario, 1990–1992.

Region	District	Moderate-to-severe defoliation (ha)		
		1990	1991	1992
Southwestern	Aylmer	30	230	0
	Chatham	20	80	123
	Simcoe	3,856	3,078	0
		3,906	3,388	123
Central	Cambridge	3,323	15,432	0
	Huronia	2,418	65,775	1,036
	Lindsay	1,118	11,418	5,081
	Maple	2,291	6,110	3,132
	Niagara	19,474	30,718	225
		28,624	129,453	9,474
Eastern	Brockville	395	85	0
	Carleton Place	143	105	0
	Cornwall	0	90	0
	Napanee	4,086	4,285	35
	Tweed	1,259	1,085	7,217
		5,883	5,650	7,252
Algonquin	Algonquin Park	172	1,172	2,130
	Bancroft	13,133	6,110	6,439
	Bracebridge	4,359	75,837	1,208
	Minden	5,056	56,163	1,555
	Parry Sound	9,367	52,647	476
	Pembroke	7,148	16,554	2,301
		39,235	208,483	14,109
Northeastern	Espanola	0	56	540
	Sudbury	0	385	2,962
		0	441	3,502
Total (Ontario)		77,648	347,415	34,460

1992 FOREST INSECT CONTROL OPERATIONS IN ONTARIO AND RELATED INITIATIVES

Joe Churcher
Manager, Silviculture Section
Ontario Ministry of Natural Resources

1992 OPERATIONS

Programs were proposed to control feeding by the spruce budworm, jack pine budworm and gypsy moth in Ontario. Due to budgetary restraints, the Minister of Natural Resources announced the cancellation of these programs on February 13, 1992, in order to re-allocate $3.8 million to other higher priority forest management programs. This marked the first time since 1967 that an aerial insecticide spray program did not occur somewhere in the province.

The spruce budworm program was to have treated about 30,000 hectares of white spruce and balsam fir stands in the Thunder Bay, Nipigon and Geraldton Districts, north of Lake Superior, and the Hearst District, northeast of Lake Superior.

An additional 3,000 hectares of jack pine were to be sprayed in a small, isolated outbreak of jack pine budworm near the boundary of Thunder Bay and Ignace Districts, northwest of Lake Superior.

Although figures had not been finalized at the time of the cancellation, gypsy moth programs were planned, primarily on private land throughout Southern Ontario, to treat approximately 36,000 hectares. Through cooperative arrangements with some municipalities, MNR helped landowners hire aerial applicators, so that some of the private land to be treated in 1992 was sprayed. An announcement had already been made that the private land gypsy moth spray program would cease at the conclusion of the 1992 season, because the insect had not caused significant tree mortality in the province. Further, the critical fiscal situation of the province prohibited MNR's continued involvement in the highly subsidized program.

As in previous years, the Ministry of Natural Resources did not treat the forest tent caterpillar infestation. Rather, information, advice and guidance was provided to private landowners in affected areas, both urban and rural, so that they could determine how best to deal with the insect.

1993 PROPOSALS

The fiscal situation in the province has not improved, and this will be the determining factor regarding the resumption of spraying in Ontario. At this time, Nipigon, Geraldton and Hearst Districts have proposed a program to treat about 50,000 hectares of spruce budworm infested forests.

As reported elsewhere in these proceedings, the isolated jack pine budworm infestation on the Thunder Bay - Ignace boundary collapsed. The jack pine budworm infestation along the North Channel of Lake Huron, however, threatens to erupt. These are the same stands which were the site of the jack pine budworm infestation of the mid-1980's. District and forest industry staff in that area are proposing a program to treat up to 40,000 hectares of forests. Sampling of overwintering larvae is currently being conducted to determine the extent of infestation, and hence the size of the required program.

There are no spray proposals for gypsy moth on Crown land, although it is expected that some private landowners, on their own, will once again treat their property.

The forest tent caterpillar extension program will continue in those parts of the province which are experiencing an outbreak.

FOREST HEALTH EDUCATION AND AWARENESS

As noted earlier, a decision had been made that the 1992 private land gypsy moth program would be the last such endeavour. In its place, however, a new cooperative program between the Ministry and interested Municipalities was established. This relationship builds on the positive partnerships which were established during the gypsy moth program, and broadens the scope of the program to address all forest health issues, rather than focus on one insect.

Under the program, MNR provides partial funding for the Municipality to hire and support a Forest Health Coordinator. It is the job of this individual to conduct workshops, hold open houses and educate members of the municipality on a number of stresses which affect the health of their trees, woodlots and forests. MNR provides training for the municipal staff, as well as educational material which they may wish to use. When required, MNR staff will continue to make an on-site extension call and prescription for treatment, but much of the initial education of a concerned landowner will have already been completed.

To further support and coordinate this program, the Ministry has recently hired a Provincial Forest Health Specialist. The incumbent will also act as the Ministry contact and liaison for a number of specialists, from within MNR and outside agencies (Ministry of Environment, Forestry Canada, universities, etc.), with expertise in specific areas of forest health (e.g. entomologists, pathologists, physiologists, silviculturists).

MINISTRY OF NATURAL RESOURCES REORGANIZATION

On June 29, the Ministry of Natural Resources in Ontario officially adopted its re-organized structure. Instead of being organized by programs (forestry, parks, fish, wildlife, outdoor recreation, lands and waters, etc.) it adopted an integrated format and was subdivided by four main functions: Policy (including research), Operations, Information Resources and Corporate Services (administration). What used to be known at various times as the Pest Control, Pest Management and Forest Health and Protection Section was essentially split between the Policy and Operations Divisions.

Dr. Tim Myer, the Provincial Forest Pathologist, and his staff are located in the Ontario Forest Research Institute (OFRI) of the Forest Policy Branch. Similarly, Dr. Bob Wagner, the Provincial Herbicide Specialist and the coordinator of the Vegetation Management Alternatives Programs, and his technician work out of OFRI. Geoff Munro, the last Manager of the Forest Health and Protection Section, is now Manager of the Policy Development and Transfer Section of the Forest Policy Branch, Policy Division.

The operational aspects of forest pest management (planning, coordination, training) are located in the Forest Resources Branch of the Operations Division. Mike Irvine, the Nursery Herbicide Specialist, is part of the Nursery and Seed Section. The Provincial Forest Entomologist, Taylor Scarr, the Provincial Pesticide Training and Application Specialist, Sandy (Schyff) Basher, and the Provincial Forest Health Specialist, Harri Liljalehto, are included with a number of other specialists in the Silviculture Section. The author, the former Provincial Forest Entomologist, is the Manager of that Section.

FOREST INSECT AND DISEASE CONDITIONS IN QUEBEC 1992

BY

CLÉMENT BORDELEAU[1]
DENIS LACHANCE[2]

Report prepared for the Annual Pest Control Forum, Ottawa, November 17-19, 1992

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Here is a summary of the main Forest pest problems encountered in Québec Province, in 1992.

SPRUCE BUDWORM
Choristoneura fumiferana (Clem.)

OUTBREAK STATUS

The spruce budworm infestation declined considerably in the eastern part of Québec in 1992 while small pockets of new infestation were recorded in western Québec. The infestation covered an area of 46 000 ha this year, compared to 495 000 ha in 1991 (Table 1).

Table 1 - Areas (ha) of spruce budworm infestation in Québec in 1992

Administrative regions	Level of infestation			Total
	Light	Moderate	Severe	
Bas-Saint-Laurent	3 808 (73 072)*	116 (36 803)	126 (28 302)	4 050 (138 177)
Gaspésie - Îles-de-la-Madeleine	20 084 (116 135)	15 017 (92 145)	3 538 (42 768)	38 639 (251 048)
Côte-Nord	1 422 (14 813)	1 229 (63 622)	341 (27 223)	2 992 (105 658)
Outaouais	231 (-)	270 (-)	96 (-)	597 (-)
PROVINCE Total	25 545 (204 020)	16 632 (192 570)	4 101 (98 293)	46 278 (494 883)

* ( ) = Areas affected in 1991.

This constitutes a 91 % decrease in budworm infested areas over the 1991 figure. The declines were respectively 97 %, 85 % and 97 % in the Bas Saint-Laurent, Gaspésie - Îles-de-la-Madeleine and Côte-Nord regions. Some pockets of defoliation, mainly light-to-moderate, persisted in the Gaspé peninsula and in the Betsiamites Indian Reserve and its surroundings on the north shore of the Saint-Lawrence River (Figure 2).

The new infestation reported in western Québec is located northwest of Hull (Figure 1). The infested areas were mapped in the Gatineau Park and its surroundings (Sainte-Cécile-de-Masham, Aylmer, Wakefield). It was in that same sector that last budworm infestation began in 1967. In the other regions of the Province, the spruce budworm populations remained at an endemic level.

...

FORECAST

A survey of overwintering larval populations (L2) was conducted in 288 sample plots scattered throughout the Province. Findings show that budworm populations will continue to decrease in eastern Québec while infestation is expected to spread slightly in the Outaouais region. Localized and small areas of moderate-to-severe populations were discovered along the Outaouais river, between Chapeau and Hull. However, in the greater part of the region, the populations remain low. In the other regions, the overwintering populations was generally higher than L2 populations of 1991 but no visible defoliation is expected to occur.

HEMLOCK LOOPER
Lambdina fiscellaria fiscellaria (Gn.)

OUTBREAK STATUS

In 1991, the first outbreak of hemlock looper in Québec since 1973 occurred on 2 900 ha. This year, the infestation persists in the same areas as last year in Park township and on Anticosti Island (Figure 3) and no major increase was observed (Table 2). Only two small pockets of new infestation (light damage) were mapped at the New-Brunswick border, near the Miller Lake infestation.

Table 2 - Areas (ha) of defoliation caused by the hemlock looper in Québec in 1992

Administrative regions	Location	Level of defoliation			Total
		Light	Moderate	Severe	
Bas-Saint-Laurent	Canton de Parke	110 (992)*	237 (348)	479 (788)	826 (2 128)
	Rivière Rimouski	29 (-)	- (-)	- (-)	29 (-)
Côte-Nord	Rivière Jupiter	363 (700[1])	342 (-)	- (-)	705 (700)
Chaudière-Appalaches	Lac Sainte-Anne	- (48)	- (-)	- (44)	- (92)

* ( ) = Areas affected in 1991.
1. Light to moderate defoliation.

...

The infestation spread slightly in periphery of the area that was infested in 1991 in Park township, but the area of defoliation decreased in size because a part of the infested stands was harvested. The overall defoliation was still in the moderate-to-severe range. No infestation was reported this year at Lac Sainte-Anne because the previously infested stands were also harvested.

FORECAST

A survey of hemlock looper egg density was conducted in 70 locations in eastern Québec. The results of that survey are not available yet.

JACK PINE BUDWORM
Choristoneura pinus pinus Free.

OUTBREAK STATUS

Only tree infestations of jack pine budworm have been reported in Québec prior to 1992. These infestations occurred in 1967, 1969 and 1972 in the western part of the Province. The areas affected were small and they were located at L'Île-du-Grand-Calumet and near the Baskatong reservoir. In 1991, a light defoliation (8 %) was observed at L'Île-du-Grand-Calumet. Populations increased in that sector in 1992 and severe defoliation occurred over 377 ha. Light defoliation was also mapped over 165 ha in the surroundings of Fort-Coulonge.

FORECAST

The L2 surveys carried out in the fall suggest that the population levels will remain high in the pockets of infestation at L'Île-du-Grand-Calumet. No increase of the population is expected in areas of light defoliation detected near Fort-Coulonge.

GYPSY MOTH
Lymantria dispar (L.)

OUTBREAK STATUS

The damage caused by the gypsy moth has been less significant this year compared to 1991. Populations declined in older infested areas of the Outaouais and Montérégie regions while they remained at a low level in the remainder of the known distribution area of the pest.

An aerial survey conducted in the Outaouais region has revealed that 510 ha of forest land exhibited signs of light-to-moderate damage between the municipalities of Cambell's Bay and Fort-Coulonge. Moderate defoliation occurred in only two other locations in the Province (Figure 4).

FOREST TENT CATERPILLAR
Malacosoma disstria (Hbn.)

OUTBREAK STATUS

The forest tent caterpillar infestation persisted in many areas of central Québec even if a decline was observed last year. The insect attacked mainly trembling aspen, large-toothed aspen and wire birch.

The insect caused serious defoliation over 37 000 ha in the Mauricie - Bois-Francs region. Moderate to severe defoliation were recorded around the city of La Tuque, along the Saint-Maurice River and also on the south shore of the Saint-Lawrence River. Severity of the infestation decreased in some areas while it increased in others, particularly at the east of the Saint-Maurice River. The forest tent caterpillar was present in other regions of the Province but the populations were generally low. Significant damage (moderate defoliation) has been reported in only two small areas, one in the Québec region and the other in the Côte-Nord region.

...

FORECAST

The egg-mass survey conducted this fall suggests that the forest tent caterpillar populations will remain significant in many areas of the Mauricie - Bois-Francs region. In the other regions, the populations will remain low.

LARGE ASPEN TORTRIX
Choristoneura conflictana (Wlk.)

OUTBREAK STATUS

In 1992, the large aspen tortrix populations persisted at an epidemic level in many regions of Québec. The infestation was present in the Québec, Lanaudière, Abitibi-Témiscamingue and Côte-Nord regions and generally increased in size. However, in the Saguenay - Lac-Saint-Jean region, infestations which have occurred annually since 1985, declined. The infestations were generally localized except in the Québec region where the insect is widespread in the Charlevoix county. Defoliations occurred over 33 400 ha in the Côte-Nord region and on 5 425 ha in the Lanaudière region.

TREE DISEASES

Pine plantations reported severely damaged last year by scleroderris canker, *Gremmeniella abietina* (Lagerb.) Morelet, did not recover, but few of them showed a high rate of mortality in the Mt-Laurier area. In general, the incidence and severity of the disease did not increase in comparison with last year.

Two infection centers of the annosus root rot (*Heterobasidion annosum* (Fr.)) have been identified in 1989 in a 60 years old red pine plantation near lac La Blanche, in western Québec. This year, nine (9) new centers were found scattered in the same large plantation.

...

TORDEUSE DES BOURGEONS DE L'ÉPINETTE 1992
INFESTATION OUTAOUAIS

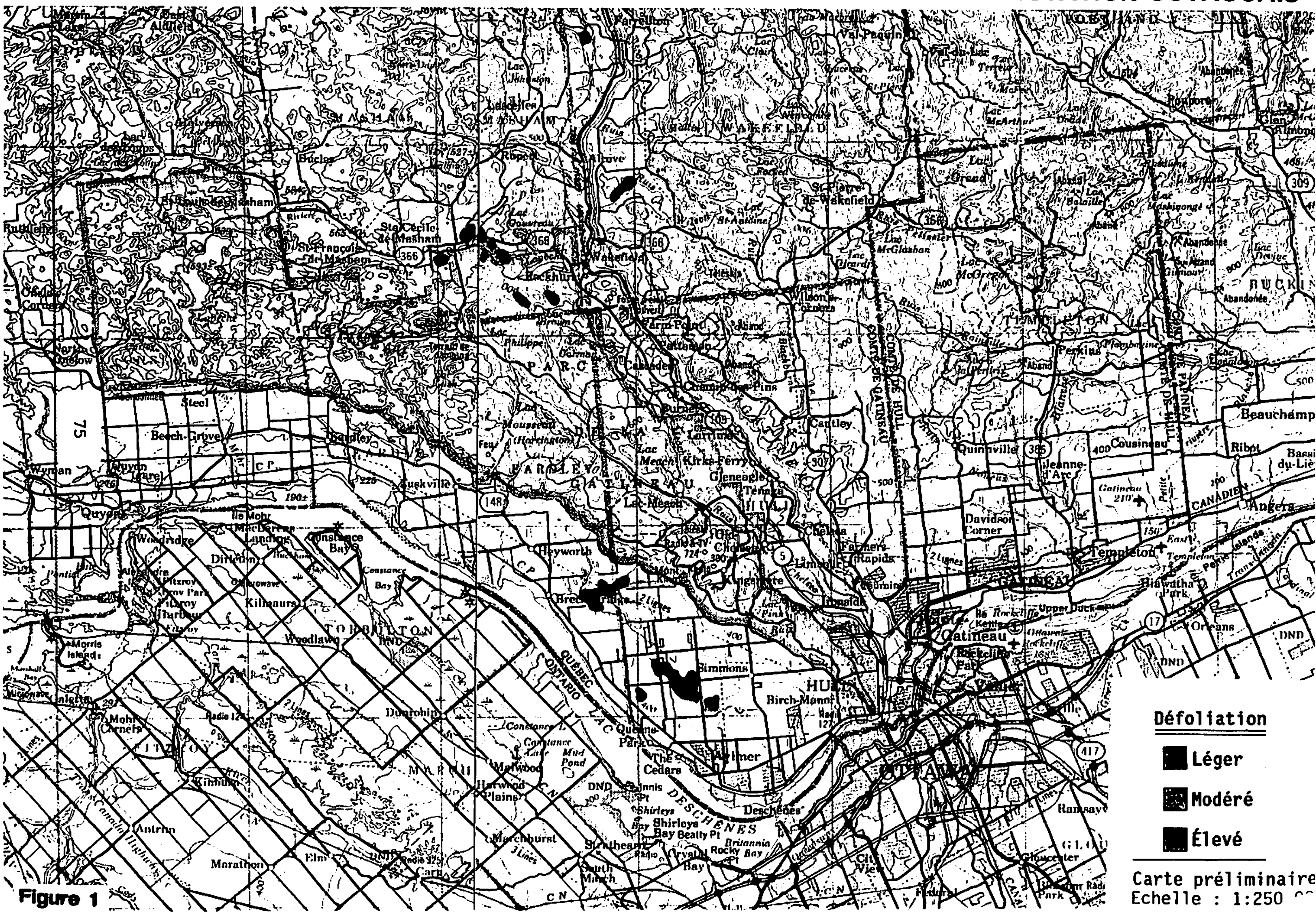


Figure 1

TORDEUSE DES BOURGEONS DE L'ÉPINETTE 1992
INFESTATION EST DU QUÉBEC

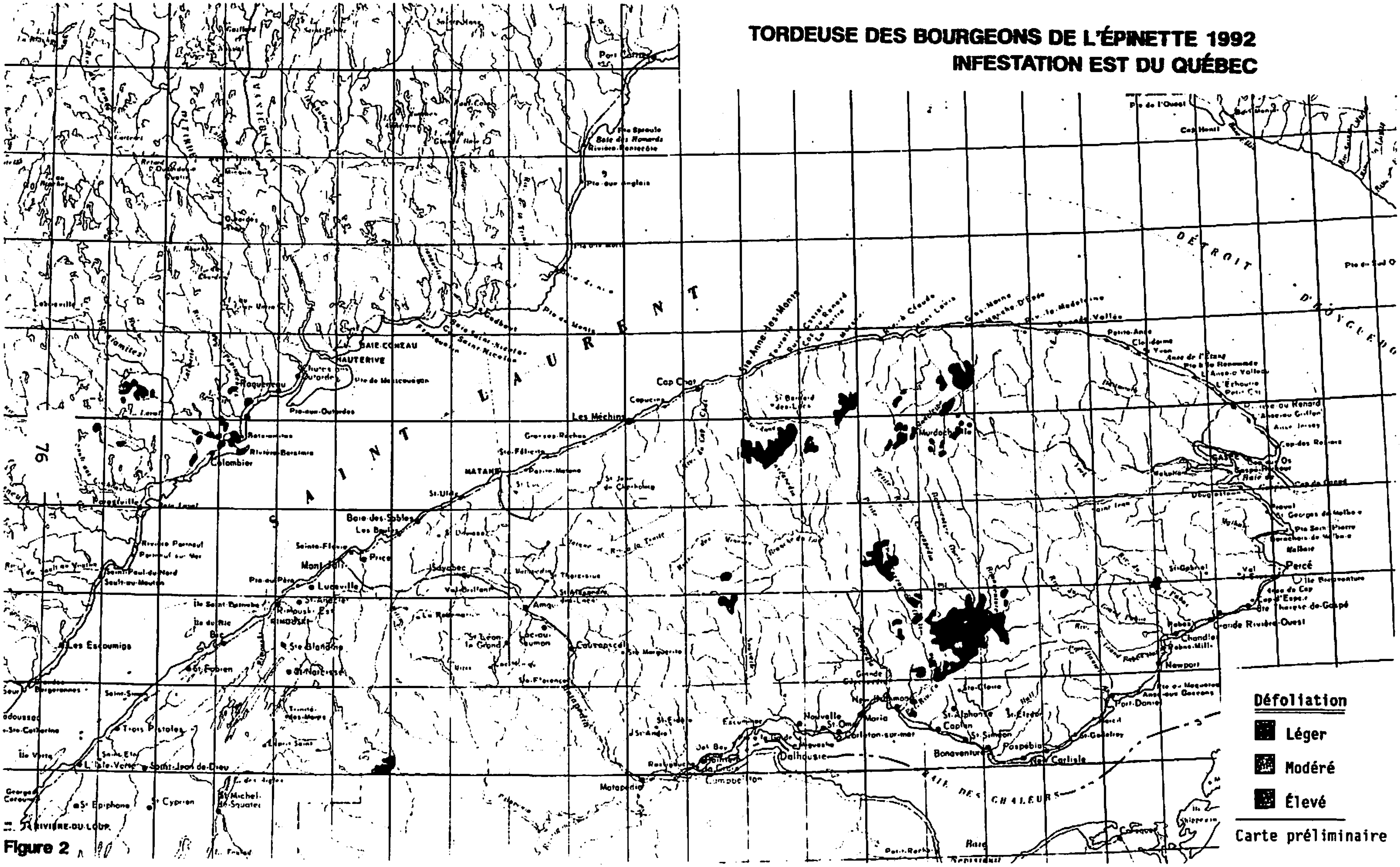


Figure 2

ARPENTEUSE DE LA PRUCHE 1992

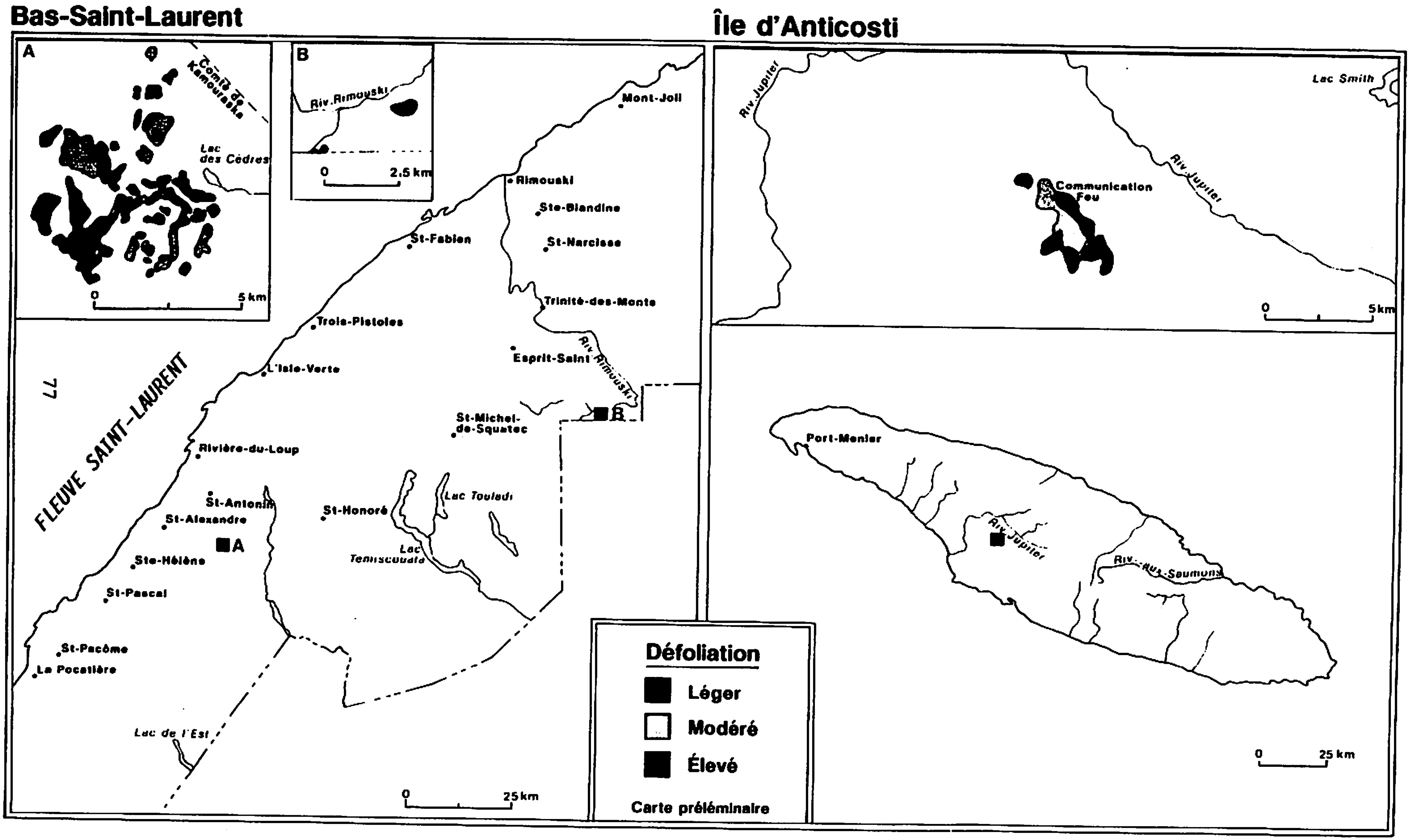
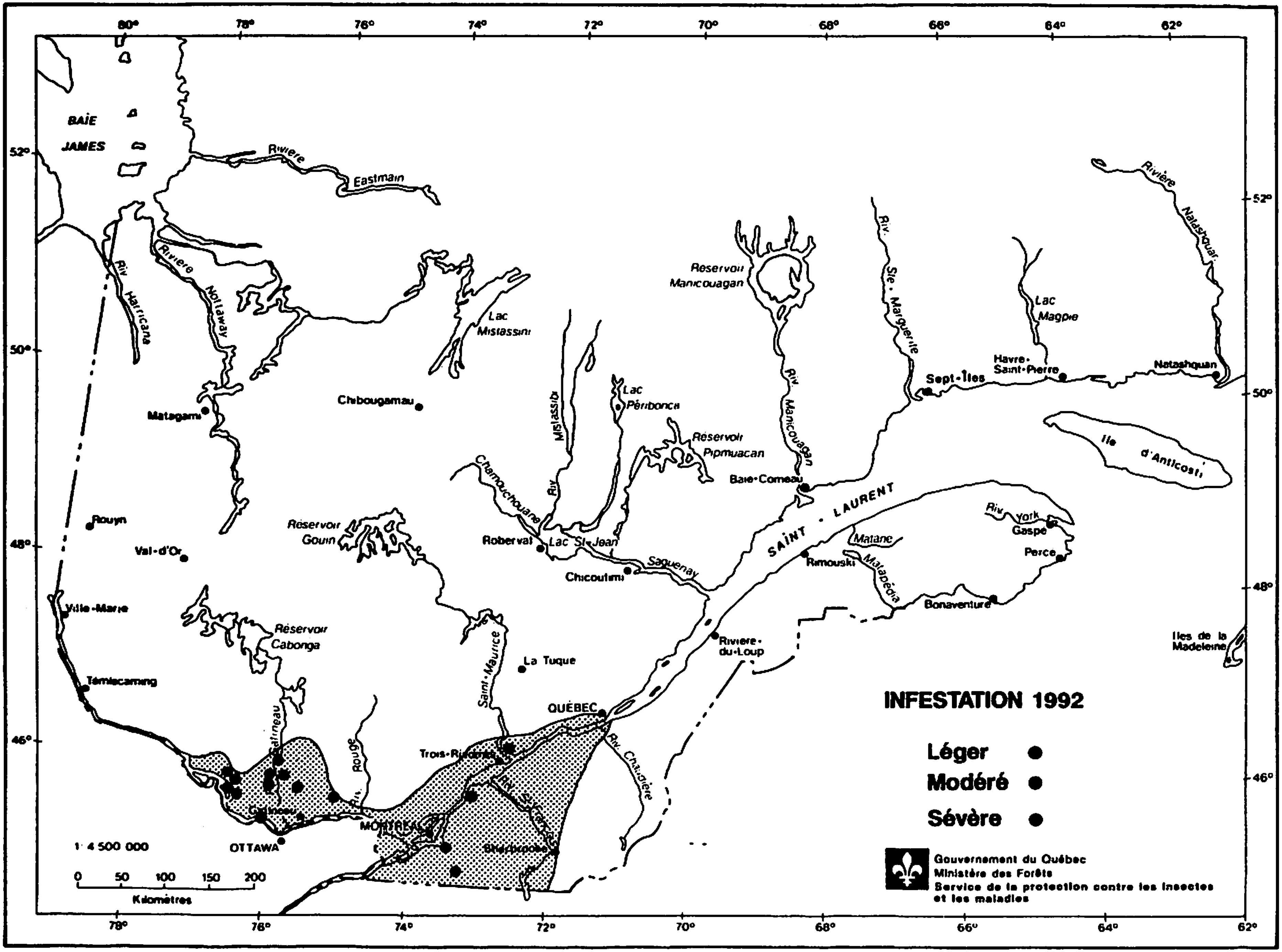


Figure 3

Aire de distribution de la spongieuse au Québec en 1992 (excluant les zones de capture des adultes mâles).



THE SPRUCE BUDWORM PROGRAM IN QUEBEC

1992

The 1992 spray program

The state of the epidemic in 1992

Forecast for 1993

Jacques Bégin, F.E., M. Sc.
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Société de protection des forêts contre
les insectes et maladies

November 1992

INTRODUCTION

The spruce budworm is an indigenous defoliator of fir and spruces in North America. It has been epidemic in Quebec since 1967 and is responsible for the loss of 235 000 000 cubic meter of wood. The insect has been active mostly in eastern Quebec for the past years and is generally declining after an upsurge in 1990.

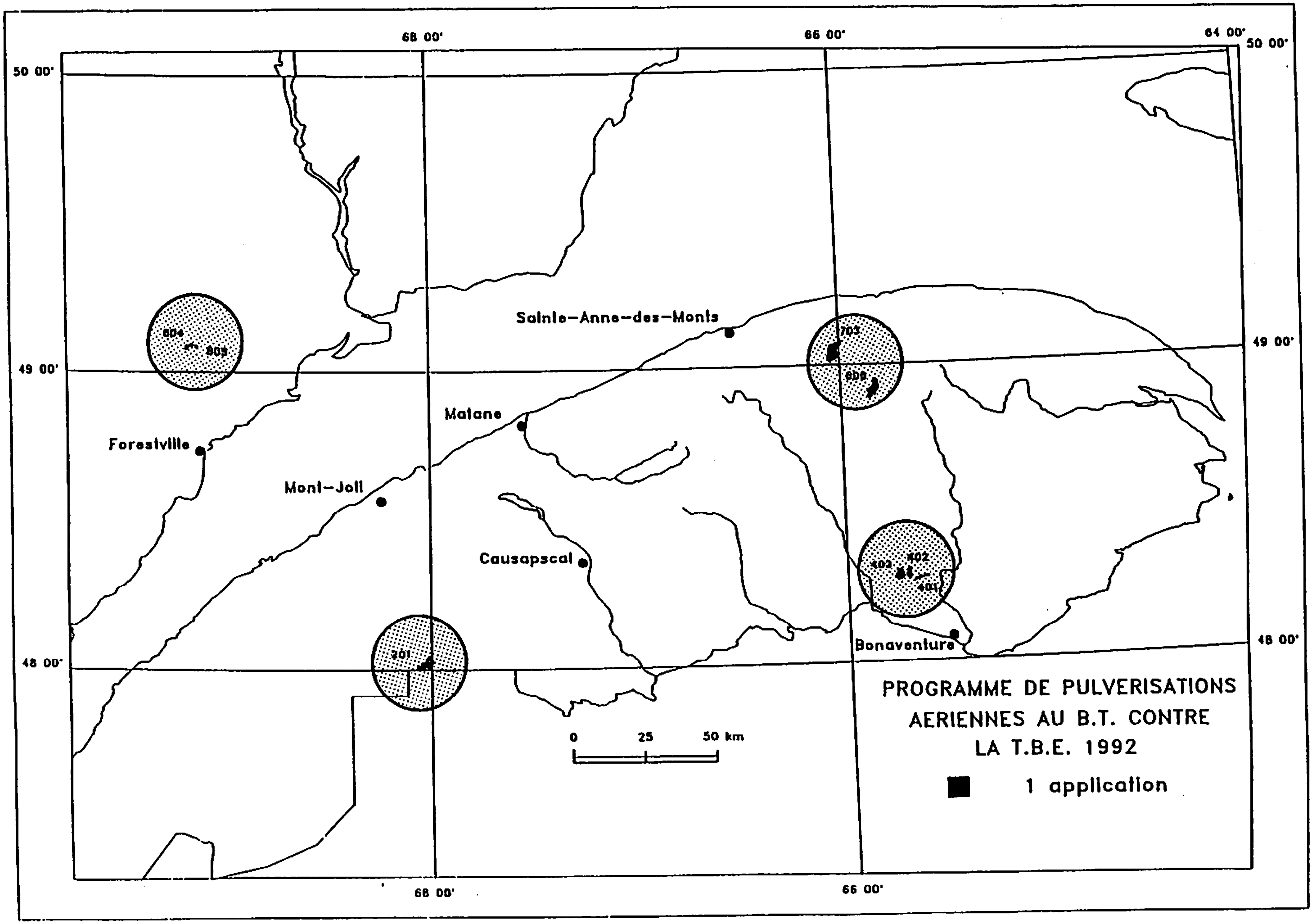
1.- THE 1992 SPRAY PROGRAM

The 1991 L-2 survey showed an important reduction in the areas threatened by the SBW. Originally, plans were made to treat 25 850 ha in the North Shore and the Gaspé regions. However, due to a severe reduction of anticiped populations observed in the early spring, the size of the program was finally cut down to 5 670 ha (figure 1). This is the smallest program since 1968 when 1 390 ha of plantations were treated to control the same insect. The program encompassed only two blocks on the North Shore region for a total of 410 ha. The remainder took place in the Lower Saint-Lawrence - Gaspé region where 330 were treated with *B.t.* on private woodlots and 4 930 on crownland.

2.- THE INSECTICIDE

For the sixth consecutive year, the biological insecticide, *Bacillus thuringiensis* var. *Kurstaki* (*B.t.*) was used throughout the spray area. The biological insecticide Dipel 176 (Abbott Laboratories) was sprayed undiluted at a rate of 30 billion international units (BIU) per hectare in a volume of 1,77 l/ha. Quality control and potency check were made on the product before spraying.

Figure 1 Aerial spray program (B.t.) against the spruce budworm in 1992. Location of spray blocks.



3.- INSECTICIDE SPRAYING

The spray program extended over a period of 6 days, from June 10 to June 15. Good weather conditions allowed for an excellent synchronization of the treatment with the development of the insect. Some 20 180 hectares of forest were withdrawn from the spray program, based on new population data, in order to avoid the uncessary use of insecticide.

Due to the rather small size of the program, and to the availability of airstrips throughout the area, it has been decided to use only 2 single-engine aircrafts (M-18 Dromader). The spray planes were rigged with 8 Micronair AU 5000 sprayers. The planes operated out of three airstrips (Sainte-Anne-des-Monts, Lac la Ferme and Forestville). Two Cessna 172 were retained on contract as pointer aircraft during the spray period.

A total of 10 400 l of insecticide have been sprayed and only one application was necessary for all blocks. The cost for the 1992 spray program is a little more than 1 million dollars.

4.- TIMING

Spray timing is based on the observations of bud flare and on budworm development. The commencement of treatment did coincide with a bud flare index of more than 3,8. In addition to the bud flare index, the larval development (IDI) had reached peak third instar. Timing was excellent for all blocks; most areas (85 %) were treated within 5 days after the blocks opening date.

5.- PRE-SPRAY LARVAL POPULATIONS

The informations on populations and defoliation were obtained from a network of 57 sample plots (28 treated, 29 control) using standard SBW sampling techniques. Larval populations were generally lower than those of 1991 and lower (12,3 lar/br) than predicted by the L-2 survey. Only 18 % of samples had populations highter than 20 larvae per 45 cm branch (fig.2). This is almost the same situation as in 1991 when 11 % of samples had more than 20 larvae/branch. The North Shore sectors had populations similar to those in the Gaspé and results were polled for the analysis.

6.- POST SPRAY POPULATIONS AND DEFOLIATION

Post spray populations (at 85% pupa) were rather low with 1,12 lar/br in treated blocks and 1,74 lar/br in controls.

One application of *B.t.* gave a corrected mortality of 95,8% which differed significantly from that of the controls (92,5%). This high mortality and the good synchronization of the treatment are reflected by the low defoliation of treated stands (26,7%). The average defoliation has been reduced by 16,7%, that is a 42% reduction in comparaison to controls.

On the average, more than 81% of samples had retained more than one half of their annual shoot; that is slightly better than what was observed in absence of treatment (62%) (fig. 3). In all instances, the spruce budworm seemed less vigorous than usually; a partial examination of larvae revealed a heavy incidence of parasites and diseases. That may explain the limited impact of the SBW in 1992.

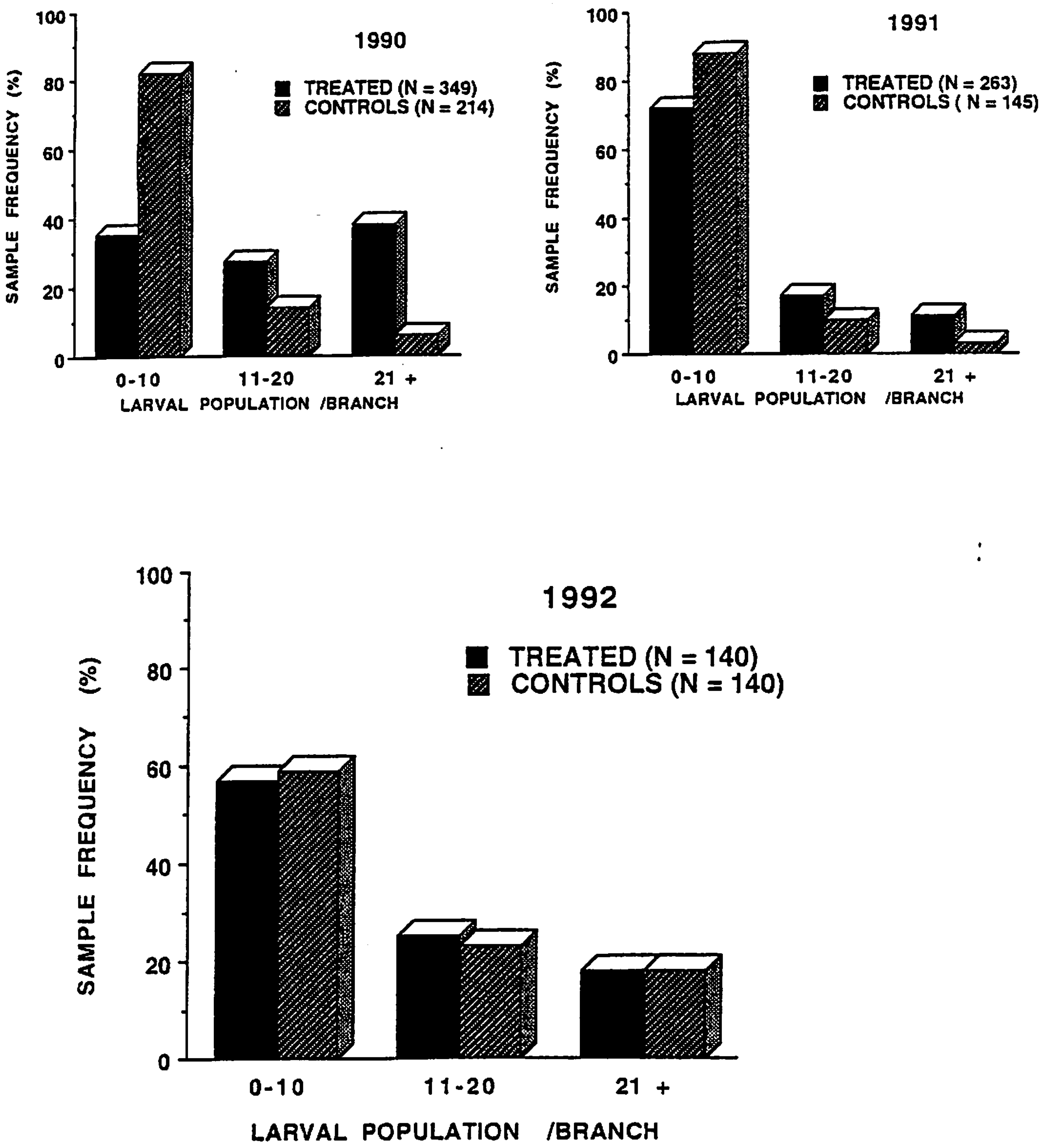


Figure 2 : Breakdown of samples by larval density class (1990-1992). Eighteen percent of the samples supported high SBW populations in 1992.

7.- AERIAL SURVEY OF DAMAGE

The annual aerial survey of damage was conducted by the government's SPIM. It showed a ten fold reduction of the damaged surfaces in comparaison to 1991. Only 46 278 ha of forest were affected in the province, including 596 ha in the Ottawa River region where the SBW's populations are starting to build up. On the average 51% of untreated stands suffered moderate to heavy damage; meanwhile, treated stands showed moderate defoliation on hardly 3% of the area.

8.- FORECAST FOR 1993

Some 400 L-2 sample plots were visited this fall and only three indicated populations that could produce some damage in the eastern part of Quebec. On the other hand, populations have built up in the Gatineau and Ottawa River areas and moderate to extreme damage is expected in 1993. The area threatened by the SBW should remain limited and concentrated on private woodlots only. A decision has still to be made if these small patches of forest that are very close to inhabited areas will be sprayed.

Jacques Bégin

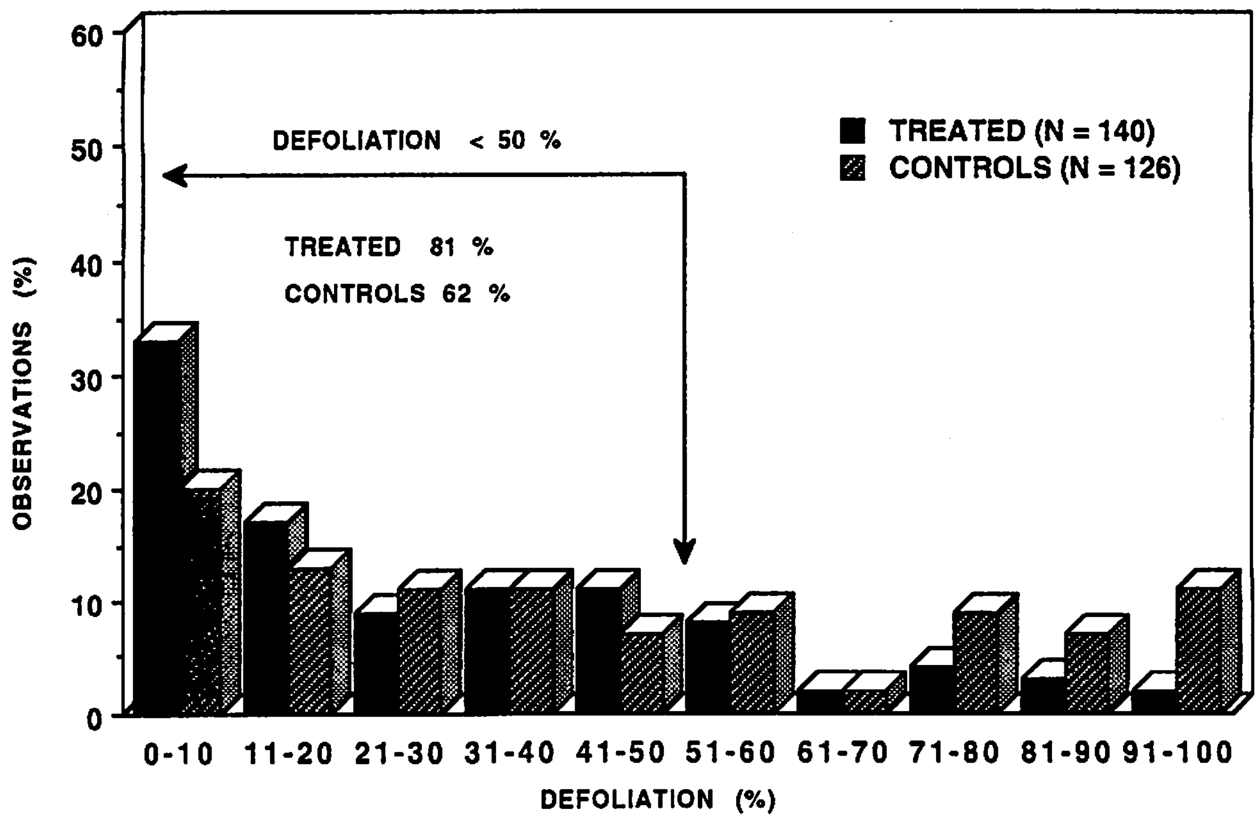


Figure 3 : Defoliation of the annual (1992) shoot by the spruce budworm. The vertical arrow marks the 50% defoliation threshold. Samples with 50% defoliation or less have received an adequate protection.

THE HEMLOCK LOOPER CONTROL

PROGRAM IN QUEBEC

1992

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Société de protection des forêts contre
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November 1992

INTRODUCTION

In the spring of 1991 an infestation by the hemlock looper (*Lambdina fiscellaria fiscellaria* Guen.) has been reported in the Parke Township, some 30 km to the south of Rivière-du-Loup in Quebec. Nearly 2 000 ha have been defoliated and plans were made to salvage the trees. Some 177 ha of fir and spruce stands were left as moose wintering areas in order to protect the high game value of the region. Fir was the dominant species in 10 of these areas which rendered them, highly vulnerable to the looper. In view of the high looper populations anticipated for 1992, the Fédération de la faune du Québec and the ministère du Loisir, de la Chasse et de la Pêche (MLCP) mandated SOPFIM to protect these wintering areas. The purpose of the spray operation was to keep the trees alive and to protect the value of these stands as wintering areas. The 10 blocks to be treated totalled 76 ha and were rather close to one another as shown of figure 1.

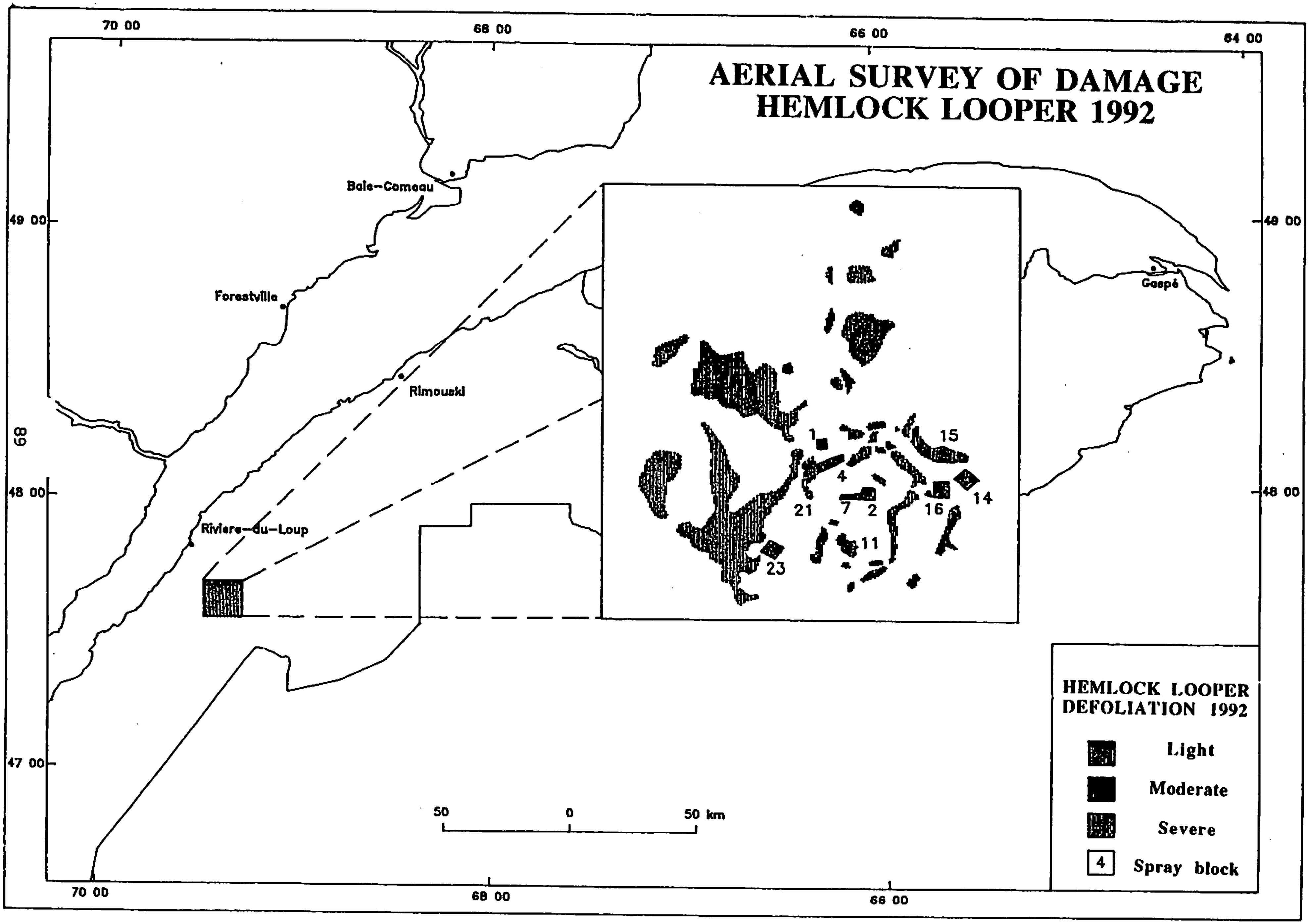
1.- INSECTICIDE

Recent trials with the biological insecticide *Bacillus thuriengiensis* var. *Kurstaki* Berliner showed that it can control the damage by the hemlock looper (West, 1988; Hartling and Carter, 1990; Carter and Hartling, 1991). Based on these results, and in view of the high populations anticiped, two applications of Dipel 176 at a rate of 30 BIU/ha (1,77 l/ha) were prescribed. Quality control and potency checks were made on the product before spraying.

2.- THE SPRAY OPERATIONS

The spray program was carried out on June 24 using a Piper Pawnee rigged with 6 Micronair AU 5000 sprayers. The spray and the spotter aircrafts operated out of the Rivière-du-Loup airport in the Lower Saint-Lawrence - Gaspé region.

Figure 1 Aerial damage by the hemlock looper and blocks location



3.- SPRAY TIMING

Spray timing was based on the development of the insect (IDI) in two five-tree sample plots. The commencement of the treatment was to happen before peak second instar (IDI = 2) and the second application, three days later. The ten spray blocks were opened on June 17, but bad weather conditions grounded the aircrafts for seven days. On June 24, the insect development was 2,3 and it was decided to do both applications on the same day, one in the morning and one in the evening.

4.- POPULATIONS ASSESSMENTS

All the informations or populations and defoliation were derived from a network of 19 plots (10 in spray blocks and 9 in controls). Pre-spray counts were made on treatment day and post spray populations were assessed ten days later. In addition to larval counts, pupal and moth populations were also sampled using the canvas and pheromone trapping techniques (Jobin, comm. pers.) on 20 and 3 trees per plot respectively.

5.- DEFOLIATION ASSESSMENT

Defoliation assessments were made in all 19 sample plots. As the hemlock looper attacks both the new shoot and the old foliage, defoliation has been the measured on new shoot and on the 1991 and 1990 foliage. The foliage of those three years accounts for 80% of the photosynthesis in fir. Fettes (1950) defoliation was measured on 20 shoots per tree and per year (total 60) ten days after treatment and at peak pupae; an aerial survey of the infestation was also made by the SPIM personnal.

6.- RESULTS AND DISCUSSION

Hemlock populations were both high and highly variable. The first larval counts indicated populations of more than 200 insects per 45 cm branch tip. At spray time, the highest populations were closer to 50 larvae/branch due to severe winds and heavy rains. It is noteworthy that looper larvae were continously crawling towards the top of the tree. These larvae cannot be accounted for in standard larval counts resulting in an underestimation of the real population.

6.1 Reduction of populations

On treatment day, average populations were almost similar in both control (15,7 lar/br) and treatment (17,5 lar/br) blocks (table 1 and figure 2). Ten days later, larval counts had dropped to 4,07 larvae/branch in the treated blocks, that is nearly six times less than in the controls. Pupae and moth counts also showed a 15-fold and 2-fold reduction in treated blocks. Dead larvae were observed to drop from treated trees for a period of 6 days after treatment.

6.2 Reduction of the defoliation

Contrary to the spruce budworm, the hemlock looper eats both the new and the old foliage. As it chews only a small amount of each needle, a lot of foliage can be ruined rapidly. There was a large variation in the amount of defoliation in both treated and untreated blocks. On the average, the new shoot lost only 38,5% of its foliage when *B.t.* was applied, that is 20% less than in the controls. Yet the difference was not significant. The delay in spraying *B.t.* is probably responsible for most of this difference since the looper was still on the new shoot at the time of spraying. The 1990 foliage did not show a significant protection either. In fact, only the 1991 foliage seemed to have benefitted from the treatment (Table 1 and figure 3).

The large variance due to a limited number of plots hides differences that were readily visible in the field. Even to the untrained eye, the control blocks were much more damaged than the ones treated with *B.t.*

This is confirmed by the aerial survey where seven out of ten blocks showed no apparent damage (Figure 1).

SUMMARY OF RESULTS
HEMLOCK LOOPER 1992

POPULATION	UNIT	TREATED		CONTROL	
		MEAN	SD	MEAN	SD
Pre-spray	Lar/br	17,5	3,5	15,7	5,6
Post-spray (10 days)	Lar/br	4,1	3,3	23,9	3,7
Pupae	#/tree	1,8	3,5	28,4	10,2
Moth	#/trap	939,4	41,8	2 161,8	165,3

FINAL DEFOLIATION (FETTE)

Annual shoot	%	38,5	27,5	58,2	31,8
1991 Foliage	%	57,8	17,6	92,3	22,4
1990 Foliage	%	56,9	13,1	70,2	23,1

NS : Non significant difference
** : Différent (α = 0,95)

Table 1 : Summary of the results, hemlock looper spray program in the Rivière-du-Loup area, 1992.

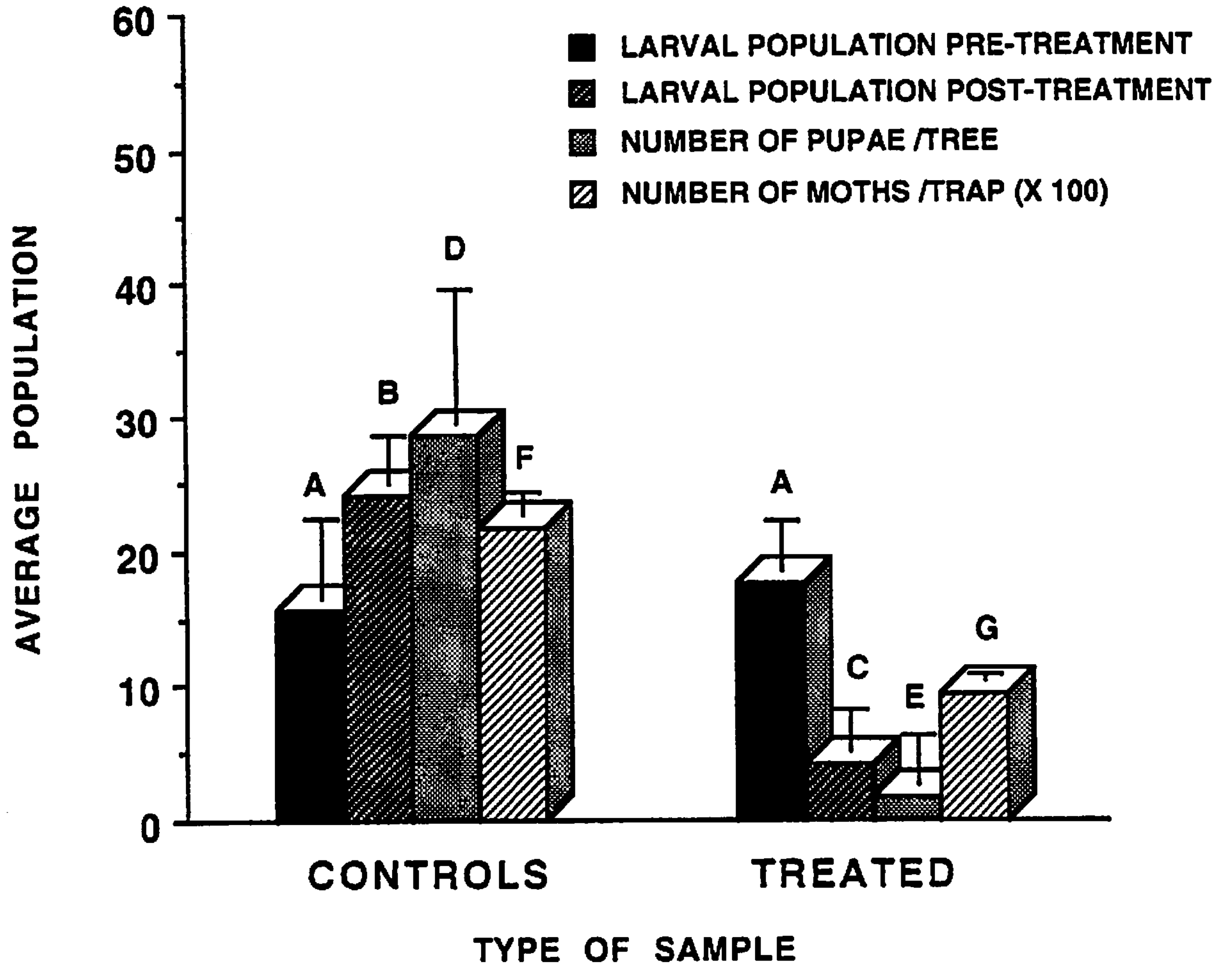


Figure 2 Population of the hemlock looper in both treated and control blocks. Bars marked with the same letter do not differ significantly (α = 0,95)

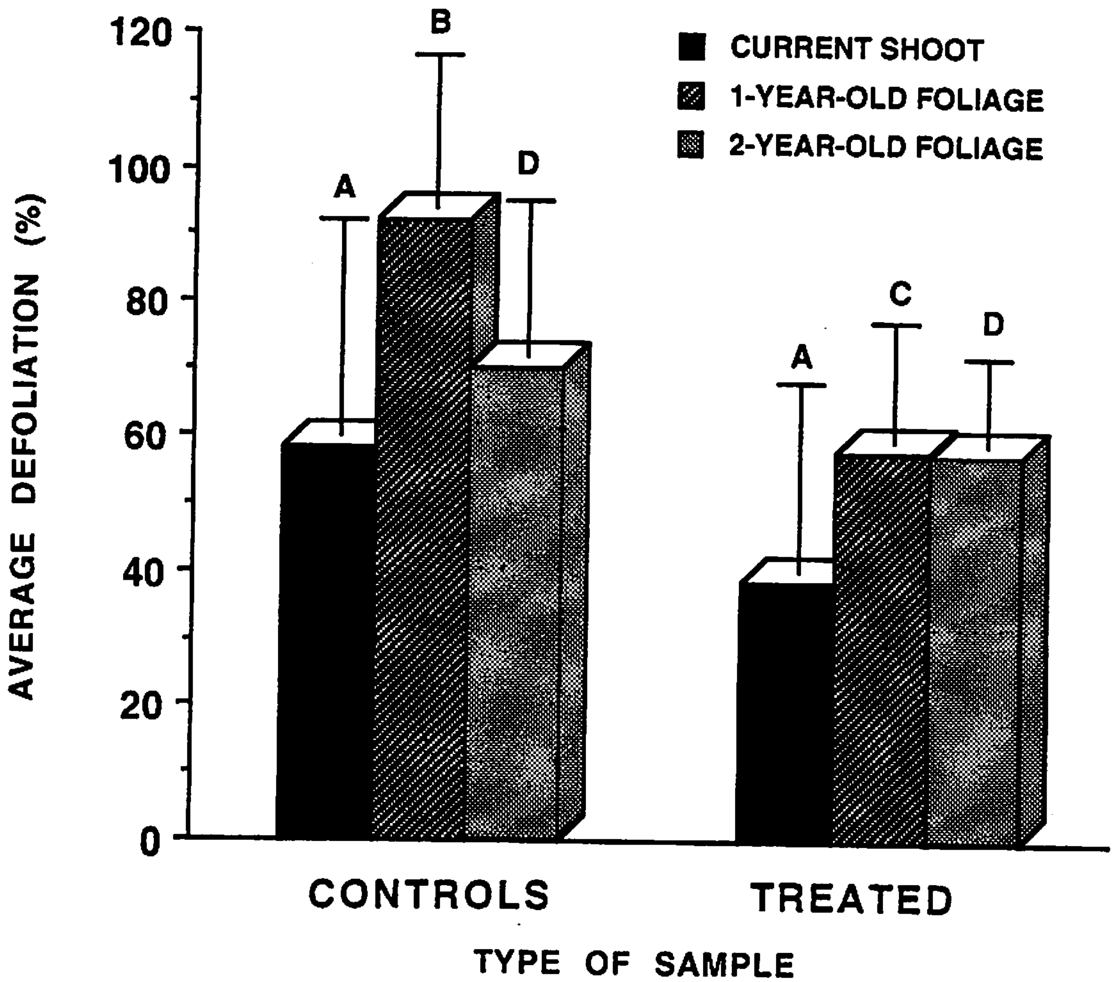


Figure 3 Defoliation by thehemlock looper . Bars marked with the same letter do not differ significantly ($\alpha = 0,95$)

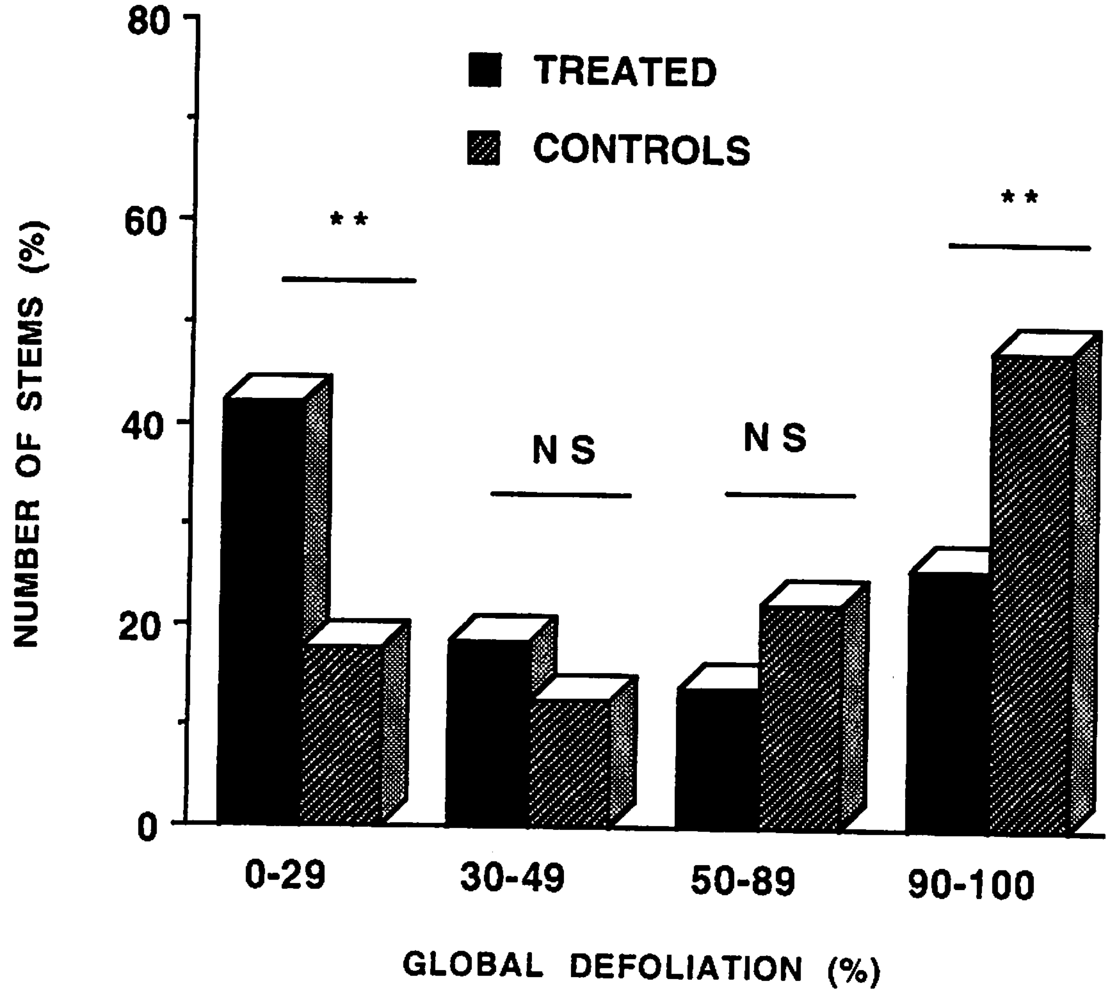


Figure 4 : Assessment of stand condition in the treated and untreated blocks. NS : No significant difference; ** : Significantly different (α = 0,95)

A ground survey of the trees condition showed that, overall, fir had more foliage and suffered less mortality in the spray blocks. More than 50% of trees have retained one half of their global foliage or more, and there was a two-fold reduction in fir mortality in treated stands. Due to the good foliage protection and tree survival, it is estimated that the stands retained their ability to provide cover for moose. Despite a very severe infestation by the hemlock looper, two applications of *B.t.* provided sufficient protection of the moose wintering areas in the Parke area.

7.- FORECAST FOR 1993

Despite a good population control, pupae and moth counts show that the hemlock looper will be active again next year. The number of pupae per tree was much higher than the nuisance level. Moreover, the high number of moths captured in pheromone traps indicate that insect survival was quite high even after two years of infestation. It is hypothesised that a high population can be expected for next year and that it will decline abruptly there after.

CONCLUSION

The 1992 spray program against the hemlock looper gave a very good control of larval populations. Due to delays in spray application the new shoot of fir supported a defoliation comparable to that in the controls. Nevertheless, the overall defoliation was much less severe and very few trees died. Stands earmarked as moose wintening areas have maintained most if not all of their canopy and will provide moose with an adequate protection for the comming seasons. It is anticipated that more protection will be required next year if these stands are to go unharmed through the 1993 epidemic.

During the past spray program, it became clear that looper populations are very mobile and that larval counts can be misleading. This is especially true if pairing is contemplated based on pre-spray larval counts. Sampling techniques will have to be adapted to fit both the insect biology and protection goals.

Jacques Bégin, F.E., M. Sc.

TECHNICAL NOTE No. 268

ISSN 0820-807

HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES IN MID-JUNE 1992

We begin another summer season with the first in a series of reports in which we will highlight forest pest conditions of significance in the Maritimes. This report covers the period up to mid-June, 1992. Subsequent reports will update the stories as they develop. More detailed information is available on request.

Announcement - We are happy to announce the newest member of the Forest Insect and Disease Survey staff, Gérard Lemieux, who joined the crew on June 1st. As our newest FIDS Ranger, Gérard will be jumping into the frying pan, so to speak, in acquainting himself with the considerable diversity of forest pest problems. Some of our New Brunswick cooperators may encounter him this summer - say hello!

Weather effects have been among our most significant conditions. Tree and insect phenology is approximately 1 week behind normal in New Brunswick and 2 weeks behind in Nova Scotia and Prince Edward Island. **Precipitation** has been far below normal and, although the effects are not usually manifested until some time later, it is noteworthy that for the month of May, the Maritimes received approximately 40% of its normal complement of rain. **Frost,** for a couple of nights in late May, caused widespread, severe damage to tender shoots and new leaves of beech and oak at several locations in southern New Brunswick.

Gypsy moth larvae have been found at Oak Hill and the Ledge Road, Charlotte County, New Brunswick, with no noticeable defoliation.

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Forest tent caterpillar has caused moderate and severe defoliation to trembling aspen in York, Sunbury, Queens, and Kent counties. The area of defoliation is greater than last year but remains patchy. Aerial surveys will be conducted to determine the extent of damage. Forest tent larvae have also been "turning up" in other areas of the region, at locations in Northumberland, Charlotte, and Victoria counties in New Brunswick, and Prince County, Prince Edward Island, although no noticeable defoliation could be found.

Balsam twig aphid populations have increased significantly in natural stands and Christmas tree plantations in New Brunswick and Nova Scotia. Moderate and severe levels of damage to current shoots are commonplace, creating serious control problems for the region's Christmas tree growers.

Aspen leafrollers, a complex of as many as six species, have caused moderate and severe leafrolling damage on trembling aspen in several areas of Carleton, Victoria, Madawaska, western Restigouche, and northwestern York counties, New Brunswick. Areas affected were most often patches of a few trees, but one location, at St. Leonard, Madawaska County, was approximately 3 ha. Most trembling aspen, with severe leafrolling, were of non-merchantable age but semi-mature trees with moderate and severe leafrolling were frequently found.

Eastern tent caterpillar nests on cherry and apple were noticeably more common in southern New Brunswick than last year. Nests were found as far north as Victoria and Northumberland counties, though only rarely. In Nova Scotia and Prince Edward Island, tent caterpillar nests were at similar levels to those of last year, i.e., only a few.

Larch casebearer was very common in areas of the southern half of New Brunswick and throughout mainland Nova Scotia, moderately and severely "scorching" trees of all age classes. Prince Edward Island had similar injury levels as last year, at trace and light levels on few trees.

Other forest pests of note: **poplar serpentine leafminer** causing severe discoloration from leafmining in northeastern N.B.; **jack pine needle rust** continued to infect needles at moderate and severe levels in a plantation in Sunbury County, N.B.; **birch casebearer** caused severe foliage browning to birches near Florenceville, Carleton County, N.B.; **oak leafroller** has caused generally light damage to date, in southwestern N.S.

J.E. Hurley and L.P. Magasi
Forest Insect and Disease Survey

June 17, 1992

NOTE TECHNIQUE N° 268

LES PRINCIPAUX RAVAGEURS FORESTIERS DANS LES MARITIMES À LA MI-JUIN 1992

Nous commençons une autre campagne estivale avec le premier d'une série de rapports dans lesquels nous traiterons des principaux ravageurs forestiers dans les Maritimes. La période couverte par le présent rapport va jusqu'à la mi-juin 1992. Dans les rapports qui suivront, nous ferons le point sur l'évolution de la situation. Des renseignements plus détaillés peuvent être obtenus sur demande.

Annonce — Nous sommes heureux de vous faire part de l'arrivée de Gérard Lemieux, qui s'est joint à l'équipe du Relevé des insectes et des maladies des arbres le 1er juin dernier en tant que garde-forestier. Notre «petit dernier» plongera dans le vif du sujet en prenant connaissance de la multitude de problèmes causés par les ravageurs. Certains de nos collaborateurs du Nouveau-Brunswick le rencontreront peut-être cet été. Qu'ils ne manquent pas l'occasion de le saluer!

Les effets des **conditions météorologiques** ont compté parmi les problèmes les plus importants cette année. Sur le plan phénologique, les arbres et les insectes accusent un retard d'environ une semaine par rapport à la normale au Nouveau-Brunswick et d'environ deux semaines en Nouvelle-Écosse et sur l'île du Prince-Édouard. Les **précipitations** ont été nettement en-dessous de la normale et, bien que les effets d'un tel phénomène ne se manifestent généralement pas avant un certain temps, il est à remarquer que, en mai, les Maritimes avaient reçu environ 40 % de la quantité de pluie habituelle. Le **gel** qui s'est produit pendant deux nuits à la fin mai a causé des dommages étendus et graves aux pousses tendres et aux nouvelles feuilles des hêtres et des chênes à plusieurs endroits dans le sud du Nouveau-Brunswick.

Des larves de **spongieuses** ont été repérées à Oak Hill et le long de la route Ledge, comté de Charlotte (Nouveau-Brunswick), mais n'ont pas causé de défoliation notable.

La **livrée des forêts** a causé une défoliation modérée et grave du peuplier faux-tremble dans les comtés de York, de Sunbury, de Queens et de Kent. Le secteur défolié est plus étendu que l'année dernière mais ce sont encore des îlots d'arbres qui sont touchés. On procédera à des relevés aériens afin de déterminer l'étendue des dommages. Des larves de la livrée des forêts ont «surgi» dans d'autres secteurs de la région, soit à différents endroits des comtés de Northumberland, de Charlotte et de Victoria (Nouveau-Brunswick), et dans le comté de Prince (Île-du-Prince-Édouard), mais aucune défoliation notable n'a été observée.

Les populations de **pucerons des pousses du sapin** ont grandement augmenté dans les peuplements naturels et dans les plantations d'arbres de Noël du Nouveau-Brunswick et de la Nouvelle-Écosse. Des dommages modérés et graves aux pousses de l'année sont courants, ce qui occasionne de sérieux problèmes de répression pour les producteurs d'arbres de Noël de la région.

Les **enrouleuses du tremble**, qui forment un complexe pouvant compter jusqu'à six espèces, ont causé un enroulement modéré et grave des feuilles du peuplier faux-tremble à plusieurs endroits dans les comtés de Carleton, de Victoria, de Madawaska, de Restigouche (portion ouest) et de York (portion nord-ouest) (Nouveau-Brunswick). Dans les secteurs touchés, les dommages s'observaient le plus souvent sur des îlots de quelques arbres, à l'exception d'un endroit à St. Leonard, comté de Madawaska, où environ 3 ha ont été ravagés. La plupart des peupliers faux-trembles présentant un enroulement grave n'étaient pas d'âge marchand mais on a fréquemment observé des arbres semi-matures dont le feuillage avait subi un

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enroulement modéré et grave.

Les nids de la **livrée d'Amérique** sur les cerisiers et les pommiers ont été sensiblement plus fréquents que l'année dernière dans le sud du Nouveau-Brunswick. Des nids ont été repérés, quoique rarement, aussi loin vers le nord que dans les comtés de Victoria et de Northumberland. En Nouvelle-Écosse et sur l'île du Prince-Édouard, seuls quelques nids de la livrée d'Amérique ont été observés, tout comme l'année dernière.

Les **porte-case du mélèze** étaient très répandus dans des secteurs de la moitié méridionale du Nouveau-Brunswick et partout dans la portion continentale de la Nouvelle-Écosse, provoquant un «dessèchement» modéré et grave du feuillage des arbres de toutes les classes d'âge. Sur l'île du Prince-Édouard, les dommages ont été semblables à ceux de l'année dernière, soit minimes et légers sur un petit nombre d'arbres.

Autres ravageurs dignes de mention : dans le nord-est du Nouveau-Brunswick, les galeries de la **mineuse serpentine du tremble** ont provoqué une décoloration grave du feuillage; la **rouille des aiguilles du pin gris** a continué d'infecter de façon modérée et grave les aiguilles des arbres d'une plantation du comté de Sunbury (Nouveau-Brunswick); le **porte-case du bouleau** a causé un brunissement grave du feuillage des bouleaux près de Florenceville, comté de Carleton (Nouveau-Brunswick); l'**enrouleuse du chêne** a causé des dommages généralement légers jusqu'à maintenant dans le sud-ouest de la Nouvelle-Écosse.

J.E. Hurley et L.P. Magasi
Relevé des insectes et des maladies des arbres
le 17 juin 1992

TECHNICAL NOTE No. 269

ISSN 0820-807

HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES AT THE END OF JUNE 1992

Forest pest conditions in the Maritimes, as they appear at the end of June 1992, are summarized here in our second report of the year.

Aerial surveys for **forest tent caterpillar** defoliation have mapped approximately 77,500 ha of moderately and severely defoliated trembling aspen in York, Sunbury, Queens, Kent, and Westmorland counties, New Brunswick. In Nova Scotia, a small population caused trace and light defoliation north of Heatherton, Antigonish Co. and a severely defoliated oak tree was found in Truro, Colchester Co. Pupation is well under way and some moths should be flying by this publication date. FIDS and our cooperators, the provincial Pest Detection Officers, have distributed 250 pheromone traps for monitoring purposes throughout the region.

Gypsy moth have been found at a few additional locations: St. Stephen, Charlotte Co., N.B.; Peter's Point, Kejimkujik National Park, Queens Co., and Annapolis Royal, Annapolis Co., N.S. No defoliation was found at any of these locations.

Aspen leafroller damage, reported in our previous highlights, has been found at several other locations in Madawaska, Victoria, Carleton, and York counties, N.B. Damage is more common in Victoria Co., but there are many areas, particularly aspen-regenerated cutovers in all four counties, where damage from leafrolling is so severe that the trees appear to have suffered complete defoliation. Several hundred meters of roadside trembling aspen suffered moderate and severe damage north of Heatherton, Antigonish Co. and at two other locations in Pictou Co., N.S.

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Spruce budworm aerial defoliation surveys will soon be underway in all three provinces. Expectations are that areas with significant defoliation will largely be in the north and north-central areas of N.B. No defoliation is expected to be found in aerial surveys for N.S. Ground surveys have found spruce budworm damage at all damage levels, primarily on white spruce, in southern Kings and southeastern Queens counties, P.E.I. Overall damage is moderate and similar to last year; however, the area affected may be slightly larger.

Hemlock looper larvae, although a bit behind in development, have been found at a few sample locations including a few of the areas where previous defoliation had been found in N.B. and N.S. Noticeable defoliation has not yet been found.

Stillwell's syndrome, the sudden death of balsam fir trees, is common in western Restigouche, southern Madawaska, and northern Northumberland counties, N.B. Affected trees have been found across N.S. and the condition appears to be more common in P.E.I.

Spruce bark beetle continues to attack trees at areas found affected last year in N.S. Near Tiverton and Mink Cove, Digby Co., beetles have killed 20 and 10%, respectively, of several hectares of white spruce and 2-3 ha at each of two locations in Pictou Co. A half dozen dying trees were found near St. Anns, Victoria Co.

Birch casebearer is very common throughout the southern two-thirds of N.B. Severe leaf-browning was found at six locations in Carleton, York, Charlotte, and Northumberland counties. Population levels are generally similar to 1991 in N.S., however, there was one exception at Cap Rouge, Inverness Co., where it was far more common than last year.

Other forest pest conditions of note: **satin moth** has moderately and severely defoliated silver poplar in south-central N.B. and throughout P.E.I.; **fall cankerworm** severely defoliated Manitoba maple at Petit-Rocher and Bathurst, Gloucester Co., N.B.; **uglynest caterpillar** nests are very common at some locations in Northumberland, Kent, York, Sunbury, and Charlotte counties, N.B.; **Bruce's spanworm** has defoliated a wide variety of tree species at light and moderate levels at Yarmouth, Yarmouth Co., N.S.; **winter moth**, mostly on apple, has defoliated at all levels and is more prevalent than last year throughout P.E.I.; **spruce twig aphid** has caused light and moderate damage to white spruce shoots at several locations in western and northern N.S.; **Scleroderris canker** caused branch mortality on the bottom half of 2-m tall jack pine near Mount Elizabeth, Northumberland Co., N.B.; **maple leafroller** has affected 2- to 10-ha patches of red maple at light and moderate levels in Kings Co., P.E.I.

J.E. Hurley
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Forest Insect and Disease Survey

July 7, 1992

NOTE TECHNIQUE N° 269
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PRINCIPAUX RAVAGEURS FORESTIERS DANS LES MARITIMES À LA FIN DE JUIN 1992

Ce deuxième rapport de l'année sur les ravageurs forestiers résume la situation observée dans les Maritimes à la fin de juin 1992.

Les relevés aériens des ravages causés par la **livrée des forêts** ont permis de cartographier environ 77 500 ha de peupliers faux-trembles défoliés modérément et gravement dans les comtés de York, Sunbury, Kent et Westmorland, au Nouveau-Brunswick. En Nouvelle-Écosse, une petite population de livrées des forêts a causé une défoliation minime et légère au nord d'Heatherton, comté d'Antigonish, et un chêne gravement défolié a été repéré à Truro, comté de Colchester. La pupation est avancée et certains papillons devraient voler au moment de la publication de ce rapport. Le personnel du RIMA et ses collaborateurs, les agents provinciaux de détection des ravageurs, ont distribué 250 pièges aux phéromones à des fins de surveillance dans toute la région.

La spongieuse a été repérée à quelques endroits supplémentaires : St. Stephen, comté de Charlotte (Nouveau-Brunswick), Peter's Point, parc national Kejimkujik, comté de Queens, et Annapolis Royal, comté d'Annapolis (Nouvelle-Écosse). Aucune défoliation n'a été observée à ces endroits.

Les enrouleuses du tremble dont nous avons fait état dans notre rapport précédent ont causé des ravages à plusieurs autres endroits des comtés de Madawaska, Victoria, Carleton et York (Nouveau-Brunswick). Les dommages sont plus fréquents dans le comté de Victoria, mais il y a plusieurs secteurs des quatre comtés, particulièrement dans les coupes à blanc où il y a eu régénération de peupliers, où les ravages sont si graves que les arbres semblent avoir été complètement défoliés. Sur plusieurs centaines de mètres en bordure des routes, les peupliers faux-trembles ont subi des dommages modérés et graves au nord de Heatherton, comté d'Antigonish, et à deux autres endroits dans le comté de Pictou (Nouvelle-Écosse).

Des relevés aériens de la défoliation causée par la **tordeuse des bourgeons de l'épinette** seront bientôt entrepris dans les trois provinces. On s'attend à trouver dans le nord et le centre-nord du Nouveau-Brunswick surtout les secteurs présentant une défoliation importante. Aucune défoliation ne devrait être observée lors de ces relevés en Nouvelle-Écosse. Au cours de relevés au sol, tous les niveaux de dommages pouvant être causés par la tordeuse des bourgeons de l'épinette ont été observés, principalement sur l'épinette blanche, dans le sud du comté de Kings et le sud-est du comté de Queens (Île-du-Prince-Édouard). Dans l'ensemble, les dommages sont modérés et semblables à ceux observés l'an dernier; toutefois, le secteur touché risque d'être légèrement plus étendu.

Malgré que leur développement accuse un certain retard, des larves de l'**arpenteuse de la pruche** ont été observées à quelques stations d'échantillonnage, y compris dans quelques-uns des secteurs où une défoliation avait été notée antérieurement

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au Nouveau-Brunswick et en Nouvelle-Écosse. Aucune défoliation notable n'a encore été observée.

Le syndrome de Stillwell, ou mort subite des sapins baumiers, est courant dans l'ouest du comté de Restigouche, le sud du comté de Madawaska et le nord du comté de Northumberland (Nouveau-Brunswick). On a repéré des arbres touchés partout en Nouvelle-Écosse et ce problème semble plus répandu sur l'île du Prince-Édouard.

Le scolyte de l'épinette continue d'attaquer des arbres dans des secteurs touchés l'année dernière en Nouvelle-Écosse. Près de Tiverton et de Mink Cove, comté de Digby, les scolytes ont tué 20 % et 10 %, respectivement, des arbres sur plusieurs hectares d'épinettes blanches; ils ont également tué des arbres à deux endroits dans le comté de Pictou, sur 2-3 ha dans les deux cas. Six arbres moribonds ont été repérés près de St. Anns, comté de Victoria.

Le porte-case du bouleau est très répandu dans les deux tiers méridionaux du Nouveau-Brunswick. Un brunissement grave du feuillage a été observé à six endroits dans les comtés de Carleton, York, Charlotte et Northumberland. Les niveaux de population sont généralement semblables à ceux de 1991 en Nouvelle-Écosse, à l'exception toutefois de Cap Rouge, comté d'Inverness, où les porte-case étaient nettement plus répandus que l'année dernière.

Autres ravageurs dignes de mention : le papillon satiné a causé une défoliation modérée et grave du peuplier argenté dans le centre-sud du Nouveau-Brunswick et partout sur l'île du Prince-Édouard; l'arpenteuse d'automne a gravement défolié des érables du Manitoba à Petit-Rocher et à Bathurst, comté de Gloucester (Nouveau-Brunswick); les nids de la tordeuse du cerisier sont très fréquents à certains endroits des comtés de Northumberland, Kent, York, Sunbury et Charlotte (Nouveau-Brunswick); l'arpenteuse de Bruce a causé une défoliation légère et modérée d'une grande variété d'arbres à Yarmouth, comté de Yarmouth (Nouvelle-Écosse); l'arpenteuse tardive, observée la plupart du temps sur les pommiers, a causé une défoliation allant de minime à grave et est plus répandue que l'année dernière partout sur l'île du Prince-Édouard; le puceron des pousses de l'épinette a causé des dommages modérés et graves aux pousses de l'épinette blanche à plusieurs endroits dans l'ouest et le nord de la Nouvelle-Écosse; le chancre scléroderrien a tué des branches dans la moitié inférieure de pins gris de 2 m de hauteur près de Mount Elizabeth, comté de Northumberland (Nouveau-Brunswick); l'enrouleuse de l'érable a causé des dommages légers et modérés à des érables rouges sur des parcelles de 2-10 ha dans le comté de Kings (Île-du-Prince-Édouard).

J.E. Hurley
L.P. Magasi
Relevé des insectes et des maladies des arbres

le 7 juillet 1992

TECHNICAL NOTE No. 270

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HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES AT THE END OF JULY 1992

This, our third report, summarizes forest pest conditions in the Maritimes as they appeared at the end of July, 1992.

Weather continues to significantly hamper insect development and, at the same time, there is considerably more than the usual variability between locales. Lots of rainfall and below normal temperatures have not only affected insects but have greatly hindered the **spruce budworm** aerial survey effort in New Brunswick. Heavy rains and, at some locations, hail have removed the typical redness caused by budworm defoliation which in turn has made the separation of defoliation into damage classes very difficult. Defoliation is restricted to areas in northern New Brunswick. No further information is available at this time. In Prince Edward Island, more defoliation was found on white spruce than last year in Kings and Queens counties, averaging in the moderate category. No defoliation was found in Nova Scotia.

Hemlock looper larvae have been found in New Brunswick and Nova Scotia in areas of previously recorded defoliation: near Mount Elizabeth, Northumberland Co., several areas in Charlotte Co., most noticeably on Deer Island, N.B. and in southern Halifax Co., N.S, along the eastern shore. At this point, it is difficult to predict the extent of damage since the majority of feeding is yet to come, however, the highest number of larvae have been found in areas of previous defoliation in southern Halifax Co. Considerable defoliation is expected in these areas.

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Gypsy moth traps should now be in place throughout the region. Daily observation traps, at several locations in New Brunswick and southwestern Nova Scotia, had catches of 10-15 moths on July 21. A change in weather pattern coincides with this catch episode. All moths are considered blow-ins from parts west of us in the northeastern United States. Early and mid-instar larvae were found as late as July 17, making it very unlikely that local emergences could be any earlier than August 1. Recent larval finds were made at Mohannes, Charlotte Co., N.B., and Shelburne, Shelburne Co.; Bear River, Digby Co.; Bridgetown, Annapolis Co.; New Minas, Port Williams, and Canning, Kings Co., N.S. A single egg mass, believed to have hatched this year, was found on a travel trailer, purchased in the United States, in Yarmouth, Yarmouth Co., N.S. No larvae were found in the immediate area. No noticeable defoliation has been found at any location in the region.

Elm leafminer has caused moderate and severe browning of elm in Bridgetown, Annapolis Co.; Truro, Colchester Co.; Halifax, Halifax Co.; and Sydney, Cape Breton Co., N.S. Damage is less severe than last year, most often light and moderate browning on exotic elms in Charlottetown and York, Queens Co., and Summerside, Prince Co., P.E.I.

Spruce bark beetle damage, observed during aerial surveys in Nova Scotia and Prince Edward Island, is up overall in eastern Nova Scotia and less common in Prince Edward Island. New damage is most common along the northeast coast of Pictou Co. and northern areas of Antigonish Co., N.S.

Other forest pests of note: **Dutch elm disease**-infected trees are showing the typical symptoms of wilting and browning of foliage, generally on young trees in areas where it has been extant for a number of years; **yellow witches' broom** on dead and dying spruce at several coastal locations, especially Antigonish, Guysborough, Victoria, and Inverness counties, N.S.; **cherry blight** found throughout New Brunswick, but most severe in Carleton, Victoria, and Northumberland counties, damage levels are up in eastern Nova Scotia, most notable in Victoria Co.; **white pine weevil** is very common in several New Brunswick counties, often more than 50% of young trees showing the typical crooked top leader; **yellowheaded spruce sawfly** severely defoliated pockets of a few trees each near Hammondvale, Kings Co., N.B.; **maple leafroller** severely damaged about 2 ha of mature sugar maple at Lower Queensbury, York Co., N.B.; and **elm leaf beetle** has caused moderate and severe leaf browning of many elm trees in Fredericton, York Co., N.B.

J.E. Hurley and L.P. Magasi
Forest Insect and Disease Survey

August 5, 1992

NOTE TECHNIQUE N° 270
ISSN 0820-807

LES PRINCIPAUX RAVAGEURS FORESTIERS DANS LES MARITIMES À LA FIN DE JUILLET 1992

Ce troisième rapport sur les ravageurs forestiers résume la situation observée dans les Maritimes à la fin de juillet 1992.

Les conditions météorologiques continuent de retarder de façon significative le développement des insectes et, simultanément, on observe des variations considérablement plus élevées que la normale d'un emplacement à un autre. Des pluies abondantes et des températures sous la normale ont non seulement eu des effets sur les insectes mais elles ont également nui grandement aux relevés aériens de la tordeuse des bourgeons de l'épinette au Nouveau-Brunswick. Les fortes pluies et, à certains endroits, la grêle ont fait disparaître les aiguilles rougies par suite du broutement de la tordeuse, ce qui a rendu très difficile la distinction des classes de dommage. La défoliation est limitée à des secteurs du nord du Nouveau-Brunswick. Aucune autre information n'est disponible pour le moment. Sur l'île du Prince-Édouard, on a observé une plus grande défoliation de l'épinette blanche que l'année dernière dans les comtés de Kings et de Queens; les dommages sont modérés en moyenne. Aucune défoliation n'a été observée en Nouvelle-Écosse.

Au Nouveau-Brunswick et en Nouvelle-Écosse, des larves de l'arpenteuse de la pruche ont été repérées dans des secteurs où une défoliation avait déjà été signalée, soit près de Mount Elizabeth, comté de Northumberland, à plusieurs endroits dans le comté de Charlotte, particulièrement sur l'île Deer (Nouveau-Brunswick), de même que dans le sud du comté de Halifax (Nouvelle-Écosse), le long de la rive est. Il est difficile à ce moment-ci de prévoir l'étendue des dommages étant donné que la plus grande partie du broutement reste à venir; toutefois, le nombre le plus élevé de larves a été repéré dans les secteurs défoliés antérieurement dans le sud du comté de Halifax. On s'attend à une défoliation considérable à ces endroits.

Les pièges à spongieuses devraient maintenant être installés partout dans la région. À plusieurs endroits du Nouveau-Brunswick et du sud-ouest de la Nouvelle-Écosse, des pièges servant aux observations quotidiennes renfermaient de 10 à 15 papillons le 21 juillet. Un changement des conditions météorologiques coïncide avec cet épisode de captures. On considère que tous les papillons sont poussés par le vent depuis des secteurs du nord-est des États-Unis situés à l'ouest des Maritimes. Des spongieuses parvenues aux stades larvaires 1 et 2 de même qu'aux stades 3 et 4 ont été observées jusqu'au 17 juillet, ce qui rend très improbable les éclosions locales avant le 1er août. Des larves ont été découvertes récemment à Mohannes, comté de Charlotte (Nouveau-Brunswick), de même qu'aux endroits suivants en Nouvelle-Écosse : Shelburne, comté de Shelburne; Bear River, comté de Digby; Bridgetown, comté d'Annapolis; New Minas, Port Williams et Canning, comté de Kings. Une seule masse d'oeufs dont l'éclosion aurait eu lieu cette année a été trouvée à Yarmouth, comté de Yarmouth (Nouvelle-Écosse), sur une roulotte achetée

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aux États-Unis. Aucune larve n'a été repérée dans les environs immédiats et aucune défoliation évidente n'a été observée dans la région.

La tenthrède-mineuse de l'orme a causé un brunissement modéré et grave du feuillage des ormes à Bridgetown, comté d'Annapolis, à Truro, comté de Colchester, à Halifax, comté de Halifax, et à Sydney, comté du Cap-Breton (Nouvelle-Écosse). Les dommages sont moins graves que l'année dernière; il s'agit la plupart du temps d'un brunissement léger et modéré du feuillage des ormes exotiques de Charlotte et de York, comté de Queens, et de Summerside, comté de Prince (Île-du-Prince-Édouard).

Les dommages causés par le scolyte de l'épinette, qui ont été observés au cours des relevés aériens en Nouvelle-Écosse et sur l'île du Prince-Édouard, sont plus élevés dans l'ensemble de l'est de la Nouvelle-Écosse et moins fréquents sur l'île du Prince-Édouard. Les nouveaux dommages sont le plus fréquents le long de la côte nord-est du comté de Pictou et dans les secteurs septentrionaux du comté d'Antigonish (Nouvelle-Écosse).

Autres ravageurs dignes de mention : les ormes touchés par la thyllose parasitaire, généralement les jeunes arbres des secteurs où la maladie existe depuis un certain nombre d'années, montrent des symptômes typiques de dessèchement et de brunissement du feuillage; la rouille-balai de sorcière est présente sur des épinettes mortes et moribondes en plusieurs endroits côtiers, particulièrement dans les comtés d'Antigonish, de Guysborough, de Victoria et d'Inverness (Nouvelle-Écosse); la détérioration des feuilles du cerisier a été observée partout au Nouveau-Brunswick mais elle est le plus grave dans les comtés de Carleton, de Victoria et de Northumberland, et les niveaux de dommages sont plus élevés dans l'est de la Nouvelle-Écosse, particulièrement dans le comté de Victoria; le charançon du pin blanc est très répandu dans plusieurs comtés du Nouveau-Brunswick et, souvent, la pousse apicale de plus de 50 % des jeunes arbres est tordue de façon caractéristique; la tenthrède à tête jaune de l'épinette a gravement défolié des parcelles comptant quelques arbres chacune près de Hammondvale, comté de Kings (Nouveau-Brunswick); l'enrouleuse de l'érable a gravement endommagé environ 2 ha d'érables à sucre mûrs à Lower Queensbury, comté de York (Nouveau-Brunswick); et la galéruque de l'orme a causé un brunissement modéré et grave du feuillage de nombreux ormes à Fredericton, comté de York (Nouveau-Brunswick).

J.E. Hurley et L.P. Magasi
Relevé des insectes et des maladies des arbres

le 5 août 1992

TECHNICAL NOTE No. 272

ISSN 0820-807

HIGHLIGHTS OF FOREST PEST CONDITIONS IN THE MARITIMES IN MID-SEPTEMBER, 1992

This, our fourth and final highlight report for the year, discusses forest pest conditions in the Maritimes in mid-September, 1992.

Early fall color was evident at many Maritime locations, particularly in northern New Brunswick. The earliest signs of fall began to show in mid-August on red maple in low-lying areas. Many of our cooperators have reported this phenomenon. No doubt our unusual summer weather conditions played a role in triggering early leaf senescence.

Spruce budworm defoliation has been mapped in New Brunswick and Prince Edward Island. The total area of defoliation in N.B. is unofficial at this time, however, preliminary estimates place it considerably less than last year. In Prince Edward Island, approximately 35,000 ha of white spruce have been severely and moderately defoliated, averaging moderate overall.

Gypsy moth adults were caught in quantity during late August in Bridgewater and Annapolis Royal, Annapolis Co., Nova Scotia. Considering the "late season," it is important that traps were not collected before the September 15th pick-up date. However, exceptions do occur for operational reasons. We ask that cooperators indicate on their data summary sheets the date(s) of trap pick-up. We also ask that results, or traps, be forwarded to FIDS in Fredericton as soon as possible. Your prompt response facilitates timely preparation for a regional perspective so important to the Gypsy Moth Coordinating Committee.

- [ ] NURSERIES
- [ ] PLANTATIONS
- [ ] SILVICULTURE
- [ ] UTILIZATION
- [ ] ECONOMICS
- [ ] TREE IMPROVEMENT
- [x] INSECTS AND DISEASES

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Hemlock looper aerial defoliation surveys are nearly complete in New Brunswick and are under way in Nova Scotia. Defoliation in New Brunswick has been mapped in the Big South area of Northumberland Co. and Deer Island and some adjacent islands, Charlotte Co. The total area of defoliation appears to be less than last year. Data is not available for N.S., however, aerial surveys will be focused on Halifax County's coastline.

Fall webworm nests were found on a wide variety of hardwoods throughout southern New Brunswick, across Nova Scotia (but more frequently in western areas, with a few locations having as many as 20 nests in a 1/2-k distance), and throughout Prince Edward Island (but more often at a few locations in Queens and Prince counties).

Balsam fir needle rust, causing noticeable foliage yellowing, is widespread at trace and light levels of damage in Victoria, Madawaska, and Restigouche counties. **Spruce needle rust** was very common, causing light and moderate damage to black spruce, usually trees of less than 1 m in height, in and around bogs in Northumberland, Westmorland, Kent, and Kings counties, N.B.

Eastern larch beetle infested trees showed typical yellowing much later than usual, but beetle populations appear to be low for another year. Current tree mortality in southern New Brunswick averages less than 15%.

Birch skeletonizer has severely defoliated white birch saplings at locations in Northumberland Co. and is particularly striking around Rexton and Buctouche, Kent Co., N.B.

Alder flea beetle defoliation can be found at all levels of damage in the southern half of New Brunswick and throughout Nova Scotia and Prince Edward Island. Damage remains very noticeable, but severely defoliated alder is very patchy in N.B. and eastern N.S., unlike the expansive areas of severe defoliation observed in recent years, suggesting a declining population.

Other forest pests of note: **larch sawfly** severely defoliated 2 ha of larch at Rexton, Kent Co., N.B. and there were a few trees with severe and moderate defoliation at Marinette, Halifax Co., N.S.; **leaf blotch of horse-chestnut**, light and moderate damage with a few severely damaged trees throughout western N.S.; **willow flea weevil**, moderate and severe browning on ornamentals at several locations throughout the Maritimes; **apple-and-thorn skeletonizer**, moderate and severe defoliation on apple in Pictou, Cumberland, and Colchester counties, N.S. and at a few locations across P.E.I.; and ***Astrodochium colorandense***, a new fungal record for the Maritime region, is a leaf fungus that has caused severe and moderate foliage discoloration on largetooth aspen at several locations in western N.S.

J.E. Hurley and L.P. Magasi
Forest Insect and Disease Survey

September 18, 1992

NOTE TECHNIQUE N° 272
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LES PRINCIPAUX RAVAGEURS FORESTIERS DANS LES MARITIMES À LA MI-SEPTEMBRE 1992

Ce quatrième et dernier rapport sur les ravageurs forestiers résume la situation observée dans les Maritimes à la mi-septembre 1992.

Une **coloration automnale précoce** a été observée à de nombreux endroits dans les Maritimes, particulièrement dans le nord du Nouveau-Brunswick. Les premiers signes de l'automne ont commencé à se manifester à la mi-août sur les érables rouges des secteurs déprimés. Beaucoup de nos collaborateurs ont signalé le phénomène. Il ne fait pas de doute que les conditions météorologiques inhabituelles de l'été ont joué un rôle dans la manifestation précoce de la sénescence des feuilles.

Les secteurs défoliés par la **tordeuse des bourgeons de l'épinette** au Nouveau-Brunswick et sur l'île du Prince-Édouard ont été cartographiés. Au Nouveau-Brunswick, la superficie totale défoliée n'est pas encore déterminée avec exactitude mais, d'après les estimations préliminaires, elle serait considérablement moins étendue que l'année dernière. Sur l'île du Prince-Édouard, environ 35 000 ha d'épinettes blanches ont été gravement et modérément défoliés, les dommages étant modérés en moyenne.

Des **spongieuses** adultes ont été capturées en grand nombre vers la fin du mois d'août à Bridgewater et à Annapolis Royal, comté d'Annapolis (Nouvelle-Écosse). Compte tenu de la «saison tardive», il est important que les pièges n'aient pas été enlevés avant le 15 septembre, soit la date prévue à cet effet. Il peut toutefois y avoir des exceptions pour des raisons d'ordre opérationnel. Nous prions les collaborateurs d'indiquer sur la feuille du sommaire des données la ou les dates d'enlèvement des pièges. Nous leur demandons également de faire parvenir les résultats ou les pièges au bureau du RIMA à Fredericton le plus tôt possible. Grâce à votre prompte collaboration, le rapport régional qui est si important pour le Comité de coordination de la spongieuse peut être préparé en temps opportun.

PÉPINIÈRES ☐

PLANTATIONS ☐

SYLVICULTURE ☐

UTILISATION ☐

SCIENCE ÉCONOMIQUE ☐

AMÉLIORATION DES ARBRES ☐

INSECTES ET MALADIES ☐

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Les relevés aériens de la défoliation causée par l'**arpenteuse de la pruche** sont pratiquement terminés au Nouveau-Brunswick et sont en cours en Nouvelle-Écosse. Au Nouveau-Brunswick, les dommages dans le secteur de Big South du comté de Northumberland, de même que sur l'île Deer et d'autres îles adjacentes, comté de Charlotte, ont été cartographiés. La superficie totale défoliée semble moins étendue que l'année dernière. Les données ne sont pas disponibles pour la Nouvelle-Écosse; toutefois, les relevés porteront principalement sur le littoral du comté de Halifax.

Des nids de **chenille à tente estivale** ont été repérés sur une grande variété de feuillus partout dans le sud du Nouveau-Brunswick, dans l'ensemble de la Nouvelle-Écosse (mais plus fréquemment dans l'ouest de la province, où jusqu'à 20 nids sur une distance de 0,5 km ont été observés à quelques endroits) et sur toute l'île du Prince-Édouard (mais plus souvent à quelques endroits des comtés de Queens et Prince).

La **rouille des aiguilles du sapin baumier**, qui a provoqué un jaunissement évident du feuillage, est répandue dans les comtés de Victoria, Madawaska et Restigouche, où elle cause des dommages minimes et légers. La **rouille des aiguilles de l'épinette** était très fréquente, causant des dommages légers et modérés aux épinettes noires — de moins de 1 m de hauteur habituellement — dans et autour des tourbières des comtés de Northumberland, Westmorland, Kent et Kings (Nouveau-Brunswick).

Le jaunissement typique des arbres infestés par le **dendroctone du mélèze** est apparu beaucoup plus tard que d'habitude mais les populations de dendroctones semblent peu nombreuses encore cette année. La mortalité actuelle des arbres dans le sud du Nouveau-Brunswick est inférieure à 15 % en moyenne.

La **squeletteuse du bouleau** a gravement défolié des gaules de bouleau à papier à certains endroits du comté de Northumberland et ses attaques sont particulièrement marquantes autour de Rexton et de Buctouche, comté de Kent (Nouveau-Brunswick).

La défoliation causée par l'**altise de l'aulne** va de minime à grave dans la portion méridionale du Nouveau-Brunswick et partout en Nouvelle-Écosse et sur l'île du Prince-Édouard. Les dommages restent fort visibles mais les arbres gravement défoliés sont très dispersés au Nouveau-Brunswick et dans l'est de la Nouvelle-Écosse, contrairement aux dernières années où de vastes secteurs étaient gravement défoliés, ce qui porte à croire à une diminution des populations de ce ravageur.

Autres ravageurs dignes de mention : la **tenthrède du mélèze** a gravement défolié 2 ha de mélèzes à Rexton, comté de Kent (Nouveau-Brunswick), et l'on trouve quelques arbres défoliés gravement et modérément à Marinette, comté de Halifax (Nouvelle-Écosse); la **brûlure des feuilles du marronnier d'Inde** a causé des dommages légers et modérés, quelques arbres étant gravement atteints partout dans l'ouest de la Nouvelle-Écosse; l'**orcheste du saule** a provoqué un brunissement modéré et grave d'arbres ornementaux à plusieurs endroits dispersés dans l'ensemble des Maritimes; la défoliation causée par la **squeletteuse du pommier et du cenellier** a été modérée et grave sur les pommiers dans les comtés de Pictou, Cumberland et Colchester (Nouvelle-Écosse) et à quelques endroits partout sur l'île du Prince-Édouard; et ***Astrodochium colorandense***, un champignon qui s'attaque aux feuilles et qui est un nouveau venu dans la région des Maritimes, a entraîné une décoloration grave et modérée du feuillage du peuplier à grandes dents à plusieurs endroits dans l'ouest de la Nouvelle-Écosse.

J.E. Hurley et L.P. Magasi
Relevé des insectes et des maladies des arbres

le 18 septembre 1992

1992 NEW BRUNSWICK PROTECTION PROGRAM AGAINST SPRUCE BUDWORM

(Prepared* for Annual Forest Pest Control Forum, Ottawa, Nov. 17-19, 1992)

Spruce Budworm Conditions in 1992

The extent of defoliation mapped during the 1992 aerial survey was hampered by high winds, heavy rain, and even hail showers. Consequently, it was not possible to reasonably classify light, moderate and severe categories. Overall, only 84 300 ha of detectable defoliation were mapped from the air (Figure 1). Observations at ground survey plots associated with the spray program as well as limited supplementary sampling confirmed that defoliation occurred over areas not detected from the air. Resources were not available to develop an inclusive map. Understandably therefore, the mapped area of defoliation was only 31.7% of the moderate and severe defoliation identified in 1991 (266 000 ha). Defoliation was detected mainly in Gloucester, Northumberland and York Counties in the central and northern parts of the Province. The majority of the rest of the Province was undamaged except for occasional scattered small areas of defoliation. Due to the adverse factors which influenced the aerial defoliation survey, no attempt was made to stratify the area of defoliation between treated and untreated areas.

1992 Protection Program

The 1992 protection program against Spruce Budworm, conducted by Forest Protection Limited (FPL), in New Brunswick covered approximately 236 675 hectares (Figure 2). This was 17.9% less than the 288 150 ha treated in 1991. Another (33 100) ha were treated by J. D. Irving Ltd. on its own freehold limits (compared to 30 040 ha in 1991).

Various aircraft, equipment, insecticides, and application rates were used (Table 1). Of the total area treated by FPL, 62.2% received a double application of the chemical fenitrothion (Sumithion) mostly (57.3%) at 210 g/ha but some (4.9%) at 140 g/ha. About 30.0% of the area received a double application of bacterial insecticide, Bacillus thuringiensis var. kurstaki (B.t.) in the form of three products, viz. Futura XLV-HP, Foray 48B and Foray 76B (Table 1). One area (3.9%) received a single application of B.t. (Foray 48B) and the remaining 3.8% received a first application of fenitrothion followed several days later by an application of B.t. (Futura XLV-HP).

Insecticides were applied by 7 TBMs, all with standard boom and Teejet nozzles (11010), and 5 single-engine agricultural-type small spray planes (SSPs), 3 Thrushes and 2 Ag Trucks, equipped with wind-driven Micronair AU4000 rotary atomizers. Undiluted B.t. was primarily applied in two applications, each at 15 BIU/ha, using SSPs with enhanced atomization (i.e. Micronair AU4000s with flow rates of 2L/min/unit). This has been the standard operational rate in New Brunswick over the past three years. For logistical reasons, one 9200-ha block was treated with undiluted Foray 48B at 30 BIU/2.36 L/ha, and one 7900-ha block received undiluted Foray 48B at 2 x 15 BIU/1.16 L/ha using TBMs equipped with boom and nozzles. Fenitrothion was primarily applied in water-based formulation at the normal 2x210 g/1.46 L/ha rate from TBMs with boom and nozzles, and at 2 x 210 g/0.44 L/ha from SSPs with Micronair AU4000s. For trial purposes some fenitrothion was applied at 2 x 140 g/0.97 L/ha using TBMs with boom and nozzles.

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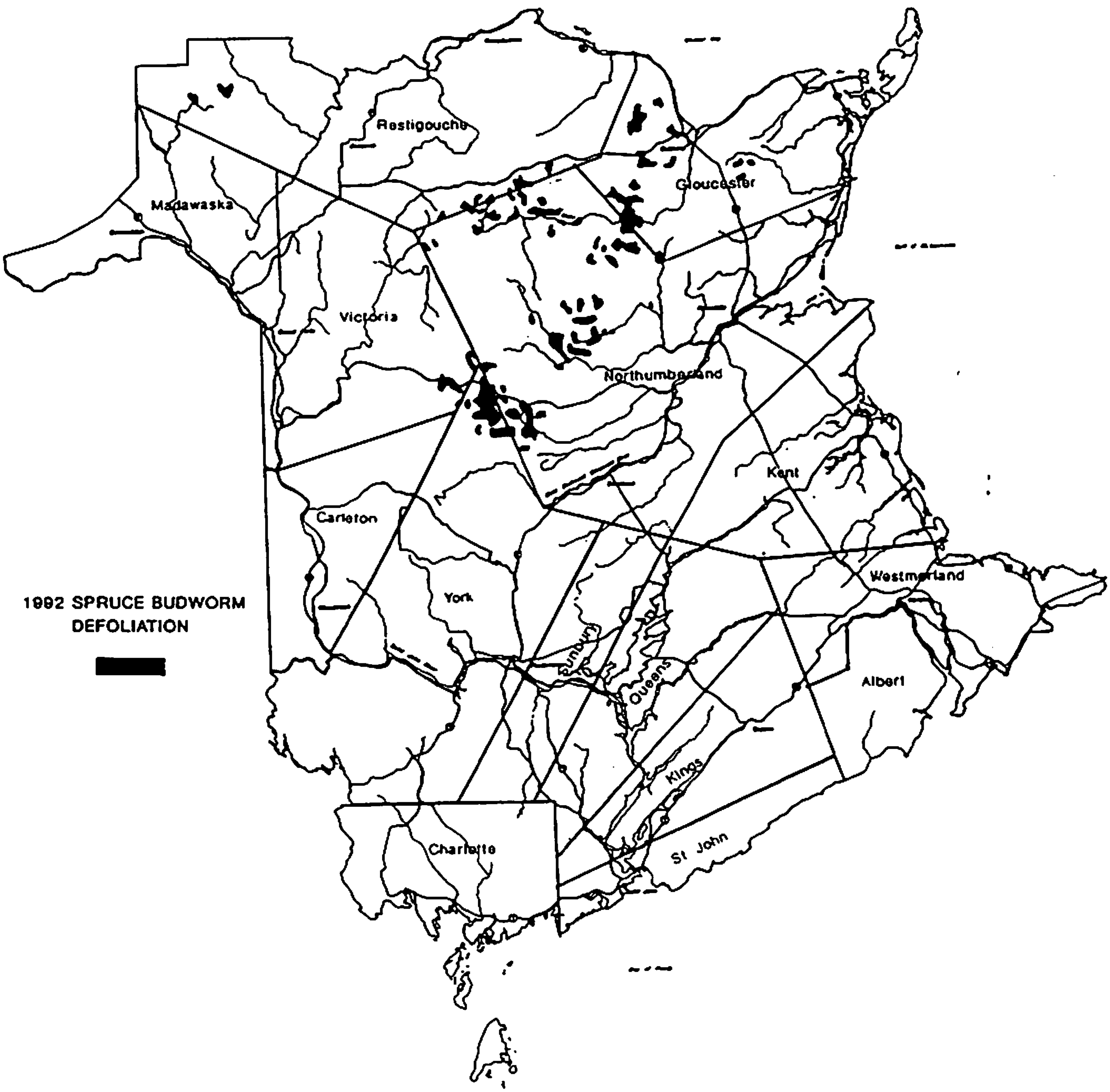

Figure 1. Areas defoliated by spruce budworm in New Brunswick in 1992. Due to adverse weather it was not possible to classify areas as light, moderate, or severe.

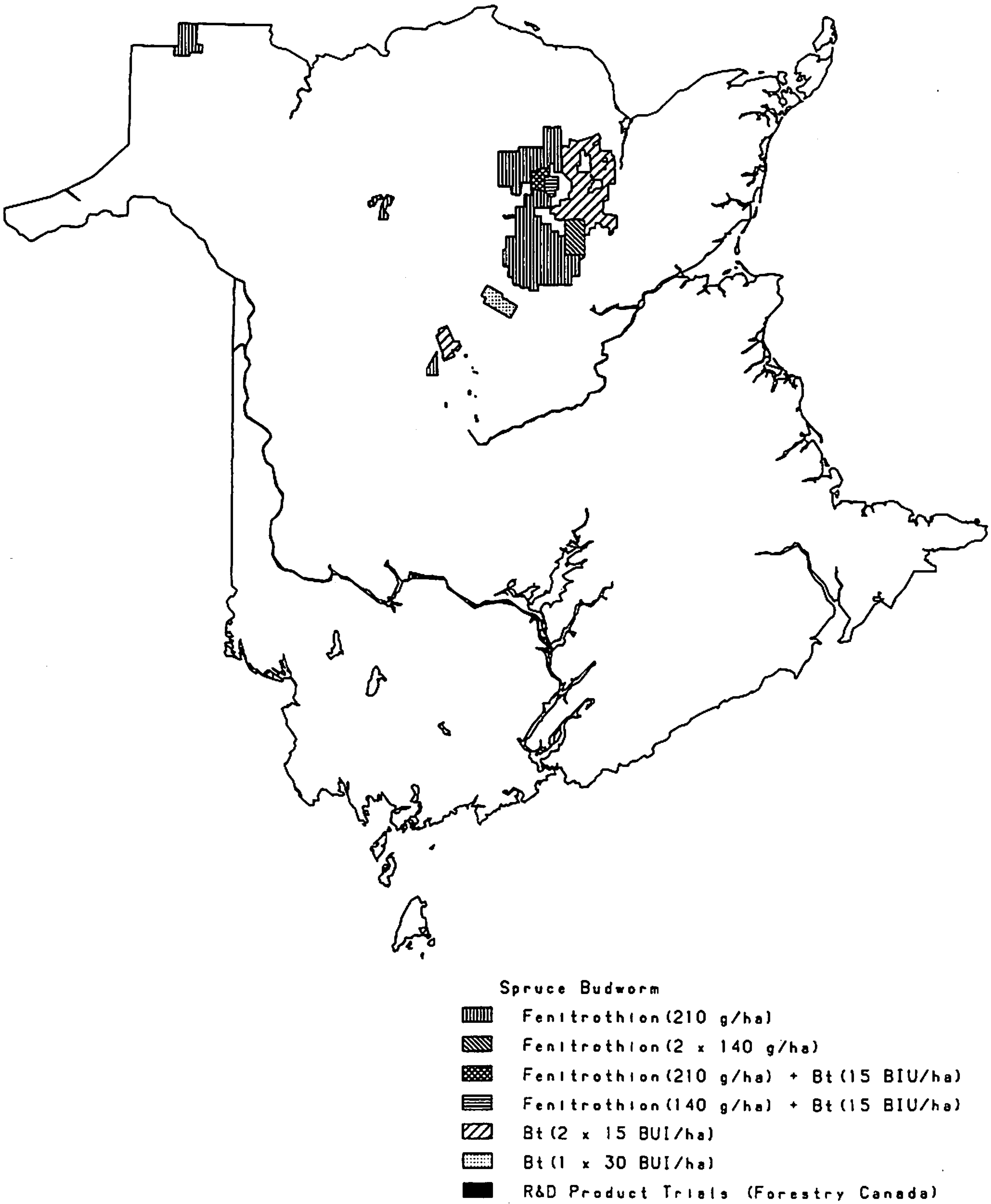

Figure 2. Areas treated by FPL for protection against spruce budworm in New Brunswick in 1992. (Does not include J. D. Irving Ltd. program).

Table 1. Treatments applied by Forest Protection Limited for protection against spruce budworm in New Brunswick in 1992 (does not include J. D. Irving Ltd. program).

Treatment[a]	Hectares (Thousands)	Percent	Aircraft Type[b]
One Application - Biological			
30 BIU F-48B/2.36 L/ha 12.7 BIU/L.	9.2	(3.9)	TBM/b
Two Applications - Biological			
15 BIU FXLV-HP/0.45 L/ha + 15 BIU FXLV-HP/0.45 L/ha 30 BIU = 0.9 L ~ 10 BIU/L	52.4	(22.1)	SSP
15 BIU F-76B/0.75 L/ha + 15 BIU F-76B/0.75 L/ha 20 BIU/L.	10.8	(4.6)	SSP
→15 BIU F-48B/1.18 L/ha + 15 BIU F-48B/1.18 L/ha	7.9	(3.3)	TBM/b
SUB-TOTAL:	71.1	(30.0)	
SUB-TOTAL BIOLOGICAL ONLY:	80.3	(33.9)	
Two Applications - Chemical			
210 g Fen/1.46 L/ha + 210 g Fen/1.46 L/ha	129.1	(54.5)	TBM/b
210 g Fen/0.44 L/ha + 210 g Fen/1.46 L/ha	6.6	(2.8)	SSP, TBM/b
140 g Fen/0.97 L/ha + 140 g Fen/0.97 L/ha	11.7	(4.9)	TBM/b
SUB-TOTAL CHEMICAL ONLY:	147.4	(62.2)	
One Appl. Chemical + One Appl. Biological			
210 g Fen/1.46 L/ha + 15 BIU FXLV-HP/0.45 L/ha	4.8	(2.0)	TBM/b,SSP
140 g Fen/0.44 L/ha + 15 BIU FXLV-HP/0.45 L/ha	4.2	(1.8)	SSP
SUB-TOTAL CHEMICAL + BIOLOGICAL:	9.0	(3.8)	
GRAND TOTAL:	236.7	(100.0)	

a. FXLV-HP = Futura XLV HP
F-48B = Foray 48B
F-76B = Foray 76B
Fen. = Fenitrothion

b. TBM/b = TBM with boom + nozzle
SSP = Small Spray Planes with Micronair AU4000s

The first B.t. and chemical blocks were declared biologically ready for treatment the morning of May 28th and evening of May 29th, respectively. This "early opening" of a B.t. block, corresponding to a chemical timing, was an attempt to determine whether advancing the window of application for B.t. would provide acceptable results. Unfortunately, this biological timing was more "normal" by the time treatment commenced. Poor weather delayed the first application of B.t. until the evening of May 29th. Chemical applications commenced the morning of May 30th. By June 9th all blocks were ready for treatment. All first applications of fenitrothion and B.t. were completed by June 5th and June 10th, respectively. All double applications were scheduled to have a minimum 5-day interval between applications except for two small blocks (135 ha, 300 ha) done the last two days of the project. The block with the single application of B.t. was completed on June 9th. Applications terminated on June 12th.

Results of Protection Program

The 1992 protection program was characterized by the use of: (1) one chemical insecticide (fenitrothion) at two rates; (2) three brands of biological insecticide (B.t.) at two rates; (3) some treatments where the first application was fenitrothion and the second was B.t.; (4) three types of spray planes; and (5) two types of spray equipment. Overall, a total of 8 aircraft/equipment/insecticide "treatment" combinations were sampled. The two main treatments, however, were: fenitrothion applied twice at 210 g/ha by TBMs equipped with boom and nozzles; and Futura XLV-HP applied twice at 15 BIU/ha using SSPs equipped with Micronairs.

To assess the efficacy of the program, various numbers of 5-tree plots were distributed throughout each treatment block and in untreated check areas. Information from these plots was representative of normal variability among treated and untreated areas, and provided data for analysis (e.g. pre-spray and post-spray populations, larval development and delays in treatment). General weather data were available from nearby weather stations. In this way, different treatment regimes (= aircraft/equipment/insecticide) were sampled. Subsequent sample sizes within each regime, however, were not always sufficient to do statistical comparisons of differences between them. Deposit measurements, plot-specific weather data, and more intensive biological data were not collected operationally.

This year, pre-spray populations of spruce budworm larvae in check plots were generally lower than those encountered in 1991; nevertheless, expected levels of defoliation this year were higher at low and moderate populations. Shoot elongation and larval development were favorable at the time areas were deemed ready for treatment (except for block A17 where bud mining was prevalent). Delays beyond the scheduled 5-day interval ranged from 0 to 4.5 and averaged only 1 day in plots assessed. Adverse post-spray weather did not appear to be a problem, though some frost damage was observed (generally <5%).

Also this year, a research project was designed and conducted to investigate key parameters which influence the efficacy of a sequential fenitrothion/B.t. treatment. Specific results from that investigation will be reported elsewhere by Forestry Canada - Maritimes.

For program evaluation, the two major treatments were chosen for direct comparison between each other and the untreated plots, i.e. 2 x 210 g/ha of fenitrothion applied by TBMs, and 2 x 15 BIU/ha of B.t. (Futura XLV-HP) applied by SSPs with Micronairs. Other treatments were also assessed keeping in mind the size of area treated, limited sample sizes, and other factors associated with their use.

Fenitrothion vs. B.t.

Variability of results between treated blocks was evident as usual (Table 2). Nevertheless, analysis of curves of average percent defoliation based on pre-spray populations (classes of 0.05 larvae/bud) demonstrate the trend that defoliation was generally lowest in fenitrothion plots, somewhat higher in B.t. plots, and highest in untreated plots (Figure 3). Differences in trends of defoliation between fenitrothion and B.t. tended to be fairly constant across different population levels.

Treatment data were non-normal in distribution and hence were subjected to non-parametric analysis (Table 3). Because overall populations were different between treatments, the data were stratified into four pre-spray larvae/bud categories as follows: low = $>0\leq0.1$; moderate = $>0.1\leq0.2$; high = $>0.2\leq0.3$; extreme = >0.3. Significance between means of percent defoliation, percent reduction in defoliation, and percent corrected mortality were revealed (Table 3). These data corroborate conclusions from the defoliation curves and confirm significant differences in defoliation as well as percent reduction in defoliation in favour of fenitrothion in each population category.

Curiously this year, the levels of mean percent corrected mortality for both fenitrothion and B.t. were 10-15% lower than seen in previous years, but still with chemical mortality being higher than B.t. No explanation is readily apparent for this observation though it might be related to low or variable deposit, as well as the heterogeneity associated with declining populations.

Foray 48B

Forest Protection Limited had surplus Foray 48B in storage due to cancellation of the second application of B.t. in the 1991 protection program against hemlock looper. Bioassay results indicated the material was of sufficient potency for use in 1992. For logistical reasons it was decided to apply the material to two of the distant blocks using TBM aircraft. One block was chosen to receive 1x30 BIU/ha and the other 2 x 15 BIU/ha. There were insufficient data within the four population classes to make meaningful statistical comparisons - although both had positive effects as indicated in Table 2.

Foray 76B

Forest Protection Limited wished to use this new product to gain experience in its handling as well as to check its efficacy. One block (10 800 ha) was chosen for treatment and assessment. Unfortunately, budworm populations turned out to be very low in this block and hence efficacy data were limited, but positive nonetheless (Table 2).

Table 2. Mean larval densities, larval mortality, and current defolation on balsam fir trees from treated and untreated transects within the M-H forecast in northern N.B. in 1992.

		Pre-Spray Larvae		% Mortality		Defoliation	Reduction in Defoliation	
Block	n	/45-cm	/bud[a]	Obs.	Corr.[b]	Obs. %	Abs.[c]	%[d]
Fenitrothion - 2 X 210 g/ha								
A-4	60	12.3	.197	77.1	49.1	27.9	40.1	59.8
A-14	80	11.1	.237	70.7	41.7	41.9	29.9	44.9
A-15	145	11.5	.220	84.1	66.2	31.9	36.0	54.8
Fenitrothion - 2 X 140 g/ha								
A-14	95	7.3	.098	80.4	66.8	24.0	39.0	62.2
Bacillus thuringiensis - (Futura XLV-HP) - 2 X 15 BIU/ha								
A-5	100	11.9	.160	65.2	33.7	35.2	32.1	48.1
A-8	100	4.5	.072	69.5	49.8	26.1	31.8	56.2
A-13	96	6.4	.100	62.7	41.1	44.4	21.4	34.7
Bacillus thuringiensis - (Foray 76B) - 2 X 15 BIU/ha								
A-6	65	2.0	.046	83.0	79.3	13.4	41.1	75.3
Bacillus thuringiensis - (Foray 48B) - 2 X 15 BIU/ha								
A-17	44	10.9	.151	82.9	70.8	57.5	16.4	26.5
Bacillus thuringiensis - (Foray 48B) - 1 X 30 BIU/ha								
A-16	50	9.4	.126	90.8	77.6	26.1	39.9	62.1
Fenitrothion(210 g/ha) + B.t.(Futura XLV-HP @ 15 BIU/ha)								
A-9	15	7.5	.087	71.0	55.7	30.5	34.4	54.1
Fenitrothion(140 g/ha) + B.t.(Futura XLV-HP @ 15 BIU/ha)								
A-9	79	8.0	.144	45.5	24.7	47.0	20.9	31.4
Untreated								
C-101	50	14.8	.213	63.7	-	94.6	-	-
C-102	75	10.6	.179	55.5	-	66.3	-	-
C-103	50	13.4	.275	71.5	-	69.8	-	-
C-201	50	6.5	.108	55.6	-	81.7	-	-
C-202	50	7.0	.127	70.8	-	57.3	-	-
C-203	50	10.7	.175	79.0	-	37.7	-	-

[a] Larvae/bud corrected at tree level for frost damage.
[b] Abbott (1925).
[c] Absolute reduction in defoliation = Σ (Exp. % - Obs %)/n.
[d] % Reduction in Defoliation = Σ (((Exp. % - Obs. %)/Exp. %) x 100)/n.

Table 3. Means, standard errors and non-parametric (Kruskal-Wallis, Wilcoxon two-sample test ($P < 0.05$)) results for treatments in New Brunswick in 1992.

Pre-spray Population Range (Larvae/Bud)	Treatment*	n	Larvae/Branch $\bar{x}\pm SE$	NP**	Larvae/Bud $\bar{x}\pm SE$	NP	% Mortality $\bar{x}\pm SE$	NP	Corrected Mortality $\bar{x}\pm SE$	NP	% Defoliation $\bar{x}\pm SE$	NP	% Reduction in Defoliation $\bar{x}\pm SE$	NP
≤ 0.1	Untreated	109	3.4±0.2	a	.052±.003	bc	49.0±4.1	ab	-	-	60.3±2.8	d	-	-
	2 x Fen.@ 210 g/ha	102	3.7±0.3	a	.045±.003	ab	69.6±4.0	c	57.4±4.8	c	24.2±1.8	a	58.0±2.8	c
	2 x Fen.@ 140 g/ha	52	3.5±0.4	a	.042±.006	a	73.4±5.5	c	62.3±6.7	c	23.1±2.7	a	60.9±4.2	c
	2 x B.t.	188	4.1±0.3	a	.048±.002	abc	58.7±2.9	b	40.7±3.4	b	30.1±1.5	b	50.7±2.2	b
	Fen.+ B.t.	49	4.4±0.5	a	.058±.005	c	35.6±5.8	a	23.6±5.7	a	42.1±3.1	c	34.3±4.3	a
>0.1 ≤0.2	Untreated	111	9.9±0.5	a	.149±.005	ab	68.8±6.2	a	-	-	67.7±2.7	c	- -	-
	2 x Fen.@210 g/ha	75	9.2±0.5	a	.155±.004	b	80.6±3.1	b	60.6±4.6	b	29.1±2.9	a	62.0±3.5	b
	2 x Fen.@140 g/ha	34	9.9±0.8	ab	.134±.005	a	85.8±3.4	b	70.0±6.1	b	27.1±3.5	a	60.8±4.9	b
	2 x B.t.	74	11.3±0.6	b	.152±.003	ab	73.2±2.6	a	37.1±4.1	a	40.5±2.5	b	43.2±3.3	a
	Fen.+ B.t.	29	8.4±0.8	a	.146±.005	ab	66.5±6.2	a	36.5±7.7	a	42.4±3.7	b	37.9±4.4	a
>0.2 ≤0.3	Untreated	56	14.1±0.8	a	.255±.005	a	73.5±3.7	a	-	-	74.2±3.2	c	-	-
	2 x Fen.@210 g/ha	42	14.2±1.2	a	.252±.005	a	80.6±3.6	a	53.0±6.3	a	38.0±2.7	a	49.0±3.7	b
	2 x Fen.@140 g/ha	6***	16.5±2.6	(-)	.249±.017	(-)	93.4±3.1	(-)	76.2±10.5	(-)	21.5±4.8	(-)	70.3±6.6	(-)
	2 x B.t.	21	15.6±1.8	a	.255±.006	a	79.1±5.0	a	54.9±8.0	a	49.3±4.3	b	33.2±5.1	a
	Fen.+ B.t.	9***	12.3±2.2	(-)	.252±.013	(-)	55.5±14.5	(-)	44.4±14.8	(-)	50.6±7.9	(-)	36.7±10.8	(-)
>0.3	Untreated	49	21.8±1.8	a	.443±.023	a	79.1±2.5	a	-	-	77.2±3.0	b	-	-
	2 x Fen.@210 g/ha	66	23.5±1.7	a	.545±.026	b	87.2±2.1	b	48.8±5.3	-	51.6±3.7	a	39.5±3.9	-
	2 x Fen.@140 g/ha	3***	25.3±7.0	(-)	.341±.011	(-)	94.7±2.8	(-)	75.6±13.3	(-)	11.3±5.6	(-)	85.0±7.4	(-)
	2 x B.t.	13***	19.5±3.0	(-)	.538±.062	(-)	88.8±2.9	(-)	40.6±10.5	(-)	53.6±6.5	(-)	32.6±8.2	(-)
	Fen.+ B.t.	7***	21.6±3.5	(-)	.475±.041	(-)	60.1±13.9	(-)	17.2±12.7	(-)	60.1±5.9	(-)	25.9±6.9	(-)
Pooled	Untreated	325	10.5±0.5	b	.179±.008	c	65.2±1.9	b	-	-	67.8±1.5	d	-	-
	2 x Fen.@210 g/ha	285	11.6±0.7	b	.220±.013	c	78.7±1.8	c	55.3±2.6	c	33.9±1.5	b	53.1±1.8	c
	2 x Fen.@140 g/ha	95	7.3±0.7	a	.098±.008	a	80.4±3.2	c	66.8±4.2	d	24.0±2.0	a	62.2±2.9	d
	2 x B.t.	296	7.6±0.4	a	.110±.007	a	65.6±2.0	b	41.0±2.5	b	35.1±1.3	b	46.5±1.7	b
	Fen.+ B.t.	94	7.9±0.7	a	.135±.013	b	49.4±4.2	a	29.5±4.2	a	44.4±2.2	c	35.0±2.8	a

*Treatments: Untreated -Unsprayed transects.
2 x Fen.@210g/ha -Fenitrothion @ 2 x 210 g/ha.
2 x Fen.@140g/ha -Fenitrothion @ 2 x 140 g/ha.
2 x B.t. -Futura XLV-HP @ 2 x 15 BIU/ha.
Fen.+B.t. -Fenitrothion @ 1 x 210 or 140 g/ha + Futura XLV-HP @ 1 x 15 BIU/ha.

**NP: means with same letter within population classes in each column are not significantly different (Kruskal Wallis; Wilcoxon two-sample test, $P<0.05$)

***: low sample sizes; (-) indicates that treatment was excluded from non-parametric test.

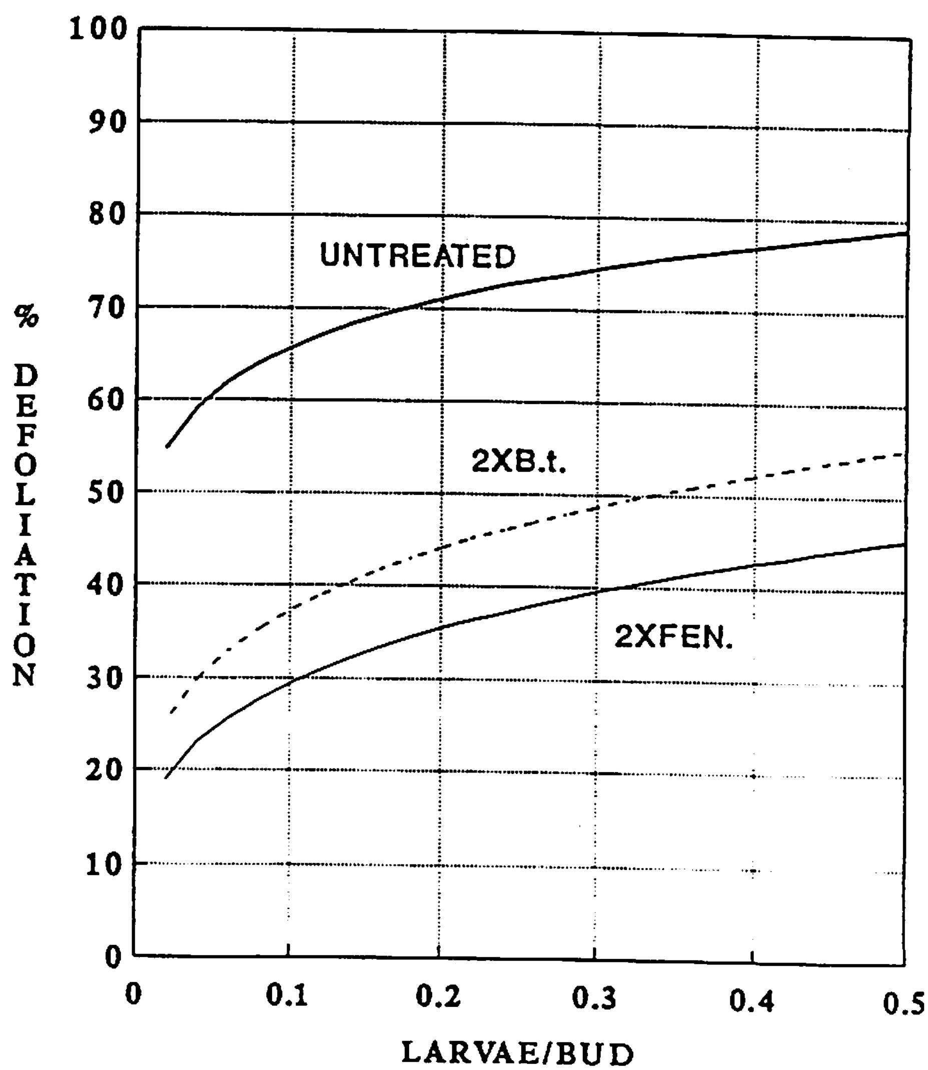

Figure 3. Comparison of relationships between expected defoliation and larvae/bud from treated and untreated check plots in 1992.

Fenitrothion at Reduced Dosage

In recognition of the federal review of the registration of fenitrothion, it was jointly decided by the N.B. Department of Natural Resources and Energy and Forest Protection Limited to evaluate the efficacy of fenitrothion applied at the reduced rate of 2 x 140 g/ha instead of the normal 2 x 210 g/ha rate. Approximately 11 700 ha were treated with the reduced rate applied by TBMs with boom and nozzles. Unfortunately, data were generally in the low and moderate ranges. Nevertheless, non-parametric analysis within these two categories showed no significant difference between means of percent corrected mortality, percent defoliation, or percent reduction in defoliation (Table 3). Whether this would hold true for high and extreme populations was not well demonstrated (due to low sample sizes). This use pattern is worth further investigation.

Sequential Fenitrothion/B.t. treatment

It has been speculated that if the standard double application of fenitrothion is environmentally unacceptable and that if the application of B.t. is not sufficiently efficacious for target levels of foliage protection, then perhaps an integrated use pattern might be an acceptable compromise. Operational trials in the past two years in New Brunswick have produced ambiguous results. Data collected this year (Table 3) show that despite being an improvement over the untreated situation, the sequential treatment had the lowest mean corrected mortality, the highest mean defoliation, and the lowest mean percent reduction in defoliation. These data suggest that the sequential treatment did not retain the full benefits of both products perhaps because both are sub-optimal in this pattern. This should not be taken as a final conclusion, however, as a more thorough analysis could reveal why this is so (e.g. information on timing or deposit collected in the R & D program by Forestry Canada this year). Perhaps a refinement of techniques might improve future results as this strategy is worth pursuing.

Forecast of Infestation for 1993

The forecast for 1993 is for 175 000 ha (Figure 4) of variable low-to-moderate and moderate populations. The area of moderate to high populations has decreased 72% from 620 000 ha in 1991 (Table 4). Considering that a decade ago the forecast covered 5.3 million ha with moderate and high populations, the scene has dramatically changed in New Brunswick. This is reflected in the proportion of forecast points falling within the various egg-mass or L2 population categories over these years (Table 5).

Plans for 1993

Protection plans for 1993 area being considered as 77% of the forecast area falls within the Hazard criteria normally used to select areas for treatment.

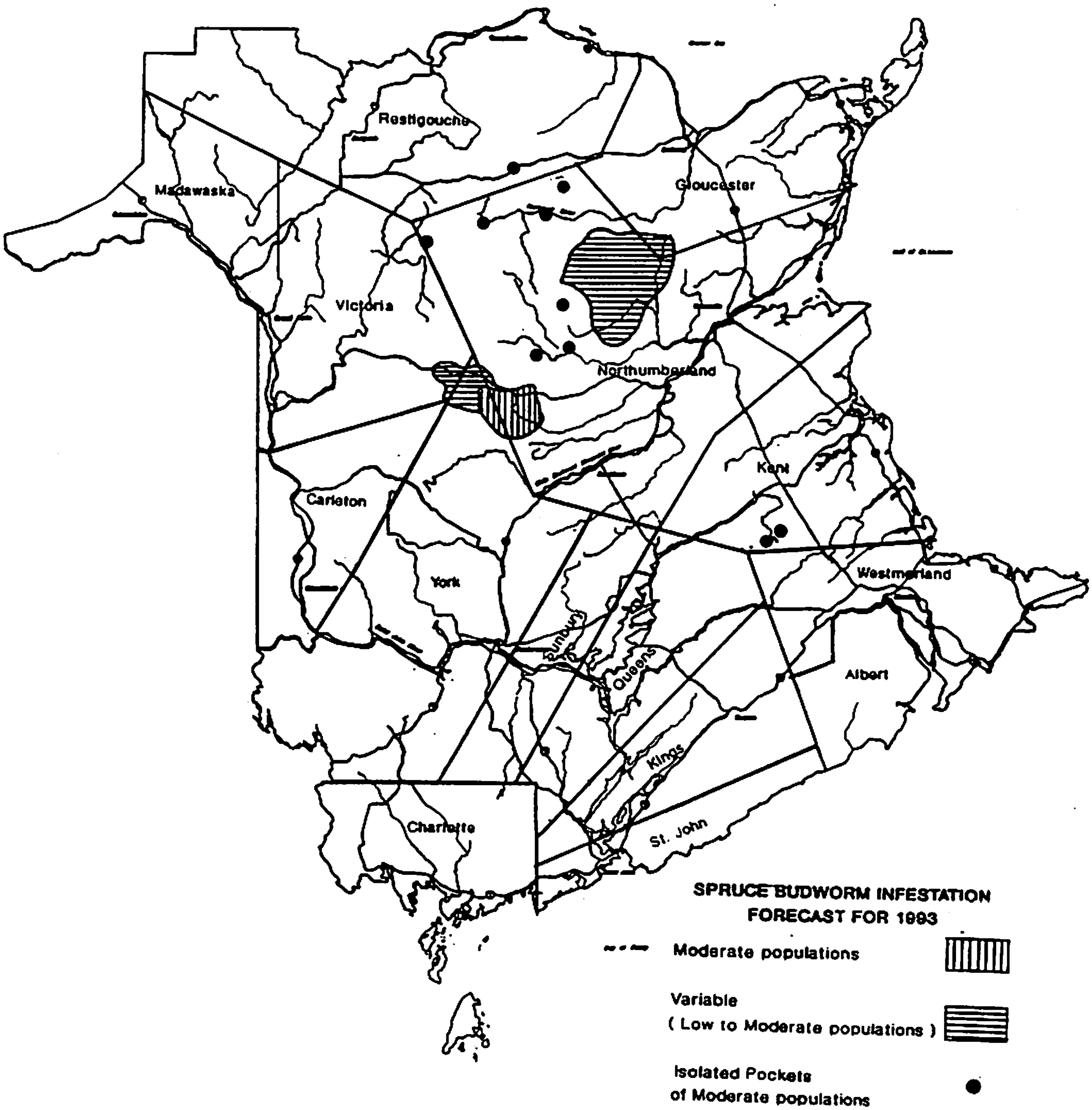

Figure 4. Areas of New Brunswick forecast to have moderate or variable low-to-moderate spruce budworm populations in 1993 based on the 1992 L2 survey.

Table 4. Comparison of forecast area (ha) of Moderate and High infestations 1982-1991, including variable (low-moderate) infestations in 1988, 1989 and 1992, and variable (low-high) infestations in 1990.

Year (N)	(N + 1) FORECAST
1982	5.30 million ha
1983	4.10 million ha
1984	3.57 million ha
1985	3.15 million ha
1986	1.71 million ha
1987	1.50 million ha
1988	1.65 million ha
1989	1.47 million ha
1990	0.99 million ha
1991	0.62 million ha
1992	0.17 million ha

Table 5. Comparison of spruce budworm infestation levels 1981-1992.

	FORECAST INFESTATION LEVEL (N + 1)			
YEAR/SURVEY (N)	LOW	MODERATE	HIGH	LOCATIONS[a]
1981/egg-mass	591 (34%)	441 (25%)	708 (41%)	1740
1982/egg-mass	458 (26%)	512 (29%)	783 (45%)	1753
1983/egg-mass	636 (48%)	257 (20%)	423 (32%)	1316
1984/egg-mass	747 (51%)	331 (22%)	398 (27%)	1476
1985/L2	833 (56%)	503 (32%)	185 (12%)	1521
1986/L2	1216 (77%)	322 (20%)	48 (3%)	1586
1987/L2	1198 (76%)	230 (15%)	144 (9%)	1572
1988/L2	879 (73%)	226 (19%)	99 (8%)	1204[b]
1989/L2	1102 (82%)	180 (13%)	67 (5%)	1349[b]
1990/L2	1007 (84%)	128 (11%)	63 (5%)	1198[b]
1991/L2	933 (87%)	111 (10%)	35 (3%)	1079[b]
1992/L2	904 (94%)	60 (6%)	4 (<1%)	968[bc]

a - Supplementary sampling not included.
b - Fewer samples taken because of collapse in southern part of province.
c - No samples taken south of east-west line through Taymouth (approx 30 km north of Fredericton).

FOREST PROTECTION LIMITED

1992 SPRUCE BUDWORM
AERIAL TREATMENT PROGRAM REPORT

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June 30, 1992

FOREST PROTECTION LIMITED

1992 SPRUCE BUDWORM AERIAL TREATMENT PROGRAM REPORT

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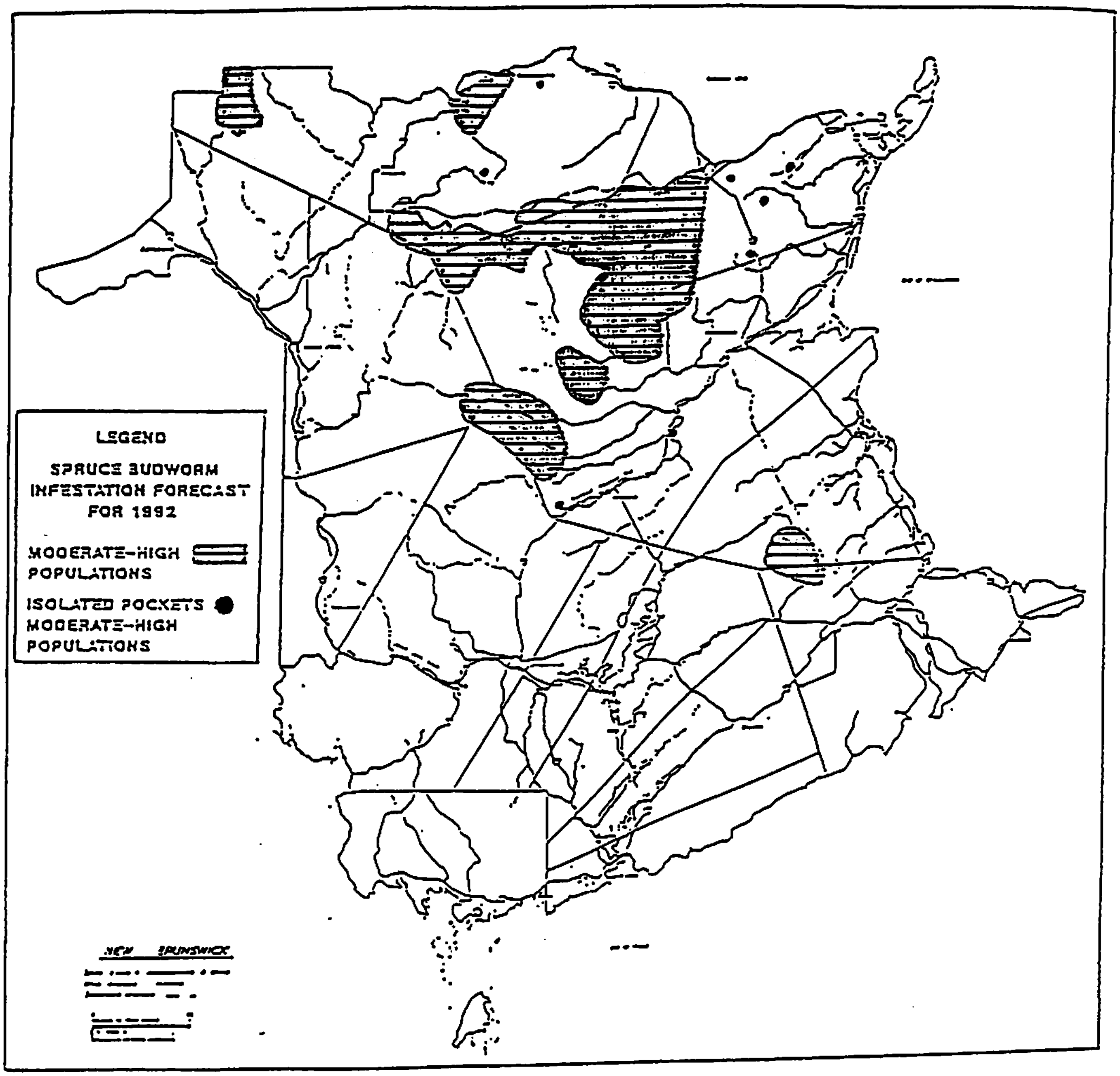
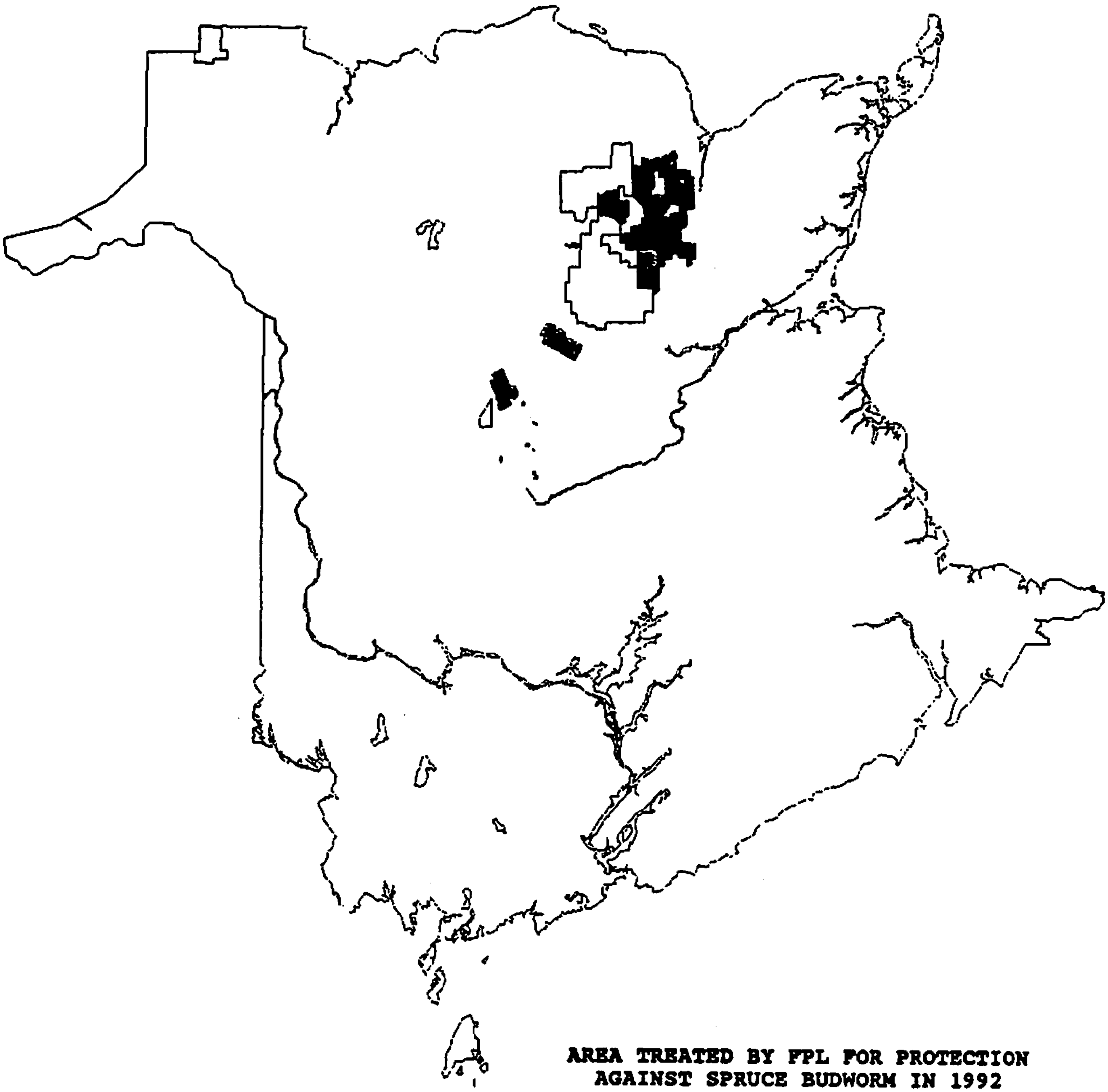


AREAS FORECAST TO HAVE MODERATE TO HIGH SPRUCE BUDWORM POPULATIONS IN NEW BRUNSWICK IN 1992 (SOURCE - DEPARTMENT OF NATURAL RESOURCES AND ENERGY)



AREA TREATED BY FPL FOR PROTECTION AGAINST SPRUCE BUDWORM IN 1992

- Fenitrothion (2 x 210 g/ha)
- Fenitrothion (2 x 140 g/ha)
- Fenitrothion (210 g/ha) + B.t. (15 BIU/ha)
- Fenitrothion (140 g/ha) + B.t. (15 BIU/ha)
- B.t. (2 x 15 BIU/ha)
- B.t. (1 x 30 BIU/ha)
- R&D Product Trials (Forestry Canada)

FOREST PROTECTION LIMITED

1992 AREA (HECTARES) TREATED AGAINST SPRUCE BUDWORM BY INSECTICIDE AND AIRCRAFT TYPE

Insecticide	Dosage	Aircraft Type	Number of Hectares: First Application	Number of Hectares: Second Application	Percent
Fenitrothion	2 x 210 g/ha	TBM (Boom & Nozzle)	129 102	135 670	56%
		Cessna 188	6 568	---	1%
Fenitrothion	2 x 140 g/ha	TBM (Boom & Nozzle)	11 710	11 710	5%
TOTAL FENITROTHION TREATED AREA			147 380	147 380	62%
Fenitrothion	1 x 210 g/ha	TBM (Boom & Nozzle)	4 840	---	2%
+ B.t. (Futura XLV-HP)	1 x 15 BIU/ha	THRUSH 600	---	4 840	
Fenitrothion	1 x 140 g/ha	Cessna 188	4 160	---	2%
+ B.t. (Futura XLV-HP)	1 x 15 BIU/ha	Cessna 188	---	4 160	
TOTAL FENITROTHION + B.t. TREATED AREA			9 000	9 000	4%
B.t. (Futura XLV-HP)	2 x 15 BIU/ha	THRUSH 600	48 869	48 869	21%
		Cessna 188	3 486	3 486	1%
B.t. (Foray 76B)	2 x 15 BIU/ha	THRUSH 600	10 820	10 820	5%
B.t. (Foray 48B)	2 x 15 BIU/ha	TBM (Boom & Nozzle)	7 880	7 880	3%
B.t. (Foray 48B)	1 x 30 BIU/ha	TBM (Boom & Nozzle)	9 240	---	4%
TOTAL B.t. TREATED AREA			80 295	71 055	34%
TOTAL AREA TREATED (1 or 2 applications)			236 675	227 435	100%

FOREST PROTECTION LIMITED

1992 AREA (HECTARES) AGAINST SPRUCE BUDWORM BY TREATMENT AND OWNERSHIP

Treatment	Department of Natural Resources and Energy	Fraser Inc.	NBIP Forest Products Inc.	Miramichi Pulp and Paper Inc.	TOTAL
Fenitrothion (2 x 210 g/ha)	129 600	2 910	3 000	160	135 670
Fenitrothion (2 x 140 g/ha)	10 915	---	---	795	11 710
Fenitrothion (1 x 210 g/ha) + B.t. (1 x 15 BIU/ha)	4 840	---	---	---	4 840
Fenitrothion (1 x 140 g/ha) + B.t. (1 x 15 BIU/ha)	4 160	---	---	---	4 160
B.t. (2 x 15 BIU/ha)	70 960	---	80	15	71 055
B.t. (1 x 30 BIU/ha)	9 240	---	---	---	9 240
TOTAL	229 715	2 910	3 080	970	236 675

S.H. Napper-LeDuc

GENERAL

Authorizations

The Deputy Minister of the Department of Natural Resources and Energy (DNRE) by letter of January 16, 1992, authorized Forest Protection Limited (FPL) to proceed on behalf of DNRE with the purchase of materials and contract aircraft for the 1992 aerial treatment program against spruce budworm. The area to be treated was approximately 230 000 ha at a ratio of approximately 63% fenitrothion to 37% B.t.

At a meeting of the Board of Directors of FPL on February 12, 1992 "it was Resolved that the General Manager at this time be authorized to make commitments for R&D projects to be conducted in the 1992-93 fiscal year not to exceed $110,000, not including dedicated funding from other sources..."

On May 19, 1992 Hon. Alan Graham, Minister DNRE, signed a letter of agreement to implement Order-in-Council #92-352, which authorized FPL to conduct the spray program as specified.

(Copy of letter in Appendix, pg A-1).

Permit to Spray

On February 06, 1992 a completed "Application for a Permit (Aerial)" was submitted to the Minister of Environment.

By letter dated May 12, 1992, and signed by Hon. Jane Barry, Minister, Department of Environment, the authorization for aerial application of insecticides was granted as outlined in the February 6th request for permit.

(Copy of permit in Appendix, pg A-3).

Support Facilities

Mixing and loading facilities were set up at Bathurst Airport and Sevogle airstrip through April and May. Bathurst Airport was only utilized for two B.t. products (Futura XLV-HP and Foray 76B) while Sevogle airstrip was used for two different B.t. products (Futura XLV-HP, Foray 48B) and two fenitrothion (Sumithion/Folithion) formulations (52:48 and 85.6:14.4 emulsifiable concentrate:water - Appendix pg A-9).

Complete kitchen, dining and sleeping facilities were established at Sevogle. Arrangements were made for personnel working at Bathurst to live and eat at the most convenient motels and restaurants.

Personnel

In addition to FPL's 19 regular staff, 44 seasonal ground workers and 29 contract flight crew were employed. The ground workers were employed, 4 at Bathurst, 33 at Sevogle, 6 in Fredericton and 1 at Dunphy. They were employed in a wide range of positions such as information monitors, tower operators, cooks, pump operators, payroll clerk, truck drivers, security, labourers, etc. All were paid daily rates according to responsibilities.

In order to operate the Cessna Dry lease fleet of Supervision and Pointer aircraft, 10 Navigators and 11 Pilots were contracted for the aerial treatment program. Four of these Pilots were kept on into July to fly aircraft for DNRE's aerial defoliation survey. FPL contracted 8 Spray Pilots to fly the TBM's and Cessna 188s. FPL's Chief Pilot was also used as a Spray Pilot on occasion.

For Firebombing purposes, FPL employed an additional 5 firebomber pilots, 4 birddog pilots and 1 security personnel.

Aircraft and Spray Equipment

A fleet of 12 spray aircraft, 9 of which were owned by FPL, and 12 navigation aircraft was assembled for the project. One helicopter was retained on contract for search and rescue purposes. Details of ownership and type of aircraft are in the Appendix, pg A-8.

The Thrush 600 and Cessna 188 spray aircraft were equipped with six and four Micronair AU4000 wind-driven rotary atomizers respectively. Seven TBM spray aircraft were equipped with T-Jet 11010 nozzles.

FPL operationally tested two navigation/data logging systems in 1992. One TBM was equipped with a SOCOMAR navigation/data logging system for recording latitudes and longitudes from a Global Positioning System (GPS) and altitudes from a radar altimeter. One Cessna 188 was equipped with a REMSPEC navigation/data logging system for recording latitudes and longitudes from a GPS, altitudes from a radar altimeter, ground and air speeds, atomizer rpms, flow rates and temperature. These systems are still being evaluated for operational purposes.

Insecticide Purchases

Price quotations were requested from major suppliers of pesticides for the spruce budworm program and all quotations were received by January 31, 1992.

Purchase orders were issued as follows:

Sumitomo Canada Limited - for 200 drums each containing 250 kg of 96% technical fenitrothion, total of 50 000 kg @ $13.37 per kg.

Novo Nordisk Bioindustrials, Inc. - for 62 136 ℓ of Futura XLV-HP B.t. at 33.0 B.I.U.'s per litre, total 2 050 488 B.I.U.'s @ $0.30 per B.I.U.

- for 16 275 ℓ Foray 76B B.t. @ 20.0 B.I.U.'s per litre for a total of 325 500 B.I.U.'s @ $0.29 per B.I.U.

In addition, FPL had existing inventories of fenitrothion (Sumithion and Folithion) and B.t. (Foray 48B and Futura XLV-HP). Details of insecticide utilization and inventory are in the Appendix, pg A-9.

Aerial Treatments

A total of 236 675 ha were aerially treated during the 1992 project. The two major treatments completed during the project were a double application of fenitrothion at 210 g a.i. per ha to 135 670 ha and a double application of B.t. at 15 B.I.U.'s per ha to 71 055 ha for 57% and 30% of the total program respectively. In addition, a double application of fenitrothion at 140 g a.i. per ha was applied by TBM (boom and nozzle) to 11 710 ha to operationally test a lower dosage rate for this pesticide. A single application of B.t. (Foray 48B) at 30 B.I.U. per ha was also applied to 9 240 ha to operationally test this low-concentration (12.7 B.I.U.s/ℓ) B.t. at a single high volume application. (2.362ℓ/ha)

A first application of fenitrothion followed several days later by a second application of B.t. was applied to one block of 9 000 ha or 4% of the program. A portion of this block (4 160 ha) was treated with fenitrothion at 140 g a.i. followed by B.t. at 15 B.I.U.'s per ha (both applied by Cessna 188s) for the research and development project "Development of a Spray Strategy Against the Spruce Budworm Using Fenitrothion and B.t. Applied Through Enhanced Atomization." This project is outlined in the Appendix pg A-13. The fenitrothion treatment for the first application in the remaining portion of this block was at 210 g a.i. per ha applied by TBM's.

Formulations and application rates for all treatments are detailed in the Appendix pg A-9.

<u>Block Openings</u>

The first block to be treated with B.t. was declared open (ie biologically ready for treatment) by DNRE for the morning of May 28th, but weather did not permit spraying to commence until the evening of May 29th. This particular B.t. Block was being operationally sampled by DNRE to test an "early timing", ie. it was declared biologically ready for treatment at the same timing as for traditional fenitrothion treatments. The traditional timing for first application of fenitrothion occurs when most of the larvae are 3rd instar; the insects have migrated from mined needles to the fir shoots; and the fir shoots are mostly Class III and Class IV. Traditional timing for first B.t. application would occur a few days later when the larvae are at least 3rd instar; insects have migrated from mined needles and are feeding within fir shoots; and the fir shoots are Class IV and Class V (source DNRE).

The first blocks to be treated with fenitrothion were declared biologically ready for the evening of May 29th and treatment began the following morning. More fenitrothion and B.t. blocks were declared ready on subsequent days until all blocks were opened by June 9th.

All first applications of fenitrothion and B.t. were completed by June 5th and June 10th respectively. The block with a single application of B.t. was completed on June 9th. All operational applications were completed on June 12th. There was a minimum of a 5 day period between first and second applications for fenitrothion. This 5 day minimum waiting period was also applied to B.t. blocks, with minor exceptions being made for operational considerations (3 areas totalling 4 365 ha).

Applications of products being evaluated for spruce budworm control by Forestry Canada-Maritimes which included single and double applications were completed by FPL's Cessna 188s on June 18.

Weather

FPL contracted Atlantic Weather Environmental Consultants (AWEC) to provide operational weather forecast support including the establishment and operation of a weather observation station at Sevogle airstrip. Weather forecasts were used to judge the suitability of conditions for aircraft safety and operational feasibility; and to assist in making decisions on efficacious protection based upon guidelines developed from the research project "Post-Spray Weather Influences on Efficacy of Chemical Insecticide and B.t. Against the Eastern Spruce Budworm - Transferring Research Results to Operational Situations". This project is outlined in the Appendix pg A-12.

"Very good" spray weather conditions were experienced after applications began. Blocks were aerially treated on fifteen of a potential sixteen days during the project with unfavourable weather conditions occurring only during 7 morning or evening sessions during the entire project.

Accidents and Incidents

There were no incidents or accidents involving spray aircraft during the project.

On June 12th, a Cessna 206 spotter aircraft landing at Fredericton Airport at the completion of a return ferry flight had a prop and wing touch the runway causing minor damage. The mishap was attributed to very gusty wind conditions and an insurance settlement is pending.

Research and Development

FPL is participating wholly or in part in various research and development projects relating to weather influences re efficacy and timing; evaluating/developing spray technology/strategies, navigation systems, data-loggers, spray deposition models; and product testing.

Other participants in these projects include Atlantic Weather Environmental Consultants (AWEC), Atmospheric Environment Services - Environment Canada (AES), DNRE, Forestry Canada - Maritimes (FCM), Forestry Canada - Forest Pest Management Institute (FPMI), National Research Council (NRC), New Brunswick Research and Productivity Council (RPC), Novo Nordisk Bioindustrials, Inc., Ontario Ministry of Natural Resources (OMNR), Rohm & Haas Canada Inc., Spray Efficacy Research Group (SERG) and the University of New Brunswick, Department of Chemical Engineering (UNB).

The eleven projects undertaken to date in 1992 are outlined in the Appendix, pg A-11. Direct project costs total approximately $402,000, FPL's portion being approximately $100,000. Direct project costs do not include the in-house costs of the various participants.

<u>Information Centre</u>

An Information Centre was operated from FPL's headquarters at the Fredericton Airport. As announced by public notice in New Brunswick newspapers, a toll-free bilingual service was available from any part of the Province for those requesting information. This service was in operation daily from 5 a.m. to 10 p.m. during the project period. The Information Center personnel answered all calls in a factual manner and arranged for call-backs if the requested information was not readily available.

In addition, information as to zones open for treatment was sent daily by FAX for distribution via the Communications New Brunswick closed circuit teletype. This same information was also made available to a toll-free Code-a-Phone service on a 24 hour-a-day basis. Information on which blocks or portions of blocks that could be treated during the next 24 hours was also sent daily by FAX to DNRE and forest industry representatives.

Other than Code-a-Phone use, 13 calls for information were received, recorded and classified as: Environment Canada (3), Media (6), DNRE (2), Industry (1), General Information (1).

Projected Costs

The FPL budgeted expenditures for the 1992 program are approximately $3,735,000 for aerial treatment excluding overhead, research and development expenditures. This will result in a projected cost to FPL participants of approximately $14.60/ha for two applications of fenitrothion, $17.60/ha for two applications of B.t. and $16.10/ha for the fenitrothion/B.t. treatment.

FPL's actual costs to participants for the 1991 program were $14.71/ha for fenitrothion/fenitrothion, $17.32/ha for B.t./B.t. and $16.01/ha for fenitrothion/B.t.

Results of the 1992 Program and Forecasts for 1993

DNRE will complete surveys to assess the results of the 1992 spray project once larval feeding has ceased. Also, surveys will be conducted in the late summer/fall for predicting 1993 populations. Analysis of these surveys will be available from DNRE this autumn.

D.C. Davies

June 30, 1992

FOREST PROTECTION LIMITED

RAPPORT DU PROGRAMME
DE PULVÉRISATION AÉRIENNE CONTRE
LA TORDEUSE DU BOURGEON DE L'ÉPINETTE DE 1992

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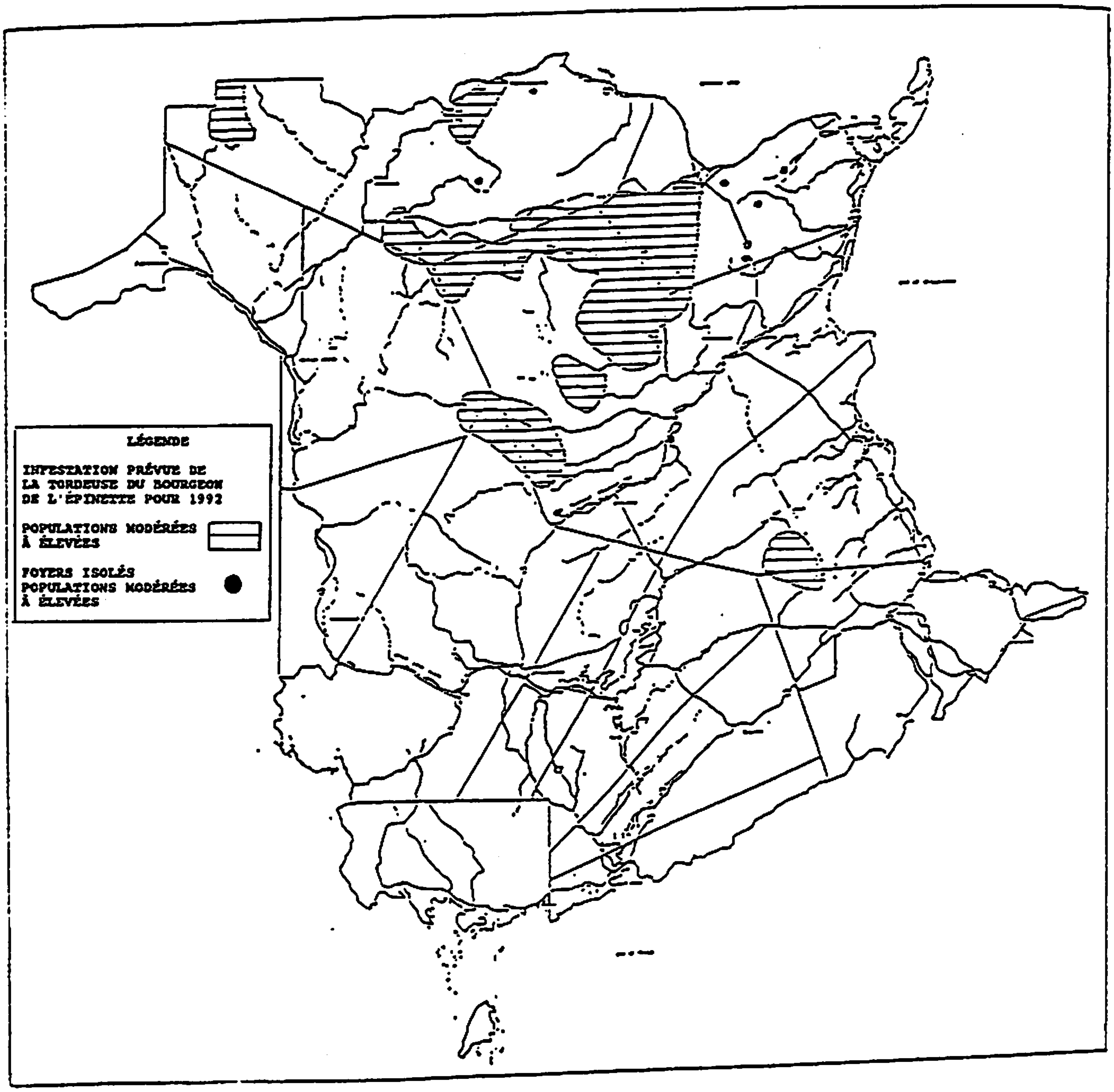
le 30 juin 1992

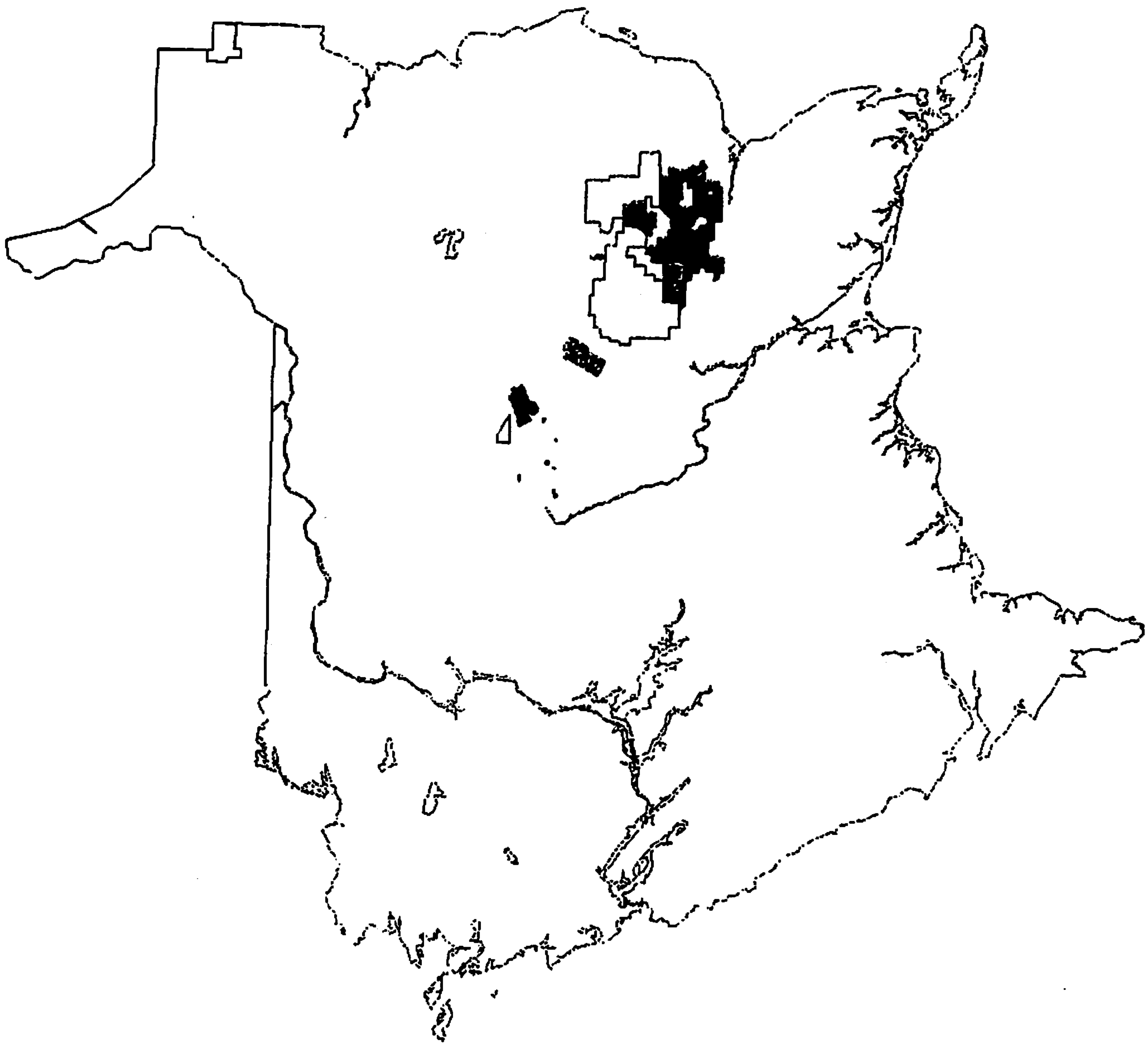
FOREST PROTECTION LIMITED

RAPPORT DU PROGRAMME DE PULVÉRISATION AÉRIENNE CONTRE LA TORDEUSE DU BOURGEON DE L'ÉPINETTE DE 1992

TABLE DES MATIÈRES



SECTEURS OÙ DES POPULATIONS MODÉRÉES À ÉLEVÉES DE TORDEUSE DU BOURGEON DE L'ÉPINETTE SONT PRÉVUES AU NOUVEAU-BRUNSWICK EN 1992 (SOURCE: MINISTÈRE DES RESSOURCES NATURELLES ET DE L'ÉNERGIE)



**SUPERFICIE TRAITÉE PAR FPL EN 1992
POUR LUTTER CONTRE LA TORDEUSE
DU BOURGEON DE L'ÉPINETTE**

- **Fénitrothion (2 x 210 g/ha)**
- **Fénitrothion (2 x 140 g/ha)**
- **Fénitrothion (210 g/ha) + B.t. (15 MUI/ha)**
- **Fénitrothion (140 g/ha) + B.t. (15 MUI/ha)**
- **B.t. (2 x 15 MUI/ha)**
- **B.t. (1 x 30 MUI/ha)**
- **Essais de produits, recherche et développement (Forêts Canada)**

FOREST PROTECTION LIMITED

SUPERFICIE (HA) TRAITÉE EN 1992 CONTRE LA TORDEUSE DU BOURGEON DE L'ÉPINETTE SELON L'INSECTICIDE ET LE TYPE D'AVION

			Nombre d'hectares		
Insecticide	Dosage	Type d'avion	1^{e} application	2^{e} application	Pourcentage
Fénitrothion	2 x 210 g/ha	TBM (gicleurs ouverts)	129 102	135 670	56 %
		Cessna 188	6 568	---	1 %
Fénitrothion	2 x 140 g/ha	TBM (gicleurs ouverts)	11 710	11 710	5 %
SUPERFICIE TOTALE TRAITÉE AU FÉNITROTHION			147 380	147 380	62 %
Fénitrothion	1 x 210 g/ha	TBM (gicleurs ouverts)	4 840	---	2 %
+ B.t. (Futura XLV-HP)	1 x 15 MUI/ha	THRUSH 600	---	4 840	
Fénitrothion	1 x 140 g/ha	Cessna 188	4 160	---	2 %
+ B.t. (Futura XLV-HP)	1 x 15 MUI/ha	Cessna 188	---	4 160	
SUPERFICIE TOTALE TRAITÉE AU FÉNITROTHION + B.t.			9 000	9 000	4 %
B.t. (Futura XLV-HP)	2 x 15 MUI/ha	THRUSH 600	48 869	48 869	21 %
		Cessna 188	3 486	3 486	1 %
B.t. (Foray 76B)	2 x 15 MUI/ha	THRUSH 600	10 820	10 820	5 %
B.t. (Foray 48B)	2 x 15 MUI/ha	TBM (gicleurs ouverts)	7 880	7 880	3 %
B.t. (Foray 48B)	1 x 30 MUI/ha	TBM (gicleurs ouverts)	9 240	---	4 %
SUPERFICIE TOTALE TRAITÉE AU B.t.			80 295	71 055	34 %
SUPERFICIE TOTALE TRAITÉE (1 ou 2 applications)			236 675	227 435	100 %

S.H. Napper-LeDuc

FOREST PROTECTION LIMITED

SUPERFICE (HA) TRAITÉE EN 1992 CONTRE LA TORDEUSE DU BOURGEON DE L'ÉPINETTE SELON LE TRAITEMENT ET LE PROPRIÉTAIRE

Traitement	Ministère des Ressources naturelles et de l'Énergie	Fraser Inc.	NBIP Forest Products Inc.	Miramichi Pulp and Paper Inc.	TO'
Fénitrothion (2 x 210 g/ha)	129 600	2 910	3 000	160	135
Fénitrothion (2 x 140 g/ha)	10 915	---	---	795	11
Fénitrothion (1 x 210 g/ha) + B.t. (1 x 15 MUI/ha)	4 840	---	---	---	4
Fénitrothion (1 x 140 g/ha) + B.t. (1 x 15 MUI/ha)	4 160	---	---	---	4
B.t. (2 x 15 MUI/ha)	70 960	---	80	15	71
B.t. (1 x 30 MUI/ha)	9 240	---	---	---	9
TOTAL	229 715	2 910	3 080	970	236

S.H. Napper-LeDuc

CONSIDÉRATIONS GÉNÉRALES

Autorisations

Le 16 janvier 1992, Forest Protection Limited, ou FPL, reçoit l'autorisation écrite de la sous-ministre des Ressources naturelles et de l'Énergie de procéder, au nom du ministère, à l'achat du matériel et aux contrats relatifs aux avions pour le programme de pulvérisation aérienne de 1992 contre la tordeuse du bourgeon de l'épinette. La superficie à traiter s'étend sur quelque 230 000 ha; le fénitrothion sera utilisé dans une proportion d'environ 63 %, et le B.t., d'environ 37 %.

À une réunion du conseil d'administration de FPL tenue le 12 février 1992, il est résolu d'autoriser le directeur général à engager dans des projets de recherche et de développement pour l'année financière 1992-1993 un montant maximal de 110 000 $, excluant les fonds provenant d'autres sources.

Le 19 mai 1992, l'hon. Alan Graham, ministre des Ressources naturelles et de l'Énergie, signe une lettre d'entente permettant la mise en vigueur du décret en conseil 92-352, qui autorise FPL à exécuter le programme de pulvérisation tel qu'il est précisé. (On trouvera une copie de la lettre à la page A-1 de l'annexe.)

Permis de pulvérisation

Le 6 février 1992, une demande de permis de pulvérisation est présentée à la ministre de l'Environnement.

Le 12 mai 1992, l'hon. Jane Barry, ministre de l'Environnement, accorde l'autorisation d'effectuer l'application d'insecticides par voie aérienne, tel que précisé dans la demande de permis présentée le 6 février. (On trouvera une copie du permis à la page A-3 de l'annexe.)

Installations de soutien

En avril et en mai, on procède à l'installation de l'équipement de mélange et de chargement à l'aéroport de Bathurst et à la piste d'atterrissage de Sevogle. L'application de deux produits de B.t. (Futura XLV-HP et Foray 76B) est faite à partir de l'aéroport de Bathurst; à partir de la piste d'atterrissage de Sevogle, celle de deux produits de B.t. (Futura XLV-HP et Foray 48B) et de deux préparations de fénitrothion (Sumithion et Folithion), soit des concentrés émulsionnables + eau 52/48 et 85,6/14,4. (Voir la page A-9 de l'annexe.)

Une cuisine, une salle à manger et des installations pour dormir sont établies à Sevogle. Des arrangements sont pris pour que le personnel travaillant à Bathurst loge et mange dans les motels et les restaurants les plus proches.

Personnel

En plus des 19 membres du personnel régulier de FPL, 44 travailleurs saisonniers au sol sont recrutés, ainsi que 29 personnes comme personnel navigant technique contractuel. Les membres du personnel au sol sont répartis ainsi : 4 à Bathurst, 33 à Sevogle, 6 à Fredericton et 1 à Dunphy. Ces personnes sont affectées à divers postes, notamment comme préposés aux renseignements, radiotechniciens, cuisiniers, préposés aux pompes, commis du service de la paie, camionneurs, manoeuvres, etc. Elles sont toutes rémunérées à un taux quotidien, selon leurs responsabilités.

Au total 10 navigateurs et 19 pilotes sont recrutés pour la flotte en location sèche de Cessna de surveillance et d'avions de pointage. Quatre des pilotes demeureront en service en juillet pour effectuer le relevé aérien de défoliation du ministère des Ressources naturelles et de l'Énergie. FPL a engagé à contrat 8 pilotes pour la pulvérisation pour conduire les TBM et les Cessna 188. Le pilote en chef de FPL est également pilote de pulvérisation à l'occasion.

À des fins de largage contre les incendies, FPL a aussi employé 5 pilotes d'avion-citerne, 4 pilotes d'avion de pointage et 1 agent de sécurité.

Avions et équipement de pulvérisation

Il est rassemblé pour le programme une flotte de 12 avions de pulvérisation, dont 9 appartiennent à FPL, et de 12 avions de pointage. Les services d'un hélicoptère sont retenus à des fins de recherche et de sauvetage. Les détails concernant les propriétaires et les types d'avion figurent à la page A-8 de l'annexe.

Pour le programme de pulvérisation, les Thrush 600 sont munis de six atomiseurs rotatifs éoliens Micronair, et les Cessna 188, de quatre. Par ailleurs, sept avions de pulvérisation TBM sont munis de buses T-Jet 11010.

En 1992, FPL a fait l'essai de deux systèmes de consignation de données. Un TBM a été muni d'un consignateur de données SOCOMAR pour enregistrer les latitudes et les longitudes au moyen d'un réseau global de positionnement, et les altitudes par un altimètre radar. Un Cessna 188 a été muni d'un consignateur de données REMSPEC pour enregistrer les latitudes et les longitudes au moyen d'un réseau global de positionnement, les altitudes par un altimètre radar, les vitesses au sol et dans les airs, les tours par minute des atomiseurs, les taux d'écoulement et la température. Ces systèmes font toujours l'objet d'une évaluation opérationnelle.

Achats d'insecticides

Des prix ont été demandés aux principaux fournisseurs de pesticides pour le programme de lutte contre la tordeuse du bourgeon de l'épinette, et les estimations ont toutes été reçues au plus tard le 31 janvier 1992.

Les bons de commande suivants ont été émis :

Sumitomo Canada Limited - 200 barils contenant chacun 250 kg de fénitrothion (96 % I.A.); total de 50 000 kg @ 13,37 $/kg.

Novo Nordisk Bioindustrials, Inc. - 62 136 l de B.t. Futura XLV-HP, 33,0 MUI/l; total de 2 050 488 MUI @ 0,30 $/MUI;
- 16 275 l de B.t. Foray 76B, 20,0 MUI/l; total de 325 500 MUI @ 0,29 $/MUI.

Par ailleurs, FPL avait en stock du fénitrothion (Sumithion et Folithion) et du B.t. (Foray 48B et Futura XLV-HP). Les détails concernant l'utilisation et les stocks d'insecticides figurent à la page A-9 de l'annexe.

Traitements par voie aérienne

Au cours du programme de 1992, un total de 236 675 ha a été traité par voie aérienne. Les deux principaux traitements effectués ont consisté en une double application de fénitrothion à 210 g I.A./ha sur 135 670 ha et en une double application de B.t. à 15 MUI/ha sur 71 055 ha, ce qui représente respectivement 57 % et 30 % du programme. De plus, une double application de fénitrothion à 140 g A.I. a été faite par TBM (gicleurs ouverts) sur 11 710 ha, afin de procéder à l'essai opérationnel d'un dosage plus faible de ce pesticide. Une application unique de B.t. (Foray 48B) à 30 MUI/ha a également été faite sur 9 240 ha afin de procéder à l'essai opérationnel d'une faible concentration de B.t., soit 12,7 MUI/l, appliquée en une fois à un volume élevé, soit 2,362 l/ha.

Un bloc de 9 000 ha, ou 4 % du programme, a reçu une première application au fénitrothion, suivie quelques jours plus tard d'une deuxième application au B.t. Une portion du bloc, soit 4 160 ha, a été traitée au fénitrothion à 140 g I.A., suivie de B.t. à 15 MUI/ha; ce double traitement, appliqué par Cessna 188, s'inscrivait dans le cadre du projet de recherche et développement sur la mise au point d'une stratégie de pulvérisation dans la lutte contre la tordeuse du bourgeon par recours au fénitrothion et au B.t. appliqués au moyen d'une atomisation améliorée. Un aperçu du projet est donné à la page A-13 de l'annexe. Le fénitrothion utilisé pour la première application de l'autre portion du bloc était à 210 g I.A./ha, appliqué par TBM.

Les préparations et les taux d'application de tous les traitements sont détaillés à la page A-9 de l'annexe.

Ouverture des blocs

Le ministère des Ressources naturelles et de l'Énergie a annoncé que le premier bloc serait biologiquement prêt à être traité dans la matinée du 28 mai; les conditions météorologiques n'ont toutefois pas permis d'entreprendre la pulvérisation avant le 29 mai en soirée. Ce bloc, à traiter au B.t., a servi d'échantillon opérationnel pour le ministère qui voulait faire l'essai d'un traitement précoce, ce qu'il a fait en déclarant le bloc biologiquement prêt à être traité au même moment que pour les traitements habituels au fénitrothion. La première application de fénitrothion est normalement effectuée au moment où la plupart des larves ont atteint l'âge L3; les insectes ont émigré des aiguilles minées aux pousses de sapin. Ces dernières sont principalement de catégories III et IV. D'habitude, la première application de B.t. se fait quelques jours plus tard, une fois que les larves ont au moins atteint l'âge L3; les insectes ont émigré des aiguilles minées et se nourrissent maintenant à l'intérieur des pousses de sapin, qui sont alors principalement de catégories IV et V (source : Ressources naturelles et Énergie).

Les premiers blocs à être traités au fénitrothion ont été déclarés biologiquement prêts pour la soirée du 29 mai, et le traitement a débuté le matin suivant. D'autres blocs à traiter au fénitrothion et au B.t. ont été déclarés prêts les jours suivants, jusqu'à l'ouverture de tous les blocs, le 9 juin.

Les premières applications de fénitrothion et de B.t. ont été achevées les 5 et 10 juin respectivement. Le bloc recevant une application unique de B.t. a été achevé le 9 juin. Le 12 juin, toutes les applications opérationnelles étaient achevées. Il y a eu un minimum de cinq jours qui se sont écoulés entre la première et la seconde application de fénitrothion. Cette période minimale d'attente de cinq jours s'est également étendue aux blocs pulvérisés au B.t., à quelques exceptions mineures près pour des raisons opérationnelles (3 secteurs représentant au total 4 365 ha).

Les applications de produits contre la tordeuse du bourgeon de l'épinette que Forêts Canada, région des Maritimes (FCM), évalue, dont des applications uniques et des applications doubles, ont été effectuées le 18 juin par les Cessna 188 de FPL.

Conditions météorologiques

FPL a retenu les services d'Atlantic Weather Environmental Consultants, ou AWEC, pour fournir un soutien opérationnel en prévisions météorologiques, y compris l'établissement et l'exploitation d'un poste d'observation météorologique à la piste d'atterrissage de Sevogle. Les prévisions météorologiques ont servi à juger de l'opportunité des conditions pour la sécurité des avions et la faisabilité opérationnelle, ainsi qu'à faciliter la prise de décisions visant une protection efficace et fondées sur les lignes directrices élaborées grâce au projet de recherche suivant : Influences météorologiques postpulvérisation sur l'efficacité des insecticides chimiques et du B.t. dans la lutte contre la tordeuse du bourgeon de l'épinette de l'Est, et application des résultats de recherche à des situations opérationnelles. Ce projet est décrit à la page A-12 de l'annexe.

On a connu de très bonnes conditions météorologiques après le début des applications. Les blocs ont été traités par voie aérienne pendant 15 des 16 jours possibles; les conditions ont été défavorables pendant seulement 7 séances en matinée ou en soirée durant tout le programme.

Accidents et incidents

Aucun accident ni incident impliquant des avions de pulvérisation n'a eu lieu pendant la durée du programme.

Le 12 juin, un pointeur Cessna 206 atterrissant à l'aéroport de Fredericton après un vol de convoyage a subi de légers dommages lorsqu'un propulseur et une aile ont heurté la piste. La mésaventure a été attribuée au vent soufflant en fortes rafales, et les assureurs ont été saisis d'une demande de règlement.

Recherche et développement

FPL finance partiellement ou entièrement divers projets de recherche et de développement, dont le rapport entre les conditions météorologiques et l'efficacité ainsi que le moment du traitement, l'évaluation et la mise au point de techniques et de stratégies de pulvérisation, les systèmes de navigation, les consignateurs de données, les modèles de dépôts de pulvérisation et l'essai de produits.

Participent également à ces projets les intervenants suivants : Atlantic Weather Environmental Consultants (AWEC); les Services de l'environnement atmosphérique d'Environnement Canada (SEA); le ministère des Ressources naturelles et de l'Énergie; Forêts Canada, région des Maritimes (FCM); l'Institut pour la répression des ravageurs forestiers (IRRF); le Conseil national de recherche du Canada (CNRC); le Conseil de la recherche et de la productivité du Nouveau-Brunswick (CRP); Novo Nordisk Bioindustrials, Inc.; le ministère des Ressources naturelles de l'Ontario; Rohm & Haas Canada Inc.; le Spray Efficiency Research Group (SERG); le département de génie chimique du l'Université du Nouveau-Brunswick (UNB).

On trouvera à la page A-11 de l'annexe un aperçu des 11 projets entrepris jusqu'à présent en 1992. Les coûts directs des projets s'élèvent au total à 402 000 $, et la part de FPL se chiffre à environ 100 000 $. Les frais internes des divers participants ne sont pas compris.

Centre de renseignements

Le bureau central de FPL, situé à l'aéroport de Fredericton, a assuré le fonctionnement d'un centre de renseignements. Un avis a été publié dans les journaux du Nouveau-Brunswick pour annoncer qu'il était possible d'obtenir des renseignements bilingues en téléphonant sans frais au centre de partout dans la province. Le service a été offert tous les jours du 5 heures à 22 heures pendant la durée du programme. Le personnel du centre de renseignements a répondu aux appels de façon concrète et a rappelé les gens lorsqu'il était impossible de fournir sur-le-champ le renseignement demandé.

De plus, une télécopie des renseignements relatifs aux secteurs de traitement était transmise tous les jours pour être diffusée par le téléscripteur en circuit fermé de Communications Nouveau-Brunswick. Ces renseignements étaient également à la disposition du public grâce à un service de réponse automatique sans frais accessible 24 heures par jour. Les renseignements concernant les blocs ou les portions de blocs prêts pour le traitement au cours des 24 heures suivantes étaient également transmises tous les jours par télécopieur au ministère des Ressources naturelles et de l'Énergie et aux représentants de l'industrie forestière.

En plus des appels au service de réponse automatique, le centre a reçu 13 demandes de renseignements, qui ont été enregistrées et réparties de la façon suivante : Environnement Canada, 3; les médias, 6; le ministère des Ressources naturelles et de l'Énergie, 2; l'industrie, 1; renseignements généraux, 1.

Prévisions des coûts

Les dépenses prévues de FPL pour le programme de traitement par voie aérienne de 1992 s'élèvent à environ 3 735 000 $, à l'exclusion des frais généraux ainsi que des dépenses liées à la recherche et au développement, ce qui donne lieu pour les participants au programme de FPL à un coût prévu de 14,60 $/ha pour deux applications de fénitrothion, de 17,60 $/ha pour deux applications de B.t. et de 16,10 $/ha pour le traitement fénitrothion-B.t.

Les coûts réels de FPL assumés par les participants au programme de 1991 ont été de 14,71 $/ha pour un traitement fénitrothion-fénitrothion, de 17,32 $/ha pour un traitement B.t.-B.t. et de 16,01 $/ha pour un traitement fénitrothion-B.t.

Résultats du programme de 1992 et prévisions pour 1993

Le ministère des Ressources naturelles et de l'Énergie terminera les relevés permettant d'évaluer les résultats du programme de pulvérisation de 1992 une fois que les larves auront cessé de se nourrir. En outre, on procèdera à d'autres relevés à la fin de l'été et à l'automne afin de pouvoir prévoir les populations de 1993. Il sera possible d'obtenir l'analyse des relevés auprès du ministère à l'automne.

D.C. Davies
le 30 juin 1992

Status of Some Forest Insect Pests in Nova Scotia

Entomological Services
Nova Scotia Department of Natural Resources

Entomological Services is a section within the Nova Scotia Department of Natural Resources. It is responsible for monitoring and assessing insect populations as well as disease occurrence in the forest. Some of the surveys are still ongoing and the analysis of data has just started. Full reports will be published this winter, through the Department. These reports are brief summaries of information collected to date.

General Overview:

The cold late spring we had seemed to have slowed insect development this year. For the most part, this has been a quiet year with numbers of insects generally low (Most notable exception being aphids). Catches from light traps have been reduced and even less calls from the public.

Spruce Budworm:

The Department along with Forestry Canada (FIDS) did an aerial survey to determine the extent of defoliation caused by the SBW. Again this year no defoliation was noted.

The amount of area in the province where some level of budworm was found during the L-2 Survey was 207 500 ha (Map 1). This is a decline of 54% from the area infested last year. Of the 1992 area of 207 500 ha, only 9 500 ha or 5% of this was even in the moderate population range the rest, making up 95%, was in the low population category. No treatment programs were necessary in 1992, none are planned for 1993.

Hemlock Looper:

The Department along with FC-FIDS did an aerial survey of Hemlock looper damage along the east coast of the province between Guysborough and Halifax (Map 2). Defoliation was found on 3 618 ha. This is only an increase of 5% from last year. It seems that the hemlock looper outbreak this year has not increased so much in new areas as it has intensity within established areas of previous infestation. In 1991, only 2.7% of the area was classed as having severe defoliation. In 1992, over 47% of the infestation fell into the severe class of defoliation.

The egg wash has just been completed and in general, the counts have been very low. No analysis have been undertaken as yet.

Gypsy Moth:

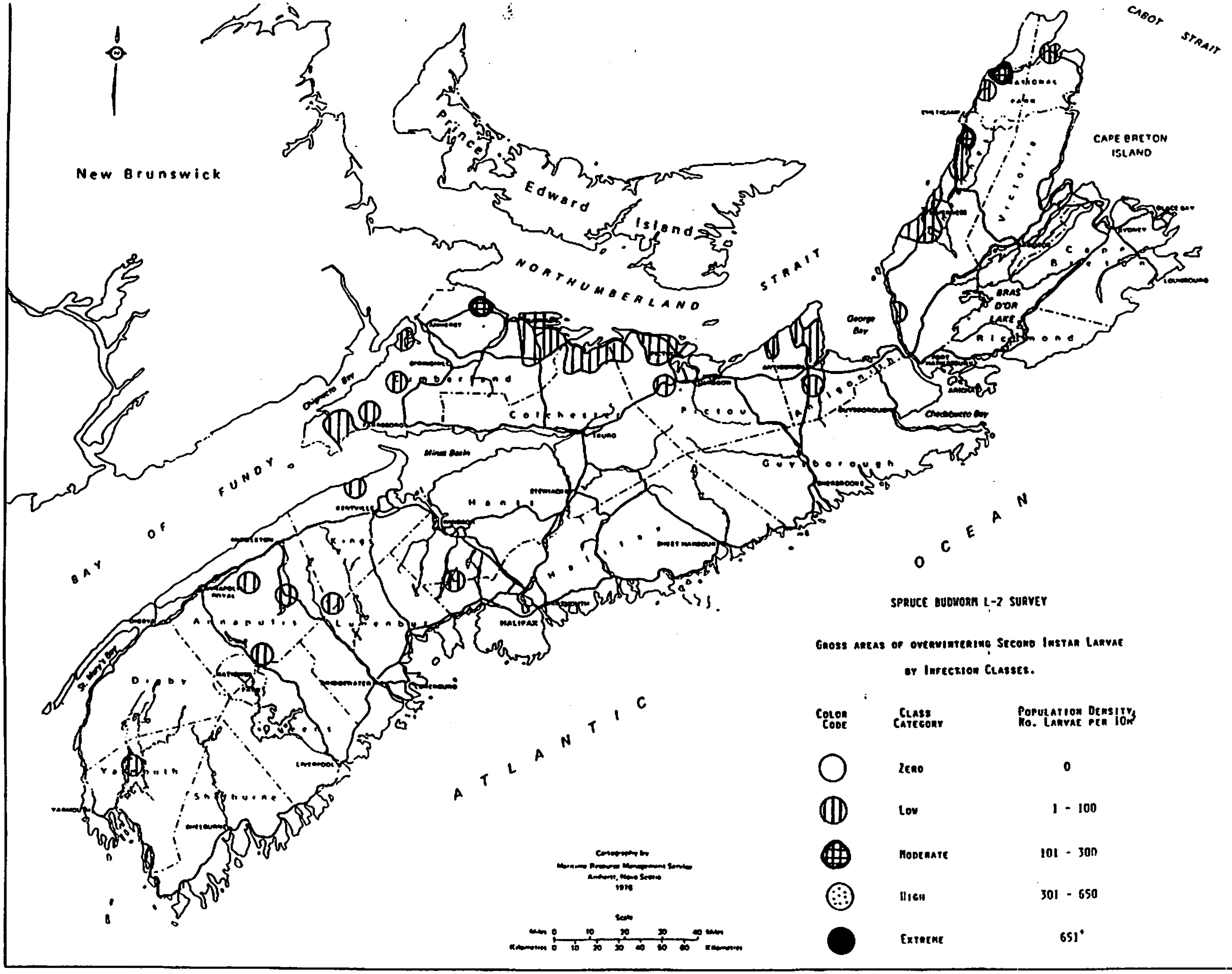
A very limited survey was made using burlap skirts around trees. This was done in a number of Valley towns including Canning, Kentville, Bridgetown and Annapolis Royal. The catches of larvae and pupa were down by 50% over last year.

Spruce Bark Beetle:

This is a new aerial survey that we tried this year in the Cape George area, north of Antigonish. A number of requests from landowners had come in regarding mainly the distribution of the spruce bark beetle. This is our first attempt to address the problem. No analysis of data yet, but map 3 shows the extent of the problem.

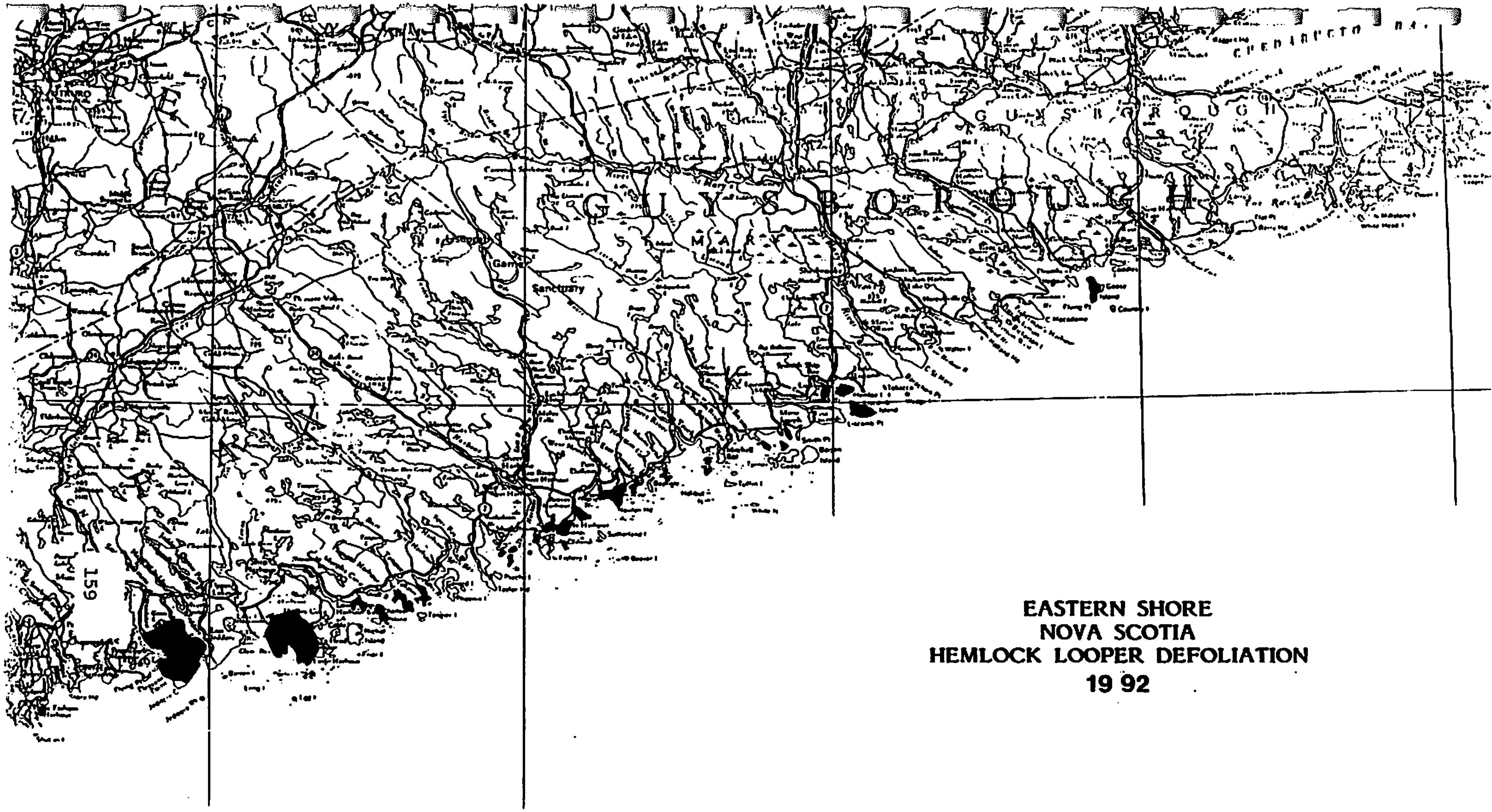
Seed and Cone Insects:

The only two seed orchards monitored this year were around the Debert area. In general, insects were down, but there were two important exceptions, the cone maggot and aphids. Spruce cone maggots were up approximately 40% in population, while aphids were up 62%. No analysis of data yet.



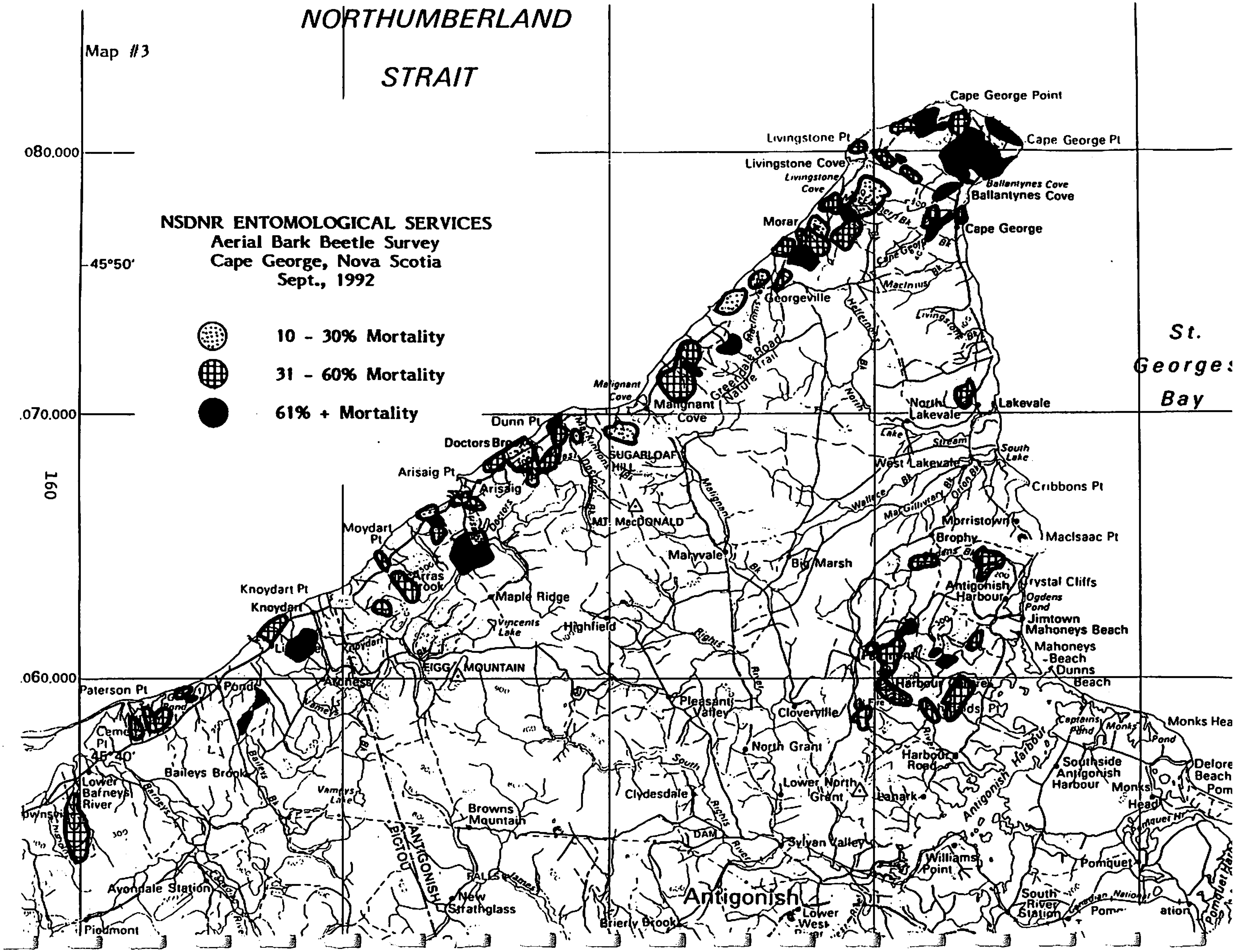
New Brunswick
Prince Edward Island
NORTHUMBERLAND STRAIT
CABOT STRAIT
CAPE BRETON ISLAND
BAY OF FUNDY
ATLANTIC OCEAN
George Bay
Chignecto Bay
Minas Basin
Chedabucto Bay
St. Mary's Bay
BRAS D'OR LAKE
Cumberland
Colchester
Pictou
Antigonish
Guysborough
Hants
Halifax
Kings
Annapolis
Lunenburg
Digby
Yarmouth
Shelburne
Victoria
Cape Breton
Richmond
TRURO
HALIFAX
SPRUCE BUDWORM L-2 SURVEY
GROSS AREAS OF OVERWINTERING SECOND INSTAR LARVAE
BY INFECTION CLASSES.
COLOR CODE
CLASS CATEGORY
POPULATION DENSITY, NO. LARVAE PER 10M²
ZERO
0
LOW
1 - 100
MODERATE
101 - 300
HIGH
301 - 650
EXTREME
651+
Scale
Miles 0 10 20 30 40 Miles
Kilometres 0 10 20 30 40 50 60 Kilometres

Map #1



EASTERN SHORE
NOVA SCOTIA
HEMLOCK LOOPER DEFOLIATION
19 92

Map #2


NORTHUMBERLAND
STRAIT
Map #3
NSDNR ENTOMOLOGICAL SERVICES
Aerial Bark Beetle Survey
Cape George, Nova Scotia
Sept., 1992
10 - 30% Mortality
31 - 60% Mortality
61% + Mortality
080,000
45°50'
070,000
060,000
160
St. Georges Bay
Cape George Point
Cape George Pt
Livingstone Pt
Livingstone Cove
Ballantynes Cove
Morar
Cape George
Georgeville
Greendale Road Nature Trail
Malignant Cove
North Lakevale
Lakevale
Dunn Pt
SUGARLOAF HILL
Doctors Brook
Arisaig Pt
Arisaig
West Lakevale
Cribbons Pt
MT. MacDONALD
Morristown
MacIsaac Pt
Brophy
Moydart Pt
Maryvale
Big Marsh
Arras Brook
Crystal Cliffs
Maple Ridge
Antigonish Harbour
Ogdens Pond
Knoydart Pt
Knoydart
Vincents Lake
Highfield
Jimtown
Mahoneys Beach
Dunns Beach
EIGG MOUNTAIN
Paterson Pt
Pleasant Valley
Cloverville
Monks Head
North Grant
Baileys Brook
Southside Antigonish Harbour
Lower Barneys River
Clydesdale
Lower North Grant
Lanark
Browns Mountain
Harbour Road
Antigonish Harbour
Sylvan Valley
PICTOU
ANTIGONISH
Williams Point
Pomquet
Avondale Station
New Strathglass
Antigonish
South River Station
Lower West River
Brierly Brook
Piedmont

HEMLOCK LOOPER IN NEW BRUNSWICK

(Prepared for Annual Forest Pest Control forum, Ottawa, Nov. 17-19, 1992)

STATUS OF OUTBREAK

The first hemlock looper outbreak to ever occur in New Brunswick was recorded in 1989 in the north-central part of the Province in an area called the Christmas Mountains. The total area of defoliation was ca. 3 800 ha mainly in mature and over-mature stands of balsam fir. An egg survey in the fall/winter led to a forecast of 20 000 ha for 1990. That year, following New Brunswick's first-ever protection program against hemlock looper, an aerial survey mapped defoliation over almost the same total area, ca. 3 500 ha, distributed in the same general location.

The forecast for 1991 was for ca. 22 700 ha in north-central New Brunswick and also ca. 6 800 ha in the southwest region. Following the second protection program, the total area of defoliation once again remained at the same low level of ca. 3 600 ha, again mostly in the general Christmas Mountain area, but also in one small pocket (near Miller Lake) close to the Quebec border in the northwest, and in the southwest in Charlotte County (mostly on Deer Island). According to the Forest Insect & Disease Survey of Forestry Canada -Maritimes some 94 000 m^3 of balsam fir were killed during 1989-91 in the north.

The forecast for 1992 failed to detect areas of significant populations in the north-central and northwestern regions, but did indicate the potential for pockets of defoliation scattered throughout some 56 600 ha in the southwest in Charlotte County. The aerial survey confirmed the general low forecast in the north with ca. 300 ha near Miller Lake and ca. 1 000 ha in the north-central area. Only ca. 200 ha of defoliation was detected in Charlotte County (on coastal islands) where the outbreak appeared to collapse.

PROTECTION PROGRAMS

The forecast for 1990 was for outbreak conditions within areas containing valuable and vulnerable stands of fir. It was decided to treat the outbreak for foliage protection and population suppression. Consequently, a protection program of 21 160 ha was conducted. The majority (17 800 ha) was treated three times using a fenitrothion (210 g/ha) - B.t. (Futura XLV, 30 BIU/ha) - fenitrothion (210 g/ha) spray regime. The balance (3 360 ha) received two applications of B.t. (Futura XLV) primarily for research purposes.

In view of the continued forecast in the north in 1991, it was decided to treat the area once again for foliage protection and population suppression, even though egg counts had decreased from the previous year. No action was scheduled for the southwest where populations were lower and scattered, and the forest was younger and mixed with hardwood. Originally the prescribed treatment was for two applications of B.t. to ca. 17 000 ha, but pre-treatment surveys failed to detect substantial larval counts throughout the areas sampled. Therefore, as a precautionary measure only a single application was made (Foray 48B @ 30 BIU/ha to ca. 15 500 ha, and Futura XLV-HP @ 30 BIU/ha to ca. 1 500 ha).

There was no protection against hemlock looper in New Brunswick in 1992.

Study of Natural Bio-control Agents in 1992

Because of the paucity of baseline information concerning hemlock looper in New Brunswick, the Department of Natural Resources and Energy undertook a limited study to investigate what parasites and pathogens were present as natural bio-control agents of looper. One site was chosen in Charlotte County and larval collections were made throughout the summer. Larvae were returned to a lab and reared individually on diet or foliage until the emergence of adult moths, parasites, or death. Dead insects were immediately frozen for later diagnosis.

During the study it was noted that survivorship to the adult stage was very low, only 11% and death due to unknown causes was high (56%) (Table 1). Examination of the data revealed little difference whether the larvae were reared on diet or foliage (the former being more convenient for handling).

Of the 439 cadavers which were examined, 32% had nuclear polyhedrosis virus, 9% were suspected to have granulosis virus, and 2% had the fungus Entomophaga aulicae (Table 1). The latter has often been associated with declines of hemlock looper outbreaks in Newfoundland. Diagnostics were done by or under the direction of Forestry Canada - Maritimes.

Only 6 parasites (suspected to be two species) were found (Table 1). Positive identifications beyond Family Tachinidae could not be made at either Forestry Canada - Maritimes or Newfoundland and Labrador Region. The specimens were sent to Biosystematics in Ottawa for identification but results have not yet been received.

Because only one site was monitored, it is not known to what degree these natural control agents influenced the decline throughout Charlotte County. Weather was frequently wet and windy this year and probably dislodged larvae making them more prone to predation also.

Table 1. Hemlock looper - study of parasites and diseases - interim results.

Larval Index	'n'	% Moths	Cadavers Examined	Cause of Death (%)				
				NPV	?GV	EA	PAR	NIL
1.4	131	0	122	7	11	0	0	82
2.3	145	3	129	16	8	2	0	74
3.4	128	13	110	71	6	2	1	26
4.5	118	33	78	41	10	4	6	21
Totals	522	11	439	32	9	2	1	56

NPV - Nuclear Polyhedrosis Virus.
?GV - Unconfirmed Granulosis Virus.
EA - Entomophaga aulicae.
PAR - Parasite (Tachinidae - I.D. Pending).
NIL - No Pathogen Found.

FORECAST FOR 1993

Based on observations of larval or adult activity during the summer and fall, an egg survey was conducted in four general zones within the Province, i.e. northwest, northeast, north-central and southwest. A total of 421 plots were sampled. Most of these plots (342) were extensive in distribution, much as the L2 survey for spruce budworm, and represented ca. 1 plot per 5 000 ha. Previous experience had suggested that whereas this intensity would likely be sufficient to detect sizeable areas of outbreak it would not be reliable to detect and delimit small pockets of infestation. Consequently, with the assistance of Regional staff and one of the pulp and paper companies, more intensive sampling was done in several areas around known pockets of damage. The intensity was ca. 1 plot per 200-400 ha.

As a result of the egg survey, three general outbreak areas (Figure 1) have been identified for a total area of ca. 11 260 ha, viz. near Miller Lake in the northwest (1 050 ha), and in the north-central area south of Popple Depot (9 380 ha), and in Mt. Carlton Provincial Park (830 ha). Delimiting these areas was the direct result of more intensive sampling. No significant populations were detected in Charlotte County.

CONTROL PROGRAM FOR 1993

At the time of the Annual Forest Pest Control Forum, results of the forecast were not known. Control actions for 1993 are under consideration.

N. Carter and L. Hartling
Forest Pest Management Section
Dept. of Natural Resources & Energy
P.O. Box 6000
Fredericton, N.B.
E3B 5H1

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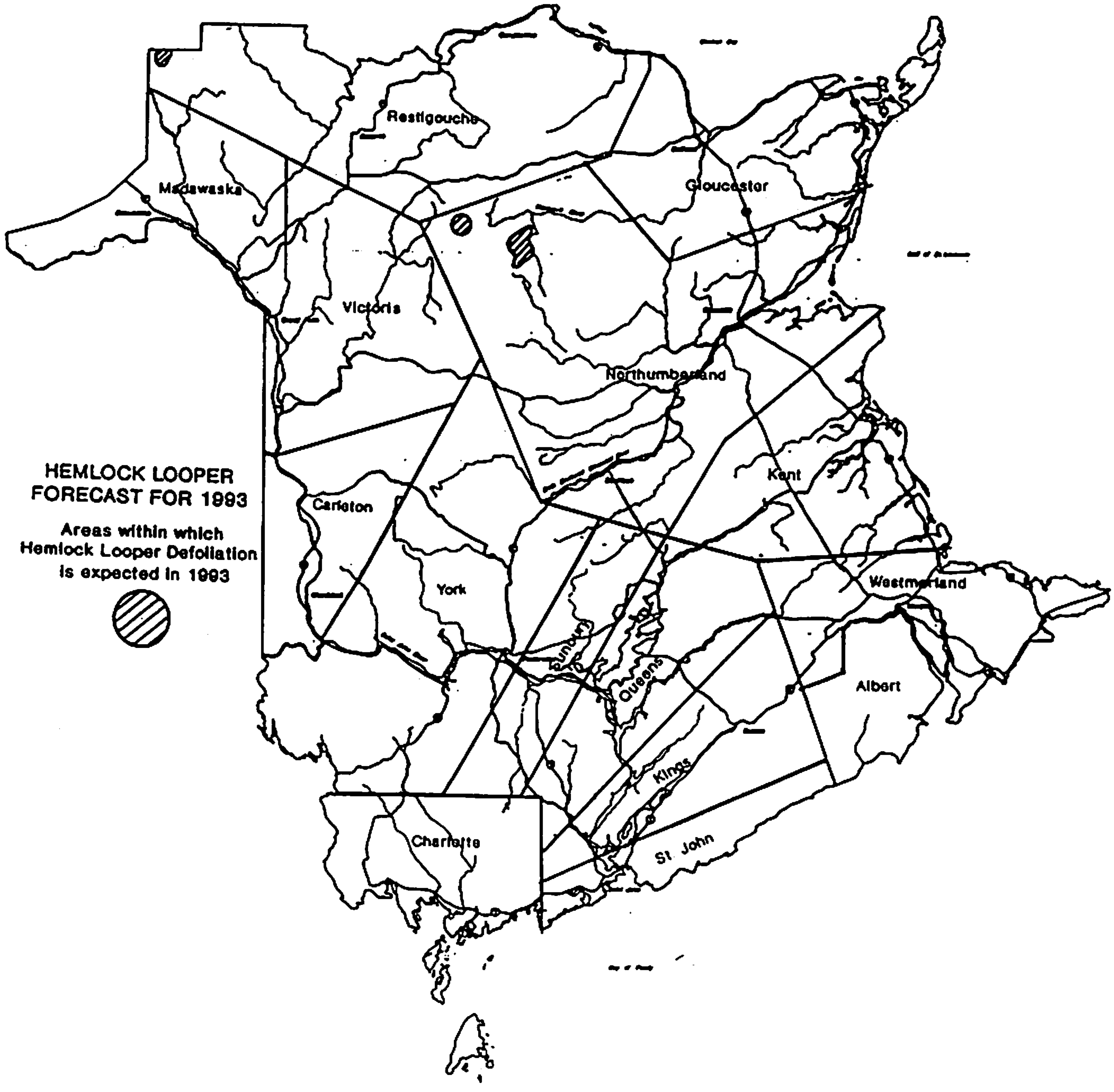


Figure 1. Areas within which defoliation by hemlock looper is expected to occur in New Brunswick in 1993.

THE SPRUCE BUDWORM IN NEWFOUNDLAND IN 1992

by

Bowers, W.W.

REPORT TO THE 20TH ANNUAL FOREST PEST CONTROL FORUM,
Ottawa, 17-19 November, 1992

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

THE SPRUCE BUDWORM IN NEWFOUNDLAND IN 1992

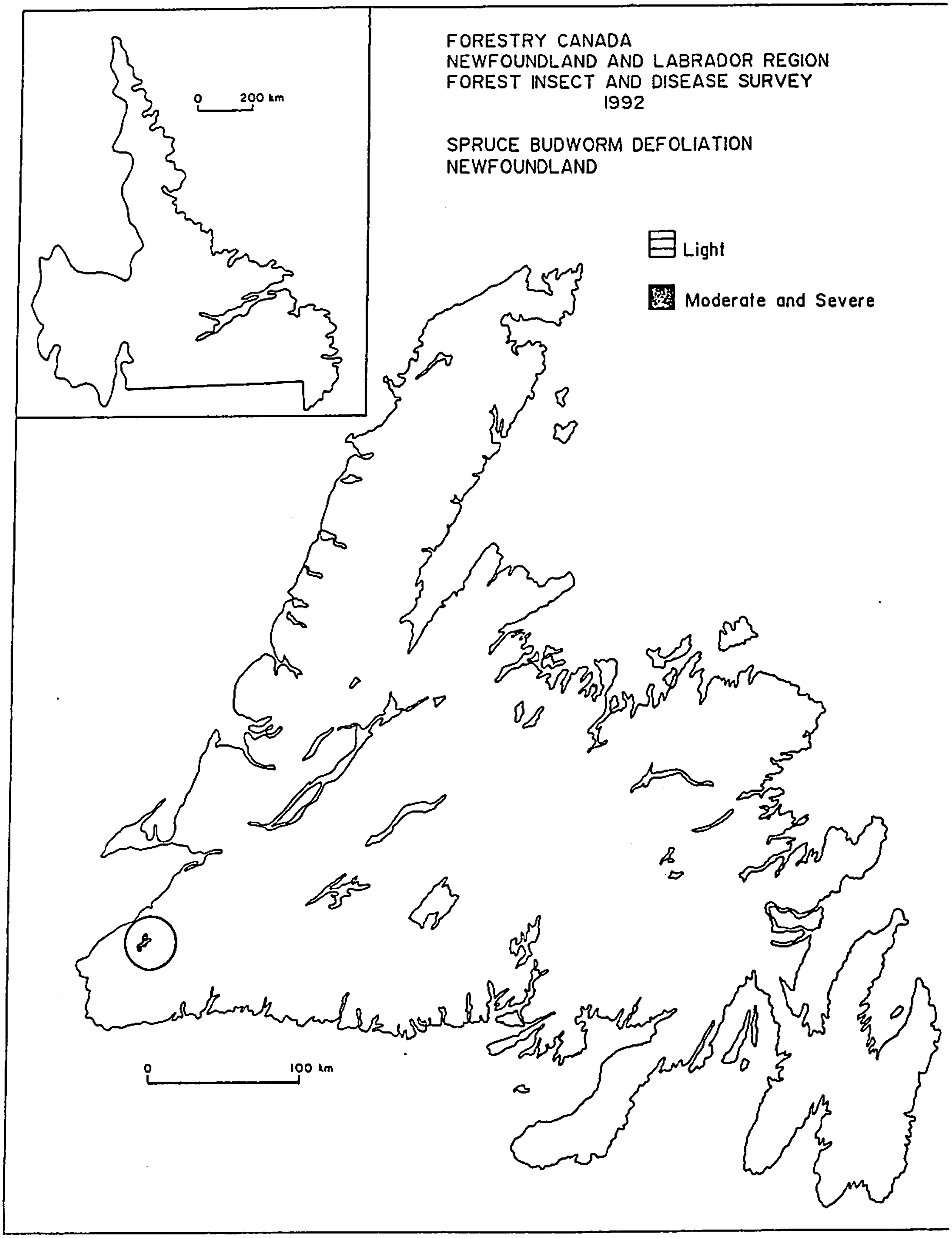
by

W.W. Bowers

Larval Development and Defoliation - Seasonal development of eastern spruce budworm (ESB) was delayed by almost 1 month due to cold wet weather for most of June and July. The infestation in the Codroy Valley in southwestern Newfoundland continued in 1992 with 1 919 ha of moderate and severe defoliation compared to 2 251 ha in 1991 (Fig 1, Table 1.). Areas of light defoliation increased slightly from 500 in 1991 to 721 ha in 1992. The total area of infestation in productive forests was 1 990 ha in 1992 and encompassed 94 300 m^3 of timber in all 3 defoliation categories.

Biological Mortality Factors - Data on mortality factors were collected from the infestation in western Newfoundland. Ten percent of the larvae (n = 711) reared were parasitized and 43% were killed by diseases.

Pheromone Trapping - Pheromone traps were placed at 50 permanent sample locations throughout the Island. The total number of moths captured decreased about three-fold from 6086 in 1991 to 1898 in 1992. The overall mean catch in 1992 was 38 moths per location, compared to 122 moths per location in 1991. In western Newfoundland the mean number of moths per location was 48.6, compared to 209 in 1991. The highest numbers trapped were along the west coast of the island at Campbells Creek ($\overline{X}$ number per trap = 86.0) and Bay of Islands ($\overline{X}$ = 69.0). The next highest trap catches were recorded at three coastal locations in western



FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
SPRUCE BUDWORM DEFOLIATION
NEWFOUNDLAND
Light
Moderate and Severe
0
200 km
0
100 km

Table 1. Areas (ha) of defoliation and gross merchantable volume (m^3) of affected stands caused by the spruce budworm in productive forests and areas of defoliation of total infestation in Newfoundland in 1992.

Mgmt. Unit	Productive Forest*								Total Infestation (ha)			
	Light		Moderate		Severe		Total					
	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Light	Mod.	Sev.	Total
14	538	16.5	264	12.1	1 188	65.6	1 990	94.3	721	375	1 544	2 640
Totals	538	16.5	264	12.1	1 188	65.6	1 990	94.3	721	375	1 544	2 640

* Provided by the Forest Management Division, Dept. of Forestry & Agriculture.

Newfoundland: Codroy Pond ($\overline{X}$ = 38.0), Sally's Cove ($\overline{X}$ = 30.3) and Trout Brook ($\overline{X}$ = 28.3). In central Newfoundland, traps at 17 locations averaged 38 moths per location, a number identical to 1991. The highest trap catch was at Twillick Brook ($\overline{X}$ = 28.0), however the average number of moths per trap was 13.2. Trap catches in eastern Newfoundland, including the Avalon Peninsula, were significantly lower than in western and central Newfoundland. Trap catches in 8 locations in eastern Newfoundland, averaged 4.4 moths per location in 1992, compared to an average of 27 moths per location in 1991. The highest trap catch in eastern Newfoundland was at Heart's Content ($\overline{X}$ = 4.0), and the overall average catch per trap decreased from 9 in 1991 to only 1.7 in 1992. In contrast to 1991 few moths were observed in the traps prior to local emergence.

Control Program - The Newfoundland Department of Forestry and Agriculture conducted an operational control program against spruce budworm in 1992 beginning on 21 June and ending on 14 July. Approximately 7800 ha were treated with the biological insecticide, *B.t.*

Forecast of Spruce Budworm Defoliation for 1993 - Overwintering populations were sampled in conjunction with the hemlock looper and blackheaded budworm egg sampling from mid- to late October, and a forecast will be prepared when the samples have been processed.

THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1992

by

Bowers, W.W.

REPORT TO THE 20TH ANNUAL FOREST PEST CONTROL FORUM,
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A1C 5X8

THE HEMLOCK LOOPER IN NEWFOUNDLAND IN 1992

by

W.W. Bowers

Larval Development and Defoliation - Seasonal development of eastern hemlock looper (EHL) was delayed by almost 1 month due to cold wet weather for most of June and July. Continued infestations of EHL caused moderate and severe defoliation on the Avalon Peninsula and new infestations were recorded throughout the Peninsula (Fig. 1). The infestation on the Northern Peninsula collasped but pockets of severe defoliation presisted on the Bonavista Peninsula in 1992. Significant defoliation also occurred near near Bernard's Brook in the Bay d'Espoir area. The total area of infestation increased from 4870 ha in 1991 to 9808 ha in 1992 with light, moderate and sever defoliation accounting for 2693, 1790 and 5325 ha, respectively (Table 1). Similarly, the total area of infestation in productive forests increased from 3042 in 1991 to 5625 ha in 1992 encompassing 237 272 m^3 of timber in all 3 defoliation categories.

Biological Mortality Factors - Larvae (n = 558) were collected for parasite rearing from infestations on the Avalon Peninsula. No parasities were recovered from EHL larvae, however diseases killed 74% of developing larvae.

Pheromone Trapping - A pheromone grid was established in summer 1992 using 50 permanent sample locations throughout Newfoundland. At each location, 3 pheromone baited traps (Multi-pher I, Multi-pher II and Gypsy Moth) were used to capture adult males. The multi-pher I type trap caught significantly higher numbers of moths ($\overline{X}$ number per trap = 698) than the multi-pher II ($\overline{X}$ = 170.8) and Gypsy Moth ($\overline{X}$ = 117.7) types. The mean number of moths per trap

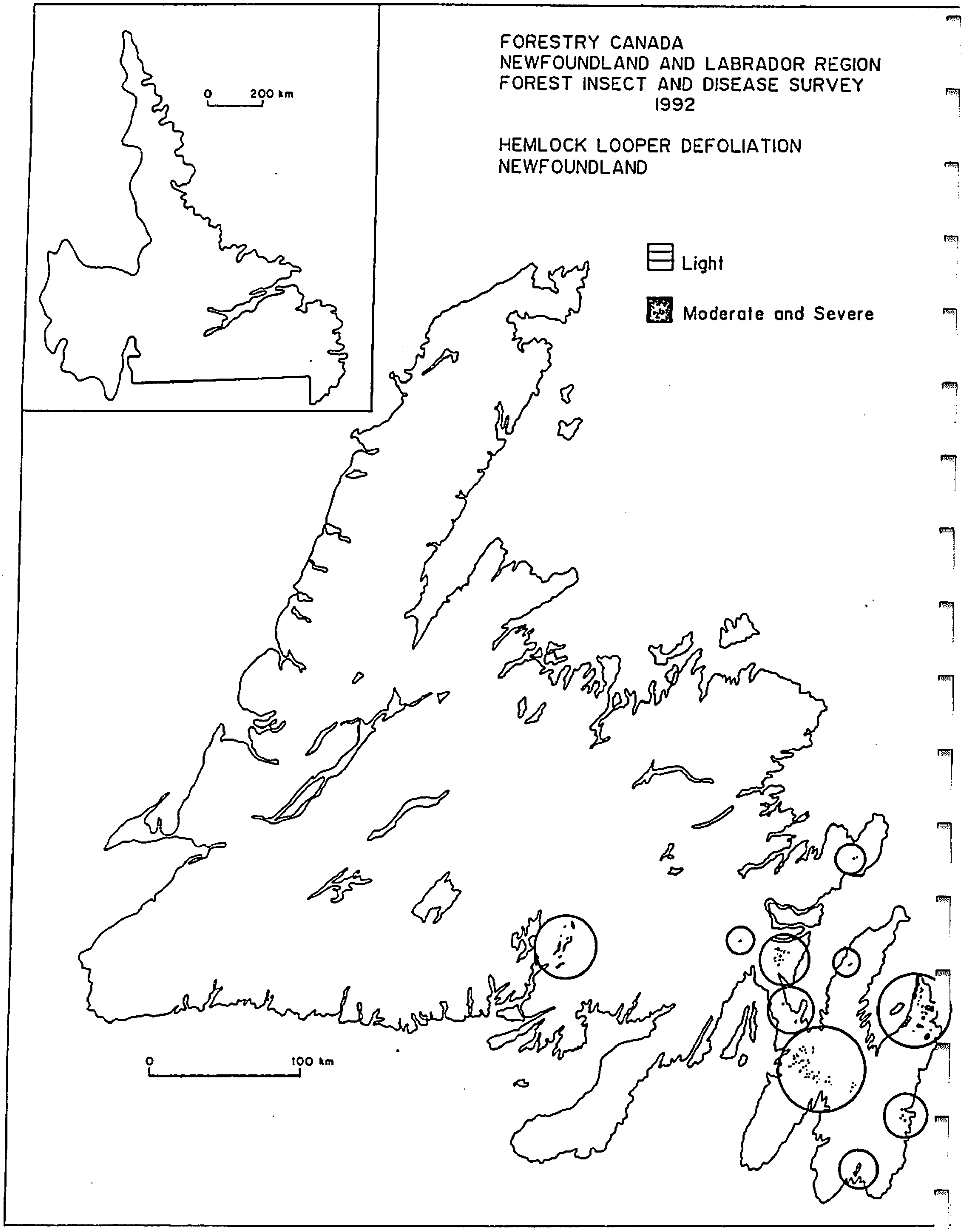

FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
HEMLOCK LOOPER DEFOLIATION
NEWFOUNDLAND
Light
Moderate and Severe
0 200 km
0 100 km

Table 1. Areas (ha) of defoliation and gross merchantable volume (m^3) of affected stands caused by the hemlock looper in productive forests and areas of defoliation of total infestation in Newfoundland in 1992.

Mgmt. Unit	Productive Forest*								Total Infestation (ha)			
	Light		Moderate		Severe		Total					
	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Light	Mod.	Sev.	Total
1	1 155	47.0	625	29.2	1 191	56.4	2 971	132.7	2 191	969	3 718	6 878
2	33	1.7	10	0.6	133	6.1	176	8.4	33	22	179	234
7	406	13.8	644	21.4	1 428	60.9	2 478	96.2	469	799	1 428	2 696
Totals	1 594	52.5	1 274	51.2	2 752	123.4	5 625	237.3	2 693	1 790	5 325	9 808

* Provided by the Forest Management Division, Dept. of Forestry & Agriculture.

caught in central and eastern Newfoundland was identical ($\bar{X}$ = 419) and significantly higher than the numbers captured in western Newfoundland ($\bar{X}$ = 231). In western Newfoundland the highest moth catches occurred near La Scie (3025), Lomond (2738), Burlington (1430) and Georges Lake (1228). The highest catches in central Newfoundland occurred near Burnt Woods Rd (3330), St. Joseph's Cove (2220), Exploits Dam (1810) and Twillick Brook (1390). In eastern Newfoundland, the highest catch occurred at Logy Bay (2516) followed by Salmonier Line (2270) and Hillview Jct. (1308).

Control Program - The Newfoundland Department of Forestry and Agriculture (NDFA) tested the efficacy of Futura XLV, a water-based formulation of *Bacillus thuringiensis (B.t.)*, against EHL in 1992. The insecticide was applied from helicopter on 6-11 August to protect thinned balsam fir stands in the Salmonier Line area from EHL.

Forecast of Hemlock looper defoliation for 1993 - Overwintering egg numbers were sampled from mid- to late October and a forecast will be prepared when the samples have been processed.

THE BALSAM FIR SAWFLY IN NEWFOUNDLAND IN 1992

by

Bowers, W.W.

REPORT TO THE 20TH ANNUAL FOREST PEST CONTROL FORUM, Ottawa, 17-19 November, 1992

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

THE BALSAM FIR SAWFLY IN NEWFOUNDLAND IN 1992

by

W.W. Bowers

The balsam fir sawfly is a member of a species complex whose members feed predominantly on fir and occasionally on spruce. The sawfly was first recorded in Newfoundland in the mid 1930s, and the first outbreak occurred in 1947. The preferred host in Newfoundland is balsam fir although white and black spruce may also be severely defoliated during outbreaks. Generally, foliage of old growth is consumed giving severely defoliated trees a characteristic tufted appearance. This feeding causes little damage and tree mortality usually occurs only in conjunction with damage by other insects, such as the spruce budworm, blackheaded budworm, hemlock looper and balsam woolly adelgid.

Infestations in the Bay d'Espoir areas of southern Newfoundland that caused severe defoliation in 1991 collasped in 1992. In contrast, an infestation in Western Newfoundland increased slightly from 800 to 1 256 ha (Fig. 1, Table 1.). This infestation was comprised of 723 ha with severe defoliation and 533 ha with light defoliation. The area of infestation in productive forests of Western Newfoundland was 1 134 ha compared to 800 ha in 1991 and encompased 39 400 m^3 of timber in both defoliation categories.

<u>Biological Mortality Factors</u> - Parasites or a viral disease were responsible for reducing high populations of BFS.

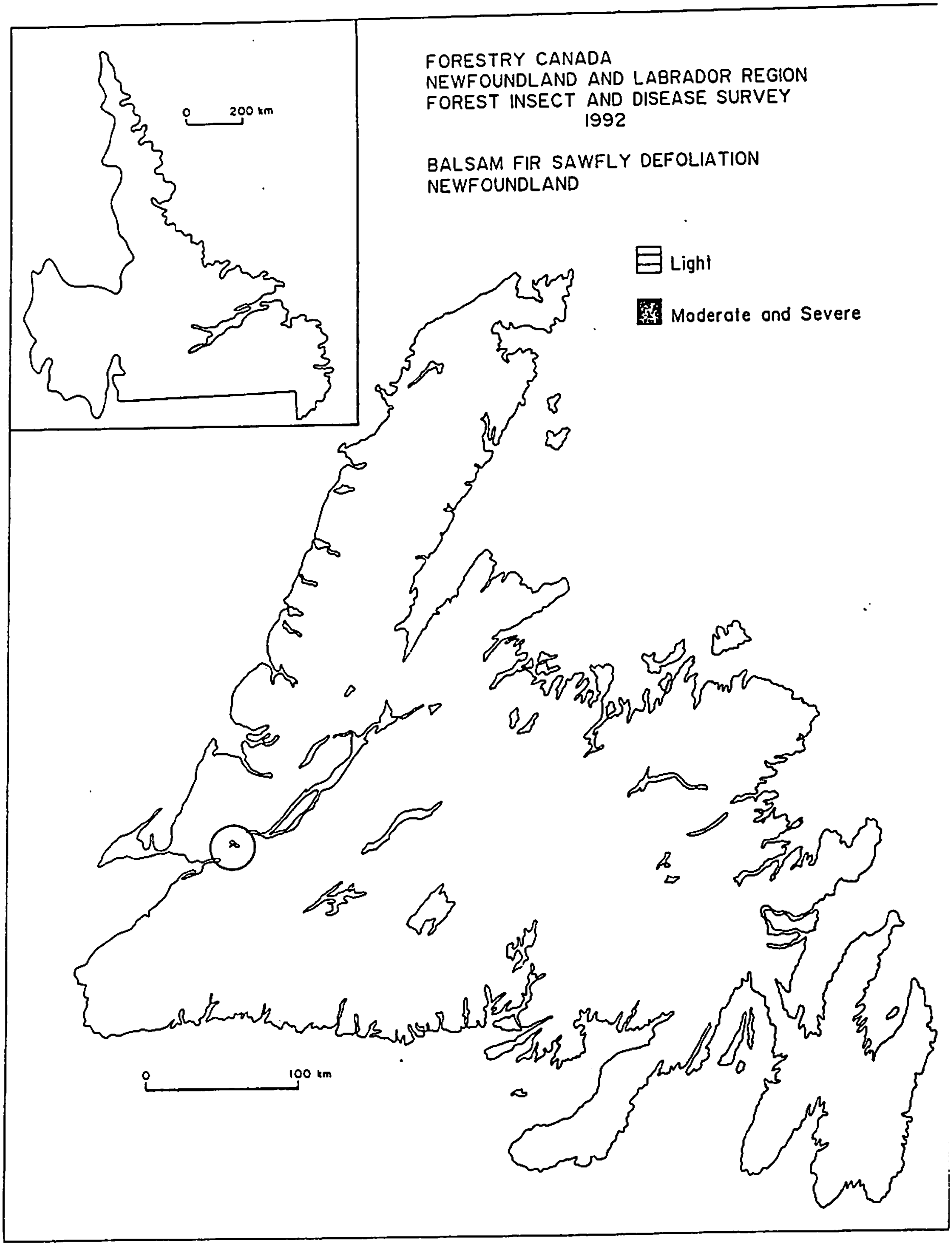

FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
BALSAM FIR SAWFLY DEFOLIATION
NEWFOUNDLAND
Light
Moderate and Severe
0 200 km
0 100 km

Table 1. Areas (ha) of defoliation and gross merchantable volume (m^3) of affected stands caused by the balsam fir sawfly in productive forests and areas of defoliation of total infestation in Newfoundland in 1992.

Mgmt. Unit	Productive Forest*								Total Infestation (ha)			
	Light		Moderate		Severe		Total					
	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Light	Mod.	Sev.	Total
14	426	8.5			708	30.9	1 134	39.4	533	-	723	1 256
Totals	426	8.5			708	30.9	1 134	39.4	533	-	723	1 256

* Provided by the Forest Management Division, Dept. of Forestry & Agriculture.

THE BLACKHEADED BUDWORM IN NEWFOUNDLAND IN 1992

by

Bowers, W.W.

REPORT TO THE 20TH ANNUAL FOREST PEST CONTROL FORUM,
Ottawa, 17-19 November, 1992

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

THE BLACKHEADED BUDWORM IN NEWFOUNDLAND IN 1992

by

W. W. Bowers

Larval Development and Defoliation - Seasonal development of eastern blackheaded budworm (BHB) was delayed by almost 1 month due to cold wet weather for most of June and July. The latest outbreak of blackheaded budworm started on the Northern Peninsula in 1987 and encompassed 35 000 ha of balsam fir forests. Moderate and severe defoliation occurred mainly in overmature stands, with some light defoliation in pre-commercially thinned stands. In several areas of the outbreak BHB fed in association with the hemlock looper and both insects contributed to tree mortality.

In 1992 the outbreak continued on the Northern Peninsula but moderate and severe defoliation decreased sharply from 12 400 ha to 3 757 ha (Fig. 1, Table 1.). Also, areas of light defoliation decreased from 4 000 ha in 1991 to 2 955 ha in 1992. Scattered areas with high BHB populations were present on the Avalon Peninsula but no significant defoliation occurred.

The area of productive forests infested encompassed 1 900 ha in areas of moderate and severe defoliation and 2 637 ha in areas of light defoliation, with 409 179 m^3 of timber in all 3 defoliation categories.

Biological Mortality Factors - In 1992 populations were sampled at Brig Bay on the Northern Peninsula. Nearly 20% of developing larvae (n = 560) were parasitized and 50% died from diseases.

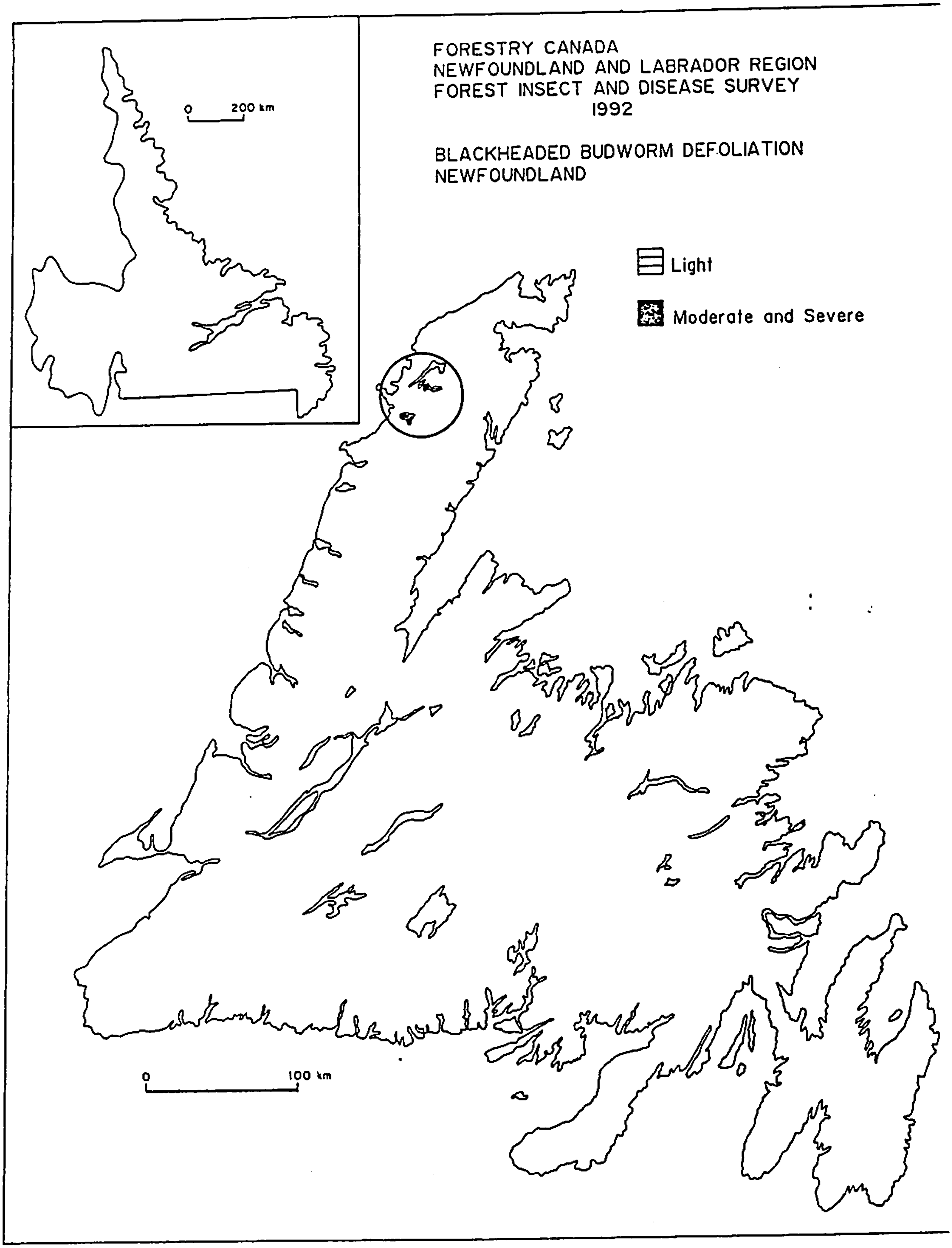

FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
BLACKHEADED BUDWORM DEFOLIATION
NEWFOUNDLAND
Light
Moderate and Severe
0 200 km
0 100 km

Table 1. Areas (ha) of defoliation and gross merchantable volume (m^3) of affected stands caused by the blackheaded budworm in productive forests and areas of defoliation of total infestation in Newfoundland in 1992.

Mgmt. Unit	Productive Forest*								Total Infestation (ha)			
	Light		Moderate		Severe		Total					
	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Area	Vol. (x 000)	Light	Mod.	Sev.	Total
17	2 341	256.3	988	120.7	912	10.8	4 241	387.8	2 758	1 698	2 059	6 515
18	296	21.4	-	-	-	-	296	21.4	197			197
Totals	2 637	277.7	988	120.7	912	10.8	4 537	409.2	2955	1 698	2 059	6 712

* Provided by the Forest Management Division, Dept. of Forestry & Agriculture.

Control Program - There was no experimental or operational control program against the blackheaded budworm in 1991.

Forecast of Blackheaded Budworm Defoliation for 1993 - Overwintering egg numbers were sampled from mid- to late October, and a forecast will be prepared when the samples have been processed.

SCLERODERRIS CANKER IN NEWFOUNDLAND IN 1992

by

Warren G.R. and G.C. Carew

REPORT TO THE 20TH ANNUAL FOREST PEST CONTROL FORUM,
Ottawa, 17-19 November, 1992

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

SCLERODERRIS CANKER IN NEWFOUNDLAND IN 1992

by

G.R. Warren and G.C. Carew

Scleroderris canker was first recorded on Austrian pine near St. John's in Newfoundland in 1979. Because of the potential severity of this disease infecting natural red pine stands in central and western Newfoundland a quarantine zone for the northeast Avalon Peninsula was established in 1980. The disease has since been recorded in several localities on the northeast Avalon Peninsula. In 1981 a 2 ha red pine plantation north of St. John's was severely infected. In 1982 infected ornamental Scots pine, Jack pine and red pine were found along Salmonier Line 30 km west of St. John's. In both localities all diseased trees were cut and burned.

In 1985 a Sitka spruce plantation on the Northern Peninsula near Roddickton was found to be infected with Scleroderris canker. The plantation was sanitized by removing severely infected trees and lower branches, but symptoms have reoccurred in 1990, 1991 and 1992. The source of this infection was traced to imported nursery stock from the Maritimes and was independent of the introduction to the Avalon Peninsula.

Severe foliar damage, caused by Scleroderris canker, was detected on Scots pine in an old abandoned nursery on Salmonier Line in 1987. Other plantations established with stock from this nursery were inspected and only one site, Colliers Ridge 40 km west of St. John's, was infected with Scleroderris. Increased foliar damage at the nursery has recently occurred but tree morality has been minimal. Arrangements between the landowner and provincial forestry are being made to have this area thinned and sanitized to remove infected trees.

Scleroderris canker infections have been localized in and around St. John's, occurring on a variety of hard pines used as ornamentals or wind breaks. Infected red pines show the severest damage, usually tree mortality whereas on Austrian pine there is only scattered leader and lower branch mortality. Within the quarantine zone there is continuous monitoring throughout the growing season for new infections. Sanitation recommendations are presented to homeowners and businesses where new infections are detected, and most individuals comply with them.

Three new infection sites were recorded in 1992 all in the St. John's area with Austrian pine as the host. They included the Memorial University grounds, Prince Philip Drive where up to 10% of the shoots were infected, Portugal Cove Road with up to 50% of the shoots infected and Strawberry Marsh Road with a low incidence of infection.

Fungal isolates from diseased trees were tested by electrophoresis for race determination. Isolates from pines in Newfoundland have been identified as the European race of *Gremmeniella abietina* (Lagerb.) Morelet var. *abietina*, and isolates from Sitka spruce as *G. abietina* var. *balsamea*; a different race. Cooperative research is in progress with the Quebec Region to study the etiology of Scleroderris canker in Newfoundland. Methodology for inoculum production has been conducted and inoculation tests to research the infectivity of the different races on a variety of conifers, intended for reforestation programs, is commencing.

PHEROMONE TRAPPING - NEWFOUNDLAND, 1992

by

Bowers, W.W. and R.J. West

REPORT TO THE PHEROMONE TRAPPING WORKING GROUP,
Ottawa, 16 November, 1992

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

PHEROMONE TRAPPING, NEWFOUNDLAND - 1992

by

Bowers, W.W. and R.J. West

Eastern Hemlock Looper - A pheromone grid was established in summer 1992 using 50 permanent sample locations throughout Newfoundland. At each location, 3 pheromone baited traps (Multi-pher I, Multi-pher II and Gypsy Moth) were used to capture adult males. The multi-pher I type trap caught significantly higher numbers of moths ($\overline{X}$ number per trap = 698) than the multi-pher II ($\overline{X}$ = 171) and Gypsy Moth ($\overline{X}$ = 118) types (Figs. 1-3). The mean number of moths per trap caught in central and eastern Newfoundland was identical ($\overline{X}$ = 419) and significantly higher than the numbers captured in western Newfoundland ($\overline{X}$ = 231). In western Newfoundland the highest moth catches occurred near La Scie (3025), Lomond (2738), Burlington (1430) and Georges Lake (1228). The highest catches in central Newfoundland occurred near Burnt Woods Rd (3330), St. Joseph's Cove (2220), Exploits Dam (1810) and Twillick Brook (1390). In eastern Newfoundland, the highest catch occurred at Logy Bay (2516) followed by Salmonier Line (2270) and Hillview Jct. (1308).

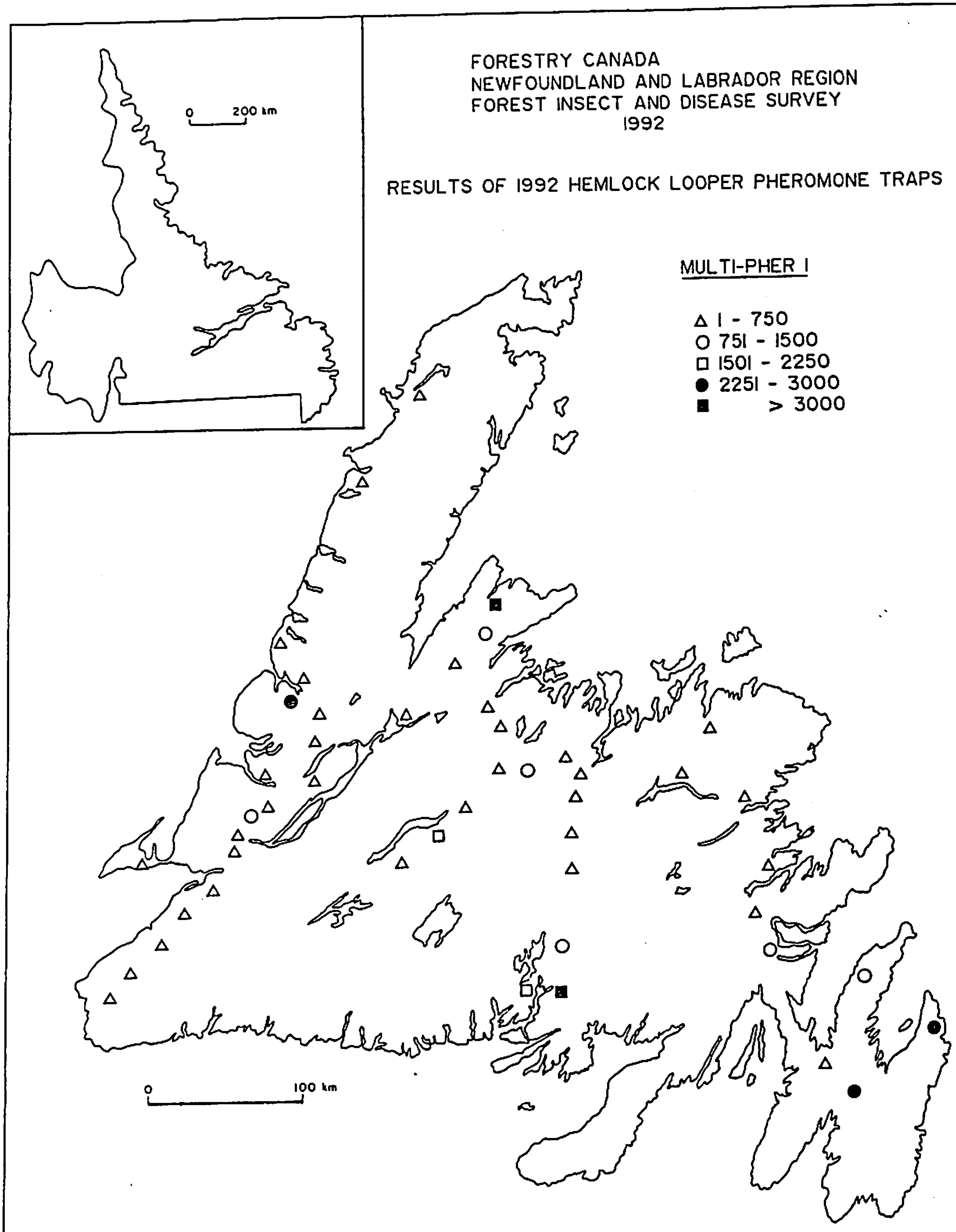

FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
RESULTS OF 1992 HEMLOCK LOOPER PHEROMONE TRAPS
MULTI-PHER I
1 - 750
751 - 1500
1501 - 2250
2251 - 3000
> 3000
0
200 km
0
100 km

FIG. 1.

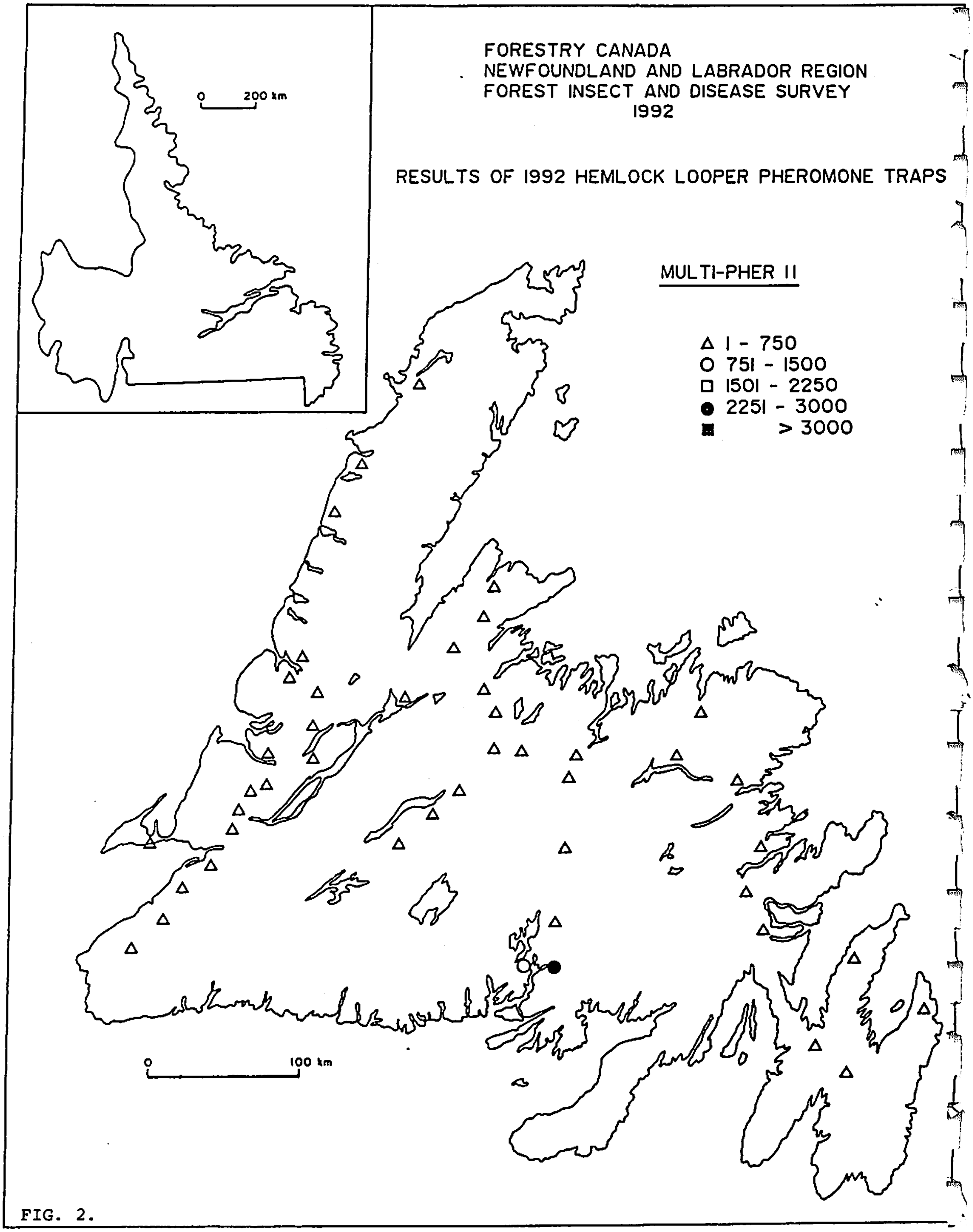

FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
RESULTS OF 1992 HEMLOCK LOOPER PHEROMONE TRAPS
MULTI-PHER II
1 - 750
751 - 1500
1501 - 2250
2251 - 3000
> 3000
0 200 km
0 100 km

FIG. 2.

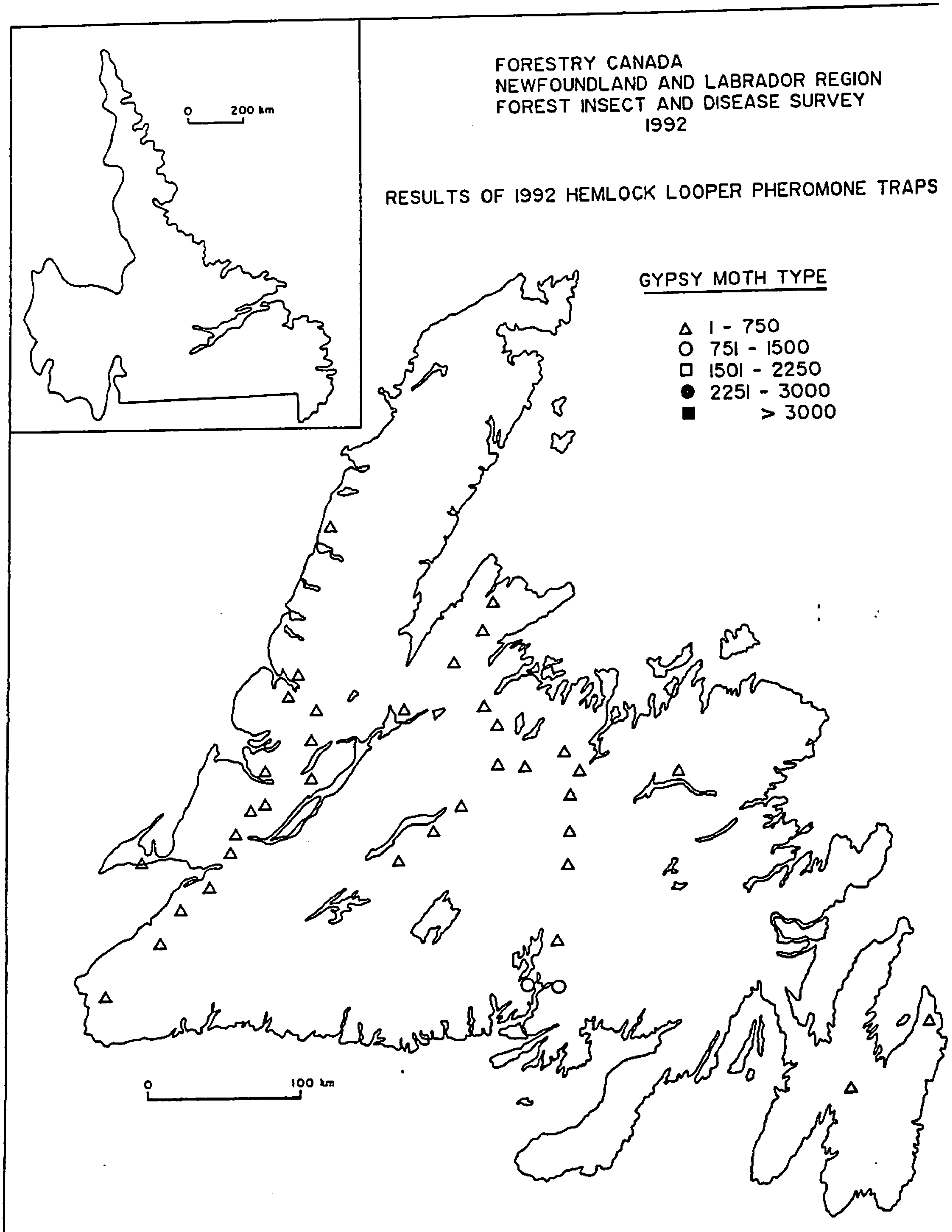
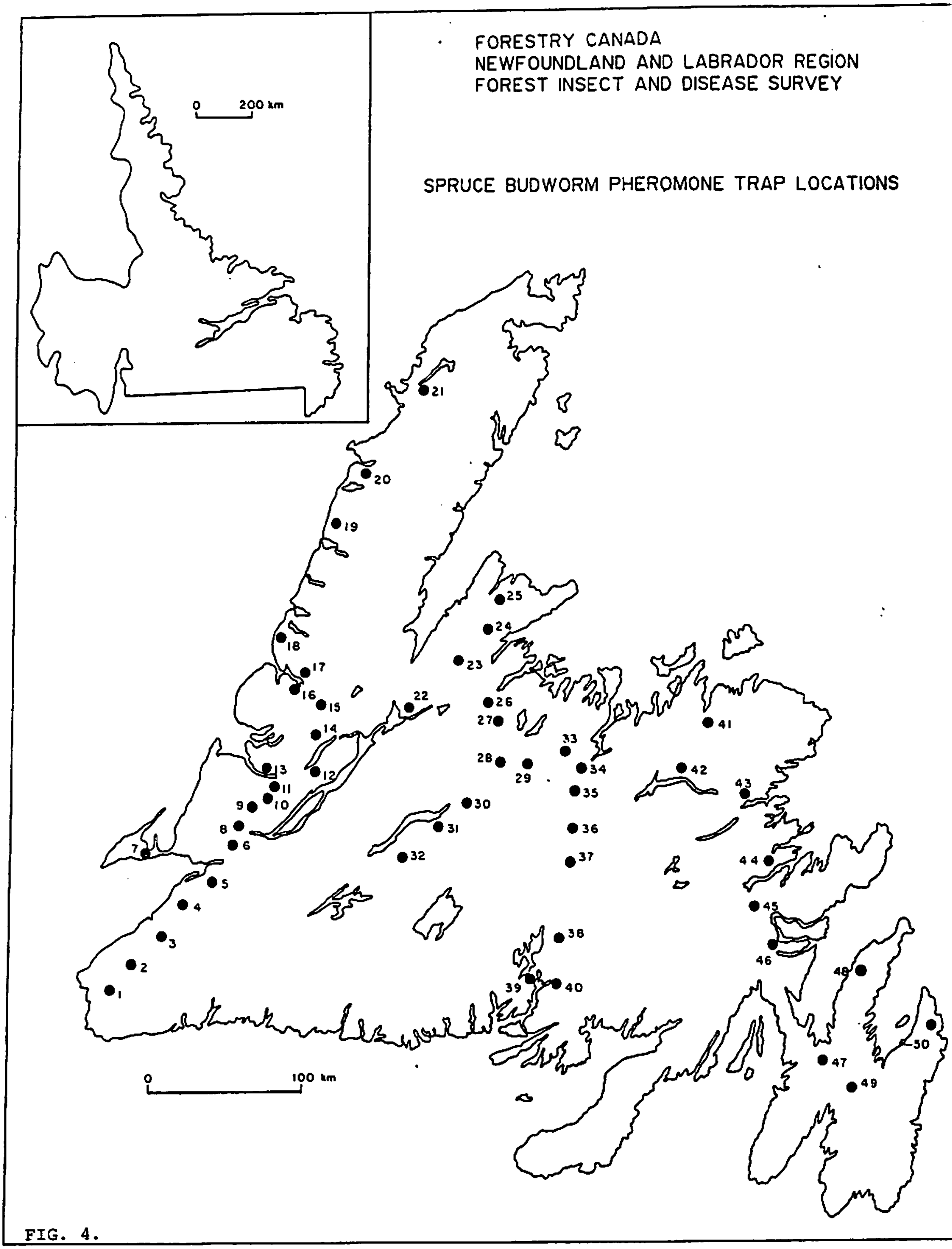

FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
RESULTS OF 1992 HEMLOCK LOOPER PHEROMONE TRAPS
GYPSY MOTH TYPE
1 - 750
751 - 1500
1501 - 2250
2251 - 3000
> 3000
0 200 km
0 100 km

FIG. 3.

Eastern Spruce Budworm - Pheromone traps were placed at 50 permanent sample locations throughout the Island (Fig 4.). The total number of moths captured decreased about three-fold from 6086 in 1991 to 1898 in 1992. The overall mean catch in 1992 was 38 moths per location, compared to 122 moths per location in 1991. In western Newfoundland the mean number of moths per location was 48.6, compared to 209 in 1991. The highest numbers trapped were along the west coast of the island at Campbells Creek ($\overline{X}$ number per trap = 86.0) and Bay of Islands ($\overline{X}$ = 69.0) (Fig 5.). The next highest trap catches were recorded at three coastal locations in western Newfoundland: Codroy Pond ($\overline{X}$ = 38.0), Sally's Cove ($\overline{X}$ = 30.3) and Trout Brook ($\overline{X}$ = 28.3). In central Newfoundland, traps at 17 locations averaged 38 moths per location, a figure identical to 1991. The highest trap catch was at Twillick Brook ($\overline{X}$ = 28.0). Traps catches in eastern Newfoundland, including the Avalon Peninsula, was significantly lower than in western and central Newfoundland. Trap catches in 8 locations in eastern Newfoundland, averaged 4.4 moths per location in 1992, compared to an average of 27 moths per location in 1991. The highest trap catch in eastern Newfoundland was at Heart's Content ($\overline{X}$ = 4.0). In contrast to 1991 few moths were observed in the traps prior to local emergence.


FORESTRY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
SPRUCE BUDWORM PHEROMONE TRAP LOCATIONS
0
200 km
0
100 km
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
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24
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30
31
32
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40
41
42
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44
45
46
47
48
49
50

FIG. 4.

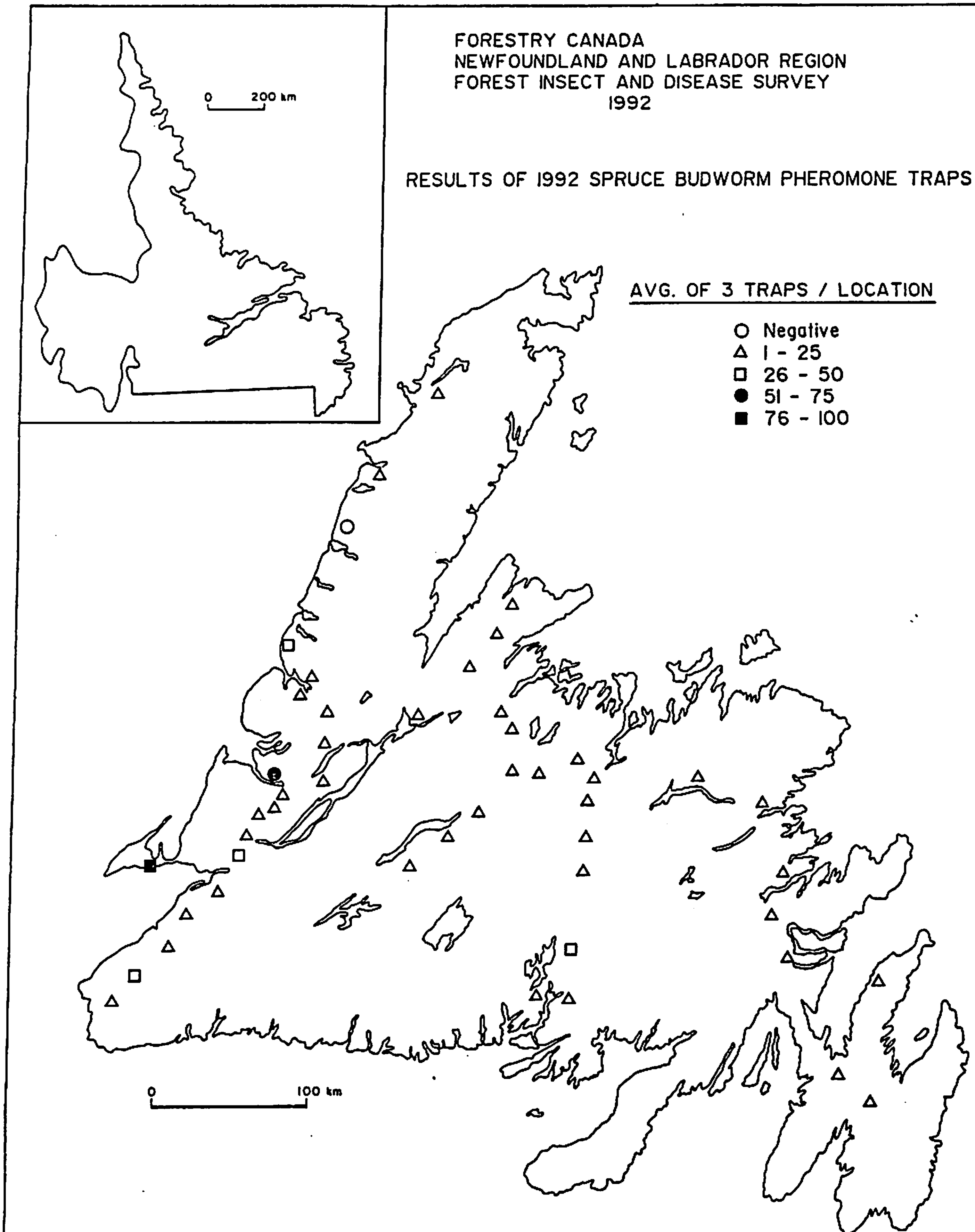

FOREST RY CANADA
NEWFOUNDLAND AND LABRADOR REGION
FOREST INSECT AND DISEASE SURVEY
1992
RESULTS OF 1992 SPRUCE BUDWORM PHEROMONE TRAPS
AVG. OF 3 TRAPS / LOCATION
Negative
1 - 25
26 - 50
51 - 75
76 - 100
0 200 km
0 100 km

FIG. 5.

Gypsy Moth - A total of 250 delta traps (Agriculture Canada 200 and Forestry Canada 50) baited with disparlure were located at selected sites throughout Newfoundland in July, 1992. Generally, sites chosen were Provincial and Federal campgrounds, urban and suburban recreational sites, tourist chalets and wooded areas frequented by visitors and travellers. Site and number of traps were as follows:

Site 1. St. John's, Avalon and Burin Peninsulas to and including Terra Nova National Park - 62 traps.

Site 2. Gander, Grand Falls and Central NF area - 28 traps

Site 3. Northern Peninsula Gros Morne National Park to Roddickton Road Jct. - 50 traps

Site 4. Corner Brook and environs - 50 traps

Site 5. Port aux Basques and environs to Robinsons - 60 traps

Traps were collected and examined for Gypsy moth in mid-September. Only 1 male Gypsy moth was found in a trap located at Eastern Brook in western Newfoundland in 1992.

Forest Tent Caterpillar - A total of 100 baited pherocon III traps were used to sample FTC in 1992 in Newfoundland. Traps were placed throughout the Province near major urban centres and in national and provincial parks. Traps were collected and examined in September. No FTC was trapped in 1992.

1992 INSECT CONTROL PROGRAMS - NEWFOUNDLAND

Prepared by
H. Crummey

(Report for Annual Forest Pest Control Forum, Nov. 1992, Ottawa)

Department of Forestry & Agriculture
Insect & Disease Control Section, Corner Brook

Introduction

The Department of Forestry & Agriculture carried out insect control operations against two forest pests in 1992, using the biological insecticide, B.t. The first operation was conducted on the west coast of the Island against the Spruce Budworm and a second, smaller operation was conducted against the Hemlock Looper on the Salmonier Line in eastern Newfoundland.

The 1992 Programs were carried out under licence and within guidelines established by the Department of Environment & Lands.

SPRUCE BUDWORM:

Forecast:

The forecast for 1992, excluding the National Parks, was for defoliation to occur on 87 200 hectares (ha) with 16 500 ha in the moderate and severe category, mainly near Codroy Pond in southwestern Newfoundland, but also on the Avalon Peninsula, Bonavista Peninsula, near Baie Verte and Ten Mile Lake. Light defoliation was expected in many parts of the Island.

Proposed treatment:

Based on the forecast, the Department proposed to treat approximately 10 000 ha of balsam fir and spruce using two applications of B.t. The program objective was to reduce insect numbers and thereby limit expected defoliation. The last spruce budworm spray program was conducted in 1985. There was no insect control program carried out in 1991.

Spray operations:

The project began on June 21 and ended on July 16. Some delays were experienced due to poor spray weather, but operations ran quite well and within a reasonable time frame.

Aircraft:

Aircraft for the budworm project consisted of two (2) single-engine Dromader M-18s spray planes equipped with Micronair AU4000 spray atomizers. These were on contract from Epandair Inc. of Quebec. Spray operations were based out from Stephenville Airport. Navigation was provided by a Bell 206L helicopter, and supervision of spray missions was carried out using a twin-engine fixed-wing aircraft.

Treated areas:

Seven (7) blocks totalling 7 757 ha were treated using the biological insecticides Futura®XLV and a small amount of Foray®48B, from existing stock. All treatment areas were located in southwestern Newfoundland around Codroy Pond and northeast to Crabbes River

(Table 1, Figure1). Of the total of seven (7) blocks, two (2) blocks (totalling 2,504 hectares) received one (1) application, two (2) blocks (2,256 hectares) received two (2) applications, and three (3) blocks (2,997 hectares) received three (3) applications of B.t. The blocks receiving three applications had higher population levels and previous defoliation in 1991. The remainder of the proposed blocks were monitored for insect populations, but were not treated because of very low insect numbers.

Results:

Table 2 summarizes data collected to determine the success of the program.

Blocks 110 & 112 - 1 Application (July 4/5)

These two blocks were located in pre-commercial thinnings, not previously defoliated during the past year. Although the average larvae per branch was low (3.1), the average expected level of defoliation, based on the number of larvae per feeding site in the untreated area, was 30 %.

The average percent larval mortality in the untreated areas, with a corresponding number of larvae per shoot, was 24.5 % compared with 85.3 % in these treated blocks, i.e. a population reduction of about 81 %.

The actual average observed defoliation in the treated areas was about 7 %. The average percent foliage saved was 79.7.

Blocks 116 & 117 - 2 Applications (June 25/30 & July 5)

These two blocks contained semi-mature trees which had not been defoliated in 1991. The average larvae per branch was 6.1, with the average expected level of defoliation about 40 percent. Population levels and hence expected levels of defoliation were higher in Block 116.

The average percent larval mortality in untreated areas was about 32 % compared with 76 % in the spray blocks, i.e. indicating a population reduction of about 65 %. The population reduction after the first application was only about 22 %.

The actual average observed defoliation in the treated blocks was approximately 15 %. The average percent foliage saved was 63.6.

Table 1. Area (ha) treated and number of applications against spruce budworm in Newfoundland - 1992

BLOCK #	LOCATION	BLOCK SIZE (HA)	B.t. - 30 BIU/HA/APPL.		
			AREA TREATED - ONE APPL.	AREA TREATED - TWO APPLS.	AREA TREATED - THREE APPLS.
110	Crabbes River North	2 287	2 287		
112	Little River Brook	217	217		
116	Bald Mountain	1 656		1 656	
117	North Branch River	600		600	
118	Crooked Brook	226			226
119	Codroy Pond	1 946			1 946
120	South Branch River	825			825
	TOTAL	7 757	2 504	2 256	2 997

All Blocks treated with FUTURA XLV except 660 Ha of Block 110 treated with FORAY 48B

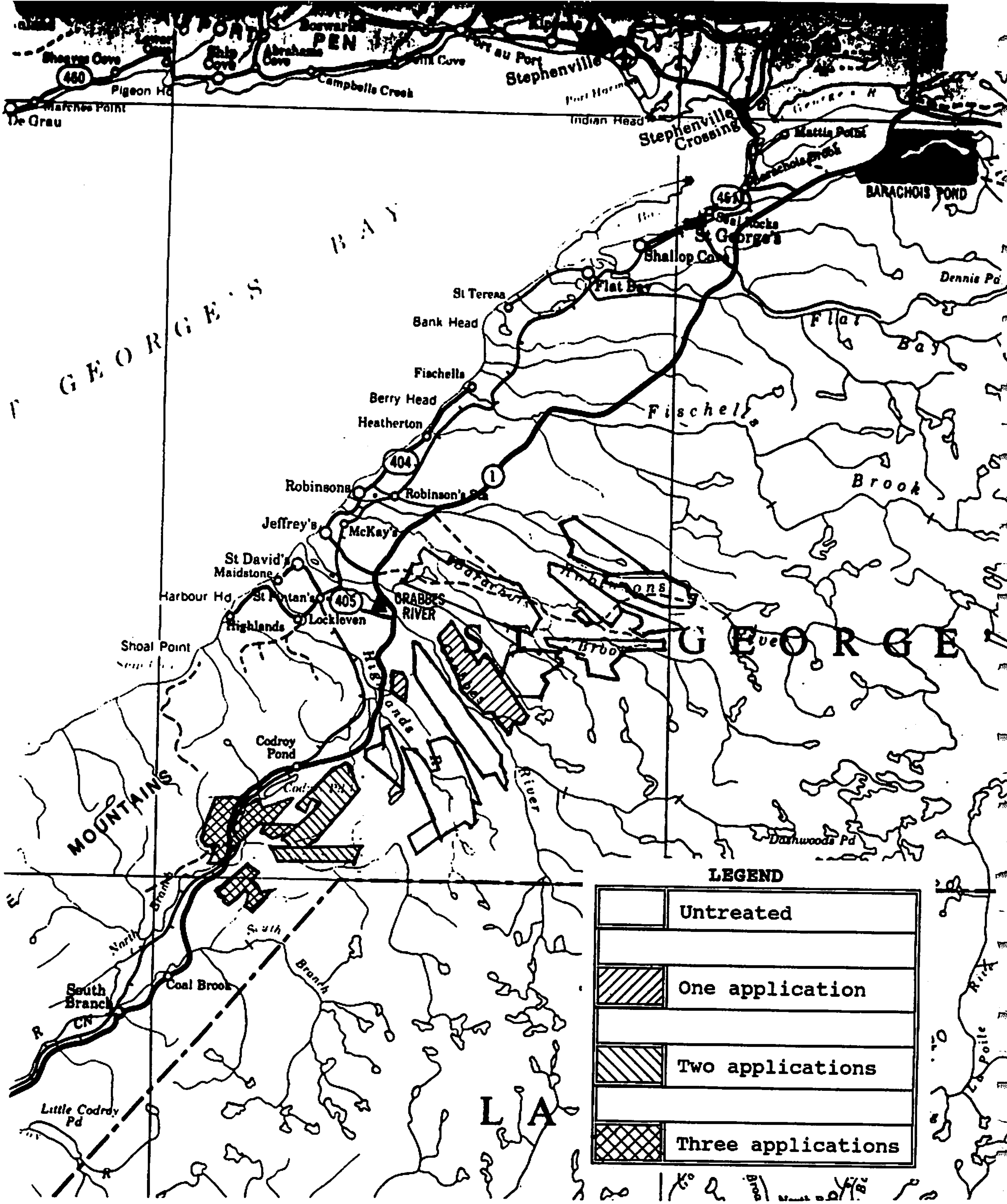


Figure 1. Locations and treatments of 1992 spruce budworm spray blocks.

Table 2. Mean larval densities, larval mortality and defoliation for treated and untreated areas, 1992 Newfoundland spruce budworm spray program.

Block	n	Pre-spray larvae					Post-spray		Post-spray		Final Post-spray			
		/45-cm	/bud	ID_L	ID_S	% Def.	% Mort.	% Def.	% Mort.	% Def.	% Mort.	% Def.	% Pop. Redu.	% Fol. Saved
ONE APPLICATION - Treatment dates - July 4/5														
110	15	3.2	0.05	4.4	5.0	3.0	-	-	-	-		4.9	72.5	84.4
	Range (1-8)													
112	8	3.0	0.04	4.6	5.0	2.9	-	-		-	92.9	7.5	90.0	73.6
	Range (1-7)													
TWO APPLICATIONS - Treatment dates - June 25/30 & July 5									POST-1					
116	14	9.6	0.15	3.6	4.3	2.5	-	-	41.2	6.0	62.1	23.3	44.3	49.5
	Range (1-27)													
117	16	3.0	0.07	3.7	4.5	1.1	-	-	41.5	1.4	88.8	7.1	83.6	79.6
	Range (1-7)													
THREE APPLICATIONS - Treatment dates - June 22, June 28 & July 14/15														
							POST-1		POST-2					
118	15	11.5	0.34	3.9	4.4	25.7	16.6	60.6	43.5	71.9	88.8	82.0	83.6	0.0
	Range (4-36)													
119	19	16.1	0.28	3.7	4.6	9.8	21.5	23.4	35.8	54.7	66.7	68.4	51.1	0.0
	Range (1-61)													
120	10	11.8	0.34	3.9	4.9	17.3	11.7	22.6	42.4	44.2	81.9	71.9	73.4	0.0
	Range (3-22)													
UNTREATED														
	27	11.3	0.16	3.6	4.7	6.0	6.0	13.2	25.3	27.0	31.9	50.9	-	-
	Range (1-25)													

Blocks 118, 119 & 120 - 3 Appl. (June 21/22, June 28-30 & July 14/15)

Blocks 118 and 120 contained mainly semi-mature and mature timber, while Block 119 contained pre-commercial thinnings as well. All three blocks received defoliation in 1991, including significant defoliation in the moderate to severe category.

Block 118 had an average larvae per branch of 11.5, but a high population based on the number of larvae per shoot. The average expected level of defoliation was about 68 %, based on the untreated areas. However, the average number of larvae per shoot was twice as high in the spray block. At pre-spray, there was 26 % defoliation recorded in this block compared with approximately 6 % in the untreated areas.

The average final larval mortality in the untreated plots was 32 % compared with 89 % in Block 118, indicating a population reduction of about 84 %, but the actual observed defoliation in the treated block was 76 %, thus showing no foliage protection. Considering percent larval mortality after the first and second applications, it was seen that these were 17 and 43 % respectively, in the treated block, compared with 6 % and 25 % in the untreated areas. This means that the first application had very little impact and the second limited. In the meantime, the high budworm population continued to feed.

Similarly, blocks 119 and 120 followed the same trend. Block 119 had an average of 16.1 larvae per branch and Block 120 - 11.8. The average expected defoliation for both were 59 % and 67 % respectively. Again, the number of larvae per shoot was high. Pre-spray defoliation was 10 % and 17 % respectively. The average percent mortality after the first, second and final application was 21, 36 & 67 for Block 119 and 12, 42 & 82 for Block 120, compared to 6, 25 & 32 in the untreated areas, showing the trend as in Block 118. The actual average percent defoliation for both Blocks was 72 % and 68 % respectively, again indicating no foliage protection.

Aerial defoliation assessment:

The annual aerial survey to map defoliation, conducted by the Department in conjunction with Forestry Canada, was used to determine defoliation in treated areas. The results (Table 3) indicated that, Blocks 110, 112, 116 and 117 had no defoliation detected. Block 118 had 27 % moderate to severe defoliation and 46 % light, while Blocks 119 and 120 had 28 % and 58 % moderate and severe defoliation and 9 % and 27 % light defoliation respectively.

Conclusion:

The budworm spray program provided final population reduction in all blocks, but did not provide foliage protection in the three blocks which received three applications. The reasons for this are not known, but several observations on the program may be useful. These blocks were different from the others in having higher budworm populations, received their first

Table 3. Aerial defoliation estimate for spruce budworm spray blocks - 1992

BLOCK #	LOCATION	TREATED BLOCK SIZE (HA)	% OF BLOCK - NO DEFOL.	% OF BLOCK- LIGHT DEFOL.	% OF BLOCK - MODERATE DEFOL.	% OF BLOCK - SEVERE DEFOL.
110	Crabbes River North	2 287	100			
112	Little River Brook	217	100			
116	Bald Mountain	1 656	100			
117	North Branch River	600	100			
118	Crooked Brook	226	27	46	7	20
119	Codroy Pond	1 946	63	9	13	15
120	South Branch River	825	15	27		58
	TOTAL	7 757				

application about one week earlier than the others, and had significant previous defoliation. All three, but especially Block 119 was located in difficult terrain. However, terrain was similar in Block 116 and Block 117. It was noted that there were rain showers within a few days after some of the applications, but these may have been localized and it is not possible to determine where or if any or all of the treated areas may have been affected. No measure of spray deposit is carried out operationally, so the level of droplet deposit after each application is not known. The B.t. used came from existing stock. The potency was checked and it was determined that it had decreased by an average of approximately 17 % from label specifications, within normal variation in the industry. The decision was to apply the B.t. at the maximum label dosage (30 BIU per hectare, and go with two applications, or more if necessary.

HEMLOCK LOOPER:

Forecast:

The forecast for 1992 was for defoliation to occur on 26 500 ha with 5 700 ha in the moderate to severe category. Infestations were expected on the Northern Peninsula and in Eastern Newfoundland. Initially, however, no control action was proposed after reviewing the forecast information. However, in the course of field surveys, hemlock looper larvae were detected in several silviculture areas in the Salmonier Line on the Avalon Peninsula.

Proposed treatment:

Based on field information collected by Forestry Canada, a limited aerial spray project was planned to protect silviculture thinnings situated from Back River Pond in the west to the vicinity of Mikes Pond in the east and southwest to Commissioners Gullies on the Salmonier Line. In addition, three other areas, one in the Tower Road, the second adjacent to the Pinsent Falls access Trail, and a third at Bottle Hill Pond were also to be treated. In total, it was proposed to treat approximately 500 hectares of balsam fir Pre-commercial Thinnings with two applications of B.t.(Futura XLV), a biological insecticide.

Spray operations:

Treatment was to commence on August 3, but was delayed until August 8, due to poor weather conditions. The looper project ended on August 12.

Aircraft:

Spray aircraft consisted of one(1) Bell Jet Ranger 206B helicopter, with a second helicopter (206L) providing navigation and supervision. Operations were based out of the Salmonier Forestry Depot.

Treated areas:

The total area treated was 538 hectares, all receiving one application of insecticide and approximately 130 hectares (about 24 percent) receiving a second application (Table 4, Figure 2). The remainder of the area did not receive a second application due to timing and logistics related to weather delays.

Assessment of project:

Forestry Canada kindly agreed to collect field data from two of the treated blocks and analyze the results, as Department staff were still occupied with the budworm project.

Results:

Based on tree-beating surveys, hemlock looper larvae were detected in numbers (as high as 176 larvae per sample) sufficient to cause light defoliation to silviculture areas on the Salmonier Line. It was felt that there could also be pockets of infestation which might cause moderate defoliation. The purpose of the project was to reduce population levels and thereby limit defoliation.

Spray deposit was monitored, as this was the first time a helicopter was used in insect control operations. Deposit was excellent, with an average of 2 droplets per needle.

Unfortunately, it was not possible to determine the effect of the spray on looper larvae, as there was a natural collapse in the looper population in the area. As a result of the collapse, there was no further defoliation.

Table 4. Area (ha) treated and number of applications against hemlock looper in Newfoundland - 1992.

BLOCK #	LOCATION	BLOCK SIZE (HA)	AREA TREATED - ONE APPL.	AREA TREATED - TWO APPLS.
201	Tower Road	8		8
202	Tower Road	5		5
203	Tower Road	79		79
204	Tower Road	19		19
205	Tower Road	9		9
206	Back River Pond	138	138	
207	Maries Gullies	128	128	
208	Commissioners Gullies	85	85	
209	Burkes Pond	45	45	
210	Bottle Hill Pond	22	22	
	TOTAL	538	418	120

NOTE: Blocks treated with *B.t.* at 30 BIU/Ha/Application

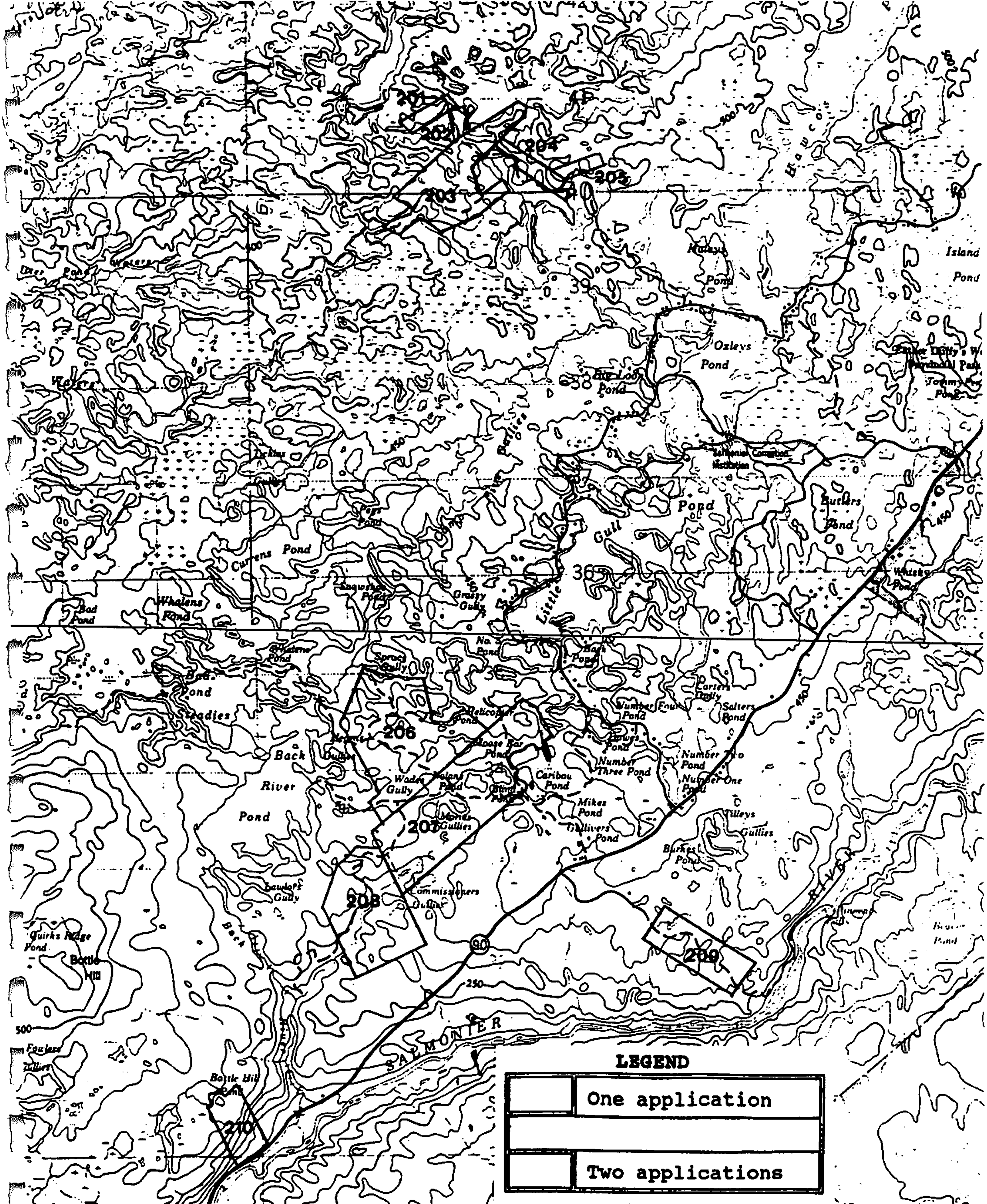


Figure 2. Locations and treatments of 1992 hemlock looper spray blocks.

INSECT & DISEASE CONDITIONS IN THE UNITED STATES--1992[1]

Contributors:

Region 1
Region 2
Region 3
Region 4
Region 5
Region 6
Region 8
Region 10
Northeastern Area
Durham, NH
St. Paul, MN
Morgantown, WV

1 Report prepared for the Twentieth Annual Forest Pest Control Forum, Ottawa, November 16-19, 1992.

EASTERN SPRUCE BUDWORM

LAKE STATES

The only State placing pheromone traps within our field office zone is Minnesota. They have found no correlation between defoliation and the numbers of moths caught in the traps. They feel it might provide some information on trends.

At this time in Minnesota, budworm populations are present in Cooke, northern Lake, northern St. Louis, and eastern Itasca Counties. This was the first year populations were seen in Itasca County. Budworm defoliation estimates were based on information obtained through ground surveys. Estimates show about 100,000 acres of defoliation. Cook County had the most severe defoliation affecting the greatest contiguous area. The northern portion of Lake County and the southwest portion of St. Louis County were also affected. Blandin Paper Company had a large acreage of spruce affected in eastern Itasca County. They are considering spraying if spring samples indicate a potential for moderate to severe defoliation. Scattered pockets of defoliation were also observed in northeast Aiken and in Koochiching Counties.

In 1992 insecticide treatments were conducted for 6 State plantations consisting of approximately 300 acres, within this area in northern Minnesota.

Within the spruce budworm areas in northern Minnesota there has been some change in forest type. It is impossible to document how much has actually occurred. In some cases stands have been converted to other species to recover mortality and to eliminate future spruce budworm losses. In many of these areas spruce-fir is the climax species and eventually stands will convert back to these species. Where forest management is not actively being practiced, these stands will eventually return to a spruce-fir forest and budworm activity will again increase.

NORTHEAST

Spruce budworm activity remained low in 1992. Trap catches are increasing in some areas when compared to 1991. In 1992 two eastern Maine locations had more than 25 moths per trap, and in other locations multiple trap catches were recorded. This may indicate a rise in populations in 1993.

Suppression: The Grand Portage Indian Reservation has requested assistance in treating a spruce budworm outbreak on 132 acres at an estimated cost of $7,000. Egg mass counts are very high in the affected stands. A biological evaluation will be completed in the near future.

Presented by Daniel R. Kucera, Staff Entomologist, Northeastern Area, State and Private Forestry, USDA Forest Service, Radnor, Pennsylvania, at the Twentieth Annual Forest Pest Control Forum, Ottawa, November 16-19, 1992.

REGION 1 (NORTHERN REGION)

Western spruce budworm-caused defoliation dropped by over one-third during 1992 in Region 1. Our aerial detection surveys recorded 400,578 ha. of budworm defoliation this year compared to over 650,000 ha. in 1991. Most of this decrease occurred in Montana west of the continental divide. This marks the second year budworm populations have declined in western Montana. Over the past two years the Bitterroot National Forest is down by almost 150,000 ha. and the Garnet Mountain Range area near Missoula decreased by 136,696 ha. Conditions were mixed in Central Montana east of the divide. The Lewis and Clark, and Deerlodge National Forests dropped by about 25,000 ha. each while defoliation increased on the Helena and Beaverhead National Forests. In Northern Idaho the budworm outbreak on the Nez Perce National Forest is up by over 14,000 ha. from last year. Currently at 19,410 ha. defoliation on the Nez Perce is at a 15-year high and could return to the 500,000 ha. level recorded during the early 1970's.

Infested Area (ha.)

Forest/Area	1989	1990	1991	1992	Trend 91/92
Nez Perce	6,463	2,159	4,940	19,410	+ 14,470
Beaverhead	92,703	24,326	10,823	16,166	+ 5,343
Bitterroot	49,754	152,996	111,814	3,467	- 108,347
Custer	0	0	3,556	0	- 3,556
Deerlodge	139,896	132,430	144,221	114,243	- 29,978
Flathead IR	37	0	22	27	+ 5
Gallatin	Fire	0	12,528	2,560	- 9,968
Helena	50,347	86,179	134,252	168,158	+ 33,906
L & C	4,367	48,693	85,065	59,062	- 26,003
Lolo	51,242	23,814	76,826	11,693	- 65,133
Garnets	94,167	130,367	67,159	5,792	- 61,367
Total	488,975	600,964	651,206	400,578	- 250,628

Control 1992: No projects in FY 1992.

Outlook for 1993: Populations in Northern Idaho are expected to increase to twice the 1992 level, while in Montana no major changes are forecast.

REGION 2 (ROCKY MOUNTAIN)

Defoliation and tree mortality in Douglas-fir stands continues west of Denver, Colorado. Surveys detected 10,000 acres along the Front Range as well as 26,000 acres of defoliation in western Colorado forests.

REGION 3 (SOUTHWESTERN)

Western spruce budworm defoliation in the Southwest decreased significantly from 74,176 hectares in 1991 to 5,590 hectares in 1992. In New Mexico, western spruce budworm defoliation was aerially detected on the Santa Fe (650 hectares), Lincoln (35 hectares), and Gila (195 hectares) National Forests and Santa Clara Indian Reservation (65 hectares). In Arizona, defoliation was observed on the Apache-Sitgreaves (2,050 hectares), Kaibab (2,250 hectares) and Coconino (380 hectares) National Forests. Defoliation was largely light to moderate in intensity.

No insect suppression projects were conducted in the Region in 1992 nor are any anticipated for 1993.

REGION 4 (INTERMOUNTAIN)

Western spruce budworm activity remained at comparatively low levels with the only significant activity located on the Salmon National Forest in southern Idaho. Activity is also present on the Payette National Forest in conjunction with Douglas-fir tussock moth. While aerially visible defoliation was estimated at approximately 56,700 acres it should be noted that ground evaluations suggest that western spruce budworm activity is more widespread than our aerial surveys indicate.

REGION 5 (PACIFIC SOUTHWEST)

Choristoneura retiniana, Modoc budworm, has caused light to heavy defoliation in the Warner Mountains of the Modoc National Forest and Modoc County. Aerial surveys indicate 26,000 acres of heavy defoliation out of 80,177 acres mapped.

REGION 6 (PACIFIC NORTHWEST)

There were 4.28 million acres detected for western spruce budworm in Region 6. Approximately 186,000 acres were treated to reduce mortality and growth loss.

REGION 10 (ALASKA)

In 1991, approximately 20,000 acres of white spruce (*Picea glauca*) were defoliated by spruce budworms (both *Choristoneura orae* and *C. fumiferana*) in interior Alaska and another 5,000 acres of Sitka spruce (*P. sitchensis*) were defoliated by either *C. orae* or *C. biennis* in southeast Alaska. Budworm defoliation levels dramatically increased in 1992: more than 180,000 acres were defoliated as follows:

> 168,998 acres of white spruce were defoliated in the Fairbanks, Tanana and Delta Junction areas of interior Alaska. Pheromone trapping indicated that two *Choristoneura* species were responsible for the defoliation: *C. orae* and *C. fumiferana*. Tree mortality is not expected although significant growth reductions have occurred. Some defoliation of outplanted nursery stock has occurred. Populations are expected to decline in 1993.

Approximately 11,521 acres of Sitka spruce were defoliated by either *C. biennis* or *C. orae* 25 miles northwest of Haines in southeast Alaska. This is the third consecutive year of heavy defoliation in this area. Similar levels of defoliation are expected for 1993. There were no budworm suppression projects undertaken in Alaska.

NORTHEAST

Defoliation: In the Northeastern Area, the European gypsy moth currently infests all or parts of 14 states: Connecticut, Delaware, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and West Virginia. In 1992, gypsy moth defoliation reported from the 14 states totaled 2,309,000 acres, with the greatest amounts reported by Michigan (712,227 acres) and Pennsylvania (641,445 acres). This represents a decrease in defoliation from the 3,535,800 acres reported in 1991.

Insect populations and related defoliation tend to remain at very high levels along the "leading edge" areas in Michigan, Ohio, and West Virginia. Here, the insect continues to spread by natural and artificial means into adjacent uninfested hardwood forests.

Suppression and eradication--1992: In 1992, gypsy moth suppression and eradication projects were conducted in 9 Northeastern Area states and 14 other Federal sites with total treatment of 716,950 acres, down from 902,000 acres treated in 1991. Cooperative State suppression and eradication projects totaled 684,336 acres. The chemical growth regulator Dimilin (diflubenzuron), was applied to 23 percent of this acreage and 77 percent was treated with the biological insecticide *Bacillus thuringiensis* (Table 1). Total cost of the cooperative effort was $13 million, with the Forest Service contributing $6.2 million and the nine states $6.8 million. Treatment of National Forest lands totaled 25,432 acres on the Allegheny and Huron-Manistee forests. Treatment of other Federal sites totaled 7,182 acres and primarily involved forested sites managed by the Departments of Defense and Interior. It is important to note that most of the cooperative State suppression occurs in high value forested parks and recreation areas, forested residential communities and a small amount of high value commercial forest stands. Much of the outbreak area in any given State remains untreated and no efforts have been made to prevent or slow the natural spread of the insect into uninfested areas. Gypsy moth populations in the untreated areas are therefore influenced by environmental conditions and natural control factors, such as the gypsy moth virus, parasite, and predators or the fungus *Entomophaga maimaiga*.

A wide variety of fixed wing and rotary wing aircraft were used to apply the insecticides. Most of the *B.t.* applications by slower aircraft utilized micronair rotary atomizers. Larger and faster fixed wing aircraft used flat fan nozzles. The 1992 applications of Dimilin involved a major shift from the wetable powder formulations to the new 4L liquid formulations. The general consensus among cooperators was that the 4L product has superior handling and mixing characteristics compared to the wetable powder formulation.

Weather conditions throughout the 1992 gypsy moth treatment period were generally favorable for aerial application, allowing completion of most suppression and eradication projects on time or ahead of schedule. In general, all cooperating states and Federal agencies reported good to excellent project results in minimizing defoliation and reducing insect populations. Undoubtedly the favorable weather conditions contributed to the effectiveness of the treatments.

Project Safety In response to an increasing number of fatal aircraft accidents, incidents, and pesticide spills, the Northeastern Area initiated efforts to increase safety awareness in all aspects of suppression and eradication projects. An assessment of project safety needs was conducted among State and Federal personnel involved in the planning, organization, and conduct of suppression and eradication projects. Based on the assessment a number of standard fire suppression courses were modified and made available to 114 State and Federal personnel. A radio communications seminar was also presented to 214 students to enhance the proper use of project radios. In 1992, no major aircraft or ground support accidents, incidents, or insecticide spills were reported from suppression or eradication projects in the Northeastern Area.

Suppression and Eradication Activities Outlook for 1993: Cooperative State gypsy moth suppression is expected to decline slightly in 1993, in response to the downward trend in populations and defoliation over the last two years (Table 2). However, slightly larger projects are being planned in Ohio, Michigan, and West Virginia, states where the insect continues to spread into new areas. In addition, Wisconsin anticipates the need to continue eradication efforts in those areas having isolated infestations that were not included as part of the 1992 project. In 1993, cooperative State suppression efforts will continue to be limited by the availability of both State and local funds. The amount of gypsy moth suppression on National Forest lands will increase as will treatment on other Federal lands.

Slow-the-Spread Pilot Project: The objective of this Pilot Project is to demonstrate the effectiveness of methods and techniques to reduce the natural rate of spread of the gypsy moth into adjacent uninfested areas. In 1992, project areas were selected along the leading edge of gypsy moth infestations in North Carolina, Virginia, and West Virginia. An intensive monitoring grid, utilizing pheromone baited traps, was implemented throughout the selected project areas to determine the level of infestation. This information will be used to plan appropriate intervention methods needed to slow the spread of the moth in 1993. In addition, a similar Pilot Project will be initiated in the Upper Peninsula of Michigan in 1993.

New Gypsy Moth Environmental Statement (EIS): In February 1991, the Area Director, Northeastern Area State and Private Forestry, was given the assignment of determining the adequacy of the 1985 EIS for gypsy moth suppression and eradication projects. This EIS covers the operational activities of both the USDA Forest Service and the Animal and Plant Health Inspection Service. Based on the results of this assessment it was recommended that a new gypsy moth EIS be written to include the new technology and research findings that have occurred since 1985. The USDA Forest Service, as lead agency, has established a core team in Radnor, PA, to accomplish this task. The Notice of Intent was published on November 12, 1992, indicating the intention of the agency to prepare a new gypsy moth EIS and providing an opportunity for interested members of the public, Federal, and State agencies, and others to comment on the proposed intent. Comments may be sent to: John Hazel, USDA Forest Service, 5 Radnor Corporate Center, 100 Matsonford Road, Suite 200, Radnor, PA 19087-4585. The EIS is expected to be finalized in late 1994.

REGION 6 (PACIFIC NORTHWEST)

Asian gypsy moth eradication projects in Portland (8,000 acres) and Tacoma (116,800 acres) were conducted on 124,800 acres. Three applications of B.t. were applied on each area. Intensive trapping for Asian and European gypsy moth has been conducted this fall in both Washington and Oregon. Trapping was substantially incurred around ports and shipping lanes.

REGION 8 (SOUTHERN STATES)

In 1992, the gypsy moth defoliated over 900,000 acres of forest land in the southeastern United States. This level of defoliation accounted for approximately one third of the defoliation in the nation by the gypsy moth. Much of the heaviest defoliation occurred along the expanding front as it moved down the Appalachian Mountains in northern Virginia. Defoliation in Virginia alone was 747,300 acres.

The introduced insect fungal pathogen Entomophaga maimaiga, was discovered throughout the areas defoliated this year, and has added in the general decline of the infestation in the northern Virginia area. It is believed that the cool wet spring aided the spread of the fungus and in the gypsy moth population decline.

The Commonwealth of Virginia aerially treated approximately 200,000 acres of forest land to suppress gypsy moth populations within the generally infested area. An additional 15,917 acres of federally-owned land was also treated. An eradication project in southwest Virginia treated 5,280 acres of which 1,000 acres used the mating disruption technique using Hercon flakes.

North Carolina treated 6,688 acres for suppression in the northeastern corner of the state, along with approximately 1,000 acres for eradication in adjacent counties. An additional 1,000 acres was treated for eradication in the mountains in the northwestern part of the state. Tennessee treated approximately 3,000 acres for eradication in the southeastern corner of the state. While Georgia, treated 5,250 acres in White County, located in the northern part of the state. Follow up trapping and egg mass surveys have discovered additional areas for treatment in 1993 in Georgia.

WESTERN REGIONS

REGION 1 (NORTHERN)

Through cooperative agreements between the Forest Service and the states over 10,000 gypsy moth pheromone traps were deployed throughout the Region. Traps were concentrated near high-use recreation sites, along major travel routes, and most urban areas. The only postive catch was a single moth near Cooke City, Montana. No followup action is planned in 1993.

REGION 2 (ROCKY MOUNTAIN)

Regional trapping surveys turned up seven moths in the Black Hills of South Dakota in 1991. A ten square mile delimitation survey is scheduled in that same area for 1993. Thirteen moths were caught adjacent to a nursery in Omaha, Nebraska, and 3 caught elsewhere in Omaha. Some singles were caught in Boulder, Colorado, and in Fremont County, Colorado.

REGION 4 (INTERMOUNTAIN)

In Utah 15,700 acres were aerially treated with B.t. for eradication of the gypsy moth. Treatment blocks encompassed portions of Davis, Salt Lake, Utah, and Wasatch counties and were treated three times at 5-7 day intervals during May and June.

REGION 5 (PACIFIC SOUTHWEST)

Gypsy moth: No outbreaks and only 9 moths trapped.

REGION 6 (PACIFIC NORTHWEST)

One Asian gypsy moth was trapped in the Portland, OR, area and 9 in the Tacoma, WA, area.

REGION 4 (INTERMOUNTAIN)

Douglas-fir beetle activity remained static Regionwide with most mortality located in southern Idaho and northern Utah.

REGION 6 (PACIFIC NORTHWEST)

There were 154,000 acres infested with Douglas-fir beetle.

DOUGLAS FIR TUSSOCK MOTH (DFTM)

REGION 4 (INTERMOUNTAIN)

Defoliation of Douglas-fir and true fir by the Douglas-fir tussock moth increased from last years levels. Most defoliation is located on the Boise, Sawtooth and Payette National Forests in southern Idaho; smaller outbreaks are located in the Owyhee Mountains on State, BLM, and private lands, and on the Wasatch-Cache National Forest in northern Utah. This is the highest level of Douglas-fir tussock moth defoliation ever recorded in the Region (380,280 acres).

FOREST TENT CATERPILLAR

LAKE STATES

Populations have basically collapsed in Minnesota. There are still scattered pockets of defoliation throughout the area but no forest tent caterpillar defoliation will be reported. Wisconsin had forest tent caterpillar increase dramatically in the Marinette County area. About 200,000 acres were defoliated, which is basically all the host type within the county.

NORTHEAST

In central New York about 90,000 acres of Forest Tent Caterpillar were detected this year; one area was in Herkimer County and the other in St. Lawrence County.

REGION 4 (INTERMOUNTAIN)

Approximately 500 acres of forest tent caterpillar activity was detected on the Uinta National Forest in central Utah.

REGION 8 (SOUTHERN)

In 1992, forest tent caterpillar populations remained relatively high in southern Louisiana. The defoliation occurred primarily in the Atchafalaya Basin, south of Baton Rouge and totaled approximately 300,000 acres. About 120,000 acres were considered to be heavily defoliated.

HEMLOCK LOOPER

NORTHEAST

Defoliation: Two native species of Hemlock loopers, (*Lambdina fiscellaria* (Guenee) and *L. fervidaria athasaria* (Walker)) are common defoliating insects throughout the eastern hemlock forest type, occurring in the eastern United States from Maine to Georgia and west to Wisconsin. The larvae can be extremely destructive to hemlock, balsam fir, and white spruce. Hemlock may die after one year of severe defoliation, fir in one or two years. In the Northeastern Area, populations and associated defoliation have been on the increase in New England over the last three years.

Suppression: In 1992, a Federal project on lands of the Passamaquoddy Indian Reservation in Maine was conducted to suppress populations and reduce defoliation in susceptible hemlock stands. A total of 13,633 acres were aerially treated with Foray 48B at 16 BIU per acre. A post suppression evaluation indicated that populations of the insect were reduced and sufficient hemlock foliage was protected to keep the trees alive. Total cost of the project was approximately $300,000.

Outlook in 1993: Populations of this insect are expected to remain high enough in Maine to require some suppression action in 1993. Both the Passamaquoddy and Penobscot Indian Tribes have requested Federal assistance in conducting suppression projects in 1993. Biological evaluations are expected to be completed by early November 1992. Accurate treatment acreages and costs will be available at that time.

FRUITTREE LEAFROLLER

REGION 8 (SOUTHERN)

In Louisiana, the fruittree leafroller, *Archips argyrospyila*, caused defoliation of approximately 135,000 acres of bald cypress. This has resulted in growth loss and dieback. The areas severely affected were in the southern Atchafalaya Basin. Movement of the outbreak is continuing eastward to the New Orleans area.

REGION 4 (INTERMOUNTAIN)

Estimated number of trees killed/acres infested by bark beetles and acres infested by defoliators in Region 4 during 1992 as determined by aerial detection surveys. Areas of defoliator activity are displayed in figures 1 and 2. Please understand that this information is garnished from rough flight maps and our aerial sketchmappers observations and not from finalized digitized maps.

Bark Beetles:

Pest	Trees Killed	Acres Infested
Mountain pine beetle	25,275	16,400
Douglas-fir beetle	80,000	78,200
Ips/Western Pine Beetle	4,100	4,750
Spruce Beetle	40,000	44,000
Fir Engraver Beetle	286,800	136,300
Western Balsam Bark Beetle	281,000	238,600
Jeffrey Pine Beetle	3,624	6,625
TOTAL	720,800	524,875

REGION 5 (PACIFIC SOUTHWEST)

Bark Beetles/drought. At the beginning of summer, there was about 5 billion board feet of dead or dying timber on the National Forests of California. Of the estimated mortality about 1 billion board feet is available for salvage. The remainder is in areas set aside because of wildlife or watershed concerns/issues.

FIR ENGRAVER BEETLE

REGION 4 (INTERMOUNTAIN)

The most extensive tree killer in the Region continued to be the fir engraver beetle with most activity located on the Toiyabe National Forest in Nevada. Smaller outbreaks are located on the the Boise and Payette National Forests in southern Idaho, and on the Wasatch-Cache National Forest in northern Utah.

REGION 5 (PACIFIC SOUTHWEST)

Fir engraver, Scolytus ventralis, is the primary factor of mortality in the true fir where about 1,750,000 acres are affected.

REGION 6 (PACIFIC NORTHWEST)

There were 560,000 acres infested for fir engraver in Region 6.

JEFFREY PINE BEETLE

REGION 4 (INTERMOUNTAIN)

Jeffrey pine beetle activity increased on the Toiyabe National Forest with most mortality located in the Tahoe Basin.

SPRUCE BEETLE

REGION 4 (INTERMOUNTAIN)

Regionwide, spruce beetle activity increased slightly with significant outbreaks located on the Payette National Forest in southern Idaho and the Manti-LaSal National Forest in central Utah. A small outbreak is located on the Bridger-Teton National Forest in western Wyoming.

MOUNTAIN PINE BEETLE

REGION 2 (ROCKY MOUNTAIN)

Generally, beetle activity in the region is down. The Bearhouse Mountain pine beetle project is near Hill City, South Dakota. The goal of the project was to return beetle population to endemic levels through aggressive silvicultural management. Many local landowners began private logging operations to manage the beetle on their property.

REGION 4 (INTERMOUNTAIN)

Mountain pine beetle activity continued to decrease primarily due to lack of contiguous host type from past catastrophic outbreaks. The largest outbreak is located in the Sawtooth National Recreation Area in southern Idaho. Increases in mountain pine beetle activity in limber/whitebark pine occurred throughout the Region.

REGION 6 (PACIFIC NORTHWEST)

There were 445,000 acres infested with mountain pine beetle in 1992.

REGION 4 (INTERMOUNTAIN)

Western pine beetle activity, located primarily on the Boise and Payette National Forests in southern Idaho, decreased due to host depletion and parasite/predator activity.

REGION 5 (PACIFIC SOUTHWEST)

Western pine beetle, *Dendroctonus brevicomis*, is killing ponderosa pine on about 1,400,000 acres.

WESTERN BALSAM BARK BEETLE

REGION 4 (INTERMOUNTAIN)

Killing of subalpine fir by the western balsam bark beetle increased Regionwide with activity present throughout the host type.

DWARF MISTLETOE

REGION 2 (ROCKY MOUNTAIN)

Dwarf mistletoe continues as the most damaging in the region. Similar levels as in 1991.

DOGWOOD ANTHRACNOSE

REGION 8 (SOUTHERN)

Dogwood anthracnose, first discovered the in southeastern United States in the late 1980's, has spread to seven southern states and affected trees in 163 counties. The acres affected has increased from 0.5 million acres in 1988 to 9.5 million acres in 1992. In a series of permanent plots, the percentage of severely affected or dead trees has increased from 3 to 22 percent during the same time period. Control techniques are not available for forest trees, but hazard rating techniques are available. For high value trees, the hazard rating system also works, as well as a number of control techniques, such as mulching, fertilization, pruning, proper watering, and the use of pesticides. A decision key with the ten essential steps to maintaining a healthy dogwood has been completed. The University of Tennessee and the Forest Service are cooperating to identify possible sources of resistance. The geographic distribution and severity of the disease is projected to increase in the South during 1993.

OAK WILT

REGION 8 (SOUTHERN)

Description: Oak wilt, a native vascular wilt disease caused by the fungus, *Ceratocystis fagacearum* (Bretz) Hunt, is a primary cause of oak mortality throughout the oak-hickory forest type group and especially in the sandy soils of the Lake States. The disease is believed to have been in the Lake States since the 1880's. Currently, oak wilt can be found in 21 states and more than 600 counties in the United States. All oak species are susceptible to the disease, but species of the red oak group are the most susceptible. Once infected with the disease, red oaks die in a few weeks, but members of the white oak may survive for many years. The oak wilt fungus is spread from diseased to healthy trees in two ways. Local spread occurs primarily through root grafts between diseased and healthy trees. Long-distance spread is vectored by sap-feeding beetles that carry fungal spores from diseased to healthy trees. Such insects are attracted to fresh wounds, often caused by logging damage or pruning. This type of spread is most effective in spring when wounded trees are most susceptible. Transmission through root grafts is more common and prevalent in deep sandy soils than in heavy clay or rocky soils.

Oak Wilt Supression, 1992: Minnesota has been experiencing heavy oak mortality on sandy loam sites for many years. This problem has been accelerated dramatically with the expansion of housing developments into many of the high risk forest areas. Housing construction and related activities damage residual oaks, creating numerous oak wilt infection centers. The centers expand at a very rapid rate, eventually killing all of the residual oak trees throughout residential developments.

A cooperative five-year oak wilt suppression project was funded in Minnesota in 1991. This project complies with NEPA through the preparation of a site specific Environmental Assessment and approval of a Decision Notice and Finding of No Significant Impact. A total of $244,000 in Federal funds were provided by the Forest Service and matched by $311,531 in local county and community funds to initiate control efforts in 1992. The method of control used in the project involves the mechanical disruption of natural root grafts between healthy trees adjacent to active infection centers. This process is carried out by use of a specially designed 5 foot vibratory plow. Research results have been shown that the technique is 98 percent effective in preventing the spread of the disease, as long as the vibratory plow lines are properly placed around the infection centers. In 1992, Minnesota planned to treat 464 infection centers in 4 counties. However, this target was exceeded with treatment of 514 infection centers, 40 more than originally planned.

Oak Wilt in 1993: The Forest Service plans to support the Minnesota oak wilt control project in 1993. Minnesota will expand the control project area into several new counties during the year. Initial work will be directed toward control of infection centers in residential developments before control efforts turn to infected parks and woodlots. The development and establishment of community ordinances related to the prevention and control of the disease in residential areas will continue. Similar efforts in public education and developer/ builder requirements will be initiated in new counties entering the program. Minnesota anticipates a total project of $1.5 million in 1993 (Table 2).

REGION 1 (NORTHERN)

The Northern Region has continued an aggressive program of chemical and biological control of exotic noxious weed species. Target species include the knapweeds (spotted, diffuse, and Russian), yellow starthistle, leafy spurge, common crupina, rush skeletonweed, Canada thistle, houndstongue, and others. Approximately 10,000 acres are treated annually with herbicides. Herbicides used include: Tordon (picloram), 2,4-D, and Transline (clopyralid).

In conjunction with their Canadian and European counterparts, American researchers are making progress in the search for biological controls of introduced weed species. To date Forest Service personnel have tested a variety of biological control agents including several Apthona species on leafy spurge and the root-boring species Agapeta zoegana and Cyphocleonus achates on spotted knapweed.

REGION 2 (ROCKY MOUNTAIN)

Noxious weed treatment is what most of the Region's pesticides are used for. Thistle, knapweed, and leafy sprurge are three of the major weed species treated throughout the Region. The herbicides with most use are 2,4-D, Picloram, and Glyphosate. Biological control of noxious weeds has been initiated on a small scale but is being evaluated.

REGION 5 (PACIFIC SOUTHWEST)

Vegetation Management: Herbicides were used on 10 projects on four National Forests to control competing vegetation. To date about 9,000 acres have been treated with the herbicides glyphosate, hexazinone, or triclopyr.

REGION 6 (PACIFIC NORTHWEST)

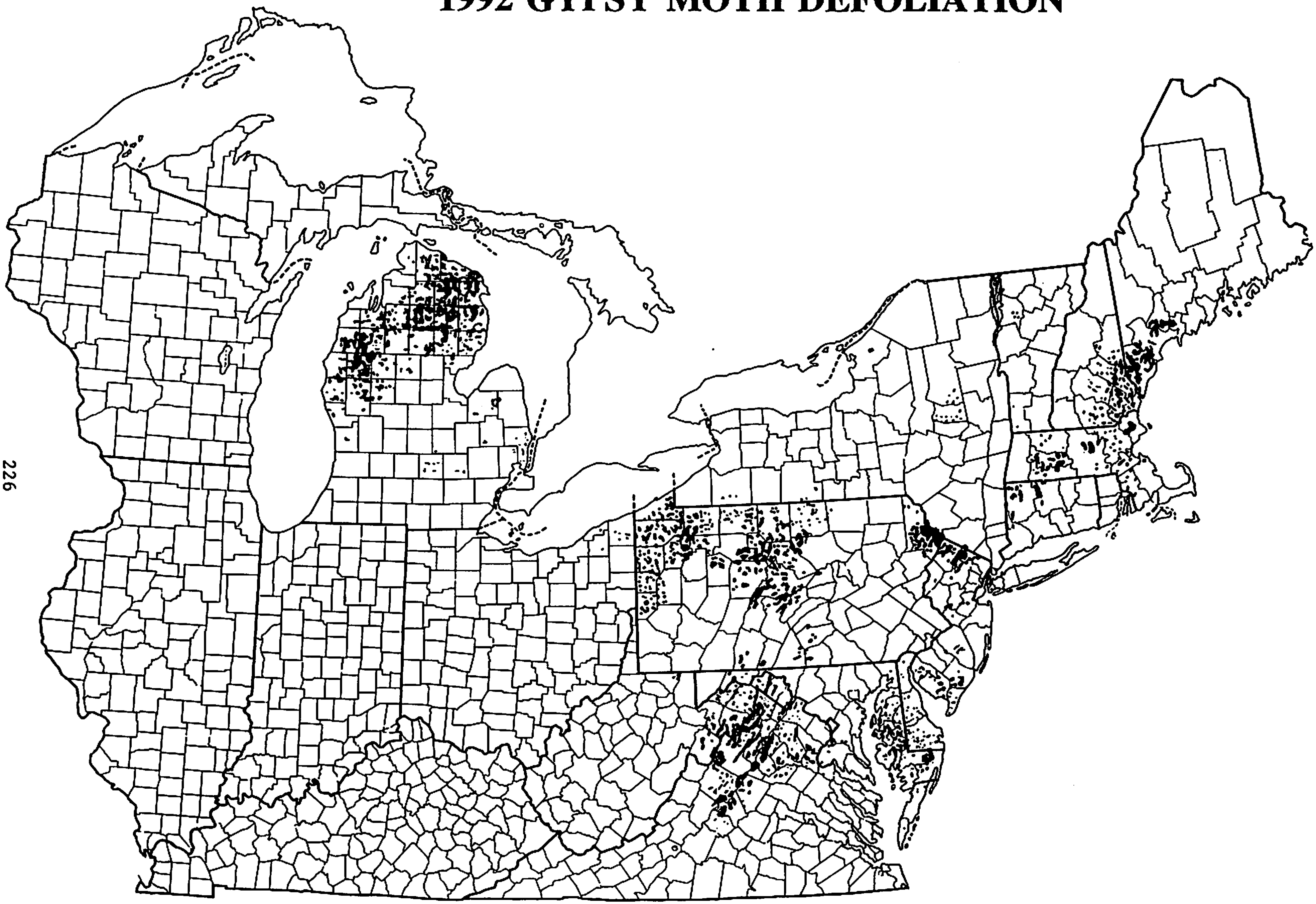
Weed suppression is broken down into four categories: Manual (7,828 acres), Mechanical (220 acres), Biological (1,816 acres), and Chemical (724 acres). Chemical suppression is broken down into two groups: noxious weeds (516 acres), and nursery weeds (208 acres).

REGION 8 (SOUTHERN)

In 1992, the Region 8 herbicide program on Federal lands showed a decline from 1991 levels in both acreage treated and use rate per acre. Acreage treated was about 25% less than 1991 levels with 60,000 acres being treated in 1992. Selective treatment (backpack foliar, cut surface or stumps and streamline) accounted for the bulk of the Region's activity. Essentially no broadcast treatment was done. Four active ingredients accounted for the bulk of the herbicide used; glyphosate (about 1,000 ac release [unspecified] and 1,700 ac of site preparation work), hexazinone (about 2,000 ac conifer release and 3,000 ac site prep), imazapyr (2,500 ac conifer release and 1600 ac [+ triclopyr] site prep), and triclopyr (amine formulation used for about 7,300 ac conifer release, 10,300 ac site prep, and 4,400 ac of wildlife habitat improvement; ester formulation used for about 6,100 ac conifer release, 1,300 acres of hardwood release and 7,400 ac of site prep).

Glyphosate use was at an average of about 0.65 lbs ai/ac; hexazinone averaged about 1 lb ai/ac for release and about 2 lb ai/ac for site prep; imazapyr use was an average of 0.5 oz ai/ac for release and about 4 oz ai/ac for site prep; triclopyr amine was used at an average of 0.8 lb ai/ac for release and site prep and averaged about 1.75 lb ai/ac in the habitat improvement work; and triclopyr ester was used at an average of 1.3 lb ai/ac for conifer release and site prep and at about .7 lb ai/ac for hardwood release.

1992 GYPSY MOTH DEFOLIATION



Gypsy Moth Defoliation

1992

State	Acreage
Connecticut	31,637
Delaware	4,943
Massachusetts	123,794
Maryland	38,704
Maine	278,485
Michigan	712,227
New Hampshire	182,575
New Jersey	165,960
New York	60,022
Ohio	1,130
Pennsylvania	641,445
Rhode Island	0
Vermont	83
Virginia	748,000
West Virginia	67,508
Total	**3,056,513**

Data obtained from GMDigest, Forest Health Protection, Morgantown, WV (12/92)

GYPSY MOTH IN MAINE IN 1992

Dick Bradbury
Maine Forest Service
Augusta, Maine

Gypsy Moth populations remained in the epidemic phase in 1992. Aerial surveys delineated 278,485 acres of forested type which received some degree of defoliation this year. This damage was located predominately in the southern portion of the State in York and Cumberland counties.

Overwintering mortality had little impact in the winter of 1991-92 with nearly 100% of the egg masses collected in March and April of 1992 exhibiting some degree of hatch. Egg hatch exceeded 75% in all samples taken from below the snow line. Egg parasitism by <u>Anastatus disparis</u> and <u>Ooencyrtus kuvanae</u> was common at egg mass collection sites, but not at sufficient levels to limit defoliation.

First hatch was reported May 1st in Arundel. The hatching period was very extended in 1992, complete egg hatch was recorded on May 21st which was approximately seven days later than in 1991. The peak of the second instar occurred circa June 6th. Development sampling was done biweekly until June 22nd when the mean larval index was 4.68. Pupation had begun in many locations in York County on July 1st.

Populations collapsed in many infested areas, apparently due to a combination of starvation and wilt. Small losses were caused by infection from <u>E. maimaiga</u>, but these were scattered and much less dramatic than losses due to the virus.

The Maine Forest Service did not participate in the USDA-FS 1992 Cooperative Gypsy Moth Suppression Program because of the lack of response to the 1991 program. Municipalities were unwilling to commit funds for 1992 spray projects given the current economic climate.

Aerial surveys were done in July over the Southern half of the State. Defoliated acreage was recorded in two intensity classes: >60% leaf loss (219,469 acres) and 30 - 60% leaf loss (59,016 acres). There was a large increase in defoliated acres to the south and a general collapse within central Maine where the population had been very high for the previous two years.

Pheromone trapping conducted along the intrastate quarantine line utilized 234 "milk carton" traps baited with Disparlure. Moth catches were generally up in the east and much reduced in the west. These results reflect the decline of the gypsy moth in south central Maine and moderate numbers along the "edge" of the most desirable forest type.

Egg mass levels going into the fall and winter of 1992 were measured using fixed (one two hundreth acre) and variable (10 BAF prism) plots. Twelve of seventy plots exhibited greater than 250 egg masses per acre. These plots were all in the southern area which experienced increased population levels in 1992. While the number of egg masses in these twelve plots was high, all had either the same number or fewer egg masses than in 1991.

Data on egg masses, observation of the health of overwintering egg masses and past population patterns, all indicate a continuation of the decline of gypsy moth populations in Maine in 1993.

THE HEMLOCK LOOPER IN MAINE - 1992

An update prepared for the 20th annual

FOREST PEST CONTROL FORUM - OTTAWA, ONTARIO
by

Henry Trial Jr., Maine Forest Service

The past hemlock looper feeding season has been interesting and at times confusing. Looper egg hatch was seven to fourteen days later in 1992 than in 1992. Eggs in interior sections of Maine hatched far in advance of those in coastal areas but in all areas significant hatch did not occur until the first week of June. Nearly the entire larval feeding period was characterized by cool, wet, and windy, weather. Larvae were knocked from trees frequently and many were unable to return to an acceptable feeding site. This added to the generally poor weather conditions resulted in very low larval survival and less defoliation than predicted with egg and early season larval counts. The 1992 conditions were nearly opposite the extremely favorable conditions seen in 1991.

Aerial defoliation mapping for 1992 is nearly complete but has been extremely difficult. Many areas are being ground checked to determine if the damage seen was caused in 1991 or 1992. Brown needles from defoliation that occurred were quickly removed from trees by rain and wind. Most of the feeding seen in 1992 occurred on 1991 needles and only the heaviest areas had much damage on new, 1992 needles. These heaviest areas were easy to identify as new 1992 damage. However, many other areas that lost all the 1991 but few 1992 needles do not show as 1992 feeding from the air. Unless a significant amount of 1992 needles were damaged, observers were unable to distinguish 1991 feeding from 1992 feeding. Ground observation of larval numbers, defoliation, and moth activity are the only ways to detect current damage in many areas. These surveys are underway but will take most of the fall to complete.

Based on preliminary information from the aerial survey and ground checks completed to date, the area of moderate to severe defoliation will probably be between 100,000 and 200,000 acres compared to 325,000 acres in 1991. Most of the reduction in acreage will be in Penobscot county in some of the oldest infested areas. Most of these areas did receive light defoliation in 1992. The heaviest defoliation in 1992 occurred in eastern and coastal Washington county. Much of this damage occurred on fir and white spruce. Some new areas of hemlock defoliation were mapped in Penobscot and Washington counties.

Host mortality due to looper feeding became much more apparent in 1992. In many areas such as Medway, Lincoln, Woodville, Georgetown, and Cranberry Isle trees hard hit by looper in 1991 did not refoliate in 1992. Mortality in inland areas was restricted to hemlock but fir and spruce was killed in many coastal areas. Most mortality occurred on intermediate and suppressed trees but in some areas trees of all sizes were lost. In addition to whole tree mortality, tree tops (5 to 20 feet) were killed. The ultimate survival of trees in many areas is still in doubt, but the less severe defoliation seen in 1992 will certainly improve chances for survival.

Heavy moth activity was seen in portions of Washington, Hancock, Penobscot, and York counties but generally moth activity was down compared to 1991. In some areas such as eastern Maine moth activity was extremely prolonged and extended beyond the operation dates (ending September 30) of light traps established to monitor looper activity. Based on the large numbers of moths seen in some areas, and the high light trap catches in southwestern and eastern Maine the looper outbreak will continue into 1993.

Several private spray operations were conducted in 1992. Approximately 1000 acres of small private lots were treated. Most areas treated were recreational and residential properties on the coast or on lakes. Residential and recreational properties treated aerially with Foray 48 accounted for over 600 acres while approximately 250 acres of Christmas trees were treated with Diazinon DZN Ag 500. Preliminary data suggest that results were good.

Further updates will be issued when the aerial defoliation survey and the predictive egg survey are completed.

SPRUCE BUDWORM CONDITIONS IN MAINE - 1992

An update prepared for the 20th annual

FOREST PEST CONTROL FORUM - OTTAWA ONTARIO

by
Henry Trial Jr., Maine Forest Service

The Maine Forest Service, Insect and Disease Management Division did not detect any significant populations of spruce budworm larvae in 1992 but, reports of individual larvae in general survey and hemlock looper collections were up. No defoliation by budworm was mapped either from the ground or aerially.

The MFS operated it's statewide network of 23 light traps through the budworm moth flight period. Also, budworm moth activity was evaluated at sixteen locations across the state with multi-pher traps baited with budworm pheromone provided by the U.S. Forest Service. Results of these surveys were somewhat contradictory. Moth catch in light traps remained very low as they have been for several years but, catch in the pheromone traps was much higher. Moth catch per pheromone trap had been less than one moth per trap for several years, however, in 1992 two eastern Maine locations had more than 25 moths per trap. Three additional locations in the east and north had more than 10 moths per trap and only two traps had less than 1 moth per trap. Even though pheromone catches were much higher than in recent seasons budworm moth activity was still considered low in Maine in 1992. Reasons for the lack of an increased moth catch in light traps similar to that seen with pheromone traps are unknown but, light traps have been a reliable indicator of population trends in the past. Pheromone results in Maine have been erratic at times primarily due to changes in lures from year to year.

II. Vegetation Management Summaries/ Résumeés portant sur la répression de la végétation

I N T E R O F F I C E   M E M O R A N D U M

Date: 02-Nov-1992 02:27pm PST
From: Allan Van Sickle
AVANSICKLE
Dept: Research
Tel No: 363 0674

TO: ecaldwell (PAPER MAIL)

Subject: Pesticide Use Summary

The Provincial Summary of Pesticide Use is not yet printed for 1992, but tabular data has been provided and is the basis for the following brief summary for the 1992 pest Control Forum.

The latest year for which compiled data for British Columbia are available is 1991, including:
..a total of 43 500 ha of B.C. forest and range land were treated with pesticide in 1991, down from 59 400 in 1989. Of the total, 43% was applied by BCFS and 57% by industry.
..the herbicide glyphosate was the most used product (85% of total area), with 9% of the area treated with Bt, and 6% "others".
..by region, 50% of the area treated was within the Prince George Forest Region, 20% in the Vancouver Region, 15% in Kamloops, and lesser amounts in Prince Rupert, Cariboo and Nelson regions.
..the purpose of application was predominately to control unwanted vegetation (85%), 13% insect management, and 2% for range management.
..most treatment was aerially applied (75%) with 13% by ground application and 12% stem injection.

PRINCE EDWARD ISLAND CANADA

1991/92 Summary of Herbicide Treatments in Prince Edward Island Area Treated (ha)

Land Base	Site Preparation	Plantation Maintenance
Private land	34.22	421.53
Crown land	70.52	52.23
TOTALS	104.74	473.76

1. All herbicide treatments carried out are ground application.
2. Vision used operationally at rates of 4 liters to 6 liters per hectare.
3. Simizine used operationally at rates of 9 liters to 13.5 liters per hectare.

NEWFOUNDLAND - HERBICIDE SPRAY PROGRAMS - FOREST SITES

(Report to 20th Annual Forest Pest Control Forum (Ottawa, Nov. 17-19, 1992)

SUMMARY TABLE OF AERIAL * HERBICIDE SPRAY - NEWFOUNDLAND 1984-92

YEAR	AREA(ha)	# SITES	PRODUCT	RATE L/ha	PRESCRIPT [a]
1984	259	5	Vision	3 & 6	C, P, S
1985	475	4	Vision	4.25	P, S
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	C, P, S
	1 048				
1987	1 613	6	Vision	4 & 6	C, P, S
1988	1 010	6	Vision	4	C, P, S
1989	2 312	8	Vision	4, 5 & 6	C, P, S
1990	2 844	8	Vision	4 & 5	C, P, S
1991	1 220	6	Vision	4 & 6	P, S
1992	1 786	12	Vision	4, 4.5 & 6	C, P, S

TOTAL 12 567 Hectares

SUMMARY TABLE OF GROUND ** HERBICIDE SPRAY - NEWFOUNDLAND 1984-92

YEAR	AREA(ha)	# SITES	PRODUCT	RATE L/ha	PRESCRIPT [a]
1990	25	1	Vision	4	P
1991	15	1	Vision	6	S
1992	163	4	Vision	4, 4.5 & 6	C, P, S

TOTAL 203 Hectares

* Using helicopters with boom & nozzle

** Using back-packs in 1990 & 1991, and Muskeg (prime mover) with a 2 Radiarc system in 1992

[a] C = Conifer release P = Plantation release
S = Site preparation

(Presented by H. Crummey, Dept. of Forestry & Agriculture,
P.O. Box 2006 Herald Bldg., Corner Brook, NF, A2H 6J8)

III. Regulatory Considerations/Aspects réglementaires

Linkages between the Pest Management Secretariat and other Elements of the Pest Management System

Ivo Krupta

Pest Management Secretariat

The primary role of the Pest Management Secretariat is to coordinate implementation of the revised pesticide regulatory system announced by the Government of Canada in February 1992. In carrying out this role, the Secretariat has established and/or developed linkages with the Interdepartmental Executive Committee on Pest Management, the Interim Canadian Pest Management Advisory Council, the Directors General CORE Committee on Pest Management, the Standing Federal-Provincial-Territorial Committee on Pest Management and the Pest Management Alternatives Office (PMAO).

Interdepartmental Executive Committee (IEC) on Pest Management

The IEC comprises Assistant Deputy Ministers from the four key departments involved in the Federal Pest Management System (Agriculture, Health & Welfare, Environment, Forestry). It is responsible for the overall management of the System and for overseeing the drafting of new legislation and the implementation of the revised pesticide regulatory system. The Executive Secretary of the Pest Management Secretariat reports to and fulfills the role of secretary to the IEC. As well, the Pest Management Secretariat provides the secretariat for that Committee. Minutes of meetings of the IEC are available to the public and are distributed widely within the federal departments and to the ICPMAC and the Federal-Provincial-Territorial Standing Committee by the Pest Management Secretariat.

Interim Canadian Pest Management Advisory Council (ICPMAC)

The role of the ICPMAC is to advise the federal government on the implementation of the government response to the Pesticide Registration Review Team Report. This includes advice on priorities, policy, resource allocation and other issues related to the revised federal pesticide regulatory system. The Council conveys its advice to the Minister of Agriculture, the federal government generally, and to other bodies (e.g. the PMAO) through the Records of Discussion of its meetings. The Pest Management Secretariat provides the secretariat for the Council.

Federal-Provincial-Territorial Standing Committee on Pest Management

This Standing Committee comprises representatives of provincial, territorial and federal governments. Its primary role is to provide a formal channel of communication, consultation and collaboration among the federal, provincial and territorial governments on the implementation and maintenance of the revised federal pesticide regulatory system. Along with a provincial co-chair, the Executive Secretary of the Pest Management Secretariat co-chairs the Standing Committee. As well, the Pest Management Secretariat provides the secretariat for the Standing Committee.

Directors General CORE (DG-CORE) Committee on Pest Management

The DG-CORE Committee comprises Directors General from each of the IEC departments who have direct control over the pesticide registration process. This Committee reports to the IEC and is responsible for the development of interdepartmental workplans to implement decisions of the IEC. The Executive Secretary of the Pest Management Secretariat chairs the DG-CORE Committee and the Pest Management Secretariat provides the secretariat for the DG-CORE

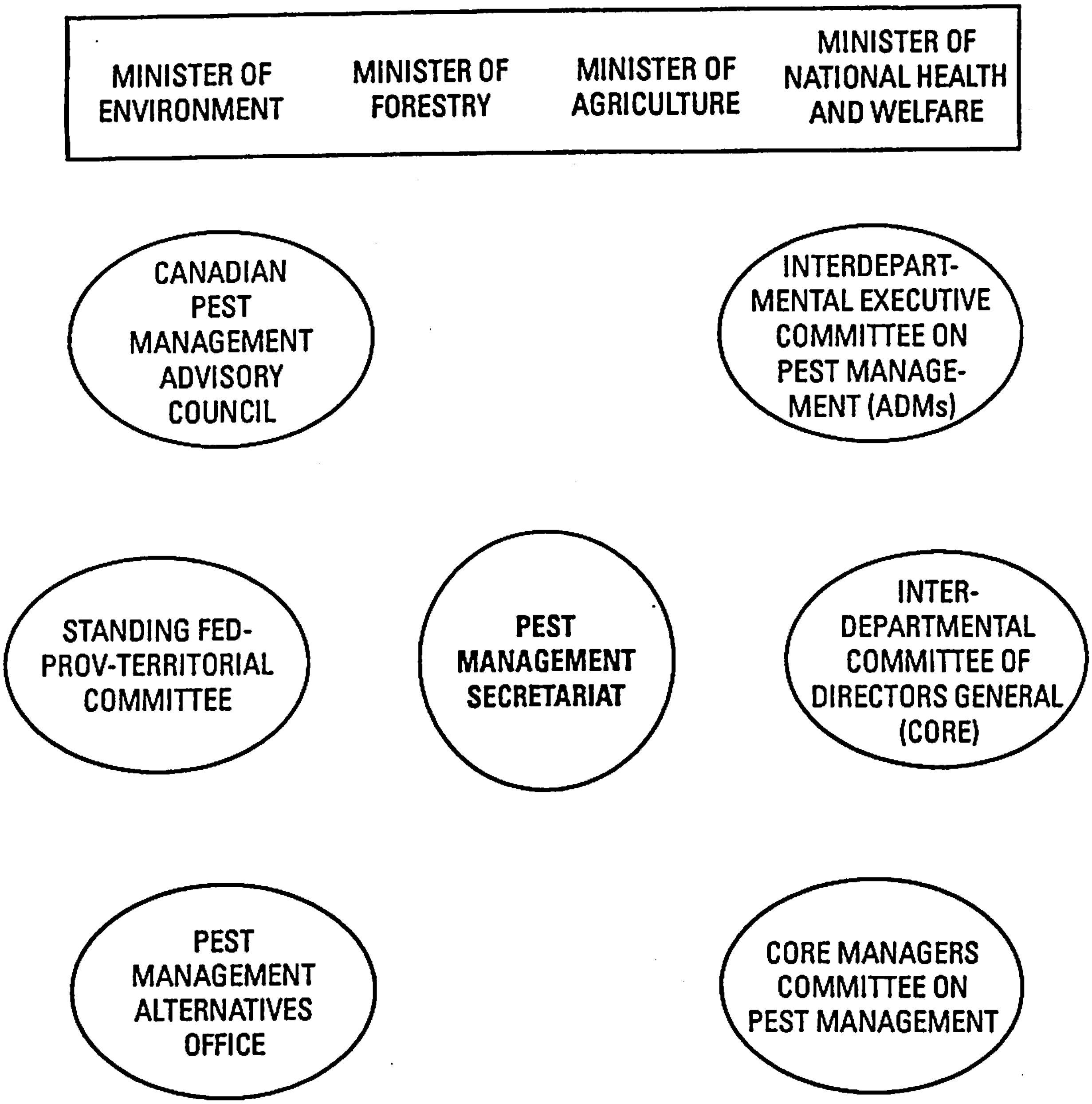
Core Managers Committee on Pest Management

Supporting the DG-CORE Committee is the Core Managers Committee, comprising directors and chiefs from the IEC departments, and its sub-committees, such as the Core Systems Committee. The Core Managers Committee serves as the first tier of the decision-making process in resolving interdepartmental issues. The Pest Management Secretariat provides the secretariat for the Core Managers Committees and participates on sub-committees of the Core Managers Committee.

Pest Management Alternatives Office (PMAO)

The main role of the PMAO is to encourage reduced use of pesticides through promoting integrated crop management to achieve the broader goals of environmental sustainability. Close liaison is maintained between the Pest Management Secretariat and the PMAO.

PEST MANAGEMENT SECRETARIAT ENVIRONMENT



The Pest Management Alternatives Office (PMAO)

Peter Perrin

Mission Statement

To promote pest management practices that ensure environmental sustainability

November 4, 1992

OBJECTIVES

In the context of the objectives of minimizing negative impacts on human health and the natural environment,

- Promote the use and, where appropriate, encourage the development of viable ecologically-sound pest management strategies that minimize risk of harm to health, safety and the environment, while optimizing pest control.

- Develop policies for the promotion of alternative ecologically-sound pest management strategies, and promote and fund relevant research.

- Work with all levels of government, pesticide users, the alternatives sector, and other stakeholders to assist them in setting targets and developing strategic plans for the appropriate reduction of pesticide use in all sectors, including agriculture, forestry, industrial, commercial lawn and turf, and domestic sectors.

- Consult with and provide advice on alternative pest control strategies to the authorities responsible for the regulation and use of pest control products as appropriate.

- Establish and maintain appropriate linkage with agencies responsible for pest control product registration and Pest Management Secretariat to, amongst other things:

    - Determine, within specified time frames, with respect to applications for emergency registration and user-requested minor-use registration whether acceptable alternative ecologically-sound pest management strategies available have been considered.

    - Determine, subsequent to notification by the regulatory agency of all of its regulatory decisions, whether there is a need for research into alternatives; and

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November 19, 1992

- Consult with and advise the regulatory agency as appropriate.

- Take a leadership role in ensuring that the above objectives are achieved by, amongst others;

  - Ensuring the establishment and maintenance of an information base on alternative ecologically-sound pest management strategies and related research projects.

  - Ensuring that the trends in relevant research both nationally and internationally are monitored.

  - Ensuring the areas where research is needed are identified and prioritized.

  - Consulting and liaising with the regulatory agencies and other federal agencies, provincial and territorial authorities, industry, users, non-governmental organizations, and international partners.

  - Communicating by appropriate means, which may include press releases, fact sheets, bulletins, newsletters and discussion documents, progress in the development and use of alternative ecologically-sound pest management strategies; and

  - Publishing an annual report detailing progress made in the implementation of the above objectives.

November 19, 1992

Presentation to the Forest Pest Control Forum

Nov. 18, 1992

PROPOSED FOREST PEST MANAGEMENT REGULATORY PROGRAM

Background

An independent multi-stakeholder team assembled by the Minister of Agriculture was requested to provide the Minister with recommendations to improve the existing federal pesticides regulatory system. Their report, entitled " **Recommendations for a revised federal pest management regulatory system** ", was presented to the Minister of Agriculture in December of 1990.

The Government's response was released to the public in February of this year, and the Federal Departments of Agriculture, Health and Welfare, Environment, and Forestry have been moving to implement the improvements contained in the response since then. Treasury Board has approved in principle an Interdepartmental request for a total of 81 million dollars (approx. 257 PY's) over the six year implementation period (91/92 - 96/97).

Overview

Forestry Canada's effort at complying with the Government's response has been formulated with the intent of optimising the use of current and projected resources. Forestry Canada will establish the **Forest Pest Management Regulatory Program** to carry out its mandate within the larger Federal effort. The program will include a **Scientific Coordinator, Pesticide Regulations**, located in Ottawa, and two linked projects, the **Forest Pest Management Regulatory Project (PMRP)** and the **Forest Pest Management Alternatives Project (PMAP)**, to be located in Sault Ste. Marie.

SCIENTIFIC COORDINATOR, PESTICIDE REGULATIONS

This position will provide advice on regulatory policies and implications to research programs forest pesticide research programs at eight research establishments across Canada. It will provide the liaison for Forestry Canada with regulatory agencies involved with the registration of pest control products in used in Forestry. The position will develop policy for pest management regulations within Forestry Canada with emphasis on developing policies that would encourage the development and use of alternative pest management tactics and strategies.

The Forest Pest Alternatives Project and the Forest Pest Regulatory Project will be incorporated into FPMI's established program. Functional responsibility for both projects will reside with the Chief Regulatory Affairs.

Individuals within each project will be expected to take lead roles in ensuring that Forest Pest Management Regulatory Program becomes an integral part of Forestry Canada's research mandate. The projects will seek to become members of existing networks or working groups, and where necessary, establish new networks to ensure that regulations are well understood by the science community and that science remains an integral part of regulatory decisions.

Prepared by: Craig A. Howard
Errol Caldwell
Nov. 10 1992

fpmrp.7

Biocontrol agents - regulatory guidelines, Agriculture Canada Proposal
- Gil Flores

Agriculture Canada has the authority to regulate biological pest control products under the Pest Control Products (PCP) Act and Regulations, which requires that all pest control products be registered prior to their manufacture, sale or use in Canada, and the Plant Protection Act which is used to prevent the introduction of potential plant pests into Canada or the movement of pests between provinces.

Presently, the importation of biocontrol agents such as insects, mites and nematodes is regulated under the Plant Protection Act. Historically, the release and commercial production of these biocontrol agents was not regulated.

With the anticipation of many new commercial products reaching the market place, questions have been raised regarding quality control, contamination, performance values, product claims, and possible environmental impacts. In response to these, the department has decided to take a more active role in ensuring the safety, merit, and value of biocontrol agents such as insects, mites and nematodes and, in order to enhance the integrity and image of this positive pest management technology, Agriculture Canada has developed a proposal for regulating research activities, commercial production and releases of biocontrol agents.

Under the current system, insect parasites and predators are assessed in-house by Plant Protection Division, with the scientific backup from the Research Branch. Biocontrol agents used against weeds are assessed by an ad hoc expert committee drawn from the Research Branch which functions as an advisor to Plant Protection Division.

The proposed Regulatory Policy is based on a tiered approach where the traditional insects, e.g., ladybird beetles, *Encarsia* sp. etc., will require virtually no regulatory oversight, whereas new commercial biocontrol agents like *Trichogramma* will require less stringent regulatory oversight in relation to the genetically-engineered biocontrol agents.

We expect that the regulatory process will provide a means of addressing misleading advertising and performance complaints by focussing on efficacy and labelling integrity. Thus, biological pest control will have to meet performance values and product claims.

w:\ipp\manda
October 19, 1992

DRAFT

SUGGESTED MANAGEMENT PROCESS
(Domestic Movement or Release)

DESCRIPTION	ACTIVITY	REGULATORY PROPOSAL
Familiar, Traditional Situation, e.g. Ladybird Beetle, *Encarsia*, etc.	Research	• Exempt via Exemption List
	Commercial Release or General Release by Government Agencies	• Exempt via Exemption List • Label • Quality Control via Inspection

IPPBIOHZ.PRS

DRAFT

SUGGESTED MANAGEMENT PROCESS
(Domestic Movement or Release)

DESCRIPTION	ACTIVITY	REGULATORY PROPOSAL
Unfamiliar - Endemic Biocontrol Agents	Research	• Exempt via Exemption List
	Commercial Release or General Release by Government Agencies	• Precedent Review • Permit • Eventual Exemption • Label • Quality Control via Inspection

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DRAFT

SUGGESTED MANAGEMENT PROCESS
(Domestic Movement or Release)

DESCRIPTION	ACTIVITY	REGULATORY PROPOSAL
Exotic Biocontrol Agents	Research	· Permit Before Release · Label · Field Inspection
	General Release by Government or Commercial Release	· Registration · Label · Quality Control · Enforcement

IPPBIOHZ.PRS

DRAFT

SUGGESTED MANAGEMENT PROCESS
(Domestic Movement or Release)

DESCRIPTION	ACTIVITY	REGULATORY PROPOSAL
Genetically Engineered Biocontrol Agents	Research	· Permit Before Release · Experimental Label · Field Inspection
	General Release by Government or Commercial Release	· Registration* · Label · Quality Control · Enforcement

* *Tiered data requirements*

IPPBIOHZ.PRS

DRAFT

provincial connection/liaison

RESEARCH ACTIVITY

Familiar/unfamiliar Naturally occurring BCA

- EXEMPT via Exemption List

Exotic/genetically BCA

- Permit before release
- Label
- Field Inspection

COMMERCIAL PRODUCTION/RELEASE

Familiar

- EXEMPT via Exemption List
- Label
- Quality Control via Inspection

Unfamiliar

- Precedent Review
- Permit
- Label
- Eventual Exemption
- Quality Control

Exotic

- Registration
- Label
- Quality Control
- Enforcement

Genetically Engineered

- Registration*
- Label
- Quality Control
- Enforcement

* *Tiered data requirements*

The Status of Agriculture Canada's Policy Regarding European Gypsy Moth (EGM)

It was noted at last year's meeting of the Forest Pest Forum Steering Committee that the status of Agriculture Canada's gypsy moth policy was unclear. It was also noted that the USDA - Forest Service had expressed concern with Agriculture Canada's present policy to abandon all eradication/ suppression efforts within a province once a portion of that province becomes infested with EGM.

As a result of the USDA concerns, the North American Plant Protection Organization (NAPPO) created an ad hoc panel, consisting of a representative from: the USDA - Animal and Plant Health Inspection Service (APHIS), the USDA Forest Service and Agriculture Canada.

The NAPPO ad hoc panel reported the following differences between the Canadian and American policies on EGM:

1. The USDA has a signed formal memorandum of understanding (MOU), between the states, APHIS and the USDA - Forest Service. This MOU was established in 1989 and clearly outlines the roles and responsibilities (including who funds the activities) of each organization in managing EGM. Canada has no such formal MOU for the management of EGM.

2. The USDA (APHIS and Forest Service) are responsible to eradicate all isolated infestations of 100 miles or further from generally infested areas. Agriculture Canada's present position is to eradicate only in provinces where EGM is not presently established. This excludes the provinces of Ontario, Quebec, New Brunswick and Nova Scotia.

3. The USDA (via the U.S. Forest Service) partially funds the state control/suppression programs in the generally infested areas, whereas, Agriculture Canada has no such funding mechanism in place.

The panel recommended that Agriculture Canada review its present gypsy moth program with the purpose of developing a harmonized North American policy for european gypsy moth.

Agriculture Canada is presently reviewing its gypsy moth program. Two workshops were recently held, involving some headquarters and regional representatives from Forestry Canada and Agriculture Canada, to arrive at a policy proposal.

The provinces will be given an opportunity to respond to the proposed policy prior to the development of the Canadian policy for european gypsy moth.

Until such time as a new policy has been adopted, Agriculture Canada will maintain its present position with EGM.

MD:mm (c:\md\0747.doc)

Agriculture Canada role in protecting Canada's forests from introduced pests.

Marcel Dawson

Introduction.

It is natural to question why an agricultural department should have any role with regard to forest pests. In some countries the plant protection role is split between agriculture and forestry departments, this is the case for example in Mexico. However, in most countries there is one organisation that attempts to prevent the entry and spread of exotic pests and diseases that may affect plants of economic significance. The main reason for this arrangement is that pests and diseases do not discriminate between agriculture and forestry.

In one of the examples I shall be describing, the same pest may occur in nursery plants, Christmas trees and in forest trees. In another case a forest pest arrived on grain ships and some of the actions that we undertook had a disruptive effect on grain exports, all with the purpose of protecting forests.

The Plant Protection Act (1990) states that "the purpose of this Act is to protect plant life and the agricultural and forestry sectors of the Canadian economy by preventing the importation, exportation and spread of pests and by controlling or eradicating pests in Canada."

The Food Production and Inspection Branch of Agriculture Canada has as its' Mission "The preservation of the marketability of Agriculture, Forest and Food products by facilitating industry compliance with established health and safety standards, and by controlling, eradicating, and preventing animal and plant diseases and pests that may have a human health or economic significance."

These statements make it clear that in Canada there is responsibility for prevention of entry and spread of pests and diseases of forestry in Agriculture Canada. The remainder of this paper describes some of the activity that has taken place in the past year in fulfilling that mandate.

Asian Gypsy Moth.

In spring of 1991, Agriculture Canada inspectors observed larvae ballooning out from a Russian grain vessel in the port of Vancouver. These were identified as larvae of gypsy moth and so an intensive trapping programme was undertaken in the fall of 1991 to determine whether any of the larvae had managed to complete their development to adult moths.

Moths were trapped at a number of locations around the harbour area and it was possible to identify some of these definitely as Asian gypsy moths. The information was reviewed by the British Columbia Plant Protection Advisory Council (BCPPAC), which includes representatives of the federal and provincial governments and of industry organisations. The Council concluded that there was a probable introduction of Asian gypsy moth, that this represented a serious pest risk and that an eradication programme was justified and feasible.

The Asian gypsy moth is a close relative of the European gypsy moth but has a number of characteristics that make it a potentially more serious forest pest for Canada. Because the female Asian gypsy moth can fly there is a potential for an infestation to become widely dispersed more quickly. In addition the Asian gypsy moth is adapted to areas with a colder climate and to a wider range of host species, including coniferous species. All of these features made it a matter of urgency to take action on two fronts, first to prevent any further arrivals and second to eradicate those that had arrived.

To prevent further arrivals it was necessary to determine what ships represented a risk of introducing infestations and when they would be a threat to Canada. The sources of infestation were identified as certain ports in Eastern Russia, including Vladivostok. The time at which ships might have been affected was the egg-laying period of the previous year. The time at which Canada was at risk was in the spring when any eggs might be likely to hatch.

Thus by early in 1992 we had decided the risk period for Canada and had identified that the ships which represemted a threat were those that had visited certain ports during the egg-laying period. We then studied Lloyds' Register of shipping to find the names of ships that would be undesirable to have visit Canada at a time when eggs might hatch. From this was developed a list of ships baaned from entering Canada at the high risk period.

To further protect ourselves a ship inspection process was instituted during the period considered low-risk. It should be noted that this was the earliest spring on record for the West coast. There came a point in the low-risk period that an inspector was inspecting a ship and found an egg-mass. He placed it in a bag in his pocket and continued his inspection. Some time later as he was leaving the ship he observed that the eggs were starting to hatch.

The ship was ordered to leave and the high-risk period was redefined and all high-risk ships were immediately banned and ordered out of the harbour area. This caused a disruption on grain shipments to Russia because most of the ships move back and forth between Vladivostok and Vancouver and they had been in Russia at the egg-laying time.

It was recognised that the problem could only be solved in

Russia. There have been several missions to Russia to try to diminish the possibility of ships becoming infested. The most recent information suggests that the population build-up that led to the infestation of ships is now over. This together with corrective actions should greatly lower the risk of re-infestation in 1993.

At the same time as we were implementing our ship policy to prevent further infestation we were planning an aerial and ground spraying programme to eradicate any infestation that had become established. This was a major enterprise that could not have worked without the full cooperation and participation of the province.

The probable site of any hatching egg-masses was in and around the city of Vancouver including an area of high-rise buildings that represents one of the most densely populated parts of Canada. In addition the population of Vancouver is amongst the most environmentally sensitive in Canada. Hence a significant part of the preparation for the spraying programme was taken up with public meetings to explain what was proposed and why.

The spray programme used Bacillus thuriengensis k., a natural pesticide and this alleviated some of the concern of some environmentalists but not all. We are still involved in two law suits related to objections to the spraying. Nevertheless the spraying did proceed. Extensive trapping this fall has not revealed the presence of any Asian gypsy moths and so it appears that the spraying was a success.

It would be remiss of me to omit from the description of this issue the very close working relationship that we have had with our counterparts in the United States. They had also detected small infestations in Oregon and Washington and decided to take the same kind of action that we did. They cooperated very closely in their ship policy so that a ship rejected in Canada was automatically rejected in the United States and vice versa.

Funding for the Canadian spray programme cost more than $5 million and this was shared between the provincial and federal governments.

I have described this particular issue in some detail because it illustrates several points which should be made. The first is the level of commitment of Agriculture Canada to eradication of exotic pests of economic significance to forestry. This commitment was shown not only in the money expended but in the priority that was given to the prevention of reinfestation. This took precedence over the export of grain at a particular point in time - with the support of the grain sector because they did not want the port of Vancouver infested.

A further very important point is that the success that was achieved was only possible because there was very close coordination between provincial and federal governments and it was operated as a joint project. The existence of a joint Advisory Council in British Columbia greatly facilitated the cooperation and we in the Plant Protection Division would like to establish a national advisory system based on similar provincial organisations from across Canada.

Pine Shoot Beetle (Tomicus piniperda)

In July the Animal and Plant Health Inspection Service (APHIS) of the United States informed us that they had detected the pine shoot beetle in a Christmas tree plantation in Ohio. As they surveyed further it became apparent that the beetle was established over quite a wide area and it is now reported from parts of six states.

Agriculture Canada undertook a pest risk assessment and concluded that this was a pest of economic significance that we should attempt to keep out. Discussions have been ongoing with provincial government officials and with the potentially affected industry.

We have instituted a ban on the import of pine Christmas trees, nursery stock and logs from the affected areas. We have also instituted a permit requirement for any pine shipments into Canada to try to keep track of pine imports.

Obviously the most desirable way of protecting Canada is to prevent pests from arriving rather than trying to take remedial action after they are here. The activity with pine control is a more developed form of the standard activities that we are carrying out on a routine basis for the protection of Canada's forests.

Conclusion.

This paper describes some examples of activities carried out in support of the plant protection programme for Canada. Since there are endless numbers of pests and diseases that could or do afflict agriculture and forest crops, there have to be choices made on which are the most important areas in which to focus resources.

The major thrust is on pests and diseases that have not yet arrived or that have not become established. It is possible at this stage to achieve a better return on the resources invested. Once a pest or disease is established then it may only be possible to achieve some degree of control to keep the level of infestation or infection at a minimal level.

It is obviously a matter for debate as to when the ...

for eradication is gone. This poses particular problems in a country as large as ours when a pest or disease is established in one area but not in another. There can be debate on the meaning of established. These are all factors in the decision that has to be made by Agriculture Canada on the future policy with regard to European gypsy moth.

IV. Research, Monitoring and Other Reports/ Recherche, surveillance et autres rapports

USE OF LECONTVIRUS IN 1992

A report to the 20th Annual Forest Pest Control Forum
(Ottawa, Ontario, 17-19 November, 1992)

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USE OF LECONTVIRUS IN 1992

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Abstract

Lecontvirus was supplied to staff in 4 Ontario Ministry of Natural Resources Districts and one Quebec Ministry of Forests District. A total of 28 plantations, infested with redheaded pine sawfly, with a combined area of 372 ha, was treated with virus.

Operational Sprays

Lecontvirus (nuclear polyhedrosis virus) was supplied in an emulsifiable oil formulation to Ontario Ministry of Natural Resources and Quebec Ministry of Forests staff. A total of 28 plantations with a combined area of 372 ha was treated to control redheaded pine sawfly, *Neodiprion lecontei* (Table 1). All treatments were applied from the ground.

Table 1. Lecontvirus applications in 1991.

Province	District	No. of plantations treated	Total area (ha)
Ontario	Bancroft	4	82
	Espanola	20	250
	Minden	1	8
	North Bay	1	20
Quebec	Trois Rivières	2	12
	Total	28	372

It was a cool wet summer and the hatch of redheaded pine sawfly adults and oviposition were over a prolonged period. Two clients did not apply Lecontvirus and returned the material. Supply of Lecontvirus is very limited. It is not known if it will be possible to service all requests in 1993 and it is vital that more virus is propagated and put in storage. Since the program was initiated in 1976, 566 red pine and jack pine plantations with a combined area of 4,662 ha have been treated both from the air and the ground.

EXPERIMENTAL AERIAL APPLICATION OF VIRUS AND *BACILLUS THURINGIENSIS* ON GYPSY MOTH IN ONTARIO IN 1992

A report to the 20[th] Annual Forest Pest Control Forum
(Ottawa, Ontario, 17-19 November, 1992)

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Abstract

A total of 19 plots with a combined area of 355 ha was aerially sprayed with double applications of gypsy moth nuclear polyhedrosis virus. Four formulations were tested and virus came from two sources, Disparvirus from the Forest Pest Management Institute and Gypchek from the USDA Forest Service. Two of the formulations were supplied by American Cyanamid Company, the third by Entotech, a subsidiary of Novo Nordisk Bioindustrials and the fourth was the standard molasses formulation. A further 3 plots with a combined area of 37 ha were treated with a double application of Foray 76B which is a formulation of *Bacillus thuringiensis* produced by Novo. It was an atypical, cool, wet summer. Reduction in egg mass densities in all treatments was excellent and untreated check plot egg mass numbers at the spring and fall counts remained steady. However, defoliation of oak trees was light on both the treated plots and the untreated check plots, and there was no discernable difference between any of the plots.

Introduction

An intensive research program on gypsy moth nuclear polyhedrosis virus (NPV) was launched in 1988 and aerial spray trials have been conducted annually since then. Until 1991, a total of 37 plots with a combined area of 635 ha had been treated with gypsy moth virus in Ontario. The virus was produced at two locations and, although the products are identical, they have different names. Disparvirus is produced at the Forest Pest Management Institute and Gypchek is produced by the USDA Forest Service at Hamden, Connecticut.

In 1991, FPMI entered into a cooperative agreement with the USDA Forest Service and some treatments were applied both in Ontario and in Virginia. FPMI was already in partnership with the Ontario Ministry of Natural Resources with a view to developing Disparvirus for operational use. Trials in 1991 indicated that it was feasible to use a reduced dosage and volume of gypsy moth virus, namely a double application of 5×10^{11} PIB/ha (total 10^{12} PIB/ha) in 5.0 L/ha, and a pilot test was proposed for 1992. "Pilot test" is a term used by USDA officials which means three large replicated plots and such a test is conducted before recommending a prescription for operational use. The tank mix used in this pilot test was the standard 25% molasses, 6% Orzan

LS and 2% Rhoplex B60A sticker mix which has been used for virus applications in forestry for several years.

The standard tank mix involves 5 ingredients, is difficult to mix, and is certainly not feasible for use by commercial applicators. The USDA Forest Service has a contract with Entotech, a division of Novo Nordisk, to produce a suitable carrier for viral insecticides. The active ingredient is added to this aqueous flowable just prior to application. A sample of this spray adjuvant was made available for FPMI to test with Gypchek.

American Cyanamid are interested in producing and marketing a viral insecticide for gypsy moth control and they formulated two wettable powder products using Disparvirus made at FPMI. The first was used at the prescribed dosage of a double application of 5×10^{11} PIB/ha giving 10^{12} PIB/ha total. The second contained an enhancer, 1% Blankophor BBH, and it was applied at one tenth of the prescribed dosage, a double application of 5×10^{10} PIB/ha giving a total of 10^{11} PIB/ha. As a standard for comparison to these wettable powder formulations, Disparvirus was also applied in the 25% molasses, 6% Orzan LS and 2% Rhoplex B60A tank mix using a double application of 5×10^{11} PIB/ha.

In concert with these virus spray trials a test was conducted with the *Bacillus thuringiensis (B.t.)* product Foray 76B supplied by Novo Nordisk. Gypsy moth is not on the Canadian label for Foray 76B. This test was conducted with a view to adding gypsy moth to the Canadian label.

Experimental Plots and Spray Application

Nineteen virus treated plots, 3 *B.t.* treated plots and 4 untreated check plots were located in Simcoe and Aylmer Districts within a 20 km radius of the town of Tillsonburg. The plots were natural woodlots and ranged in size from 48.0 to 80.0 ha for the pilot test. The plots were about 10.0 ha in area for the other tests (range 8.0 to 14.8 ha). Plots contained a minimum of 30% oak (red, white and black). A description of the plots, including stocking density of the trees and the DBH of oaks used as sample trees, is given in Table 1.

Two aircraft were used for the spray applications, both were Cessna Agtrucks equipped with 4 Micronair AU4000 rotary atomizers. The first was the FPMI aircraft and the second was contracted from Hicks and Lawrence. The atomizers were adjusted to rotate at 5,000 r.p.m. which gave a VMD around 130 µm and about 14 droplets/cm² with either water or the standard molasses tank mix emitted at 5.0 L/ha.

There were 5 virus treatments and one *B.t.* treatment which are listed in Table 2. All were double applications. All the virus treatments were at 5.0 L/ha and the *B.t.* treatment at 2.5 L/ha. Spraying commenced on 19 May and the virus treatments were completed by 26 May. The first *B.t.* application was on 26 May and the second, 7 days later, on 2 June. The meteorological conditions during the spray applications are given in Table 3. Insect development, determined by head capsule measurement, is given in Table 4. At the time of the virus applications, all

Table 1. Description of treated and check plots.

Treatment	Plot	Area (ha)	% oak	No. of trees/ha	DBH cm ± SE
1	1	80.0	40	132	58 ± 2.3
	2	48.5	40	121	47 ± 2.4
	3	48.0	40	91	38 ± 2.1
2	1	14.4	50	376	34 ± 1.4
	2	12.4	60	508	39 ± 1.5
	3	11.9	60	474	44 ± 1.3
3	1	13.8	50	646	44 ± 1.0
	2	10.0	50	453	39 ± 2.2
	3	12.0	70	921	38 ± 1.0
	4	12.1	40	544	41 ± 1.1
4	1	8.2	90	1,034	30 ± 0.7
	2	14.8	50	742	44 ± 1.6
	3	12.0	80	937	38 ± 5.4
	4	8.2	60	630	39 ± 1.6
5	1	9.0	70	338	39 ± 1.5
	2	8.4	80	640	29 ± 1.5
	3	13.0	60	641	35 ± 0.9
	4	8.0	50	351	37 ± 2.0
	5	10.6	70	943	31 ± 0.9
6	1	11.7	90	552	37 ± 1.3
	2	14.6	50	557	67 ± 1.3
	3	10.7	70	498	36 ± 1.3
Check	1	12.0	60	594	34 ± 1.2
	2	40.0	30	182	47 ± 2.2
	3	7.0	30	908	36 ± 1.9
	4	3.0	70	391	37 ± 1.5

Table 2. Virus and *Bacillus thuringiensis* applications against gypsy moth in Simcoe and Aylmer Districts in 1992.

Treatment number	Replicate	Total dosage (all double applications) PIB/ha	Days between treatments	Formulation and tank mix	Emitted volume L/ha
1	3	10^{12} (Gypchek)	3	25% molasses 6% Orzan LS 2% Rhoplex B60A or Bond	5.0
2	3	10^{12} (Gypchek)	5	Entotech aqueous flowable	5.0
3	4	10^{12} (Disparvirus)	3	25% molasses 6% Orzan LS 2% Bond	5.0
4	4	10^{12} (Disparvirus)	3	Cyanamid wettable powder	5.0
5	5	10^{11} (Disparvirus)	3	Cyanamid wettable powder plus 1% Blankophor BBH	5.0
6	3	100 BIU	7	Foray 76B undiluted	2.5

larvae were in their first instar. By the time of the second applications, 65 to 89% were still in their first instar. At the time of the first *B.t.* application 54% were in their first instar and, 7 days later, 44% were in their first instar. This slow development was due to cool temperatures. Leaves were about 25 to 35% expanded on white oak and 40 to 50% on red oak during the application period.

Kromekote cards were placed in two plots receiving each treatment at each application date. They were placed in open areas on the ground at right angles to the flight lines. These cards have not yet been analyzed.

Assessment

Egg mass counts were made in twenty 0.01/ha sub-plots in each treated and check plot using methods developed by Forest Insect and Disease Survey staff. Numbers were converted to egg masses per hectare. Counts were made in April and early May prior to hatching and the same sub-plots were re-surveyed in late October. The changes in population density were calculated for each treated and each check plot. The counts were averaged for each treatment and for the check plots and the population reduction due to treatment calculated using a modified Abbott's formula.

Microscopic diagnosis of larvae. Samples of 10 larvae were collected from 10 sites (total 100 larvae) in each virus treated and each check plot before the spray application and at 1, 2, 3, 4 and 5 weeks post-spray. These larvae were smeared on microscope slides, stained with naphthalene black 12B and examined under oil immersion at x 1,000 magnification. They were scored as positive or negative based on the presence or absence of polyhedral inclusion bodies (PIB).

Pupal counts were made from burlap traps on three oak (red or white) trees in each of the twenty 0.01 ha sub-plots used for egg mass surveys. Strips of burlap 45 cm wide were folded double and nailed to the trunks of trees. The circumference of each tree was measured and pupal counts converted to pupae/m burlap trap. Pupal counts were made during the weeks of July 13-24.

Defoliation estimates were made from 5 red oak or white oak 46-cm branch tips collected at mid-crown from trees in the twenty 0.01 ha sub-plots used for egg mass counts. This was done 8 to 9 weeks after the first spray application when larvae had ceased feeding and were either pupating or dead. A total of 100 branch tips were examined in each treated and each check plot. An estimate was made of the amount of foliage eaten on each branch and a mean was calculated for the plot.

Pheromone trapping was undertaken and 3 MultiPher gypsy moth traps were placed in each treated and check plot on July 13-15. Experimental, low-dosage lures, supplied by Dr. B.L. Leonhardt, USDA, Beltsville, were used to avoid trap saturation. Traps containing a dichlorovos strip to kill the male moths were hung 1.5 m from the ground and 0.2 m from the tree trunk. The traps were removed at the end of the flight period, August 24-26, and the catch of moths counted.

Table 3. Meteorological conditions during spray applications.

Date	Air temp at 10 m (°C)	Ground temp at 1 m (°C)	% RH	Wind speed m.p.h.
19 May	4.6 - 7.6	2.4 - 7.4	93-98	0-1
20 May	9.1 - 12.4	7.8 - 11.7	89-93	0
21 May	8.4 - 10.9	6.6 - 9.4	99	0-1
22 May	9.1 - 13.7	7.6 - 13.3	81-94	0-1
23 May	15.6 - 16.5	15.5 - 17.0	90-92	2-3
26 May	6.9 - 7.2	6.9 - 7.2	64-66	0-1
2 June	10.0 - 13.5	8.1 - 12.3	91-96	0-1

Table 4. Insect development at time of application.

Treatment	Application	Date	% L1	% L2	% L3
1	1	19 May	100	-	-
	2	22 May	89	11	-
2	1	21 May	100	-	-
	2	26 May	63	37	-
3	1	20 May	100	-	-
	2	23 May	80	20	-
4	1	20 May	100	-	-
	2	23 May	65	35	-
5	1	20 May	100	-	-
	2	23 May	76	24	-
6	1	26 May	54	43	3
	2	2 June	44	54	2

Results

Microscopic diagnosis of larvae. Only one larva was found to be infected in the 2,300 collected prior to the spray applications. A total of 11,500 larvae was collected in the 5 week period following the first spray applications and examined microscopically. The highest levels of infection in each plot, recorded between 2 weeks and 5 weeks post-spray are given in Table 5. They ranged from 6 to 66% of larvae infected in the treated plots and from 0 to 4% in the check plots.

Pupal counts are given in Table 5. The mean number in the check plots was 14.7/m burlap. All the treated plots had lower mean counts with 1.5, 4.2, 2.4, 6.4, 8.9 and 4.3/m burlap for treatments #1 to #6, respectively.

Defoliation estimates are given in Table 5. With the exception of one check plot that was 44% defoliated, all plots, both treated and check, had less than 40% of their foliage eaten, a level that cannot readily be detected by an untrained eye. Basically, there was no difference in defoliation between the different treatments and the checks. The mean defoliation of the check plots was 30.6% and the mean defoliation of the treated plots was 29.3, 23.5, 28.9, 26.9, 23.8 and 30.1 for treatments #1 to #6, respectively.

Pheromone catches of male moths were lower in the treated plots than the check plots (Table 5). The mean number/trap in the check plots was 427 and in the treated plots was 54, 161, 165, 279, 308 and 149 for treatments #1 to #6, respectively.

Egg mass counts before and after the spray application are given in Table 5. One of the check plots had a slight increase in egg mass density and 3 had slight declines. Generally, numbers remained steady. In the virus treatments, declines ranged from -38.5% to -98.4% and in the *B.t.* treatment from -89.2% to -98.3%. All post-spray egg mass counts in treated plots were below the 1,250/ha threshold when retreatment may be recommended the following year. When these figures are adjusted for population changes in the check plots, using a modified Abbott's formula, the population reductions in the 5 virus treatments were 89, 75, 79, 78 and 86% for treatments #1 to #5, respectively, and 97% for the *B.t.* application.

Discussion and Conclusions

The field season in 1992 was not typical with cool temperatures and above average precipitation. This was beneficial for trees, but detrimental to gypsy moth larvae. The area of visible defoliation in Ontario, mapped from the air by Forest Insect and Disease Survey technicians fell 90% between 1991 and 1992 from about 340,000 ha to 34,000 ha.

All treatments gave acceptable results in terms of population reduction. It is unfortunate that little foliage protection was demonstrated because only small differences in defoliation were recorded between treated and check plots. It is interesting to note that the Cyanamid wettable

RESEARCH STUDIES ON FORMULATION INGREDIENTS AND PHYSICOCHEMICAL PROPERTIES, AS RELATED TO PESTICIDE PERFORMANCE

[Project No. FP-61 - Pesticide Formulations]

Report to the 19th Annual Pest Control Forum

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ABSTRACT

During 1992, the Pesticide Formulations Project at FPMI undertook four laboratory investigations. A summary of each investigation is given in this report.

1. Spread Factor, Penetration Depth, and Stain Height of Drops of Aqueous Pesticide Mixes on Kromekote Cards (this investigation was carried out in cooperation with the FP-71 Project)

Spreading behaviour of water-based pesticide drops ranging from 50 to 450 µm in diameter was studied on Kromekote® cards (K-cards), using spray mixes of five chemical insecticides, and three commercial formulations of *Bacillus thuringiensis* var. *kurstaki* (BTK). Spread factors (SF, the ratio of the stain

diameter 'D' of a drop on the card to the spherical diameter 'd' of the drop making the stain) ranged from 1.0 to 4.5. The investigation on the role of drop size on SF, h_P (the penetration depth) and h_E (the stain height), showed that drops of the chemical insecticides underwent complete spreading and penetration into the card with no h_E above the card surface, and that both SF and h_P increased with drop size. The mixes of BTK underwent only partial spreading. The smaller drops (50 to 150 μm) of Dipel® 6AF and Thuricide® 48LV, were spherical, but the medium ones (150 to 300 μm) provided spherical segments, and the larger drops (300 to 450 μm) formed flattened cylinders. All BTK drops showed h_E but not h_P. The drops of Foray® 48B (50 to 450 μm) formed spherical segments with both h_P and h_E. The impaction energy of all drops increased dramatically with 'd', whereas the SF, h_P and h_E increased only gradually.

Spread factors of the chemical insecticide mixes increased gradually as the water proportions decreased and the ingredient concentration increased. With the most concentrated mix (no water), SF increased dramatically. All drops of Dipel 6AF and Thuricide 48LV remained spherical, despite the higher concentration of ingredients; but those of Foray 48B formed spherical segments and showed a decrease in SF at higher concentrations.

All drops of the BTK mixes took only 30 to 120 min for maximum spreading, whereas those of the chemical insecticides (except the most concentrated mixes) took 24 to 48 h. The most concentrated mixes continued to spread until 16 d after impaction, and no increase in SF was noted afterwards. Regardless of the concentration levels, all drops showed 'finite' SF values, whether they were from chemical or BTK mixes. Even the most concentrated mixes did not continue to spread indefinitely, a finding in contrast to the one reported in the literature for the drops of non-volatile, oil-based mixes, which continued to spread indefinitely for a long period of time.

2. Drop Size Spectra and Deposits of Bacillus thuringiensis Formulations on Simulated and Natural Balsam Fir Foliage Under Laboratory Conditions

Four aqueous formulations of Bacillus thuringiensis var. kurstaki, containing a dye and a chemical tracer [triethyl phosphate (TEP)], were sprayed in a laboratory chamber over balsam fir branches clipped from field-grown trees. Spray was also applied on aluminum fir branches with and without a coating of the cuticular wax extracted from natural fir foliage. Drop size spectra, drops/cm^2, and deposits (ng TEP/cm^2 of foliar area, and ng formulation protein/cm^2) were assessed on the natural foliage and wax-coated aluminum foliage (foliar simulator); but only drops/cm^2, and deposits of TEP and protein were measured on the bare aluminum foliage. Both natural foliage and foliar simulator received similar drop sizes, drops/cm^2 and deposits, but the latter two parameters were higher on the bare aluminum foliage.

The investigation provided a new method to determine the actual drop sizes deposited on a foliar simulator. The simulator not only had similar size and shape, but also the same surface characteristics. Quantification of protein deposits was also faster on the simulator than on the natural foliage, because the latter contained proteins that had to be pre-determined in order to correct for the formulation protein alone. The foliar simulator did not contain any protein, and hence the formulation protein could be determined directly.

3. Influence of Surfactant Concentration on Foliar Retention of Pesticides Used in Forestry

Aqueous tank mixes of permethrin, fenitrothion, Bacillus thuringiensis var. kurstaki (BTK), diflubenzuron, and glyphosate containing different amounts of a non-ionic surfactant, Triton X-114, were prepared. Glyphosate formed clear solutions; permethrin and fenitrothion formed emulsions; diflubenzuron and BTK provided suspensions. Emulsion stability of permethrin and fenitrothion increased with increasing surfactant level, while the emulsion drop size decreased.

Foliage of white oak, trembling aspen, white spruce and balsam fir were dipped in tank mixes of pesticides (except BTK) labelled with radioactive carbon. The amount of pesticide retained on foliage was determined by liquid scintillation counting. Foliage was also dipped in non-radioactive BTK tank mixes, and the protein retained was determined colorimetrically. With all tank mixes, a direct relationship was observed between the mass of liquids retained on foliage and liquid viscosity. In contrast, the amount of pesticide retained was unaffected by viscosity, but was influenced by emulsion drop size. Initially, the amount of pesticide retained on foliage increased with increasing surfactant concentration. Beyond an optimum surfactant level, the emulsion drop sizes were too small and the emulsions became too stable to allow maximum retention of pesticides on foliage. With the glyphosate solutions, however, no optimum surfactant level was indicated because foliar concentrations continued to increase with increasing surfactant levels.

4. Rain-Washing of Bacillus thuringiensis Deposits From Conifer Foliage

Eight oil-based and four aqueous formulations of Bacillus thuringiensis var. kurstaki (BTK) were sprayed in a laboratory chamber over potted seedlings of white spruce and balsam fir. Foliar deposits were assessed before and after a 3mm rain with a rainfall intensity of 5 mm/h, using a force-feeding bioassay method of foliar extracts on the spruce budworm larvae. In addition, a total protein assay method was used to compare the two sets of results.

The force-feeding bioassay method showed that formulations that provided high deposits (IU/cm^2) on foliage, showed some residual activity after the rainfall, whereas formulations that provided low deposits showed no activity (i.e., complete wash-off of deposits) after the rain. The total protein method was more sensitive than the force-feeding bioassay method because with all formulations, some protein deposits (ng/cm^2) were detected on foliage after the rain. The oil-based formulations showed greater rainfastness than the aqueous formulations, a finding that was not as evident when the force-feeding bioassay method was used. The differences in the two sets of data were due to the fact that the force-feeding bioassay method depended on the biological response of an insect, thus resulting in high variability in deposits, whereas the total protein assay method provided a direct estimation of protein deposits that were less variable.

STUDIES ON THE ENVIRONMENTAL CHEMISTRY OF FORESTRY INSECTICIDES

[Project No. FP-72 - Environmental and Natural Products Chemistry]

[Study No. FP-7202 - Environmental Chemistry, Insect Management Products]

Report to the 20th Annual Forest Pest Control Forum

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ABSTRACT

Major studies conducted by the Environmental Chemistry, Insect Management Products Study (Study No. FP-7202) of the Forest Pest Management Institute during 1991-92 are highlighted. The studies which were examined include (1) the distribution, deposition and persistence of Bacillus thuringiensis (kurstaki) [B.t.(k)] in a deciduous forest environment, (2) the analytical chemistry of RH-5992 from various forestry matrices (aquatic and terrestrial) and formulations, (3) the fate and persistence of RH-5992 in water and sediment from aquatic enclosures after application at four dosage rates (70, 140, 360 and 700 g A.I./ha) and unbuffered aqueous solutions at pH 4, 7 and 10, (4) the fate and persistence of RH-5992 in forest soil, litter and conifer (spruce) foliage after application at 35, 70 and 140 g A.I./ha using a hand-held ULV sprayer (spinning disc) driven by a small battery-powered motor, and (5) the chemistry of azadirachtin.

INTRODUCTION

The Environmental Chemistry, Insect Management Products Study 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 1991/92.

(1) Spray distribution, deposition and persistence of Bacillus thuringiensis kurstaki [B.t.(k)] in hardwood forests in Virginia and Pennsylvania, USA during the 1992 Gypsy Moth spray program

The distribution, deposition, persistence and biological activity of spray deposits resulting from aerial applications using helicopter and fixed-wing aircraft were examined in mixed hardwood forests of Virginia and Pennsylvania, USA using undiluted commercial preparations of Bacillus thuringiensis var. kurstaki [B.t.(k)].

In the first study, five blocks in Virginia were sprayed with Foray 48B (Novo Biocontrol, Danbury, CT) when the gypsy moths were in 2nd instar stage, using a Bell helicopter fitted with flat-fan nozzles. In the second study, Foray 48B was applied undiluted when the insects were at 4th instar levels over 5 blocks in Pennsylvania using fixed-wing aircraft fitted with flat-fan nozzles. Spray droplets were collected on water-sensitive cards placed at ground and canopy levels to determine directly the spread-factor values for the droplets. Natural foliage at mid-crown level were collected up to 96 h postspray to measure the reduction of the efficacy of B.t.(k) with time.

The droplet density (droplets/cm^2), size spectra (NMD and VMD) and percent deposition vs meteorological factors existed, application methods (helicopters vs fixed-wing aircraft) and atomizers used and formulation types applied are being critically analyzed. Similarly, the variation in initial foliar deposits (expressed in IU/cm^2 of target surface) in terms of the above variables will be studied and documented. The differences observed in total B.t.(k) activity due to spores and crystals, persistence characteristics of the toxin, its DT_{50} etc. with the variables will be examined and accounted.

All facets of the research conducted in this field study including the effectiveness of treatment (2nd instar vs 4th instar) and the impact, if any, on nontarget fauna, will be published in due course along with the USDA cooperators.

(2) The analytical chemistry of RH-5992 from various forestry matrices (aquatic and terrestrial) and formulations

A sensitive HPLC method for the analysis of RH-5992 from forest soils, litter, oak and conifer foliage, sediment, aquatic plants, fish tissues and natural waters has been developed, validated and has been accepted for publication in the *Jour. AOAC Internat.* A method for the determination of RH-5992 in formulation concentrates and spray mixes has also been investigated and will be published later as a separate paper after necessary refinement. Explorative research using solid phase extraction techniques to identify and quantify the common metabolites are in progress in spite of difficulties encountered in sample preparation. Some advances are being made in the analysis of soil metabolites.

(3) The fate and persistence of RH-5992 in water and sediment from aquatic enclosures after application at four dosage rates (70, 140, 360 and 700 g A.I./ha) and unbuffered aqueous solutions at pH 4, 7 and 10

(a) Controlled lab. studies (environ. chamber) using natural/autoclaved water at pH 4, 7 and 10 showed that RH-5992 resisted degradation at all pH levels up to 6 d and some degradation occurred beyond that period at pH 10 only. No significant decrease in concentration was noted in the other two pH levels up to 16 d. Prolonged storage (76 d) did show some degradation at all three pH levels. It appears that the chemical is somewhat resistant to biodegradative and hydrolytic processes due to the absence of functional groups that are potentially hydrolysable. On exposure to UV radiation (254 nm), considerable degradation occurred within 12 hours at all pH levels.

(b) In enclosures, the chemical readily distributed and mixed throughout the entire watercolumn at all concn. levels (0.05, 0.10, 0.26 and 0.50 mg/L) within 1 hr following application. Analysis of water samples from 0 time to 70 d post application showed that the chemical at the last sampling interval is present above 60 % of the initial concn. level in most of the enclosures indicating that DT_{50} values for the chemical will be above 70 d. Further work is in progress to arrive at definitive results and to provide insight into overall behaviour (hydrolysis, biodegradation, sediment adsorption etc.) of the chemical.

Preliminary analysis of sediment samples show gradual partitioning of the chemical from water to sediment due to its low solubility. Persistence and biodegradation potentials of RH-5992 are still under investigation.

(4) The fate and persistence of RH-5992 in forest soil, litter and conifer (spruce) foliage after application at 35, 70 and 140 g A.I./ha using a hand-held ULV sprayer (spinning disc) driven by a small battery-powered motor

Field studies conducted using soil and litter plots and single tree application of RH-5992 at 3 dosage levels will provide insight into the overall behaviour (degradation, DT_{50}, hydrolysis, adsorption etc.) in the matrices. Analysis of soil and litter samples are in progress and the preliminary data indicate the material has a tendency to persist in these two matrices probably due to resistance to biotic and abiotic processes and is expected to have high DT_{50} values.

Foliar analyses of new shoots and one year old foliage are in progress. Foliar residues varied according to the dosage applied and higher persistence in older foliage compared to new growth is apparent probably due to the absence of growth dilution. Low v.p., photostability and lack of abiotic and biotic degradations are contributory to its prolonged stability. Complete analysis of the data will give a clear picture of the overall behaviour of RH-5992 in these terrestrial components studied.

One problem encountered in the terrestrial studies is the variability among the replicates and among the successive samples. The apparent reason appears to be in nonhomogenity of the spray mix leading to uneven deposition especially when applying with a handheld applicator. This aspect should be addressed properly either by Rohm and Haas or by the formulation expert at FPMI.

(5) Chemistry of azadirachtin

An improved HPLC method has been developed to determine azadirachtin content in neem formulations and neem oil. The method was found to be rapid and reproducible, with limits of quantification and detection of 6 μg/g and 3 μg/g respectively.

The above method was refined further and examined in conifer and deciduous foliage, forest soil, litter and stream water with azadirachtin standards. The applicability of the method was demonstrated by studying the recovery levels of azadirachtin in samples fortified with standard Margosan-O. Limits of detection were 1.5 μg/g for foliage and soil, 3.0 μg/g for litter and 3.0 μg/L for water. Overall mean recoveries from terrestrial samples fortified with azadirachtin were > 80 % with good reproducibility.

The environmental fate of azadirachtin in the Margosan-O formulation was examined. Two concentrations of the formulation were sprayed on oak and balsam fir seedlings in a spray chamber. The seedlings were kept in the greenhouse and foliage was collected over time. The azadirachtin was extracted using the developed procedure and the degradation pattern was examined. After 14 d all traces of azadirachtin were gone from the foliage.

Efficacy of a Single Treatment of Futura XLV Applied by Helicopter against Hemlock Looper Larvae in Balsam Fir Stands in Newfoundland in 1992

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A report to the 20th Annual Forestry Canada Pest Control Forum

(Ottawa, Canada, November 17-19, 1992)

Introduction

The Newfoundland Department of Forestry and Agriculture (NDFA) applied Futura XLV, a water-based formulation of *Bacillus thuringiensis* (*B.t.*), by helicopter during August 6-11, 1992 to protect thinned balsam fir stands in the Salmonier Line area from damage by the eastern hemlock looper, *Lambdina fiscellaria fiscellaria* (Guen.). The decision to spray was based on tree-beating samples that indicated 127 larvae per balsam fir tree in mid-July and 176 larvae per tree on July 31. These numbers are sufficient to cause up to 20% defoliation of current-year's growth of balsam fir. At the request of NDFA, Forestry Canada, Newfoundland and Labrador Region, assessed the efficacy of the treatment and our findings are reported herein.

Materials and Methods

Plot Layout. Spray blocks were located near the Salmonier Line and were 1-2 km^2 in area. Five plots of five 6 to 10 m balsam fir trees located within spray blocks 206 or 207 and 1 control plot located in an untreated area (Number Three Pond) outside the spray block were used to evaluate spray efficacy. The hemlock looper was the main defoliating species present.

Spray Formulations and Application. Futura XLV was supplied by ChemAgro Ltd. and was 2 years old. The formulations were applied undiluted from a Bell 206B helicopter equipped with a Simplex 4900 Spray System that included 4 Micronair AU5000 miniatomizer units. Blade angle of the long blades used (EX2021) was set at 30° and the Micronairs ran at 8 000 to 9 000 rpm. The helicopter flew at a speed of 129 km/h approximately 20-25 m above the canopy.

Treated blocks were sprayed once at 30 Billion International Units (BIU)/ha in 2.3 L/ha (Futura XLV). Block 206 was treated on August 9 between 2030 and 2050 h and Block 207 was treated on August 8 between 2018 and 2050 h. Larval development on August 10 was 16% second instars, 58% third instars and 26% fourth instars.

Weather during the applications was monitored from the aircraft and at the Provincial Forestry Unit Office located near the control plot.

Spray Deposit. Spray deposit was determined by counting spray droplets on mid-crown foliage sampled about 15h after application in spray block 206. Futura XLV applied in this block was premixed with 1% Dayglo® fluorescent dye which served as a deposit tracer. Needles were examined on both sides under a black light. Six hundred and twenty-five needles were examined within 3 days of spray application: 5 needles per shoot, 5 shoots per branch, 1 mid-crown branch per tree for a total of 25 trees sampled from points spread across the block. Shoots were placed in paper bags and stored in a freezer until examined.

Effect of Treatment on Population Density. Beating samples on a 2 x 3 m sheet were used to estimate larval numbers. Five trees were used for sampling each sprayed plot and the control block. Pre-spray counts were made on August 10, within 30 h of *B.t.* application. Post-spray counts were made August 17-18. Burlap traps were placed on 5 trees per plot from August 17-31 to determine numbers of larvae surviving to the pupal and adult stages. Trees once beaten were not sampled again for larvae or pupae. Population reduction by treatment was calculated using Abbott's (1925) formula.

Effect of Treatment on Preventing Defoliation. The amount of current-year defoliation on the entire tree was estimated to the nearest 10% from the ground on August 10 at the time of application and on August 31 when essentially all surviving larvae had pupated. Trees assessed were the same as those used for estimating pupal numbers.

The percentage of foliage saved (F) as a result of treatment was calculated by:

$$F = \frac{\text{DEFOLIATION (CONTROL) - DEFOLIATION (TREATMENT)}}{\text{DEFOLIATION (CONTROL)}} \times 100$$

Mortality from Disease and Parasites. Twenty-five larvae (if available) per plot were retained from the post-spray samples and reared on unsprayed foliage until death or emergence of moths or parasites. Fresh fir foliage was provided every 4-5 days. Cadavers were examined microscopically at 400 X magnification to identify pathogens and unemerged parasites.

Results and Discussion

Weather conditions. Applications was made under ideal weather conditions with winds of about 5 km/h from the southwest and temperatures of about 13°C. The temperature at ground level was about 1°C warmer than the temperature at 250 m above the ground. The rain-free periods following spraying was 1 day for Block 206 and 2 days for Block 207.

Spray Deposit. Spray coverage was excellent across the block monitored. Deposit averaged 2.05±0.35 (S.E.) droplets per needle (d/n) ranging from 0.16 d/n to 8.88 d/n. Only 4 out of the 25 trees sampled had deposits of less than 1 d/n. These results compare favourably with applications of *B.t.* made from fixed-winged aircraft and support the use of helicopters in operational spray programs in Newfoundland.

Effect of Treatment on Population Density. Larval numbers at the time of application had dropped considerably from those in July. Mean prespray counts ranged from 15 to 41 larvae/tree and postspray counts ranged from 5 to 10 (Table 1). Following treatment, the decrease in larval numbers ranged from 55 to 70% and few or no pupae were recovered in the spray plots (Table 1). Calculations provided by Abbott's formula indicated that the reduction of larval numbers in the spray plots was due to natural mortality and not to treatment. A collapse in the looper population was indicated by a 79% drop in larval numbers and a recovery of only 4 pupae per tree in the control plot (Table 1). Larval development was 16% second-instar, 58% third-instar and 26% fourth instar (n=804) at the time of application and was 14% second-instar, 57% third-instar and 29% fourth instar (n=215) at the time the post-spray sample was taken. Widespread mortality, particularly for older larvae, could account for the apparent lack of larval development. *B.t.* also causes feeding inhibition and larval development would be expected to be arrested in the treated plots.

Eighty-five percent of the pupae collected from the burlap traps in the control plot survived to the adult stage. The survival of pupae from the treated plots was not determined because of an inadequate sample size.

Table 1. Mean number of hemlock looper and mean defoliation of current and year-old foliage per balsam fir tree in plots treated with Futura XLV and an untreated control plot near Salmonier Line, Newfoundland 1992. Five trees were sampled in each plot. Applications were made on the evenings of August 8 (Spray Block 207) and August 9 (Spray Block 206). Cur=current-year foliage, Old=1 year-old foliage.

					Defoliation/tree (%)			
	Spray	Larvae/tree		Pupae/tree	August 10		August 31	
Plot	Block	August 10	August 17	August 31	Cur	Old	Cur	Old
1	206	17.6	6.0	0	14	0	14	0
2	206	22.0	7.0	0.6	14	2	12	2
3	206	24.6	8.6	0.2	16	2	14	2
4	207	42.4	9.8	0.2	22	0	18	0
5	207	14.6	4.8	0	10	2	12	2
Control	# 3 Pond	41.4	8.2	4.0	24	2	20	2

Effect of Treatment on Preventing Defoliation. Unfortunately poor weather delayed spray application and larval development at peak third-instar was considerably beyond that considered optimal for *B.t.* treatment, ie. 50% first instar and 50% second instar. At the time of application, current-year defoliation ranged between 10% and 22% for the treated plots and was 24% for the control plot and defoliation of 1 year-old foliage was 2% or less for all plots (Table 1). By August 31 there was no further defoliation in the treated plots, but as the control plot had no further defoliation either, foliage savings due to treatment were not apparent.

Mortality from Disease and Parasites. Mortality of larvae reared from the collection on August 17 was high for both the treated and control plots (Table 2). The percentage of larvae surviving to the adult stage was 20% or less for the treated plots and only 40% for the control plot. Parasitism was low, 8% or less, and only tachinids were recovered. Disease was attributed as the cause of death for 80% to 84% of larvae collected in the treated plots and 52% of larvae from the control plot. Incidences of pathogens in a pooled sample of diseased specimens obtained from treated plots (n=93) and from the control plot (n=11) were as follows: rod-shaped bacteria, probably *B.t.*, 41% for treated and 0% for the control; fungi belonging to the family Entomophthoraceae, including *Entomophaga aulicae* and *Eryinia radicans*, 22% for treated and 45% for the control; a complex of black yeast fungi, probably *Hormonema* sp. and *Aureobasidium* sp., 27% for treated and 9% for the control; and *Nosema* sp., a protozoan, 10% for treated and 0% for the control.

Table 2. **Fate of larvae collected on August 17 from plots treated with Futura XLV near Salmonier Line, Newfoundland in 1992.**

Plot	Spray Block	No. larvae	% Survival to Pupa	% Survival to Adult	% Parasitized	% Diseased
1	206	25	16	12	4	84
2	206	25	20	16	0	84
3	206	25	24	20	0	80
4	207	25	20	12	8	80
5	207	25	8	12	8	80
Control	# 3 Pond	25	40	40	8	52

Conclusions

1. Application of *B.t.* by helicopter resulted in spray deposit comparable to fixed-winged aircraft.

2. The final decision to spray should be made before larval development gets beyond peak second instar and treatment should be applied as soon as possible thereafter. If larval numbers are marginal to warrant spraying and if lengthy delays in application are expected, due to weather or delivery of spray aircraft, then spray application should not proceed.

Research in Natural Products Entomology in 1992

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Report to the 20th Annual Forest Pest Control Forum

In 1992, a **Natural Products Research Network** was formed and coordinated by B.V.H. for the discovery and development of natural products for integrated forest insect pest management. Major participants include George Strunz, F.C. Maritimes; Barry Lyons, F.C. Ontario; Mamdouh Abou-Zaid(new Natural Products Chemist), Somu Sundaram, Arthur Retnakaran, F.P.M.I.; Thor Arnason, Cliff Beninger, U. of Ottawa; John Findlay, David Miller, U. of New Brunswick; and Murray Isman, U. of British Columbia. Green Plan funds were received to support studies on botanicals from native and tropical tree species, feeding deterrents for spruce budworm, fungal metabolites and mechanisms of forest insect-plant interactions.

Natural Product Development

MK-244, a derivative of abamectin from *Streptomyces avermitilis* is being evaluated against an array of forest pests including gypsy moth, black army cutworm, Douglas fir tussock moth, forest tent caterpillar, European spruce sawfly and spruce budworm (for comparison) on treated foliage sprayed in the Potter's tower to determine its spectrum of activity. Most species appear to be very susceptible. The residual toxicity of MK-244 on balsam fir was examined this year at 1, 5, and 25 gAI/ha with or without an immediate outdoor exposure. Unlike last year, an immediate outdoor exposure did not reduce residual toxicity much. Residual toxicity was good at 1 gAI/ha this year and increased with increasing deposit. A treatment at 1 gAI/ha with 1% Congo red dye as a potential UV protectant appeared to improve the residual toxicity of this product. Potted balsam fir trees infested with fourth-instar larvae were also sprayed with MK-244 and held outdoors for 3 days. Deposits between 5 and 25 gAI/ha provided 75-100% control under these conditions.

Azatin-EC, a commercial formulation from the neem tree containing 3% azadirachtin has been evaluated on larvae of spruce budworm, eastern hemlock looper and gypsy moth in sprayed foliage bioassays to assess the desirability of pursuing further development for forestry use. Results to date are promising and further tests have been initiated to assess its spectrum of activity on a number of representative forest pests.

Tall oil is a natural by-product of the Canadian softwood kraft pulp industry. An active fraction of tall oil has been provided by M. Isman, U.B.C. and is being evaluated for its spectrum of activity to forest pests. To date, it has been screened on larvae of spruce budworm, black army cutworm, eastern hemlock looper, forest tent caterpillar, European pine sawfly, European spruce sawfly, mountain ash sawfly, pine false webworm (see below) and adults of white pine weevil. Initial indications are that this product may be selectively active to some pests at high concentrations.

XDE-105, a naturally derived product provided by Dow Elanco is being tested on spruce budworm larvae to determine its toxicity by contact and ingestion.

Other Products

The residual toxicity of **RH-5992**, a non-steroidal ecdysone agonist, on white spruce trees outdoors was evaluated for the third year at deposits ranging from 1.5625 to 25gAI/ha this year. Dosage-related increases in mortality were observed both immediately after treatment and after periods of weathering up to 7 days post. Mortality was low at 1.5625 and 3.125 gAI/ha. Residual toxicity was good at 12.5 and 25 gAI/ha although lower than in previous years at comparable deposits. Tests are also being conducted with sixth instars to compare toxicities quantitatively in µg/larva by topical application, on treated balsam fir needles and by force-feeding to determine the relative contribution of different exposure routes.

Forest Tent Caterpillar-Red Maple Interactions

An S&T Opportunities Grant was obtained to investigate the mechanism of resistance of red maple leaves to forest tent caterpillar larvae. Several aspects of the feeding ecology of larvae on red maple in comparison with sugar maple were examined in feeding assays this year including the effects of different trees, leaf age, larval age and size, larval age synchronized with leaf age, larval source (field vs laboratory), previous food experience(diet vs poplar), duration of leaf exposure, individual vs groups of larvae and whole leaves compared to cut leaf disks. Results are still being analysed but under all conditions tested sugar maple appears to be preferred to red maple and typically little red maple is consumed.

Mamdouh Abou-Zaid with assistance from Domenic Lombardo and Dave Jaipersad has prepared both freezed-dried and fresh leaf extracts of red maple and sugar maple. A choice feeding assay test using greenhouse-grown, trembling aspen, primary leaf disks and 1-day old fourth instar laboratory-reared larvae has been developed and tests with the extracts are in progress. The fresh leaf extracts have also been divided into 12 fractions containing sugars, phenolics, flavonoid glycosides, flavonoid aglycones, and sesquiterpene lactones. To date, 7 compounds have been isolated from the latter 4 fractions of red maple.

Pine False Webworm

In collaboration with D. Barry Lyons, Forestry Canada, Ontario Region the natural products, Azatin-EC and tall oil were tested in the laboratory against newly hatched larvae on sprayed red pine branches in comparison with Dimilin. Dimilin provided 99% control at a deposit of 12.5 gAI/ha. Azatin was very promising, providing comparable control at 5 to 10 gAI/ha. Tall oil was also active on larvae at 250 ml product/ha, resulting in 84% reductions although smaller reductions of only 33% were observed at double this deposit in replicated experiments.

Cliff Beninger and Mamdouh Abou-Zaid have also prepared extracts of old and new foliage of red pine to evaluate the mechanisms involved in the preference of pine false webworm larvae to feed on old foliage compared to new. Extracts of jack, white and Scots pines have also been prepared to use in studies of the interactions of various pine-feeding pests with host and non-host pine species as well as to assess the insecticidal activity of compounds from pines on other forest pests.

White Pine Weevil

In collaboration with Peter deGroot, FPMI, trials were continued to assess the effectiveness of permethrin in comparison with methoxychlor for protecting jack pine from white pine weevil attack. The proper timing of mistblower applications with permethrin and the effectivness of mistblower treatments at anticipated higher damage levels than in 1991 were evaluated this year. The results of the timing trials are reported separately by P. deGroot

The methods used to assess the effectiveness of mistblower applications in 1992 were very similar to those in last year's report to the 19th Annual Forest Pest Control Forum on White Pine Weevil Control Research Trials in Ontario by deGroot *et al.* In 1992 a different jack pine plantation was used with 24% damage levels in the previous year. However, the damage levels in 1992 in control plots in this plantation were much lower at only 13%. Leader damage by the weevil was reduced by all insecticide treatments with permethrin at 70gAI/ha providing 91%, permethrin at 140gAI/ha providing 83% and methoxychlor at 1.1 kgAI/ha providing 82% reductions in leader damage relative to the control levels.

Experimental Aerial Applications of RH5992 (MIMIC 2F) in Ontario
A Summary of Preliminary Results

A Report to the 20th Annual Forest Pest Control Forum
Ottawa, Ontario Nov 17-19, 1992

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Two field trials were conducted in 1992 in Ontario to determine the efficacy of RH 5992 (MIMIC 2F® - 200g AI/l, Rohm & Haas, Westhill, Ontario) against spruce budworm Choristoneura fumiferana.
One trial conducted on crown lands in Rogers Township in the Hearst district investigated 35g AI/ha. The other trial was conducted on Domtar Inc. freehold properties in Hearst and investigated dosages of 1 x 17.5g AI, 1 x 35g AI, 2 x 35g AI and 1 x 70g AI/ha. All dosages were diluted in water with Latron CS-7 (an emulsifier) added at 0.025% v/v) and applied at 2.0 l/ha.
The treatments were applied with a Cessna 188 Ag truck fitted with four AU4000 Micronair atomizers. The aircraft speed was ≈ 168 kph with 33 m flight - lane separations.
Each treatment was sprayed on three 15 to 20 ha plots. Thirty (30) balsam fir Abies balsamea sample trees were randomly chosen in each of the plots in the Domtar study area; whereas, 15 balsam fir and 15 white spruce Picea glauca per plot were chosen as sample trees on the crown land. Two 45-cm midcrown branch tips were taken from each sample tree at each sampling to evaluate the spruce budworm populations. These were evaluated once before and twice after the sprays.

Results and Discussions

Spray Deposit. At time of writing, deposit analyses are incomplete. However, preliminary data (Table 1) indicate that the number of droplets per cm^2 collected on kromokote cards at midcrown level was ⟨1.5 . We postulate that the water component in the droplets evaporated rapidly and resulted in very small droplets that did not deposit efficiently.

Population reduction & host tree defoliation. The mean prespray budworm populations in the Domtar study ranged from 6.8 to 17.8 larvae per branch (Table 1). After the treatments, the mean ranged from 1.2 ± 2.4 to 6.3 ± 6.2 per branch. The corrected population reductions showed that 1 x 70g AI, 1 x 35g AI, and 1 x 17.5g AI/ha did not satisfactorily reduce larval populations. Two applications of 35 g AI/ha to moderately low populations could be termed as being marginally satisfactory. Without adjustments for differences in prespray population densities, the preliminary data show that none of the treatments in the Domtar study protected balsam fir significantly better than those that were unsprayed.
The study on crown lands also revealed that a single application of RH5992 at 35g AI did not reduce budworm satisfactorily on either balsam fir or white spruce (Table 1). As a consequence both host species were defoliated at unacceptably high levels.
At time of writing efforts are directed at analyses that might explain why the product was not as efficacious as was indicated by laboratory, greenhouse and single tree trials. Since the material is not labile, and the first indications are, that deposit on the needles was poor, it is reasonable to assume that improvements in the formulation are warranted.

Table 1 Spray deposit, spruce budworm population reduction & host tree defoliation in blocks treated with RH5992 (MIMIC 2F) on crown lands and Domtar property. Hearst 1992.

Treatment[1] (gAI/ha)	[2]Drops/cm^2	Sbw/45 cm branch ($\bar{x}$±SD) Prespray	Postspray	% Corrected Reduction	% Defoliation
			DOMTAR LANDS		
1 x 17.5	0.39 ± 0.51	11.8 ± 8.8	3.0 ± 3.0	59.5	38.1
1 x 35.0	0.29 ± 0.42	17.8 ± 13.3	6.3 ± 6.2	44.2	53.6
2 x 35.0 (1)	0.53 ± 0.84	6.6 ± 4.4	1.2 ± 2.4	71.1	20.6
(2)	0.66 ± 0.66				
1 x 70.0	1.12 ± 1.44	8.5 ± 5.2	3.2 ± 2.9	40.7	25.0
check	--	6.9 ± 4.6	4.5 ± 3.2	--	25.8
			ROGERS CROWN LANDS		
1 X 35.0 Bf	0.74 ± 0.74	15.3 ± 6.6	7.3 ± 3.8	29.9	75.1
Sw	0.29 ± 0.22	12.4 ± 10.0	7.2 ± 3.4	9.8	53.6
check	Bf	13.9 ± 6.4	10.0 ± 5.0	--	77.1
	Sw	16.3 ± 13.8	9.8 ± 4.7	--	70.9

[1] In 2.0l of water plus Latron CS-7 (0.025% v/v).

"EVALUATION OF KEY OPERATIONAL SPRAY PARAMETERS INFLUENCING B. t. SPRAY EFFICACY: THEIR IMPACT ON EFFICACY AND IMPLICATIONS FOR B. t. SPRAY APPLICATIONS"

Executive Summary

Prepared by E.G. Kettela, Forestry Canada, Maritimes Region, March 2/92

INTRODUCTION

Both B.t. and fenitrothion insecticides are used in operational spray programs against the spruce budworm in New Brunswick. Fenitrothion has been used since 1969 and B.t. since 1980 in these forest protection programs. Initially, test programs with B.t. were conducted in 1961, 1969, 1975 and 1979 leading to its first operational use in New Brunswick in 1980 as the insecticide of choice for the woodlot protection program. The results were so poor that operational use was abandoned in 1981 but continued in 1982 with a very small (4000 ha) exploratory program. B.t. has been an integral part of spray programs every year since 1983 and provided a modicum of efficacy until the program in 1988 (50% of treated area). Results that year did not match expectations.

The results of B.t. research and development, starting with the SERG sponsored test in 1983 addressed the need to understand factors affecting B.t. efficacy. The purpose of all the research and development work was to improve efficacy through development of application technology, B.t. potency, and understanding of other key factors. The development of the enhanced atomization spray method with high potency B.t. products and the registration of high potency products was the end result of concerted R & D since 1983. This resulted in the implementation of this use pattern in 1989,1990 and 1991. However, evaluation of the spray operation in 1990 indicated that there is still a considerable spread in the relative efficacy of fenitrothion and B.t., fenitrothion being apparently more efficacious. This is of concern as B.t. applications are more expensive and there is a desire to move to increased use of B.t. which is considered to be more environmentally acceptable. The question is why does this disparity in efficacy occur. Experimental trials with various B.t. products, have consistently demonstrated that the B.t. products registered should be effective budworm/forest management tools. The problem seems to be translating this probablilty into operational reality. Previous research has shown that key parameters of spraying such as meteorological conditions aircraft height, post spray weather and spray deposit play an important role in efficacy. In operational terms there is a scarcity of information on these parameters and their influence on efficacy in large scale operations. To improve the performance of B.t. in spray operations it is important to understand the operational constraints under which B.t. is applied as a key step in the improved use of B.t. in operational spraying against spruce budworm.

Participants in this investigative program were the Department of Natural Resources and Energy, Forest Protection Limited, SERG, the New Brunswick Research and Productivity Council, Atlantic Weather and Environmental Consultants, Forestry Canada-Maritimes Region, and the University of New Brunswicks Dept of Chemical Engineering.

METHODOLOGY

The objectives of this investigative program were to document the range of predetermined key parameters that may influence spray efficacy and determine if these had a discernible effect on spray results. The key parameters for investigation were: (1) meteorology, (2) spray deposit, and (3) efficacy. Initially, 12 replicate treatments of B.t. (FUTURA XLV-HP) and 3 of fenitrothion were scheduled for evaluation. The program was expanded to include two replicates of the B.t., Dipel 64 AF which was a late entry into the 1991 spray program. N.B. DNRE was responsible for pre and post spray population assessments and defoliation estimates in selected replicate sites. Forestry Canada was responsible for coordinating this effort and supervising the sampling for development at spray date, population at spray date, spray deposit, damage/defoliation on spray date, final estimates of defoliation, bioassays, and forest parameters.

Meteorological monitoring, was contracted to Atlantic Weather and Environmental Consultants. This included weather forecasting, establishment and operation of sufficient weather stations to provide a continuous record of weather information, and minisond ascents to provide information on airmass stability at the time of spraying.

Biological evaluations were supervised by scientists of Forestry Canada - Maritimes Region and included, based on 30 balsam fir sample trees per replicate, and Plot selection and set up - NB DNRE/FC-M, Pre spray population sampling - NB DNRE, Timing to start spraying - NB DNRE, Host insect Development on spray day - FC-M, Damage on spray day (for both applications) - FC-M, Population on spray day - FC-M, Bioassays/residual Toxicity - FC-M, Deposit sample collection - FC-M, Additional defoliation estimates - FC-M, Forest quality Parameters - FC-M,

Spray deposit evaluation was contracted to NB RPC as was preliminary data analysis. In all, 864 B.t. deposit samples and 240 for fenitrothion deposit samples were analyzed. Data analysis was done under FC-M supervision on the VAX computer, using established analysis techniques.

Wind tunnel studies of all spray application scenarios were performed by Dr. Picot to characterize the spray clouds formed.

Aircraft height determination was the responsibility of Forest Protection Ltd. who contracted with SOCOMAR of Quebec to install and test aircraft positioning systems and was a separate study.

RESULTS AND CONCLUSIONS

All monitoring and sampling sequences set out in the work schedule were completed. Spraying of sites chosen for evaluation commenced on the 29th of May and ended on the 16th of June. Initially, day degree heat unit accumulation was rapid resulting in similarly rapid insect and host tree development which in turn resulted in B.t. spray operations commencing on the 29th of May. This was considerably earlier than in 1990.

METEOROLOGY

Descriptions of meteorological observations associated with the 1991 spray program are detailed in 3 reports submitted by Atlantic Weather and Environmental Consultants. The Dunphy study on spray accountability identified aircraft hight above the forest canopy, aircraft wake, and airmass stability on key parameters affecting spray deposit. The 17 spray blocks equals 34 spray sorties as each block was sprayed twice. Airmass stabilities for this test series were classified as very stable on 18%, stable to moderately stable on 12%, slightly stable to Neutral in 64% and unstable in 6% of the spray sorties. Spray deposit showed no relation to airmass stability. In the case of the fenitrothion treatments all deposits were high to very high regardless of airmass stability. In all likelihood, aircraft height was so variable as to override any effect of airmass stability.

For the 19 days of this investigation, minimum temperature were lower than normal for 11 days and above normal for 8 days. Maximum daily temperatures were below normal 9 days and above normal for 10 days. Rainfall occurred on 7 days through this period and was associated with low daily maximum temperatures. Of the 17 blocks, 6 showed a clear impact on efficacy of rain followed by cool weather. This was most pronounced in the two Dipel 64 AF treatments where the 1st application was negated by rain and cool post spray weather. This confirms the negative impact of such weather systems on B.t. efficacy.

SPRAY DEPOSIT

A key factor in spray efficacy is spray deposition at the feeding site. Currently there is no quantitative measure for B.t. spray deposit. Qualitative relative estimates of deposit for B.t. are gained through the use of dyed sprays and results expressed as drops/needle. The dye used in 1991 was DaGlo Fire Orange at a concentration of 1%. Laboratory tests in August, 1991 showed that less than 50% of the droplets produced had dye pigment in them, and most of these were larger droplets. This has serious implications for precise measures of efficacy in relation to spray deposit.

Spray deposit for fenitrothion is quantified with a gas cromatograph and is an accurate measure.

The results of spray deposit measurements show a three fold difference in deposit of B.t. between the first and second spray applications. This may simply reflect a higher flying height for aircraft as pilots adjust to flying over forest in rough terrain. This shows up in both the B.t. and fenitrothion spray deposits and has implications for efficacy as the first application is key in providing a higher level of protection. In the case of B.t. low deposits permitted about 20% defoliation to occur before the second spray application considering that the B.t. applications generally are timed later than fenitrothion, with average of 20% damage already evident, low deposit compromises the goals of the protection program.

A reliable quantitative method for B.t. deposit estimation is needed, one that does not rely on the vagaries of a dye system.

Biological Evaluation:

Unsprayed control data collected by Forestry Canada and DNR were compared. As result of this analysis the Forestry Canada data was used in all calculations of efficacy. The two replicates of Dipel 64 AF, included in the evaluation, afforded us the opportunity of examining the performance of a higher volume lower potency B.t. product.

Pre-treatment populations per test site varied considerably but most were in the moderate to high range permitting direct comparison between treatments. Defoliation estimates at the time of treatment for each spray proved to be a key factor in measuring spray efficacy and in explaining results. Estimates of larval development over the sampling season showed that both fenitrothion and B.t. were selective in their impact on budworm populations. In 15 of the 17 blocks the residual population after each spray consisted of earlier instar larvae. Further, in the B.t. blocks the sixth instar phase extended well into July suggesting a significant sub-lethal effect.

Defoliation at the time of the first treatment in the fentrothion blocks was less that 5% and 20% in the B.t. blocks (4-37%). Between the first and second application in the B.t. blocks an average of 22% defoliation occurred (4-58%) and 15% in the fenitrothion blocks. The range of accumulated defoliation in the B.t. blocks reflects the combined impact of post spray weather and spray deposit.

Regression analysis of efficacy based on population and final defoliation as a function of efficacy was influenced by defoliation at the time of treatment. However, based on deposit averages, lower deposit equated to lower efficacy and higher deposit to higher efficacy.

In summary, meterological conditions at the time of treatment and immediately following spraying have a direct influence on efficacy. Airmass stability and its relation to spray deposit are masked by aircraft flying height. It may be feasible to develop spray tactics that avoid meteorological conditions that affect efficacy. Spray aircraft height control is necessary to enhance spray deposit.

Spray deposit measurements that are quantitive and reliable are a necessity as this is the first step in auditing how well the sprayers are doing their job.

Spray efficacy, though highly variable for B.t., shows that it is a function of deposit meteorological events and defoliation at the time of treatment. It may be possible to spray B.t. earlier in the feeding cycle but it is a risky venture. Initial larval population by itself is not a factor as the highest population block of B.t. had one of the better results. In general terms the fenitrothion treatments examined provided more protection largely due to low defoliation at the time of initial treatment and the very high spray deposit.

Edward G. Kettela

PHEROMONE TRAPS FOR MONITORING POPULATION FLUCTUATIONS OF SPRUCE AND JACK PINE BUDWORM

by C.J. Sanders

FC-OR, Sault Ste Marie

Introduction

A semi-operational pheromone trapping system for monitoring spruce budworm populations was started in 1985. Currently over 500 permanent sampling locations are monitored annually, spanning 9 Provinces and 6 States. Procedures are standarised, with 3 Multi-pher traps deployed at head-height, 40 m apart. The advantages are as follows: i) convenience, pheromone traps are easy to deploy; ii) reliability, deployment is routine with no vagaries due to different operators or weather conditions at time of deployment; iii) area-wide sampling, catches represent populations over an area of approximately 1 ha; iv) extreme sensitivity, catches range from around 10/trap at the lowest densities to over 1000 in expanding outbreaks.

Results

Following log-transformation, correlations with other population parameters are good, with r^2 up to 80% against L^2, or egg-mass estimates, and can be used to define areas where defoliation can be anticipated.

However, the main value of the system is expected to be in monitoring population trends, leading to 'early warning' of impending outbreaks. Analysis along these lines has just begun. GIS techniques suitable for all jurisdictions are being developed by Barry Lyons (FC-OR) starting with the Ontario data. For instance, the Ontario trap-catches conform closely to known areas of defoliation; they 'predict' expansion to the northeast and a possible collapse west of Thunder Bay.

Resolving problems

Until this year, 1992, new batches of pheromone were synthesised each year. These varied in purity, and as a result lures varied in potency from year to year making comparisons between years difficult. In 1992 a batch of high purity material was obtained which is sufficient to supply lures for 15 years. Hopefully this will result in lures of equal potency each year. In addition, in order to resolve past variation, old and new lures have been cross-calibrated by placing them out simultaneously in the same locations. This produces correction factors that can be used to standardise the catches. Similar cross-calibrations will be carried out each year in the future to safeguard against variations in lure-potency.

Experiments have shown that the plastic traps become contaminated by pheromone that is impregnated into the plastic. As a result traps are 'attractive' the following year, even without a fresh lure. This contamination cannot be removed by washing with detergent or mild bleach. In the case of the spruce budworm such contamination is not serious because it does not significantly affect catches catches when traps are re-baited. However, to remove any doubts (and also to remove the problem of storing traps over-winter) a cheap, disposable non-saturating trap is desirable.

A remaining question is how many trapping locations are necessary to adequately monitor population fluctuations. To answer this, traps were deployed in Ontario in 1992 in two grids, one with 100 locations spaced about 50 km apart in an area 550 x 350 km, the other with 40 locations spaced about 20 km apart in an area 140 x 80 km. Analysis will involve computer sub-sampling, to determine how different sample size affects the 'contours' of population density. This will be refined by following the trends shown by the data over the next 3 years.

Jack pine budworm

A similar program to that for the spruce budworm is envisaged for the jack pine budworm. A sensitive monitoring system would be particularly valuable for this species, which erupts with little warning. Unfortunately, the complete pheromone blend of the jack pine budworm is not known. An intensive investigation of the pheromone chemistry is underway in cooperation with SFU, but although the presence of extremely potent minor components has been demonstrated, their identification still eludes us. The known pheromone can be used for delimiting areas of moderate to high population density, but it is doubtful if it is adequate for detecting population surges early enough to be of value for planning control programs.

CONCLUSION

The ability of pheromone traps to detect fluctuations in low density spruce budworm populations has been demonstrated. With the aquisition of a secure supply of high quality pheromone and factors for converting past catches to a common standard, the system is now ready to go operational. Analyses during the coming year should demonstrate the potential of the system and hasten its operational use.

A similar system for the jack pine would be of great value in the management of this species, and identification of a potent pheromone remains high priority.

Research towards IPM in Seed Orchards. Jon Sweeney & Garvice Gesner, Forestry Canada - Maritimes Region.

Most of our work is focused on developing methods of predicting and controlling seed losses caused by the spruce cone maggots, *Strobilomyia neanthracina* and *S. appalachensis*, in spruce seed orchards. Some highlights of work in 1992-93 follow.

Biology and population dynamics of spruce cone maggots

Life-table studies were started this spring with the help of GREEN PLAN funds to determine the natural mortality factors affecting the spruce cone maggots. Densities of each life stage were estimated for *S. appalachensis* in black spruce at Pokiok and Bettsburg, and for *S. neanthracina* in white spruce at Queensbury, using sticky traps, emergence traps, cone samples, and drop trays. The rate of larval and pupal predation in the soil, estimated with sentinel insects, ranged from 40-60%. Potential predators were sampled with pitfall traps at each site. Laura Kilbride (MScF candidate, U.N.B. Forestry) is constructing life tables for *S. neanthracina*. An additional field site for each species will be located within the Fundy Model Forest in 1993-94.

Control of cone maggot with nematodes

Two nematode species were applied to the soil for control of spruce cone maggot larvae in the Fundy Model Forest at J.D.I.'s Sussex Tree Nursery using a conventional hydraulic sprayer with a boom adapted for herbiciding tree rows. Maggots, which naturally emerge from the cones and drop to the soil in mid-summer, were dropped within marked soil plots and allowed to burrow in at 0, 2, 6, 13, 20 and 27 days after nematode application. *Steinernema feltiae* infected 86% of the maggots that 'dropped' immediately after spraying but only 41% of those that dropped two days later, and 11% of those that dropped one week post-application. The other nematode, *S. carpocapsae* Umea, started off with a high of 40% infection and declined to 3% after one week.

A formulation of *S. carpocapsae* Umea in vermiculite was tested against a liquid formulation of the same species at Bettsburg. Percent infection peaked at 40% but was greater with the solid formulation than the liquid and did not drop significantly until more than 6 days after application, compared to only 2 days with the liquid. The rate of maggot larval predation, an index of beneficial insect activity, was lower in the treated plot (44%) than in the untreated plot (60%) but the difference was not significant (t-test, $P=0.3$).

Another species, *S. glaseri*, said to have greater searching ability than other *Steinernema* spp., was tested in the lab. and performed poorly relative to *S. carpocapsae* and *S. feltiae*.

Our drop tray samples in 1991 and '92 have shown that larval drop can extend over a period of 6 weeks but that most drop occurs within a 2-3 week period. Effective suppression of the maggots with nematodes will require a period of at least three weeks of sufficient nematode activity in the soil. Possible ways of extending this infective period include irrigation, slow-release formulations, and multiple applications. We plan to test some of these in 1993-94.

Monitoring with cone samples, sticky traps and pheromone traps

Seed orchard managers in all three maritime provinces cooperated in the monitoring of spruce coneworm and seed moth with pheromone traps, monitoring the spruce cone maggots with yellow sticky traps, and testing a sequential sampling plan for predicting seed loss to cone maggot from egg/conelet samples.

Spruce coneworm catches were low again this year; seed moths catches have been gradually increasing since 1990. The numbers of adult cone maggots caught on yellow sticky traps was much higher in 1992 than in 1991. Mean catch per trap will be tested for correlation with percent of cones infested and seed loss when the data are complete. In 1990 and '91, the sequential sampling plan correctly predicted whether or not percent seed loss would exceed 10% in 9 of 10 white spruce orchards and but in only 12 of 16 black spruce orchards; data from 1992 have not been analyzed yet. We plan to improve the accuracy of the sequential sampling plan by using data from the life table studies to refine the relationship between the density of eggs and mature larvae.

Control of larch cone maggots with Cygon

Field trials for control of larch cone maggots with foliar applications of dimethoate (Cygon) were conducted by N.B.D.N.R.& E. at Queensbury, N.B., and by P.E.I.D.E.& F. at Upton Road, P.E.I. The mean number of filled seed per cone was 3X and 1.7X greater in sprayed than in unsprayed larch at Queensbury and Upton Road respectively. A second application, made about two weeks after the first at Upton Road, did not increase the filled seed count compared to the single application.

COMPETITION BETWEEN THREE STRAINS OF STEINERNEMATID NEMATODES UNDER LABORATORY AND FIELD CONDITIONS (1992)

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A report to the 20th Annual Forestry Canada Pest Control Forum

(Ottawa, Canada, November 17-19, 1992)

Introduction

The black army cutworm (BAC) has become an occasional forestry pest damaging new plantations established in areas burned by wild fire or prescribed burning. *Bacillus thuringiensis* does not kill BAC larvae at conventional dosages and the only pesticide registered for control is Ambush which is restricted to ground application. The BAC is a good candidate for control by nematodes because it is generally in the top 5 cm of the soil when not feeding and would likely come in contact with infective juveniles. Control may be achieved by spraying or by incorporating nematodes into soil plugs prior to planting container stock in areas susceptible to attack by the black army cutworm.

Three strains of *Steinernema*: *S. carpocapsae* "All" (BIOSYS, Palo Alto, California), *S. carpocapsae* "Umea" (BIOLOGIC, Willow Hill, Pennsylvania), and *S. feltiae* L1C were evaluated in the laboratory and field in 1992. *S. carpocapse* "All" and "Umea" strains are commercial products and widely used for insect control in the United States. *S. feltiae* L1C is a cold-active strain isolated from Newfoundland soil. Laboratory tests evaluated the effectiveness of the 3 nematode strains at different temperatures and in competition with one another against *Galleria mellonella*. Field tests were designed to determine if treating black spruce seedlings with the 3 nematode strains, alone and in combination, would effectively kill BAC larvae and reduce defoliation. The rationale for applying a combination of nematode strains is that one strain may work better at low temperatures while another may work better at higher temperatures.

Methods

Laboratory

Fire burned-soil obtained from the field was oven-dried for 2 days at 110°C. One 1 kg of dried soil was added to each of five 11 litre plastic tubs, moistened to 40% w/w with distilled water then mixed well. 200 ml of a 1:1:1 aqueous suspension of All, UMEA and L1C containing about 4 000 nematodes was poured evenly over the entire soil surface with a watering can. Tubs were put on one shelf in a Conviron chamber for·1 h to acclimatize. The photoperiod was set at 16:8 L:D, the R.H. at 75%, and the temperature (depending on series) at 8, 10, 12, or 14°C. Five L5 *Galleria* larvae were added to the centre of the soil surface and covered with a 25 mm x 100 mm petri dish bottom to ensure that larvae were in contact with the soil, larvae otherwise would avoid the soil. Tubs were covered with screened lids to slow drying of the soil. After 7 days the number of dead and live larvae were recorded. Live larvae were reared until death or adult emergence. Dead larvae were placed into petri dishes containing 2 ml of water (1 larva/dish) and kept at 20°C for 10 days to recover nematodes. The identity of the nematodes was determined by polymerase chain reaction (PCR), a DNA 'fingerprinting' technique.

Field

The field site was a recently planted black spruce plantation in an area burned in 1990. The experimental design was complete randomized block with 10 replicates. Two methods of control were evaluated: inoculation of soil plugs of black spruce with nematodes prior to planting and spraying seedlings with nematodes after planting. The nematode treatments were: L1C, UMEA-SUSPENSION, UMEA-GRANULAR, ALL, MIX, and CONTROL for the soil plug applications. The same treatments except UMEA-GRANULAR were used for the spray applications. The granular formulation was simply a mix of nematodes in moistened vermiculite. The MIX contained UMEA SUSPENSION, ALL and L1C in equal proportions. Each treated black spruce seedling received 8 000 nematodes, either in 20 ml water applied to the surface of each plug 24 h before planting or in 100 ml applied through a watering can nozzle onto the foliage of the seedling 2-3 h after planting. After planting each seedling was caged with 5 L4 or L5 BAC larvae. After 2 weeks, the amount of defoliation to current-year and year-old foliage was assessed and the larvae recovered to determine mortality and infection by nematodes. The identity of recovered nematodes was determined by PCR.

Results

Laboratory

Following one week's exposure to MIX at 8, 10 and 12°C, 80% or more of the *Galleria* larvae became infected with nematodes, 60% became infected at 14°C. DNA identification of the nematodes recovered from the infected larvae indicated that the successful strains were UMEA and L1C but not ALL. With the exception of the run at 12 °C, L1C accounted for most of the nematode infection in larvae dying from the MIX treatment.

Field

Defoliation of treated seedlings was not statistically different from the controls and ranged from 60 to 85%. Three to 4 larvae per seedling, on the average, were still alive after two weeks. Few dead larvae were recovered and missing larvae were assumed to have been cannibalized. Nematodes were recovered from larvae treated with ALL, UMEA-GRANULAR, L1C, and MIX in the soil plug experiment and from larvae treated with ALL, L1C, and MIX in the spray experiment. No nematodes were recovered from larvae treated with UMEA-SUSPENSION or from CONTROL larvae. L1C appeared to be the best competitor in the soil plug MIX (4/4 positively identified samples) but ALL was recovered more from the spray MIX (2/3 positive samples). However, more data is needed before conclusions can be drawn.

The poor performance in the field was probably due to dry and warm conditions. Rain did not fall and maximum air temperatures were over 30°C in the cages for the first 7 days. Nematode infection probably occurred during the second week when conditions were more seasonable. Air temperatures were higher and the soil temperatures lower in the cages than outside the cages.

Progress/Plans

1. A technique is available to distinguish strains of nematodes. While expensive it is useful to determine competition between different strains and to verify cause and effect of nematode applications (We can distinguish between applied and endemic strains).

2. Lab studies using *Galleria* indicate that the native strain (L1C) is most effective in the 8 to 14 C range, the range which is most likely to be encountered under field conditions. These tests will be repeated using BAC.

3. Field studies need to be repeated under more seasonable conditions and at dosages higher than 8 000 nematodes/seedling. We also would like to evaluate the effect of treatments in an infested plantation should one become available. The problem of cage microclimate needs to be addressed.

4. BIOSYS will propagate L1C to supply 1 billion nematodes for field tests in 1993. This will enable treatment of several thousand seedlings. A cooperative project with the Newfoundland Department of Forestry and Agriculture is planned.

ENTOMOPATHOGENIC NEMATODES FOR FOREST INSECT CONTROL

BY
D.C.Eidt, S.Zervos and C.A.A.Weaver

Experiments were continued on spruce budmoth, seedling debarking weevil, black vine weevil and elm leaf beetle. New work was initiated on winter moth.

Spruce budmoth *Zeiraphera* spp.

Results of the 1991 field work indicate that further experimentation with larger plots was necessary. Five treatments replicated four times were carried out on a total of twenty plots; each measured approximately 20m square and contained up to 100 white spruce trees. Treatments were applied after 6 pm with a Solo mistblower, with shutoff where gaps occurred.

The treatments were: 1) 35,000 infective juveniles (IJs) of *Steinernema carpocapsae* per tree (87.5 million/ha) and 1L *Bt* as Foray 48B in 400 L/ha water under "ideal" conditions, 2) same as (1) but "despite" conditions, 3) 35,000 IJs/tree, 1L *Bt* in 200 L/ha water, 4) *Bt* without nematodes in 200 L/ha water and 5) control. "Ideal" conditions were defined as 80% or better humidity, 15 C or higher temperature; "despite" conditions ignored weather and depended on larval development.

The results were less than consistent (Table 1). The nematodes applied despite weather conditions had greatest percent reduction in emergence from the controls, although weather conditions might have been better during this application. This was followed by *Bt* alone.

Preliminary results indicate a high proportion of larva collected were infected with both *Bt* and *Xenorhabdus*. The *Bt* was probably carried in by the nematodes.

Work is currently being carried out, in cooperation with RPC, to rationalize spray formulation. The purpose of this work is to develop a better adjuvant than *Bt*.

Seedling debarking weevil *Hylobius congener*

Results of field experiments in 1990,in cages, and in 1991 with treatments in separate isolated plantings were successful. Earlier work using treatments with single plantings suggested interference through cross contamination. Another field experiment using isolated plantings was carried out in 1992.

In 1992 we treated three plantings at rates of 400, 200, and 100 thousand *Steinernema carpocapsae* per Norway spruce tree (Table 2). The 400,000 site had losses less than 10%, the economic threshold above which replanting may be necessary. The 200,000 site showed losses of slightly over 10%, this was due to heavy losses (23%) in one damp sector that had a heavy duff layer and little vegetation. This sector was comparable to the site treated at the 400,000 rate. Losses were 27% and higher on untreated sites.

These results suggest that a rate of 300,000 nematodes per tree or 750 million per hectare would be adequate. This is the approximate equivalent of $0.04 US/million or $36 Can/ha plus shipping and application, which is quick and easy.

Black vine weevil *Otiorhynchus sulcatus*

Black vine weevil, *O. sulcatus*, significantly damages roots of valuable grafted bS and jP trees in 4 litre pots at the NBDNR nursery near Fredericton, N.B. Mortality of larvae, pupae and adults was highest with nematode (*S. carpocapsae* All strain) soil drenches compared to the only allowable chemical pesticide (lindane) or controls. Nematodes persist, mainly in the top half of pots, and give protection for at least 8 months. Most weevils locate in the bottom half of pots, and adults exit through the bottom. Therefore, even greater control may be achieved using a nematode strain with better dispersal. Further work must be done to determine the life cycle of the weevil, which is univoltine outdoors in Canada. It may be multivoltine under greenhouse conditions.

Elm leaf beetle *Xanthogaleruca luteola*

In 1991 a preliminary experiment using nematodes as a ground soak against elm leaf beetle larvae results were inconclusive. The experiment was repeated again in 1992 using a ground soak and adding a treatment using tree bands containing peat and nematodes. Larvae were trapped and killed by the nematodes in the bands but the efficiency was not assessed. Soil treatment could not be assessed because of apparent collapse of the population.

Winter moth *Operophtera brumata*

An experiment using nematode soil treatments against larvae and pupae of winter moth on shade trees is under way in Nova Scotia. Lab tests had shown that they are succeptible in both stages.

Small plots were treated with a high rate of 740,000 per sq m and a low rate 74,000 per sq m just before larval drop in June 1992. Efficacy is being measured by moth emergence in November using emergence cages and sticky bands.

Table 1

SPRUCE BUD MOTH FOLIAR SPRAY

S. carpocapsae All strain, 35,000/tree, 4 replicates. Analysis by Tukey's Studentised Range Test using arcsine-transformed data.

All Million/ha	Foray 48B	Water/ha	Conditions	E/S	% reduction	
87.5	1L/ha	400L	Despite	.06750	87	b
0	1L/ha	400L	Ideal	.13625	73	b
87.5	1L/ha	400L	Ideal	.20875	58	ab
87.5	1L/ha	200L	Ideal	.22000	56	ab
Control				.50000	0	a

Table 2

SEEDLING DEBARKING WEEVIL FIELD TRIAL 1992

Treatment/tree	Trees	Girdling > 75%		Weevils trapped
		No	%	
400,000 Umea	203 nS	7	3	87
200,000 Umea	205 nS	23	11	77
100,000 Umea	200 nS	91	46	109
Control	200 nS	54	27	22
Control	200 bS	56	28	58

INSECT AND DISEASE RESEARCH DIRECTION IN THE USDA FOREST SERVICE

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Abstract: The USDA Forest Service, Forest Insect and Disease Research (FIDR) supports a broad program of research on insects and diseases. Over the past few years we have been trying to broaden our program to develop a more complete understanding of insects and disease organisms in forest ecosystems; we are even trying to expand our programs to include beneficial arthropods and microorganisms.

There are several trends that will affect what research approaches we will be used. The public's increasing awareness of natural resources and concern for environmental issues will affect the type of forest pest management tools that will be acceptable. We will continue to be challenged to provide knowledge about insects and diseases and their impacts and influences on ecosystems, as well as the impacts of our actions to mitigate losses from these organisms. The demand for sound scientific information for use in policy decisions will also continue to increase in the future. Forestry is in the process of shifting to an environmental paradigm for managing natural resources. Certainly, we are seeing such a shift in the Forest Service with the Chief's recent announcement to embrace the philosophy of ecosystem management on National Forests. This philosophy will guide the management of public forests in this country and thus will affect our research for the foreseeable future.

One area of research we want to emphasize is biological control. We use a broad definition of biological control to include a broad array of biologically-based approaches: parasites and predators, pheromones, microbial pesticides, development of resistance varieties. Although we have had a considerable amount of research in this area in the past, we believe we have not adequately addressed the problems. We propose to emphasize research in areas such as the conservation and augmentation of natural enemies of native pests, development of microbial pesticides, and the use of pheromones, for example. We will also continue to emphasize research in biotechnology.

We are also expanding the scope of the FIDR program to include arthropods and microorganisms that are not considered to be pests. In a letter from the Deputy Chief for Research about 2 years ago, FIDR was given the responsibility for an area of research that includes research on their broad ecological roles of insects and microorganisms in forest ecosystems. For example, we need to determine what microorganisms and insects are present in forest soils and the rhizosphere and develop an understanding of their roles. Where roles are positive, we need to develop ways they may be used and enhanced. Also included would be the ecological roles of insects and microorganisms, as symbionts, nutrient cyclers, decomposers, detoxifiers, etc. Understanding of these organisms and their roles is needed to maintain healthy, productive forests and healthy environments.

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The USDA Forest Service, Forest Insect and Disease Research (FIDR) supports a broad program of research on insects and diseases. Over the past few years we have been trying to broaden our program to develop a more complete understanding of insects and disease organisms in forest ecosystems; we are even trying to expand our programs to include beneficial arthropods and microorganisms. Our future program direction will be influenced by several factors, including the following.

Integrated pest management, our touted approach to dealing with forest pests, has an inadequate knowledge base to allow its full implementation.

Integrated Pest Management (IPM) in forestry begins with understanding and managing the host in a manner that satisfies its basic biological requirements. IPM has many aspects including employing silvicultural practices that favor host vigor and discourage pest outbreaks, encouraging natural enemies and competitors of pests and augmenting biological control agents, manipulating insect populations using behavioral chemicals or sterile male techniques, and using direct interventions such as chemical or biological pesticides. For some of our major forest pests we have enough knowledge to prescribe fairly complete IPM systems. For others, such as root diseases, our knowledge is quite incomplete. And, for no pest is our knowledge complete enough to prevent major losses, given real world constraints. Examples of these constraints include bans on cutting trees, bans on building roads to access infested areas, bans on using prescribed fire, and bans on aerial application of pesticides. We need more basic information so that we can develop more flexible IPM strategies that can adapt to these restrictions.

Changing public values are altering the traditional uses of forests and this has spawned new information needs about forest pests as well as about other arthropods and microorganisms.

Many of the current pest management approaches were developed under the philosophy that emphasized timber production. Under this philosophy, reductions in the timber supply caused by insects and disease could not be tolerated, and the development of control tactics reflected this philosophy. Recently, the public appreciation and demand for other uses for our forests has increased. Using forests for recreation or wilderness values, for example, are becoming more important than timber in many areas. What does this mean for pest management? It means that not every disease or insect pest must be eliminated. In fact, some level of insect and disease occurrence may be beneficial. For example, root diseases can result in increased physical and biological diversity in the forest. Heartrots and dwarf mistletoes can set the stage for bird nesting sites. There will be times when forest managers will still want to control pests to protect a valuable timber resource or a unique stand of trees. But, there will also be many times when all the manager will want is to nudge the system back toward an acceptable balance or only prevent catastrophic losses. This means that managers will need pest management strategies that are ecologically sensitive and that encourage natural processes. Research also needs to develop an understanding of the beneficial arthropods and microorganisms in forest ecosystems. These organisms must be identified and their roles must be elucidated. Then, research can focus on developing management practices to encourage these beneficial organisms.

Forest pest control, employing direct control tactics such as aerially applied pesticides and extensive sanitation logging, continue to be challenged on terms of cost and environmental concerns.

The public just does not want to see our forests sprayed, clearcut, or extensively roaded. Pest management tactics requiring any of these are out of favor in the mind of the general public. Many of our current pest management strategies are based on at least one of these activities. We must develop new ones that are not. Increasing the use of biologically-based techniques, including increasing tree resistance to diseases, offer opportunities.

Managing forests using the "Ecosystem Management" philosophy will require changes in our pest management approaches.

The Chief of the Forest Service recently announced that National Forests will be managed under a philosophy of ecosystem management. This approach shift the focus from resource productivity to maintaining ecosystems that are sustainable and flexible enough to meet reasonable future needs. Under ecosystem management clearcutting will be reduced or eliminated. Thus, this technique, which can be an important pest management tool will not be as available. The reduction of clearcutting also means that forests will more often be managed using uneven-aged silvicultural systems. These uneven-aged forests will also have greater species mixes, greater variation in canopy levels, older individual trees, and more soil compaction resulting from more frequent stand entries. These and other characteristics may complicate silviculture and the pest management practices. Ecosystem management will require new knowledge of arthropods and microorganisms and their function in ecosystems. Some organisms previously viewed as pests in the production-oriented forests may now be viewed as beneficial.

Fewer new pesticides are being developed for forest pests.

Chemicals are simply not going to be as available as they have been. Chemical companies are reluctant invest in developing chemicals specific to forestry use.

These factors suggest that our research programs must develop new approaches to forest pest management that are ecologically sound. To do so, we are trying to emphasize certain areas in our future research programs.

For example, we want to emphasize biological control. We use a broad definition of biological control to include a broad array of biologically-based approaches: parasites and predators, pheromones, microbial pesticides, development of resistance varieties. Although we have had a considerable amount of research in this area in the past, we believe we have not adequately addressed the problems. According to the Director of the National Institute of Biocontrol[1], there are three areas where the U.S. has not pursued biological control as vigorously as many other countries. These areas include urban pests, environmental pests (such as weeds in wetlands), and forest pests. We propose to emphasize research in areas such as the conservation and augmentation of natural enemies of native pests, development of microbial pesticides, and the use of pheromones, for example.

We will continue to emphasize research in biotechnology. Presently, biotechnology research related to insects and diseases makes up about 40% of the total biotechnology program in the Forest Service. Much of this research uses biotechnological tools to develop or select for pest-resistant trees. We have one unit in Delaware, OH that is a FIDR biotechnology unit. That unit concentrates on research on gypsy moth virus, metabolic enzymes of gypsy moth, and on endophytic bacteria to control vascular wilt diseases such as oak wilt and Dutch elm disease.

We are also expanding the scope of the FIDR program to include arthropods and microorganisms that are not considered to be pests. In a letter from the Deputy Chief for Research about 2 years ago,. FIDR was given the responsibility for an area of research that includes research on their broad ecological roles of insects and microorganisms in forest ecosystems. For example, we need to determine what microorganisms and insects are present in forest soils and the rhizosphere and develop an understanding of their roles. Where roles are positive, we need to develop ways they may be used and enhanced. Also included would be the ecological roles of insects and microorganisms, as symbionts, nutrient cyclers, decomposers, detoxifiers, etc. Understanding of these organisms and their roles is needed to maintain healthy, productive forests and healthy environments.

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[1] Dr. Ernest Delfosse, personal communication.

ENVIRONMENTAL MONITORING OF HERBICIDES SPRAYING IN QUEBEC'S FOREST - 1992

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G1S 4X5

Report prepared for the twentieth Annual Forest Pest Control Forum
November 17-19, 1992

GENERAL INFORMATION

To complete our knowledge of how herbicides act in the forest environment, the Direction de l'environnement of the ministère des Forêts (MFO) conducted an environmental monitoring this year.

Across the province, a total 32,817 hectares of forest land were treated: 19,792.5 ha in public forests and the rest in private forests (Programme de mise en valeur de la forêt privée du MFO and Programme de développement forestier de l'est du Québec).

The most used herbicide (97% of the area treated) was Vision™, which has glyphosate as its active ingredient. It is applied mainly from the ground with Boomjet™-type sprayers. It is used for conifers release between the end of July and the beginning of September.

Other operations aimed at preparing sites for reforestation took place in May and June. In these cases, hexazinone (commercial name: Velpar L™) was applied in one of two ways: modified agricultural spray bar or T.T.S. scarifier with herbicide.

This document briefly describes the follow-up studies conducted in 1992. The areas of study which received priority this year were:

- contamination of pollen and small mammals after plantation weed control operations using glyphosate;
- glyphosate drift during aerial spraying;
- sampling of watercourses draining treated sectors of the Ristigouche river basin;
- hexazinone sampling in different substrata.

Note that chemical analysis is underway at the MFO's chemistry laboratory.

1. ENVIRONMENTAL MONITORING OF GLYPHOSATE

1.1 Water Sampling

Results of past follow-ups indicate that, in general, no detectable residue (< 1.00 µg/L) are found in watercourses when MFO requirements for buffer zones are respected. These zones must be 60 metres wide for aerial applications. For spraying at ground level with Boomjet™-type sprayer, an untreated strip 10 metres wide protects watercourses. This is reduced to 5 metres for the agricultural conventional boom system. The width of these strips is determined according to evaluations of deposit and drift associated with each application technique.

This year, 24 water samples were taken in specific situations (ex.: accidental spills, Ristigouche river basin) or when circumstances increased the risk of contaminating watercourses. In addition, ten samples were taken from devices for capturing small mammals (pitfalls). These analyses will be used in relation with the study of the small mammals (see section 1.5).

1.2 Sediment Sampling

It is known that glyphosate is strongly adsorbed by soil particles and sediments. Consequently, sediments constitute an interesting indicator of direct and indirect aquatic contamination from, for example, run-off of contaminated soil particles. Thus, we continued to take sediment samples this year as spot checks. Insofar as possible, sampling was conducted after rainstorms. Sediments were generally sampled at the limit of treated areas (0 km). Ten samples were taken in this way, including 5 from the Ristigouche river basin. Other samples (13) were used to verify the persistence of residues in places that had previously shown positive values. Six samples were taken in two lentic environments that had been sprayed directly in 1987 and still had residues in 1991. As well, 13 samples were taken after accidental spills.

1.3 Soil Sampling

Because of the low levels of glyphosate residues found in the soil after spraying (about 1 µg/g) and because concentrations decline over time, no further study was undertaken this year. However, residues found after accidental spills since 1987 are currently under study. Sixteen samples were taken.

1.4 Sampling of Pollen and Honey

Because some pollen samples contained residues in 1991, a study on this subject was set up this year. Nine beehives were placed in or near (0, 0.5 and 1.0 km) three sectors treated with glyphosate in the course of plantation release operations. Pollen samples were taken twice a week for one month after treatment.

We also verified the potential risk of glyphosate contamination of the honey in the beehives. In 1991, a producer's request motivated the MFO to analyze six honey samples from four different apiaries located in an area that had been sprayed with glyphosate. No residue (< 0.050 µg/g) was detected.

1.5 Sampling of Small Mammals

Glyphosate contamination of small mammals was evaluated during an experimental study of conifer release in the Montmorency forest. The main objective of this study was to verify how significantly small fauna contaminate the upper trophic levels. Forty-six specimens were collected in Sherman™ live-traps and pitfalls. The three species found in any significant number (*Peromyscus maniculatus* (Wagner), *Clethrionomys gapperi* (Vigors) and *Sorex cinereus* Kerr) were sampled before treatment, and four and six weeks after spraying. Water collected in the pitfalls was also sampled to take into account the effects possible glyphosate contamination of the water might have on the results found for small mammals. This project was set up from a broad study coordinated by Université Laval and aimed at evaluating the impact different plantation maintenance methods have on fauna (research project subsidized by the MFO).

1.6 Evaluation of Drift

Drift under operating conditions was evaluated during aerial spraying operations (aircraft and helicopter). The objective of this study was to validate the dimensions of buffer zones designated for high environmental sensitivity zones because, last year, certain concentrations exceeded the objectives. Thus, collectors (sheets of aluminum) arranged perpendicularly to flight lines allowed us to verify deposits at distances of 60, 80, 100 and 120 metres. Currently, buffer zones have a width of 60 or 100 metres according to the type of protected zone. Thirty-five samples were collected during this project.

Other collectors were set up directly in high environmental sensitivity zones (ex.: streams) to verify the quality of operations. Such verifications indicates whether aerial applications have been conducted according to standards (ex.: respect of buffer zones, wind conditions, etc.). Twelve samples were collected in this way.

2. ENVIRONMENTAL MONITORING OF HEXAZINONE

2.1 Water Sampling

We currently know less about hexazinone behaviour in Québec than about glyphosate behaviour. This is mainly because of the limited use of this herbicide. Results of environmental follow-ups conducted in past years show that this product has a certain degree of mobility. Even when a 50 metres buffer zone along a watercourse was respected, residues were found in the water up to five months after spraying. In two ponds directly exposed to herbicide application, we also found residues up to 16 months after treatment.

These results motivated us to pursue follow-ups in watercourses and ponds. In addition, we intensified our sampling efforts in order to better document the noted trends. Since the product is water soluble, we paid particular attention to the influence of precipitation on the residue levels found. In total, 136 samples were collected for these follow-ups.

Spot checks (17) were also conducted near different treated zones.

2.2 Sediment Sampling

Previous follow-ups of lotic and lentic environments with detectable residues in 1991 were continued. Sampling at new stations in lotic environments was also undertaken this year. These stations were paired with water sampling sites when sediment was present. Samples were also collected this year for spot checks. In total, 77 sediment samples were collected.

2.3 Soil Sampling

We continued a study undertaken in 1989 to evaluate the persistence of residues in soils in a sector treated with a Boomjet™-type sprayer. Samples were collected from the 0-10 cm and 10-20 cm strata because these horizons still had detectable residues in 1991. Considering the characteristics of the product, we also sampled the soil at a depth of 50 cm. Nine samples were collected.

2.4 Sampling of Vegetation

To verify levels of hexazinone residues in vegetation after treatment, spot checks in fruits, foliage and twigs likely to be used by fauna or humans were realised in 1990. Some sampling was conducted during the herbicide spraying season, and some samples were collected in sectors treated in the previous year. In general, no detectable residue (< 0.050 μg/g) was observed in foliage or twigs of intolerant hardwoods treated over one year. However, residues were detected in foliage and twigs during the treatment season. The five fruit samples collected a few months after treatment or more than a year later contained no detectable residue.

To complete our data, we collected twelve samples of foliage and twigs from sites treated in 1991 along with eight others from sectors treated this year.

2.5 Study of Occupational Exposure of Forest Workers

In accordance with an agreement with the Centre de Toxicologie du Québec, the MFO evaluated forest workers' occupational exposure to pesticides.

To make workers aware of the risks of pesticide exposure, this year the Centre developed a method for qualitative evaluation of workers' cutaneous exposure. It uses a fluorescent marker. If this study proves conclusive, this method can be used during herbicide operations next year.

3. FLIGHT-OVER SPRAYED SECTORS

Once a year since 1987, the Service du suivi environnemental conducts a helicopter flyover of forested areas treated with herbicides. The efficiency of prescribed treatments and the quality of operations (ex.: respect of buffer zones) are evaluated through this exercise. Recommendations aimed at improving future operations are then issued. This tool is also used to validate certain sampling stations planned for the current year.

REPORTS PREPARED IN 1992 (english summary available)

LÉVEILLÉ, P., LEGRIS and G. COUTURE, 1992. Résidus de glyphosate dans les fruits sauvages à la suite de pulvérisations terrestres en milieu forestier en 1989 et 1990. Gouvernement du Québec, ministère des Forêts, Service du suivi environnemental, publication no. FQ92-3032, 25 p.

SAMUEL, O., D. PHANEUF and A. LEBLANC, 1992. Étude de l'exposition professionnelle des travailleurs forestiers à l'hexazinone. Rapport synthèse. Centre de Toxicologie du Québec, report prepared for the ministère des Forêts du Québec, 34 p.

SUIVI ENVIRONNEMENTAL DES PULVÉRISATIONS DE PHYTOCIDES EN MILIEU FORESTIER AU QUÉBEC - 1992

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GÉNÉRALITÉS

Afin de compléter nos connaissances sur le comportement des phytocides utilisés en milieu forestier, la Direction de l'environnement du ministère des Forêts (MFO) a poursuivi cette année un suivi environnemental.

Au total, 32 817 hectares ont été traités à travers la province. De cette superficie, 19 792,5 ha ont été réalisées en forêt publique, le reste étant fait en forêt privée (Programme de mise en valeur de la forêt privée du MFO et Programme de développement forestier de l'est du Québec).

Le Vision MD ayant comme ingrédient actif le glyphosate a été le phytocide le plus utilisé (97 % en terme de superficie). Il est appliqué principalement par voie terrestre au moyen de pulvérisateurs de type Boomjet MD. On l'emploie lors du dégagement de plantation qui se fait de la fin juillet au début septembre.

D'autres interventions ayant pour but de préparer le terrain en vue du reboisement se sont déroulées en mai et juin. On a recours alors l'hexazinone (nom commercial: Velpar L MD) et deux modes d'application ont été utilisés : la rampe agricole modifiée et le scarificateur T.T.S. avec herbicide.

Ce document présente une brève description des projets de suivi réalisés en 1992. Les dossiers qui ont été priorisés cette année concernent :

- la vérification de la contamination du pollen et des petits mammifères à la suite de travaux d'entretien de plantation avec le glyphosate;
- l'acquisition de données supplémentaires sur la dérive du glyphosate lors d'applications aériennes;
- l'échantillonnage de cours d'eau drainant des secteurs traités dans le bassin versant de la Ristigouche;
- la poursuite de l'échantillonnage de l'hexazinone dans différents substrats;

Notons que les analyses chimiques sont actuellement en cours et qu'elles sont sous la responsabilité du laboratoire de chimie du Ministère.

1. SUIVI ENVIRONNEMENTAL DU GLYPHOSATE

1.1 Échantillonnage de l'eau

Les résultats des suivis antérieurs indiquent qu'aucun résidu détectable (< 1,00 µg/l) n'est généralement retrouvé dans l'eau des cours d'eau, lorsque les bandes de protection prescrites par le Ministère sont respectées. La largeur de ces bandes est de 60 mètres lors des applications aériennes. Dans le cas des opérations terrestres avec pulvérisateur à barillet de type Boomjet^{MD}, les cours d'eau sont protégés par une bande non traitée de 10 mètres de largeur tandis qu'avec des rampes agricoles elle est de 5 mètres. Il est à noter que ces bandes sont établies à partir d'évaluations du dépôt et de la dérive associées à chaque technique d'application utilisée.

Cette année, 24 échantillons d'eau ont été récoltés lors de situations particulières (ex.: déversements, bassin de la rivière Ristigouche) ou lorsque les circonstances favorisaient les risques de contamination de l'eau. De plus, dix échantillons provenant de dispositifs de capture de petits mammifères (pièges-fosses) ont été recueillis. Ces analyses serviront à l'étude sur les petits mammifères (voir section 1.5).

1.2 Échantillonnage des sédiments

Il est reconnu que le glyphosate s'adsorbe fortement aux particules de sol et aux sédiments. De ce fait, ceux-ci constituent un indicateur intéressant de la contamination directe du milieu aquatique ou de la contamination indirecte provenant par exemple du ruissellement de particules de sol contaminées. Pour cette raison, nous avons continué à prélever cette année quelques échantillons de sédiments en guise de vérifications ponctuelles. L'échantillonnage s'est fait autant que possible après des pluies. Ces sédiments ont généralement été récoltés en bordure des superficies traitées (0 km). Dix échantillons ont été récoltés de la sorte, dont cinq proviennent du bassin de la rivière Ristigouche. D'autres prélèvements (13) ont servi à vérifier la persistance des résidus aux endroits où de telles vérifications avaient démontré des valeurs positives dans le passé. Le suivi de deux milieux lentiques directement pulvérisés en 1987 et présentant encore des résidus en 1991, a donné lieu à la cueillette de 6 échantillons. Enfin, treize prélèvements ont été recueillis lors de déversements accidentels.

1.3 Échantillonnage du sol

Compte tenu du faible niveau de résidus de glyphosate (environ 1 µg/g) retrouvé au sol après une pulvérisation et de la diminution des concentrations en fonction du temps, aucune autre étude n'a été entreprise cette année. Toutefois, une étude des résidus retrouvés lors de déversements accidentels survenus depuis 1987 se poursuit. Seize échantillons ont été récoltés.

1.4 Échantillonnage du pollen et du miel

Suite à quelques résultats positifs obtenus dans des échantillons de pollen en 1991, une étude sur le sujet a été amorcée cette année. Pour ce faire, 9 ruches ont été installées dans ou près (0, 0,5 et 1,0 km) de trois secteurs traités au glyphosate dans le cadre de travaux d'entretien de plantation. L'échantillonnage du pollen a été fait à raison de 2 prélèvements par semaine durant le mois suivant le traitement.

Nous avons vérifié également le risque potentiel de contamination du miel de ces ruches par le glyphosate. Mentionnons qu'en 1991, à la suite d'une demande d'un producteur, le MFO avait analysé six échantillons de miel provenant de quatre ruchers différents situés dans une région où des pulvérisations de glyphosate avaient eu lieu. Aucun résidu (< 0,050 µg/g) n'avait alors été détecté.

1.5 Échantillonnage de petits mammifères

Une évaluation de la contamination des petits mammifères par le glyphosate a été réalisée lors d'une étude expérimentale sur les travaux d'entretien à la forêt Montmorency. L'objectif principal de cette étude était de vérifier l'importance de la contamination que peut induire la petite faune sur les niveaux trophiques supérieurs. À l'aide de pièges-dortoirs (Sherman[MD]) et de pièges-fosses (pitfalls), 46 spécimens ont été recueillis pour analyses. Les trois espèces retrouvées de façon significative (*Peromyscus maniculatus* (Wagner), *Clethrionomys gapperi* (Vigors) et *Sorex cinereus* Kerr) avaient été échantillonnées avant le traitement, puis quatre et six semaines après la pulvérisation. Des prélèvements d'eau retrouvée dans les pièges-fosses ont aussi été faits afin de tenir compte de la contamination possible de l'eau par le glyphosate sur les résultats trouvés chez les petits mammifères. Mentionnons que ce projet a été élaboré en aval d'une vaste étude coordonnée par l'Université Laval et vise à évaluer les impacts de différentes méthodes d'entretien de plantation sur la faune (projet de recherche subventionné par le MFO).

1.6 Évaluation de la dérive

L'évaluation de la dérive en conditions opérationnelles a été réalisée lors d'application par voie aérienne (avion et hélicoptère). L'objectif de cette étude était de valider la dimension des bandes de protection accordées aux zones à susceptibilité environnementale élevée puisque certaines concentrations obtenues l'an dernier dépassaient les objectifs fixés. Ainsi, à l'aide de capteurs (feuilles d'aluminium) disposés perpendiculairement aux lignes de vol, nous avons vérifié le dépôt aux distances de 60, 80, 100 et 120 mètres. Rappelons qu'actuellement, la largeur des bandes de protection est de 60 ou 100 mètres selon la zone à protéger. Trente-cinq échantillons ont été recueillis lors de ce projet.

D'autres capteurs ont été installés directement dans les zones à susceptibilité environnemental élevé (ex.: ruisseaux) afin de vérifier la qualité des opérations. Ces vérifications ponctuelles pourront servir à évaluer si l'application aérienne s'est déroulée selon les normes (ex.: respect des bandes de protection, des conditions de vent, etc). Douze échantillons ont ainsi été récoltés.

2. SUIVI ENVIRONNEMENTAL DE L'HEXAZINONE

2.1 Échantillonnage de l'eau

Nous possédons actuellement moins de données sur le comportement de l'hexazinone en territoire québécois que sur le glyphosate. Cette situation s'explique principalement par l'utilisation plutôt restreinte de ce phytocide. Les résultats du suivi environnemental réalisé les années précédentes, nous démontrent une certaine mobilité de ce produit. Même en respectant une bande de protection de 50 mètres le long des cours d'eau, nous détectons des résidus dans l'eau jusqu'à cinq mois après la pulvérisation. Dans deux mares directement exposées à l'application du phytocide, nous retrouvons également des résidus jusqu'à 16 mois suivant le traitement.

Ces résultats nous ont donc motivé à poursuivre certains suivis dans les cours d'eau et dans les mares. De plus, afin de mieux documenter les tendances perçues, nous avons intensifié notre effort d'échantillonnage. Comme le produit est soluble dans l'eau, une attention particulière a été accordée à l'influence des précipitations sur les niveaux de résidus retrouvés. Au total, 136 échantillons ont été récoltés lors de ces suivis.

Des vérifications ponctuelles (17) ont aussi été réalisées près de différentes zones traitées.

2.2 Échantillonnage des sédiments

Les suivis de milieux lotiques et lentiques déjà entrepris et présentant des résidus détectables lors des plus récents prélèvements réalisés en 1991 ont été poursuivis. L'échantillonnage de nouvelles stations en milieu lotique, a également été amorcé cette année. Ces stations ont été couplées aux sites d'échantillonnage de l'eau lorsqu'il y avait présence de sédiments. Quelques échantillons récoltés en guise de vérifications ponctuelles lors des travaux réalisés cette année ont également été faits. Au total, 77 échantillons de sédiments ont été récoltés.

2.3 Échantillonnage du sol

Nous avons poursuivi l'étude entreprise en 1989 sur la persistance des résidus dans le sol dans un secteur traité avec un pulvérisateur de type BoomJet^{MD}. Des échantillons des strates 0-10 cm et 10-20 cm ont été récoltés puisqu'en 1991, ces horizons présentaient toujours des résidus détectables. Des prélèvements à 50 cm de profondeur ont également été effectués compte tenu des caractéristiques du produit. Neuf échantillons ont été recueillis.

2.4 Échantillonnage de la végétation

Afin de vérifier les niveaux de résidus d'hexazinone que l'on pouvait retrouver dans la végétation suite à un traitement, des vérifications ponctuelles ont été réalisées en 1990 dans les fruits, le feuillage et les ramilles présentant un potentiel d'utilisation pour la faune ou l'homme. Une partie de ces vérifications a été réalisée pendant la saison d'application du phytocide alors que d'autres échantillons ont été prélevés dans des secteurs traités un an auparavant. Dans le feuillage et les ramilles de feuillus intolérants traités depuis plus d'un an, on n'a observé généralement aucun résidu détectable (< 0,050 µg/g). Durant la saison du traitement, des résidus ont toutefois été détectés dans le feuillage et les ramilles. Dans les fruits, les cinq échantillons recueillis quelques mois après le traitement ou après plus d'un an ne présentaient aucun résidu détectable.

Pour compléter les données que nous possédons, douze échantillons de feuillage et de ramilles ont été récoltés cette année sur des sites traités en 1991 tandis que huit autres proviennent de secteurs traités cette année.

2.5 Étude de l'exposition professionnelle des travailleurs forestiers

Le Ministère poursuit son entente avec le Centre de Toxicologie du Québec pour évaluer l'exposition professionnelle des travailleurs forestiers aux pesticides.

Afin de sensibiliser les travailleurs aux risques d'exposition aux pesticides, le Centre a développé, cette année, une méthode d'évaluation qualitative de l'exposition cutanée des travailleurs à l'aide d'un marqueur fluorescent. Si cette étude s'avère concluante, elle pourrait être utilisée lors des opérations phytocides de l'an prochain.

3. SURVOL DES SECTEURS DE PULVÉRISATIONS

Depuis 1987, le Service du suivi environnemental réalise annuellement un survol en hélicoptère des superficies traitées à l'aide de phytocides en milieu forestier. Cet exercice permet de vérifier l'efficacité des traitements prescrits et la qualité des travaux (ex.: respect des bandes de protection). Des recommandations sont ensuite émises et permettent d'améliorer les travaux ultérieurs. Cet outil sert également à valider certaines stations d'échantillonnage prévues pour l'année en cours.

RAPPORTS RÉDIGÉS EN 1992:

LÉVEILLÉ, P., J. LEGRIS et G. COUTURE, 1992. Résidus de glyphosate dans les fruits sauvages à la suite de pulvérisations terrestres en milieu forestier en 1989 et 1990. Gouvernement du Québec, ministère des Forêts, Service du suivi environnemental, publication no FQ92-3032, 25 p.

SAMUEL, O., D. PHANEUF et A. LEBLANC, 1992. Étude de l'exposition professionnelle des travailleurs forestiers à l'hexazinone. Rapport synthèse. Centre de Toxicologie du Québec, rapport réalisé pour le ministère des Forêts du Québec, 34 p.

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.T. 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 deb ate 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 des fonctions semblables, mais au sein duquel les provinces étaient peu ou pas représentées. A 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 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 <u>Forum national sur la répression des ravageurs forestiers:</u>

Il sera tenu, chaque année, sous les auspices du Services canadien des forêts.

2.0 <u>Objet:</u>

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 <u>Activités:</u>

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 <u>Composition:</u>

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 recommandations du sommaire que les participants pourront ensuite utiliser à leur gré.

4.1 <u>MEMBRES DU COMITÉ DIRECTEUR:</u>

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 - adminstration 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.: représen... 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 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/ Ile-du-Prince-Édouard	Frédéricton
6	Saskatchewan	Edmonton
7	Nouvelle-Écosse	Frédéricton
8	Manitoba	Edmonton
9	Terre-Neuve	St. Jean

9.0 <u>Lieu</u>:

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 <u>Dates</u>:

Elles devraient continuer à tomber durant la troisième semaine de novembre.

11.0 <u>Budget</u>:

Le Forum continuera à se tenir sous les auspices du Services canadien des forêts, et les frais accessoires (par ex.: affranchissement, publicastion de comptes-rendus des rencontres, salle de réunion) seront supportés par le gouvernement fédéral.