1960

Meetings of the Interdepartmental Committee on Forest Spraying Operations

MEMORANDUM OF UNDERSTANDING
REACHED AT A MEETING OF REPRESENTATIVES
OF CANADA DEPARTMENT OF FISHERIES AND
NEW BRUNSWICK DEPARTMENT OF LANDS AND
MINES, JANUARY 19, 1960

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1. One-half pound DDT per gallon will be used on the Miramichi Watershed and areas to the east of it.

2. One pound DDT per gallon will be used on the St. John River Watershed.

3. Dosage on the Miramichi Watershed will be one-half gallon per acre except on certain areas of high hazard to be selected where it may be increased to as much as three quarters of a gallon per acre.

4. Dosage on the St. John River Watershed will be at an average of one-half gallon per acre.

Fredericton, N. B.
January 19, 1960.

Dr. Hasbrouck - ARR

Memo. for File 14-0-31

Interdepartmental Committee on Forest Spraying Operations

Meeting - Jan. 26/60

The Meeting discussed the "Memo. of Understanding" between the Fisheries Department and the New Brunswick Department of Lands and Mines of Jan. 19/60.

2. I had to leave before the meeting was over, but at that time two points had been agreed upon:

(a) The Committee accepted the terms of the "Memo of Understanding", though with some reluctance on the part of Fisheries and Fisheries Research Board members. It should provide for conclusive field tests of the two dosages proposed.

(b) The plan to use all Stearman aircraft for ½ lb. per acre dosage, and all TBM's for ¼ lb. per acre, was not considered good experimental design. It was recommended that a few Stearmans be flown from TBM airfields, using latter's formulation, so as to eliminate aircraft characteristics from the dosage differences.

3. I told the Committee that I agreed with both the above.

H.W.B.

H.W.B. Elwyn Doyle reports that Forest Protection Ltd. doesn't plan to segregate aircraft as in (b) above, anyway. H.W.B.

DRAFT

NOTES on a meeting with the New Brunswick government and its advisors to discuss details of the 1960 DDT spray program in the Province of New Brunswick.

In Attendance:

K.B. Brown	-	New Brunswick Department of Lands and Mines
B. Flieger	-	Forest Protection Limited
F.E. Webb	-	Forest Biology - Department of Agriculture
H. Heaney (a.m)	-)	Department of Northern Affairs and National Resources
E. Doyle (p.m.)	-)	
C.J. Kerswill	-)	
P.F. Elson	-)	Fisheries Research Board of Canada
M.H.A. Keenleyside	-)	
W. R. Houreton	- Ottawa	)
R. R. Lagie	- Halifax	)
C. E. Kilpatrick	- Fredericton	) Department of Fisheries
E. M. Burridge	- Ottawa	)

Mr. Brown opened the meeting at 10:15 a.m. with a review of the series of events since the November 10 meeting of the Interdepartmental Committee on Forest Spraying Operations. He stated that the reason for the hesitancy on the part of the province and Forest Protection in accepting the recommendations of the I.C.F.S.O. was due to the results of some field tests done in 1951 by the U.S. Department of Agriculture in the province of Quebec and the State of Maine. This agency after testing various formulations of DDT had recommended the application of 1 pound per acre. He then referred to tests undertaken by Science Service in 1953, the results of which showed lower control with reduced concentrations of DDT. A program in 1956 was also referred to, in which a portion of the spray used was at a lower concentration (9%). It was reported that the least effective control resulted in the area sprayed with this formulation.

Mr. Brown then referred to a meeting of F.P.L. on December 11 at which consideration had been given to the I.C.F.S.O. recommendations. It had been the recommendation of the meeting that the reduced dosage should be given a fair trial provided that satisfactory arrangements for testing the effect on salmon were to be made. Mr. Brown stated that it was decided at this meeting that 6% DDT would be used on approximately 1/3 of the area to be sprayed. He added that the majority of important salmon streams were located in this area - he referred to a map showing the spray area. The area to be treated with the 1/2 strength DDT spray

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included part of the drainage areas of the Southwest Miramichi and the Cains Rivers. Full strength would be applied to the Saint John, Dungarvan, Renous and Batholomew systems.

Mr. Houreton referred to the November 10 meeting of the I.C.F.S.C. and the further analysis of Dr. Fettes' data which had been asked for at this meeting. He stated that the Committee had used Dr. Fettes' final analysis in drafting their recommendations. Mr. Houreton stated that the 1961 report referred to by Mr. Brown had been discussed with Dr. Prebble and he had indicated that there was room for conclusions other than the one recommending the one pound per acre.

Mr. Houreton referred to the importance of droplet density rather than concentration in obtaining effective control as shown in Dr. Fettes' report. He added that he would like to have Mr. Brown's comments on factors that would prevent Forest Protection from obtaining the minimum droplet density. In addition Mr. Houreton asked for comments on Dr. Fettes' report.

Mr. Brown stated that he agreed with Dr. Fettes' original recommendation i.e. spraying part of the area with a 6¼% solution. He added that the entomologists have reported that the budworm population was concentrated in a clearly defined area and they did not want to take any chances of having it spread again particularly since there was some indication that the Government of Canada would not contribute to a spray program after 1960. Mr. Brown stated that he did not want to comment on the technical aspects of Dr. Fettes' report but that he did feel that certain phases of the work should be rechecked.

Mr. Houreton enquired whether the proposed spray plan represented the decision of the New Brunswick Government with respect to the recommendations of the I.C.F.S.C. Mr. Brown replied that the plan was the recommendation that Forest Protection Limited would be submitting to the Provincial Government and he hoped that as a result of this meeting he could advise his Minister that it was acceptable to the Department of Fisheries.

Mr. Houreton stated that the Department had been very optimistic as a result of Dr. Fettes' report and had hoped that the whole area would be sprayed at half strength DDT. He added that it had

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been anticipated that there might be some reluctance to spray the entire area at 1/2 strength but it had been expected that at least half of the area would be so treated. He added that although some of the sections in the proposed "full strength" spray area were not important salmon producing areas they were important trout producing areas.

Mr. Brown stated that if the whole area was sprayed with either concentration nothing would be found out in connection with the comparative effects of the two strengths of DDT on salmon and budworms. Spraying large areas with each concentration would make such checks possible.

Mr. Houreton suggested a plan, based on the Larval Mortality Progression curve (Fig.2) in Dr. Fettes' report, in which the Dungarvan-Renous section might be sprayed with the half-strength concentration. An immediate check of this would indicate the percent budworm mortality and a decision could be made whether to use 1/2 strength for the rest of the area. Messrs. Brown and Flieger stated that this plan was impractical because the spray material had to be delivered before spraying started. Mr. Flieger added that he questioned the results Dr. Fettes had obtained for this phase of the project.

Dr. Webb stated that they had had some experience in mixed dosage application in the 1953 program which had not been too successful. He added that it would not be possible to analyse the data with the time available.

Dr. Webb and Mr. Houreton then discussed the importance of droplet density.

Dr. Kerswill stated that it was his understanding as a result of the November 10 meeting of the I.C.F.S.C. that checking for salmon survival would only be undertaken if the major part of the spray area was treated with half strength. He continued that he had understood that this meeting was being held to decide which areas would be sprayed at full strength. He added that it was his feeling that the matter should now go back to the I.C.F.S.C. for their consideration.

In reply to a question by Mr. Flieger, Dr. Kerswill stated that a fairly good assessment of the Dungarvan area might be possible if it were sprayed with the half strength formulation since they had a considerable amount of back data from this area.

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A discussion followed on the use of half and full strength concentrations of the spray. Mr. Flieger stated that it was difficult to spray using two concentrations.

In reply to a question by Mr. Burridge, Mr. Flieger stated that the same type of spray equipment would be used as had been used in the past. He added that a fairly large number of aircraft would have to be used due to the size of the area and the fact that the whole area would be ready to spray at about the same time. It would all have to be done in a 2 1/2 week period.

Dr. Webb stated that it would be some time in July, at the end of the generation, before results would be available. He stated that results obtained at the end of the first week would not be too accurate.

In reply to a question by Dr. Elson, Dr. Webb stated that periodic outbreaks might be expected from time to time since the spruce budworm is a native insect.

Further discussion took place on the possibility of re-spraying certain sections in the spray area. Mr. Flieger stated that there would not be time to respray due to the tightness of the whole operation.

A discussion followed on various streams within the spray area e.g. Dungarvan, Renous and Bartholomew. Mr. Brown stated that they want to keep the south and east sections flexible in order that they may reach out and spray various "hot spots". These "side sprayings" would be done with the 1/2 strength formulation.

It was stated that the Experimental Farm Area and the Department of Agriculture's test area would be exempted from the spray area. Dr. Webb stated that bacterial toxin may be tested in this area.

Mr. Heureton stated that he would again like to make a plea for a reduced spray concentration for the Renous, Dungarvan and Bartholomew area. Dr. Morrow11 stated that these were areas of high salmon production.

Following the lunch hour Mr. Brown stated that he and Mr. Flieger had discussed the problem and come up with a possible solution (Appendix I).

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A discussion followed on contents of this suggestion. Mr. Flieger pointed out that more than one half gallon per acre would be applied by altering the flight pattern of the aircraft flying this section.

A brief discussion followed on the fisheries assessment program and it appeared that manpower would be a major problem.

Mr. Houston stated that he would like to have beforehand some idea of the areas that would receive the increased application of the half concentration of spray. Mr. Brown advised that this would be provided as soon as the spray map was finalized.

Mr. Houston stated that he would take this information back to Ottawa.

Mr. Brown stated that unless otherwise directed they would proceed on the basis of the above arrangements.

Appendix I attached.

APPENDIX I

MEMORANDUM OF UNDERSTANDING REACHED AT A MEETING OF REPRESENTATIVES OF CANADA DEPARTMENT OF FISHERIES AND NEW BRUNSWICK DEPARTMENT OF LANDS AND MINES, JANUARY 19, 1960

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3. Dosage on the Miramichi Watershed will be one-half gallon per acre except on certain areas of high hazard to be selected where it may be increased to as much as three quarters of a gallon per acre.

4. Dosage on the St. John River Watershed will be at an average of one-half gallon per acre.

Fredericton, N.B.
January 19, 1960.

CANADA

DEPARTMENT
OF
NORTHERN AFFAIRS AND NATIONAL RESOURCES

FORESTRY BRANCH

YOUR FILE.....

OUR FILE.....

ADDRESS REPLY TO
FORESTRY OPERATIONS DIVISION

P. O. Box 428,
Fredericton, N. B.

January 20, 1960.

Mr. H. W. Beall,
Chief, Forestry Operations Division,
Forestry Branch,
Dept. NA and NR,
OTTAWA, Ontario.

Sir:

I am enclosing an account of a meeting which took place at 10 o'clock on January 19, 1960, between representatives of Canada Department of Fisheries, and the New Brunswick Department of Lands and Mines. The purpose of the meeting was to reach an understanding as to the concentration of DDT to be applied in next spring's budworm spraying operation. You will also find enclosed a MEMORANDUM OF UNDERSTANDING REACHED at the above meeting.

Yours faithfully,

H. D. Heaney,
District Forest Officer.

Encls.

MEMORANDUM OF UNDERSTANDING REACHED AT A MEETING OF REPRESENTATIVES OF CANADA DEPARTMENT OF FISHERIES AND NEW BRUNSWICK DEPARTMENT OF LANDS AND MINES, JANUARY 19, 1960

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Fredericton, N. B.
January 19, 1960.

January 25th, 1960 Meeting of the Interdepartmental Committee on Forest Spraying Operations

NOTES ON A MEETING OF THE
INTERDEPARTMENTAL COMMITTEE ON FOREST
SPRAYING OPERATIONS, HELD IN THE OFFICE
OF DR. A. L. PRITCHARD AT 1:30 PM
JANUARY 25, 1960

In attendance:

Dr. M. L. Prebble	Forest Biology, Department of Agriculture
Dr. J. J. Fettes	Forest Biology, Department of Agriculture
Mr. H. W. Beall	Department of Northern Affairs and National Resources
Mr. W. W. Mair	Department of Northern Affairs and National Resources
Dr. J. L. Kask	Fisheries Research Board of Canada
Dr. A. L. Pritchard	Department of Fisheries
Mr. W. R. Hourston	Department of Fisheries
Mr. E. W. Burridge	Department of Fisheries

At the opening of the meeting Dr. Pritchard stated that the meeting had been convened in order to bring the Committee up to date on developments following the November 23rd meeting at which recommendations with reference to the proposed 1960 New Brunswick DDT spray operation were drafted and to discuss the action which might be taken by the Committee in the light of these developments.

The Minister had written to the Honourable N. B. Buchanan on November 24 enclosing a copy of the recommendations. He also wrote to the Honourable Mr. Flemming, the Premier, advising him of the studies

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of the Interdepartmental Committee and of the action he had taken in writing to Mr. Buchanan. Mr. Flemming and Mr. Buchanan met with the Minister in early December and agreement was reached that a meeting should be held to discuss the proposed spray project and the recommendations of the Interdepartmental Committee. This meeting was duly arranged with Mr. Brown and was convened on January 19 in Fredericton. Copies of the notes of this meeting (attached as Appendix I) were handed out to each Committee member for study. Dr. Pritchard drew attention to the Memorandum of Understanding attached to the notes which stated that:

1. One-half pound DDT per gallon will be used on the Miramichi Watershed and areas to the east of it.

2. One pound DDT per gallon will be used on the St. John River Watershed.

3. Dosage on the Miramichi Watershed will be one-half gallon per acre except on certain areas of high hazard to be selected where it may be increased to as much as three quarters of a gallon per acre.

4. Dosage on the St. John River Watershed will be at an average of one-half gallon per acre.

He stated that while the results of the meeting had been disappointing insofar as recommendations of the Committee were concerned some progress had been made.

Mr. Hourston then reviewed the notes briefly explaining a few of the highlights in detail.

Following a discussion of the expected budworm mortalities in high a lower hazard areas, Dr. Pritchard reviewed the progress of events since the November 23 meeting of the I.C.F.S.O.

The discussion then turned to the Miramichi spray area in which the dosage may be increased to as

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much as ¾ gal. per acre (Renous-Dungarvon). Dr. Prebble in referring to a map showing the various hazard areas stated that it would appear that the area that might be so sprayed would be no more than half the total area. He considered this to be a substantial gain over the original recommendations of F.P.L.

With reference to the Northeastern Wildlife Station's experiments, Mr. Mair stated that he had discussed the matter with Mr. Wright and some arrangement for checking would be made. He added that it was unfortunate that the entire experimental area was to be treated with the full strength material.

A discussion followed on the development of a satisfactory assessment programme. Dr. Fettes stated that this will depend to some extent on the liaison with Forest Protection Limited. After further discussion it was generally agreed that a thorough assessment must be made particularly in the area to be treated with the half strength solution.

It was indicated by Dr. Fettes that two separate studies would be undertaken by Forest Biology, one on droplet density and one to check the programme operationally. Dr. Fettes added that all areas must be checked and that it would be essential to have samples of the formulation taken directly from the spray plane tanks or periodically from the storage tanks.

Dr. Fettes drew attention to the fact that the Progression Curve data is not based solely on small test plot results but rather from a number of full scale operations.

A discussion took place on the possibility of meetings between Drs. Fettes and Kerswill to plan the assessment programme. It was agreed that this would not be initiated until the proposals had been confirmed with the New Brunswick government.

Dr. Kask referred to a talk being given by Dr. Kerswill to the Miramichi Salmon Association in Boston. He stated that he would like the committee's permission to have Dr. Kerswill describe the action being taken by the New Brunswick Government in spite of the known alternative for controlling the budworm.

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Dr. Prebble stated that Dr. Fettes' report was being printed in one of their Departmental publications for the information of the forest industry. He added that Dr. Kerswill could make use of this material in his presentation.

Dr. Fettes expressed concern regarding the proposed use of T.B.M. aircraft for applying the half strength and Stearman aircraft for applying the full strength material. He stated that there have been failures of infestation control where T.B.M.'s have been used and this could introduce another variable in the experiment and a loophole for disagreement in the final analyses. It was agreed that if the operation was to be run as a proper controlled experiment both types of aircraft should be used in the full strength and half strength spray areas.

Dr. Pritchard stated that the Minister of Fisheries would write to Mr. Buchanan expressing his disappointment that the recommendation of the I.C.F.S.O. was not fully accepted. He could hardly concur with this decision and would assume that it was taken after due consideration had been given to the reaction of those people in New Brunswick who exploit the fisheries resource. He would also indicate that his Department would be prepared to assess the effects of both formulations in cooperation with the Forest Biology group. He would expect that it would be done on a proper experimental basis and that there would be further meetings between technical staffs to discuss details.

The meeting was adjourned at 3:00 pm.

APPENDIX I

NOTES OF THE JANUARY 19 MEETING WITH THE NEW BRUNSWICK GOVERNMENT AND ITS ADVISORS TO DISCUSS DETAILS OF THE 1960 DDT SPRAY PROGRAMME IN THE PROVINCE OF NEW BRUNSWICK

In attendance:

K. B. Brown	New Brunswick Department of Lands and Mines
B. Flieger	Forest Protection Limited
F. E. Webb	Forest Biology - Department of Agriculture
H. Heaney (a.m.)	Department of Northern Affairs and National Resources
E. Doyle (p.m.)	Department of Northern Affairs and National Resources
C. J. Kerswill	Fisheries Research Board of Canada
P. F. Elson	Fisheries Research Board of Canada
M.H.A. Keenleyside	Fisheries Research Board of Canada
W. R. Hourston	Department of Fisheries - Ottawa
R. R. Logie	Department of Fisheries - Halifax
C. E. Kilpatrick	Department of Fisheries - Fredericton
E. W. Burridge	Department of Fisheries - Ottawa

Mr. Brown opened the meeting at 10:15 a.m. with a review of the series of events since the November 10 meeting of the Interdepartmental Committee on Forest Spraying Operations. He stated that the reason for the hesitancy on the part of the province and Forest Protection in accepting the recommendations of the I.C.F.S.O.

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was due to the results of some field tests done in 1951 by the U. S. Department of Agriculture in the province of Quebec and the State of Maine. This agency after testing various formulations of DDT had recommended the application of 1 pound per acre. He then referred to tests undertaken by Science Service in 1953, the results of which showed lower control with reduced concentrations of DDT. A programme in 1956 was also referred to, in which a portion of the spray used was at a lower concentration (9%). It was reported that the least effective control resulted in the area sprayed with this formulation.

Mr. Brown then referred to a meeting of F.P.L. on December 11 at which consideration had been given to the I.C.F.S.O. recommendations. It had been the recommendation of the meeting that the reduced dosage should be given a fair trial provided that satisfactory arrangements for testing the effect on salmon were to be made. Mr. Brown stated that it was decided at this meeting that 6¼% DDT would be used on approximately 1/3 of the area to be sprayed. He added that the majority of important salmon streams were located in this area - he referred to a map showing the spray area. The area to be treated with the 1/2 strength DDT spray included part of the drainage areas of the Southwest Miramichi and the Cains Rivers. Full strength would be applied to the Saint John, Dungarvon, Renous and Bartholomew systems.

Mr. Hourston referred to the November 10 meeting of the I.C.F.S.O. and the further analysis of Dr. Fettes' data which had been asked for at this meeting. He stated that the Committee had used Dr. Fettes' final analysis in drafting their recommendations. Mr. Hourston stated that the 1951 report referred to by Mr. Brown had been discussed with Dr. Prebble and he had indicated that there was room for conclusions other than the one recommending the one pound per acre.

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on factors that would prevent Forest Protection from obtaining the minimum droplet density. In addition Mr. Hourston asked for comments on Dr. Fettes' report.

Mr. Brown stated that he agreed with Dr. Fettes' original recommendation i.e. spraying part of the area with a 6¼% solution. He added that the entomologists have reported that the budworm population was concentrated in a clearly defined area and they did not want to take any chances of having it spread again particularly since there was some indication that the Government of Canada would not contribute to a spray programme after 1960. Mr. Brown stated that he did not want to comment on the technical aspects of Dr. Fettes' report but that he did feel that certain phases of the work should be rechecked.

Mr. Hourston enquired whether the proposed spray plan represented the decision of the New Brunswick Government with respect to the recommendations of the I.C.F.S.O. Mr. Brown replied that the plan was the recommendation that Forest Protection Limited would be submitting to the Provincial Government and he hoped that as a result of this meeting he could advise his Minister that it was acceptable to the Department of Fisheries.

Mr. Hourston stated that the Department had been very optimistic as a result of Dr. Fettes' report and had hoped that the whole area would be sprayed at half strength DDT. He added that it had been anticipated that there might be some reluctance to spray the entire area at 1/2 strength but it had been expected that at least half of the area would be so treated. He added that although some of the sections in the proposed "full strength" spray area were not important salmon producing areas they were important trout producing areas.

Mr. Brown stated that if the whole area was sprayed with either concentration nothing would be found out in connection with the comparative effects of the two strengths of DDT on salmon and budworms. Spraying large areas with each concentration would make such checks possible.

Mr. Hourston suggested a plan, based on the Larval Mortality Progression curve (Fig.2) in

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Dr. Fettes' report, in which the Dungarvon-Renous section might be sprayed with the half-strength concentration. An immediate check of this would indicate the per cent budworm mortality and a decision could be made whether to use 1/2 strength for the rest of the area. Messrs. Brown and Flieger stated that this plan was impractical because the spray material had to be delivered before spraying started. Mr. Flieger added that he questioned the results Dr. Fettes had obtained for this phase of the project.

Dr. Webb stated that they had had some experience in mixed dosage application in the 1953 programme which had not been too successful. He added that it would not be possible to analyse the data with the time available.

Dr. Webb and Mr. Hourston then discussed the importance of droplet density.

Dr. Kerswill stated that it was his understanding as a result of the November 10 meeting of the I.C.F.S.O. that checking for salmon survival would only be undertaken if the major part of the spray area was treated with half strength. He continued that he had understood that this meeting was being held to decide which areas would be sprayed at full strength. He added that it was his feeling that the matter should now go back to the I.C.F.S.O. for their consideration.

In reply to a question by Mr. Flieger, Dr. Kerswill stated that a fairly good assessment of the Dungarvon area might be possible if it were sprayed with the half strength formulation since they had a considerable amount of back data from this area.

A discussion followed on the use of half and full strength concentrations of the spray. Mr. Flieger stated that it was difficult to spray using two concentrations.

In reply to a question by Mr. Burridge, Mr. Flieger stated that the same type of spray equipment would be used as had been used in the past. He added that a fairly large number of aircraft would have to be used due to the size of the area and the fact that

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the whole area would be ready to spray at about the same time. It would all have to be done in a 2 1/2 week period.

Dr. Webb stated that it would be some time in July, at the end of the generation, before results would be available. He stated that results obtained at the end of the first week would not be too accurate.

In reply to a question by Dr. Elson, Dr. Webb stated that periodic outbreaks might be expected from time to time since the spruce budworm is a native insect.

Further discussion took place on the possibility of respraying certain sections in the spray area. Mr. Flieger stated that there would not be time to respray due to the tightness of the whole operation.

A discussion followed on various streams within the spray area e.g. Dungarvon, Renous and Bartholomew. Mr. Brown stated that they want to keep the south and east sections flexible in order that they may reach out and spray various "hot spots". These "side sprayings" would be done with the 1/2 strength formulation.

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Mr. Hourston stated that he would again like to make a plea for a reduced spray concentration for the Renous, Dungarvon and Bartholomew area. Dr. Kerswill stated that these were areas of high salmon production.

Following the lunch hour Mr. Brown stated that he and Mr. Flieger had discussed the problem and some up with a possible solution (see attached memorandum).

A discussion followed on contents of this suggestion. Mr. Flieger pointed out that more than one half gallon per acre would be applied by altering the

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flight pattern of the aircraft flying this section.

A brief discussion followed on the fisheries assessment programme and it appeared that manpower would be a major problem.

Mr. Hourston stated that he would like to have beforehand some idea of the areas that would receive the increased application of the half concentration of spray. Mr. Brown advised that this would be provided as soon as the spray map was finalized.

Mr. Hourston stated that he would take this information back to Ottawa.

Mr. Brown stated that unless otherwise directed they would proceed on the basis of the above arrangements.

CANADA

DEPARTMENT OF AGRICULTURE

~~SCIENCE SERVICE~~
~~RESEARCH BRANCH~~
FOREST BIOLOGY DIVISION

QUOTE FILE 7.9.14

OTTAWA, CANADA

March 2, 1960

~~RESEARCH~~ TO:

A. G. Davidson	J. M. Cameron	R. R. Lejeune
F. E. Webb	T. A. Angus	J. M. Kinghorn
D. G. Hott	A. M. Uniszpel	J. J. Pettes
H. H. Belyea		

Information copies to:

R. Glen	J. L. Kenk
D. M. Smallman	J. L. Hart
A. P. Arnason	C. J. Kerswill
A. L. Pritchard	A. M. M. Woodley
W. W. Muir	
M. W. Boyd	

Earlier this winter members of the Inter-departmental Committee on Forest Spraying Operations expressed an interest in receiving copies of a forth-coming issue of the Bi-Monthly Progress Report containing a summary of experiments by the Chemical Control Section on alternative insecticides and reduced concentrations of DDT for spruce budworm control. The first two articles in the January-February, 1960, issue of the Bi-Monthly Progress Report are drawn to your attention.

H. L. Prebble,
Director,
Forest Biology Division.

HLP/kp

CANADA

DEPARTMENT OF AGRICULTURE

RESEARCH BRANCH—FOREST BIOLOGY DIVISION

Vol. 16
REPORT
Number 1

BI-MONTHLY PROGRESS REPORT

Jan.-Feb.
1960

Published by Authority of the Hon. Douglas S. Harkness, Minister of Agriculture, Ottawa

Interdepartmental Committee on Forest Spraying Operations.—Killing of young salmon and of aquatic insects upon which they feed has resulted from extensive aerial spraying operations against defoliating insects in eastern and western Canada in recent years. Although there had been regional conferences among representatives of the various resource interests, it became evident during 1957 that a much more comprehensive review of the interrelated problems was needed. A technical conference, sponsored by the Department of Agriculture and the Department of Fisheries, was held in Ottawa, January 10, 1958, and was attended by 46 representatives of federal and provincial departments, industrial associations, and agencies concerned with forest protection, fish, and wildlife resources in regions where extensive spraying operations had been carried out. A full exchange of information resulted, and the conference recommended the formation of a representative committee to ensure improved liaison on problems related to forest spraying and to encourage additional research where needed to minimize hazards to other forms of life.

In the spring of 1958 the Interdepartmental Committee on Forest Spraying Operations was established, comprising representatives of the Fisheries Research Board, the Conservation and Development Service of the Department of Fisheries, the Forestry Branch and the Canadian Wildlife Service of the Department of Northern Affairs and National Resources, and the Forest Biology Division of the Department of Agriculture. The aims of the committee include: (1) review of forest insect outbreaks, the probability of damage to the forest, and the hazards to other forms of life that would result from chemical control operations; (2) coordination of recommendations for control action and safeguards to be taken; and (3) support of additional research to develop less hazardous insecticide formulations and improved methods of application. Objectives (1) and (2) are realized in meetings of the committee following forest insect survey returns from all regions of Canada in the autumn, and forecasts of control operations in the following year. Representatives of regional units of the participating departments, and of provincial government departments, industry, and other agencies may be invited to take part in meetings of the committee concerned with specific regional problems. Examples of research initiated under objective (3) involving co-operative laboratory and field studies by the Forest Biology Division and the Fisheries Research Board in 1958 and 1959, are described in the following article.—M. L. Prebble.

Control of the Spruce Budworm by Aircraft Spraying and the Hazard to Aquatic Fauna.—Spraying of forests with insecticides for the control of defoliating insects has caused much concern for the effects on fish and fish food organisms. Fisheries biologists have reported extensive killing of young salmon in several watersheds on Vancouver Island sprayed at the rate of one pound DDT per acre in 1957, and over large areas of New Brunswick sprayed at one-half pound DDT per acre during recent years.

In recognition of this problem, the Interdepartmental Committee on Forest Spraying Operations supported a program of investigation by the Chemical Control Section of the Forest Biology Division with the object of discovering an insecticide less hazardous than DDT or a formulation of DDT which would minimize the danger to aquatic fauna. A program organized to gain a maximum of information in a short time comprised the following phases:

(a) Tolerance tests for young salmon, both Atlantic and Pacific species, by the Fisheries Research Board Biological Station, Nanaimo, B.C.
(b) Toxicology tests for spruce budworm larvæ by the Chemical Control Section, Forest Biology Division, Ottawa.
(c) Airplane spray trials against spruce budworm populations in New Brunswick by the Chemical Control Section, Ottawa.
(d) Studies of the aquatic fauna of streams within the experimentally sprayed areas by the Fisheries Research Board Biological Station, St. Andrews, N.B.

Results of (a) and (b) are not treated here.

The first series of airplane spray trials were conducted in Kent County, N.B., in 1958. Several promising insecticides were compared with DDT. The insecticides tested in the trials were:

(1) DDD, analogue of DDT showing some specificity for lepidopterous larvæ,
(2) Korlan, an insecticide showing a low toxicity for aquatic fauna,
(3) Sevin, a new insecticide showing a very low toxicity for fish,
(4) DDT, a proven insecticide for spruce budworm but definitely hazardous to aquatic fauna. DDT was applied at several rates and concentrations preliminary to determining the lowest effective dose.

On the basis of the 1958 trials, the insecticides tested had the following relative effectiveness:

DDT— 1.0; DDD— .6; Korlan— .5; Sevin— .4.

It was concluded that none of the suggested alternatives to DDT would be effective against the spruce budworm in practicable dosages. The most significant result of the 1958 trials showed DDT to be effective at rates of 1.0, 0.5, and 0.25 pounds in one gallon of formulation per acre where the spray coverage was adequate.

Further trials in 1959 confirmed and extended the 1958 conclusions, although the ¼ pound per gallon per acre application was the least effective. Malathion was introduced into the series at one-quarter and one-eighth pounds per acre. Its effectiveness against the spruce budworm was disappointing; it is not considered a suitable alternate for DDT.

The stream studies on the effects of various dosages of DDT on aquatic fauna as reported by the Fisheries Research Board Biological Station, St. Andrews, N.B., in 1958 showed that one-quarter pound per acre of DDT had no observable effects on young salmon and little effect on aquatic insects. Similar results were obtained in 1959.

Earlier work with 10% DDT in oil (1951-53) in collaboration with the Suffield Experimental Station, Defence Research Board, showed clearly that the critical measurement for dosage effectiveness was that of droplets deposited per unit area rather than the nominal gallons per acre. This was an intensive study and resulted in a large mass of data for analysis.

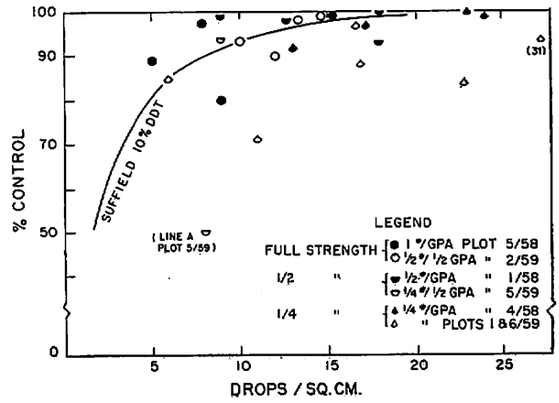

FIG. 1 The relation between DDT droplet density and spruce budworm mortality in New Brunswick, 1958 and 1959.

The DDT data for 1958 and 1959 are presented in Figure 1 in which they are compared with the curve of the Suffield data. The legend of the figure presents the various concentrations and volumes nominally applied. The 1958 points are solid black and the 1959 points are open. The three concentrations are represented by full strength (12.5% DDT, a full circle), half-strength (6.25% DDT, a half circle), and one-quarter strength (3.125% DDT, a quarter circle). The conclusions that may be drawn from the figure are:

1. The data from the 1958 and 1959 experiments agree with the "Suffield" curve and portray the same general relationship between budworm control and droplet deposit density.

2. The full strength dosages at 1♯/gal/acre in 1958 *or* ½♯/gal/acre in 1959 produced mortalities equivalent to if not superior to, the Suffield result.
3. The ½ strength dosages at ½♯/gal/acre *or* ¼♯/½ gal/acre produced mortalities comparable to that of full strength dosages at equivalent deposit densities, with the exception of Line A, of Plot 5, 1959, on which the results were erratic.
4. ½ strength DDT, ¼♯/gal/acre, produced larval mortalities somewhat lower than those produced by higher concentrations, at equivalent deposit densities, especially in 1959, but less markedly lower in 1958.
5. In general, 10 or more drops per square centimetre of a concentration of 6¼% DDT, i.e. ½ strength, should give an average of 90% control; whereas about 18 drops per square centimetre would be needed to effect the same control with a concentration of 3⅛%, i.e. ¼ strength.

The concentration of DDT in the original spray solution may have little meaning in terms of deposited spray. Evaporation of the volatile fraction is rapid immediately following droplet emission from the aircraft. For example, the volume half-life, or the time required to evaporate to one half the original volume, of a 120 micron droplet, which may take 4 minutes to fall, is only about three minutes when the spray formulation is principally a light oil such as fuel oil. (second graph from bottom Fig. 2. The volume decay curves published by W. Hopewell, Can. Jour. Plant Sc. 39: 204-209, 1959). Therefore, droplets from an original 12.5% DDT solution may be deposited at a much greater concentration; the average drop being perhaps 15 to 20% DDT. The concentration of any drop large enough to deposit would then contain much more insecticide than needed to be effective. A reduced concentration such as one-half the accepted strength (6.25% DDT) apparently contains enough insecticide, as deposited particles, to be effective.

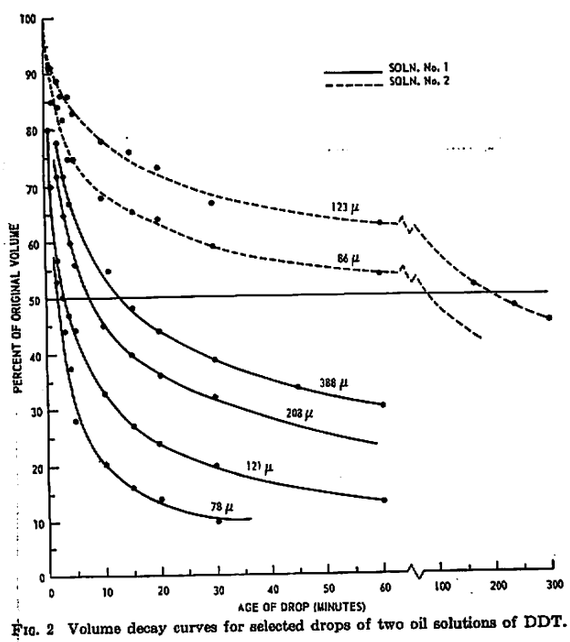

FIG. 2 Volume decay curves for selected drops of two oil solutions of DDT.

The general conclusion drawn from this work is that the dosage-concentration of DDT for the control of spruce budworm larvæ by aircraft spraying may be as low as ¼ pound in ½ gallon (U.S.) per acre without reducing the effectiveness of the operation, provided that the spray is distributed to deposit 10 or more drops per square centimetre over the target area. Reduction of the concentration to 3.125%, (¼ pound per gal/acre) can also be effective but may require about double the rate of drops deposited. This is not an unattainable objective in view of the doubling of the emitted volume of spray.

The author acknowledges in contributions of the personnel of the Chemical Control Section, A. P. Randall, W. W. Hopewell and W. Haliburton for toxicological and field study, chemical assessment and analysis and spray physics; F. E. Webb of the Forest Biology Laboratory, Fredericton, N.B. for assistance in obtaining field personnel; Forest Protection Ltd., B. W. Flieger, Manager, for providing insecticide, spray planes, and handling facilities; and C. J. Kerswill, M. H. A. Keenleyside and P. F. Elson, Fisheries Research Board Biological Station, St. Andrews, N.B., for the fish and aquatic insect studies. —James J. Fettes
Chemical Control Section

CURRENT ACTIVITIES

ATLANTIC PROVINCES

Parasites of the Red Pine Sawfly.—In 1954 an incipient infestation of *Neodiprion nanulus nanulus* Schedl was discovered in a red pine plantation at the Acadia Forest Experiment Station near Fredericton, N.B. Between 1955 and 1958 the infestation developed to a moderately high level, but elsewhere in the Province numbers were low. Information was obtained on parasitism from this local outbreak and elsewhere from a few scattered collections.

During the late winter of 1957 and the early spring of 1958, 4,020 eggs were collected but no parasites were obtained. Collections of larvae were made in the last week of June, near the end of the feeding period, in 1956 and 1958. Except for a few larvae that were preserved, all were reared. Cocoons were collected in 1957 during the first week of July or about a week after the larvae had spun up. Host adults emerged in late August and early September. The remaining cocoons were placed in cold storage until February and then incubated. Parasites reared from the larval collections emerged the following spring, those reared from the cocoon collection emerged in 1957.

The rearing results are as follows:

1955	245 larvae	11 *Lamachus lophyri* (Ashmead)
1956	6,463 larvae	64 *Lamachus lophyri* (Ashmead)
		*4 *Lamachus* sp.
1957	70 cocoons	4 *Agrothereutes lophyri* (Nort.)
		4 *Agrothereutes* sp.
		1 *Mastrus argeae* (Vier.)
		2 *Aptesis indistincta* (Prov.)
		6 *Endasys subclavatus* (Say)
1958	8,383 larvae	45 *Lamachus lophyri* (Ashmead)
		*125 *Lamachus* sp.

* Same species

In addition to the parasites from the plantation, the following species were reared in 1955 from 76 red pine sawflies collected from natural stands of red pine in York and Northumberland counties: 2 *Lamachus lophyri* (Ashmead), 3 *Lamachus* sp., 1 *Exenterus walleyi* Cushman, and 1 *Exenterus confusus* Kerr.

All parasites listed above are new records on this host in New Brunswick.

Sawfly larvae and adults were identified by D. R. Wallace and N. W. Y. Watson, Forest Insect Laboratory, Sault Ste. Marie, Ontario. Specimens of *Lamachus lophyri* and *Lamachus* sp. were identified by G. S. Walley, and all other parasites by W. R. M. Mason, Entomology Research Institute, Ottawa.—G. R. Underwood.

QUEBEC

Observations on Rhabdophaga swainei Felt in the Gaspé Peninsula.—In the course of studies on defoliators of field spruce on the shores of the Baie des Chaleurs in Gaspé, some observations were made on the spruce bud midge *Rhabdophaga swainei* Felt, an insect which develops in galled buds of white spruce.

Population data were obtained from four plots established in even-aged white spruce stands approximately 40 years old. Galled buds were counted on three full-length branches from each plot, and the foliage surface was calculated by measuring the length and width of the branches; results are shown in the accompanying table. These data indicate that, although *Rhabdophaga* was a fairly common insect in the region under study, their numbers varied considerably between localities. A total of 210 galls were placed in rearing at the end of May when *Rhabdophaga* was in the pupal stage. Adults emerged from 66.2 per cent of the galls while the remainder produced parasites. Two species of braconids were recovered and identified by members of the Entomology Research Institute as *Platygaster* sp. and *Amblymerus* sp.; this is apparently the first record of *Platygaster* sp. from *Rhabdophaga swainei*. This multiple parasite was obtained from 12.4 per cent of the galls and *Amblymerus from* 21.4 per cent.

Predation of *Rhabdophaga* larvae and pupae by the spruce coneworm *Dioryctria reniculella* (Grote) and the spruce budworm *Choristoneura fumiferana* (Clem.) was observed. It is possible that during the severe spruce budworm outbreak that occurred in this region recently, this insect was an important control factor of *Rhabdophaga swainei*.—J. R. Blais.

Plot No.	Locality	No. of Galls per 100 Square Feet of foliage
1	New Carlisle	282
2	New Richmond	140
3	New Richmond	73
4	Nouvelle	60

ONTARIO

Chemical Control of Rhyacionia adana Heinrich.—Infestations of the pine tip moth, R. *adana*, in young red and Scots pine plantations have been common in southern Onta-

rio fo__he past few years. This insect feeds upon young pines from seedling size to 3 feet in height, and by destroying the new shoots, it often causes severe deformity and stunting of growth (Bi-Mon. Progr. Rept. 15 (3) 1959). In response to numerous requests from plantation owners, spray trials were carried out in 1959.

The tests were made in a 4-year-old plantation of red pine near Stayner, Ontario, where 99.5 per cent of the trees were infested and 42.8 per cent of the shoots per tree were injured. An application of DDT, 25 per cent emulsifiable concentrate, mixed one part with nine parts of water resulted in 100 per cent control. The spray was applied with a pack sprayer on June 3, when the new shoots were between 1 and 2 inches in length, and shortly after the larvae had begun feeding.

Isolated infestations of this insect should be easily controlled with one application of DDT. However, since the adults often fly considerable distances in the spring, spraying may have to be repeated for two or three consecutive years if there are untreated infestations nearby. When trees have reached 3 feet in height, damage is usually negligible, and chemical control is unnecessary.—J. L. Martin.

Some Associative Interactions between Fomes pini (Fr.) Karst. and several Hyphomycetous Fungi Isolated from White Pine.—Antagonistic interactions between fungi are known to occur frequently. Since fungi that do not cause rot are commonly isolated from white pine it was decided to test the antagonism of selected non-rotting isolates to *Fomes pini*, a fungus responsible for 90 per cent of the loss in board feet (butts and trunks) by decay in living white pine trees (White, L. T. Studies in Forest Pathology. X. Decay of white pine in the Timagami Lake and Ottawa Valley areas. Can. J. Bot. 31: 175-200, 1953). This paper reports on some preliminary experiments carried out with this goal in view.

In 1951 pieces of excised phloem tissue from healthy white pine trees plated on malt agar yielded several hyphomycetous fungi. Cultures of these hyphomycetes were deposited at the Forest Pathology Laboratory, Maple, Ontario, and also were sent to the Mycological Unit, Botany and Plant Pathology, Ottawa, Ontario. Seven fungi, labelled PP 12, 13, 14, 15, 21, 23A, and 23B were used experimentally. Identifications for four of these fungi were made by Dr. R. F. Cain, Professor of Mycology, University of Toronto, as follows: PP 12—*Monilia* sp., PP 13—imperfect stage of *Lemalis aurea* (Lev.) Sacc., PP 21—*Alternaria* sp., and PP 23B—*Alternaria* sp.

In 1953 the seven hyphomycetes were individually paired on malt agar in petri dishes with sub-cultures from a *Fomes pini* isolate, originally obtained from an infected white pine tree. Within two weeks, a number of interactions could be observed between the paired fungi. Similar results were obtained in replicated tests. At the end of one month one hyphomycete (PP 15) exhibited mutual inhibitions with *F. pini*, four (PP's 12, 13, 14, and 23A) were inhibited and partly overgrown by *F. pini*, and two (PP 21 and 23B) were found to strongly inhibit and overgrow the *F. pini* colonies. Repeated tests showed that both PP 21 and 23B, different isolates of *Alternaria*, always inhibited and overgrew *F. pini* on the malt agar plates at room temperature.

In addition to these inhibiting effects, other interactions were noted between *F. pini* and the hyphomycete with which it was paired. Besides being dominant to hyphomycetes PP 13 or 14 in culture, the *F. pini* growth was extremely clumpy, whereas in combination with PP 12 or 23A the dominating *F. pini* culture was thin and appressed.

Although *F. pini* is highly infectious to white pine, its fruiting bodies are rarely produced on infected living white pine trees. It may be that hyphomycetes invade the affected white pines and prevent the fructification of *F. pini*.

In 1954 an infection experiment was begun to determine the effects of isolates PP 21 and 23B on white pine wood. Blocks of white pine, 2 x 3 inches in size, sterilized by steaming for one hour on each of three consecutive days, were placed in cotton-stoppered jars containing malt agar which had been previously inoculated with either *F. pini* or *Alternaria* (isolates PP 21 or 23B). The hyphomycetes began to grow on the surface of the wood blocks sooner than was the case in the jars containing *F. pini* and wood blocks. However, at the end of the second month, *F. pini* hyphae completely engulfed the wood blocks, while there was no extension of the initial mycelial growth on the wood blocks in the jars containing the hyphomycetes. After three years *F. pini* had totally decayed the wood blocks, whereas the hyphomycete growth was still confined to the surface of the wood blocks they were growing on. These tests showed that these two isolates of *Alternaria* are not primary decay-causing organisms of white pine wood. These fungi should be considered secondary organisms, which by themselves are not able to cause decay, but which may have a definite and important place in a metabiotic series.—S. N. Linzon.

The Spruce Bud Midge in Ontario.—Until recently, the spruce bud midge, *Rhabdophaga swainei* Felt, was considered a relatively rare species in Ontario. As the result of a gradual increase in its numbers and the intensification of surveys in recent years, this midge has been collected on spruce at numerous points across the province from Lake Ontario to Lake of the Woods. Although currently an unimportant forest pest, in isolated instances it has disrupted the normal growth of small trees by killing the leading buds. Most samples have been removed from open-grown or partially-shaded spruces under 2 inches D.B.H., while a few have come from the lower branches of larger trees. Although Clark states black spruce seems to be immune in the Maritimes, 40 per cent of collections in Ontario were from this host tree (Clark, J., 1952. The Spruce Bud Midge, *Rhabdophaga swainei* Felt. Can. Ent. 84: 87-89). Forest Insect Survey records also indicate that adult emergence occurs somewhat later in northern Ontario than in the Maritime Provinces; during the last half of May and the first half of June in Ontario compared with the month of May in New Brunswick.

Chalcid parasites were common in most collections, particularly *Amblymerus* sp., the only species reported by Clark. Two additional species that were reared less frequently were *Platygaster* sp. nr. *astericola*, and *Torymus* sp. nr. Lienk's #63. These parasites and adult midges were identified by the Entomology Research Institute, Ottawa.—O. H. Lindquist and D. M. McNamee.

PRAIRIE PROVINCES

Preliminary Notes on the Life History of Herculia thymetusalis Wlk.—Studies on a "complex" of insect species in the tops of black spruce in Manitoba and Saskatchewan (Can. Ent. 91:543-548, 1959), disclosed that one of the most common is *H. thymetusalis*. Collections of this pyralid in the spring indicated that several instars were present in infested tops. This suggested either a wide range of emergence or that more than one season is required for completion of the life cycle.

Laboratory studies on the life history of *H. thymetusalis* were initiated in 1957. Adults emerging in June and July were mated in a large rearing jar containing black spruce twigs. Within two to three days after mating, females deposited clusters of whitish oval eggs indiscriminately on the foliage and rearing jar. The whitish eggs changed to a dull pink and larvae hatched seven to ten days later. After hatching, the first-instar larva has a reddish body which later changes to white. Characteristic longitudinal lines appear on the body during the third instar.

Under insectary conditions the larvae passed through seven instars, four instars during the first season, and three instars during the second season. The larvae overwintered in the fourth and seventh instars. Fifth and sixth instars overwintered successfully in the first season, but died afterwards in the second season. It is suspected that larvae probably overwinter in the fourth to seventh instars under natural conditions. Pupation takes place in May and early June, after the second winter, the adults emerging soon after in late May to July.

Ten families with progenies of over 400 specimens were reared in the above program. Although survival under insectary conditions was very low, preliminary rearings indicate that *H. thymetusalis* has a two-year life cycle.—H. R. Wong.

ROCKY MOUNTAIN REGION

A method for Describing Larvae in the Insectary.—Most of the insects received by the Forest Insect Survey are in the larval stage, many of which are not readily identified. One of the main difficulties in identifying larvae in the insectary is the lack of detailed descriptions of material received previously. In the past, insectary workers have been asked to describe larvae. Since many of these people are inexperienced, their descriptions are not always understood by others wishing to follow the collections through. The method used by the Calgary Laboratory may be useful to others with similar problems.

Generalized larval diagrams, approximately three inches in length, of Geometridae, Noctuidae, and Tenthredinidae were drawn. A photo-engraved plate of these sketches was obtained, and rubber stamps were made. These stamps were kept in the receiving room of the insectary, and used by the person doing the identifying. The rearing sheets for incoming larvae to be described were stamped with the appropriate larval imprint. (The noctuid stamp was also used for other families). Personnel who received rearing sheets knew that they were expected to describe and illustrate the larvae in those collections. Colour variations and other changes were also to be noted as the rearing progressed. It was left to the discretion of the person making the identifications to avoid asking for excessive numbers of descriptions of the same insect, when reference to other collections was sufficient.

To ensure that accurate and relatively uniform observations were made, a large illustration of a larva (taken from "Field key to Geometrid larvae of the British Columbia

coast" by D. Evans) was displayed on the wall of the insectary.

On this illustration the segments were named and numbered and any lines which might be used were named and illustrated. Pertinent instructions regarding size, habits, colour, and other characteristics were outlined on the chart. The use of a colour-chart is planned to make descriptions more uniform.—D. S. Kusch.

BRITISH COLUMBIA

Overwintering of Ambrosia Beetles.—Earlier studies have shown that adults of the ambrosia beetle, *Trypodendron lineatum* (Oliv.), leave their brood logs in late summer and overwinter in the superficial layer of litter on the ground in the shelter of nearby standing timber. The highest concentrations of beetles are found in the duff at the bases of standing trees (Kinghorn, J. M. and J. A. Chapman. Forest Sci. 5: 81-92. 1959.).

In the course of current studies designated to lay the basis for a reliable population sampling method, it was found that another important overwintering site had not been detected in the preliminary investigations. Significant numbers of beetles have now been discovered hibernating in the outer bark of standing living and dead trees. The thick, heavily fissured bark of Douglas fir presents many sites where the beetles may find shelter, but even in small thin-barked western hemlock and western red cedar, the beetles are numerous in the bark immediately above ground level. In the thin bark, beetles frequently bore hibernating niches into the relatively soft tissue between the hard surface bark flakes and the solid tissue of the inner bark. No beetles have been found penetrating the cambial region. More than one beetle may occupy the same niche where the bark is thin and the population density high. In the few samples examined thus far, four is the maximum number of beetles observed together in one niche.

Bark population density just above ground level appears to correlate closely with the density in the ground litter at the base of the tree. In Douglas fir, the numbers recovered from one-square-foot bark samples taken at ground level are from 10 to 20 per cent lower than those recovered from basal square foot litter samples. Above one foot, the density drops sharply, although beetles have been recovered from samples cut at 5, 10, 15, and 50 feet above ground. In small hemlock and cedar, it is only in the first six inches above ground that the bark population density approaches that of the square foot of litter touching the base of the tree. The highest density recorded in bark to date is 70 beetles in a sample 6 × 12 inches taken from the base of a small hemlock.

Recovering beetles from bark is a slow process. After all the fissured bark has been cut from the sample area, it must be broken into small fragments with the fingers to release beetles lodged in the bark. A vibrating screen device is used to separate the beetles from most of the broken bark. Living beetles can then be recovered quickly when the screened sample is heated. Crushed and otherwise dead beetles are recovered by immersing the sample in a mixture of water and kerosene; the beetles can be detected floating in the kerosene at the interface of the two liquids.—J. M. Kinghorn and E. D. A. Dyer.

RECENT PUBLICATIONS

Cayford, J. H., Hildahl, V., Nairn, L. D., and Wheaton, M. P. H. Injury to trees from winter drying and frost in Manitoba and Saskatchewan in 1958. For. Chron. 35: 282-290. 1959.

Clark, R. C. and Brown, N. R. A method of adapting a microscope for observation of non-motile insects on tree trunks. Can. Ent. 92: 79-80. 1960.

Edwards, D. K. Mercury bleeder valve for critical adjustment of air pressure. J. Sci. Instruments 36: 507. 1959.

Henson, W. R. A method for local temperature extrapolation. J. Meteorol. 16: 585-588. 1959.

McGugan, B. M. and Blais, J. R. Spruce budworm parasite studies in northwestern Ontario. Can. Ent. 91: 758-783. 1959.

Morris, R. F. Single-factor analysis in population dynamics. Ecology 40: 580-588. 1959.

Morris, R. F. Sampling insect populations. Ann. Rev. Ent. 5: 243-264. 1960.

Parker, A. K. An unexplained decline in vigor of lodgepole pine. For. Chron. 35: 298-303. 1959.

Shepherd, R. F. Phytosociological and environmental characteristics of outbreak and non-outbreak areas of the two-year cycle spruce budworm, *Choristoneura fumiferana*. Ecology 40: 608-620. 1959.

Smith, S. G. Cytogenetics of insects. Ann. Rev. Ent. 5: 69-84. 1960.

Stehr, G. Hemolymph polymorphism in a moth and the nature of sex-controlled inheritance. Evolution 13: 537-560. 1959.

The Queen's Printer and Controller of Stationery, Ottawa, 1960

14-0-31

HWB/J

Memorandum for file:

Extract from Report of Chief of the Forest Service, 1958
United States Department of Agriculture, Page 7

"A cooperative study by the Forest Service, U.S. Fish and Wildlife Service, and Montana State Fish and Game Department showed that aerial spraying with DDT insecticide at a rate of 1 pound per acre caused no permanent damage to trout and the aquatic insects on which trout feed."

FILE No. 702-1-10

14-0-31

392334

CANADA

DEPARTMENT OF FISHERIES

OTTAWA

February 2, 1960.

Mr. H. W. Beall,
Chief,
Forestry Operations Division,
Department of Northern Affairs
and National Resources,
238 Sparks Street,
Ottawa, Ontario.

Dear Mr. Beall:

Enclosed please find a copy of the notes from the January 25th meeting of the Interdepartmental Committee on Forest Spraying Operations. A copy of the notes from the January 19th meeting held at Fredericton is attached as Appendix I.

Copies of these notes have been forwarded to those attending the meeting of the Interdepartmental Committee.

Yours very truly,

A. L. Pritchard,
Director,
Conservation & Development Service.

Encl.

FOREST BIOLOGY DIVISION, DEPARTMENT OF AGRICULTURE
OTTAWA

March 2, 1960

TO: A. G. Davidson, F. E. Webb, D. G. Mott, R. M. Belyea, J. M. Cameron, T. A. Angus, A. M. Heimpel, R. R. Lejeune, J. M. Kinghorn, J. J. Fettes

Information copies to: R. Glen, B. N. Smallman, A. P. Arnason, A. L. Pritchard, W. W. Mair, H. W. Beall, J. L. Kask, J. L. Hart, C. J. Kerswill, A. W. H. Needler

Re : Trials of Bacillus thuringiensis products against spruce budworm and black-headed budworm, 1960

This is a brief summary of the principal points brought out in lengthy discussion with T. A. Angus, A. M. Heimpel, and J. M. Cameron, February 26, 1960. In several features, it is an extension of the file distributed by Dr. Cameron February 17, but makes no attempt to recapitulate all information contained in that file of correspondence and memoranda.

1. As a starting point, B.t. suspensions were highly toxic to spruce budworm larvae in laboratory experiments, thus providing encouragement for the proposed field trials.

2. The 1959 trials against black-headed budworm larvae at Sault Ste. Marie were not considered conclusive, because of the advanced development of the larvae shipped from B.C., and their weakened condition on arrival.

3. Angus and Heimpel are to correspond direct with Lejeune, re early spring 1960 trials vs. black-headed budworm. If possible, trials would be carried out at Sault Ste. Marie, or at Victoria under instructions from Angus and Heimpel; decision would rest on prospects of rearing larvae to suitable stage.

4. In the field trials, the following division of work is agreed to:

   (a) the regional staff (Fredericton and Victoria) to be responsible for plot lay-out, studies of populations before and after treatment, arrangements involving aircraft operations, mixing of spray, assessment of deposit, appraisal of results on a population basis.

   (b) Drs. Angus and Heimpel to be responsible for detailed "bacteriological" studies to provide explanation for results in the "population" studies in (a). The "bacteriological" studies will include small-scale investigation of dispersal of bacteria, foliage contamination, rearing of larvae associated with the foliage samples, presence of B.t. in the insect, rate of mortality, etc.

   (c) Drs. Angus and Heimpel would prefer to work as a team, both in New Brunswick and British Columbia. This would have the advantage of getting the work underway without the necessity of instructing a local staff member in techniques, etc. It would also have the advantage that the earlier work at Fredericton could be approached experimentally, with the view of stream-lining procedures to be followed in the later work in the Queen Charlotte Islands. The feasibility of operating as a team will depend on phenology - see below.

..... 2.

5. The suggestion has been made that the trials should be scheduled as follows:

(a) spruce budworm near Fredericton -
at time of flaring of balsam fir foliage, and presence of 4th-5th instar.
(Webb and Mott to give us a close estimate of starting time, as soon as possible)

(b) black-headed budworm, near Skidegate Inlet, Queen Charlotte Islands -
at time of exposure of western hemlock foliage, and presence of 4th instar
(Silver and Kinghorn to give us an estimate of starting time, as soon as possible)

It is expected that work by Angus and Heimpel might last about 10 days in each location. The phenological forecasts in (a) and (b) above will indicate whether it is feasible for both Angus and Heimpel to plan to be involved in both experimental trials.

6. Products

(a) Nutrilite - larvatrol 75W
(75 billion spore count per gram, water wettable)
This is a non-clumping product, dispersing readily in suspension.

(b) Bioferm Thuricide concentrate
(66 billion spore count per gram)
The sample submitted to Sault Ste. Marie in February shows some clumping in suspension, but this may not be serious at intended concentration.

It is tentatively agreed that both products, 6(a) and 6(b), be tried in the New Brunswick tests, and that product 6(a), only, be used in the British Columbia tests. The reason for this suggestion is that better facilities, and increased man-power, will likely be available for the New Brunswick trials.

7. Formulation and dosage

The laboratory trials at Insect Pathology Research Institute this winter suggest a concentration of 2 pounds of B.t. product (6a or 6b above) per gallon of 90% oil-10% water emulsion, and application of 2 lbs./gallon/acre.

Angus and Heimpel wish Fettes and his colleagues in the Chemical Control Section to examine such a formulation from standpoint of behaviour in spraying apparatus, determination of spread factor, assessment technique using dyed cards, proportions of emulsifying agents, etc. This should be done soon. Samples of the materials are being supplied by Angus.

8. Number of field plots and quantities of the B.t. products

New Brunswick: two plots, about 40 acres each, one for each B.t. product

one plot to serve as a check

quantities: 150 pounds of product 6a
150 pounds of product 6b

(The above-noted quantities would be sufficient for more than the minimum plot size and number indicated. Extension of the test to include other dosages than 2 lbs./gallon/acre should only be undertakenif man-power is adequate).

..... 3.

British Columbia: one plot, about 40 acres, for study of product 6a.

one plot to serve as check

quantity: 150 pounds of product 6a.

(Note: It is not expected that the 1960 N.B. and B.C. trials will indicate the minimum dosages that may be effective against spruce budworm and black-headed budworm. The purpose is to determine whether B.t. products have real promise against these species. If so, at the expected over-dose application rate in 1960, refinements will be sought in formulation, concentration, and dosage rates in later years.)

9. Ordering of materials

(a) Fuel oil carrier

Angus is to write to Mott (N.B.) and Kinghorn (B.C.), suggesting the purchase of No. 2 fuel oil locally, in sufficient quantity for plots indicated in 8 above. As a minimum, this would be 80 gallons for the Fredericton trials, and 40 gallons for the Queen Charlotte Is. trials. Actually, the purchases should be at least twice or three times these quantities. The purpose is to ensure that the oils that will be used in laboratory tests this spring are precisely the same as will be used in field trials this summer. This suggestion is based on Fettes' comment that fuel oil varies with dealer and time of purchase.

Mott and Kinghorn are to send 2-quart samples of their respective oils to the following:

(i) Angus at Sault Ste. Marie
(ii) Fettes at Ottawa
(iii) Paul H. Dunn, Nutrilite Products, Inc., at address in file supplied by Angus.
(iv) Robert A. Fisher, Bioferm Corporation, at address supplied by Angus.

The supplies of oil should be purchased without delay, and samples sent as above (i to iv), being careful to identify the oil as the material which will be used in field trials in 1960, in New Brunswick and British Columbia, respectively.

(b) B.t. products and emulsifiers

These will be ordered by M. L. Prebble, following receipt of specifications from Angus and Heimpel.

(c) Shipping

The B.t. products and emulsifiers are to be shipped directly to Fredericton and Victoria, not later than May 15.

(d) Formulation

Formulation of the spray mixture is to be done locally in New Brunswick and British Columbia, following instructions to be supplied later as a result of further studies by Angus, Heimpel, Fettes, and possibly the Bioferm Corporation. It may be necessary to rent locally an apparatus for effective mixing.

(Note: Formulation should not be done until about a day or so before the field spray trials. The dry B.t. product will store well, but it is not known how long the emulsion will retain pathogenicity).

(e) Glassware, etc.

Angus and Heimpel expect to supply all the requirements for their own work. If there is any change in this, the laboratories or headquarters should be informed well in advance.

..... 4.

10. Tests of B.t. products against fish and mammals.

(a) J.S. Tener (Canadian Wildlife Service) informed me on February 15 that his service has arranged with the University of Ottawa for laboratory trials of B.t. product with white mice or rats. Tests to be done in May.

(b) O. C. Young (Fisheries Research Board) informed me on March 2 that plans are being made by Dr. Needler of the Nanaimo Biological Station to conduct tests of B.t. product with young salmon in the latter part of May.

(c) The materials required in (a) and (b) are to be supplied by the Forest Biology Division. The following delivery arrangements seem to be appropriate:

(i) tests against mice at Ottawa, materials to be drawn from Fredericton and formulated at Ottawa after further consultation with J. S. Tener:
1 pound B.t. product 6a
1 pound B.t. product 6b
1 gallon fuel oil from Fredericton (see 9a)
emulsifiers as specified for final formulation

(ii) tests against salmon at Nanaimo, materials to be supplied from Victoria, and formulated at Victoria or Nanaimo after consultation between Kinghorn and Needler:
1 pound B.t. product 6a
½ gallon fuel oil from Victoria (see 9a)
emulsifiers as specified for final formulation.

Each officer is responsible for initiating action along the lines specified above. If correspondence or consultation is necessary, please contact, directly, the person or persons concerned. Information copies would be helpful to me. There will be an opportunity for discussions at Fredericton March 9-11, and at Victoria, March 22-28, during my forthcoming visits to the two laboratories.

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp
Ottawa, March 2, 1960

GOVERNMENT OF CANADA

ACTION REQUEST

CGSB 6-GP-12
P.P.&S. Cat. 3433

TO 1. ~~Mr. Redmond~~ MKR

LOCATION 2. File - Interdept'l. Committee

FOR: Forest Spraying Opns.

FILE NO.....

	ACTION		NOTE & FORWARD
	APPROVAL		NOTE & RETURN
	COMMENTS		REPLY, PLEASE
	DRAFT REPLY		SEE ME, PLEASE
✓	INFORMATION		SIGNATURE
	INVESTIGATION		TRANSLATION
	MORE DETAILS		YOUR REQUEST
	NOTE & FILE		

PREPARE MEMO TO:.....

REPLY FOR SIGNATURES OF:.....

REMARKS:

.....

.....

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FROM	PHONE	LOCATION	DATE
Ifrey			

Mr. ~~H. W. Batt~~ ~~Mr.~~ ~~G. Bedard~~ DRR 14-0-31

FOREST BIOLOGY DIVISION, DEPARTMENT OF AGRICULTURE
OTTAWA

Our files: 7.9.14
FZ-16(1960)
CC-1-1
CC-2

OTTAWA, Ontario,
March 16, 1960.

A summary of discussions on the effects of spraying operations against the spruce budworm, 1960, held at the Forest Biology Laboratory, Fredericton,
March 10-11
1960

In attendance:

March 10, 1960	March 11, 1960	
F. E. Webb	C. J. Kerswill	B. W. Flieger
D. G. Mott	P. F. Elson	Mr. Gardiner
J. J. Fettes	M. H. A. Keenleyside	F. E. Webb
A. G. Davidson	R. R. Logie	D. G. Mott
M. L. Prebble	Mr. Edwards	J. J. Fettes
B. W. Flieger	K. B. Brown	A. G. Davidson
		M. L. Prebble

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1. Studies of DDT sprays against spruce budworm, New Brunswick, 1960.

A. Collaborative studies, including effects on fish.
Chemical Control Section (J.J.Fettes)
Fisheries Research Board (C. J. Kerswill)
Conservation Service, Fisheries Dept. (R. R. Logie)

Proposals of the Chemical Control Section were discussed in general on March 10, and collaborative studies with fisheries personnel were considered at length on March 11.

(i) Spray deposit studies and repeated budworm population measurements will be made in about three plots in each of the major spray-concentration zones ($\frac{1}{4}$ lb. DDT/$\frac{1}{2}$ gallon/acre and $\frac{1}{2}$ lb. DDT/$\frac{1}{2}$ gallon/acre, known as "$\frac{1}{2}$ strength" and "full strength" concentrations respectively). If possible, one or more plots will be studied in the "3/4 strength" concentration zone. At least one of the spray plots in each zone should include a stream to permit collaborative studies with fisheries personnel. Other plots could be independent of streams, and restricted to studies of the budworm.

(ii) Check plots will be needed for each series of spray plots. It is possible that check plots may jointly serve the requirements of Chemical Control Section and the Fredericton Laboratory (see B, below). Suggested locations of check plots are south of the St. John River, and east of the spray zone.

..... 2.

(iii) Studies of spray deposit will be made at frequent sampling stations along transects at approximate right-angles to flight lines in spray plots (i). Spray deposit will be measured on dyed cards, to yield droplet count per unit area and droplet spectrum; and on glass plates or filter paper, to yield an estimate of DDT in pounds per acre.

(iv) Budworm population counts will be made in spray and check plots (i and ii), along the same transects referred to in (iii), but there will probably be fewer biological sampling stations than deposit sampling stations. Population counts will be at short intervals, starting before spraying, and continuing until pupation. The sampling unit will be the 18-inch branch tip, at or above mid-crown level. New shoots will be counted as well as the budworm. This will permit the plotting of surviving populations on either a branch or shoot basis.

(v) Areas selected for spray plots should, if possible, be representative of different spray periods (early vs. late, relative to budworm development); and also, representative of areas sprayed by the two types of aircraft, as a measure of spray deposit from the Stearman and the Grumman.

(vi) Assessment of areas for combined studies of sprays on budworm and fish: Areas considered suitable and accessible are noted below, but acceptance will be subject to examination in late April or early May by Drs. Fettes, Kerswill, and Logie, or their representatives.

(a) Cains River. Never sprayed before, but included in area for 1960 spraying at ¼ lb./½ gallon/acre, mostly with Grumman aircraft. Certain parts of the watershed may be omitted owing to non-susceptible stands of jack pine and black spruce. Seining studies of salmon populations carried out in earlier years, will be repeated in 1960. Heavy budworm population in susceptible stands. Good accessibility.

(b) Muzroll Brook (north of Cains River). Sprayed in 1957 and 1958, will be wholly in area for 1960 spraying at ¼ lb./½ gallon/acre, with Grumman aircraft. Studies of salmon (and trout?) would be carried out with caged fish. Heavily infested with budworm. Good accessibility.

(c) Taxis River. All of this area was sprayed in 1957, and part in 1958. Whole watershed will be sprayed in 1960 at ¼ lb./½ gallong/acre, with Stearman aircraft. Aquatic studies would be based on caged fish. The area is accessible. The infestation is rather light, but heavier infestations suitable for Chemical Control Section studies are close by.

The Taxis River watershed is close to the full-strength spray zone. If the Taxis area is used for experimental studies, Forest Protection Limited should be asked for aerial inspection of the spray aircraft in operation, to ensure spraying of the watershed area according to the proposed schedule.

... 3.

(d) Big Hole Brook (west of Doaktown). This small watershed, comprising north and south branches, was originally scheduled for half-strength spraying. However, owing to accessibility, heavy infestation level, and probable suitability for fisheries studies, it would be a promising area for test of three-quarter strength spraying. The proposal, therefore, is that the watershed be sprayed at 3/8 lb. DDT/acre, possibly by Stearman aircraft.

(e) Two sections of the Nashwaak River drainage were considered for experimental studies in 1960, when spraying will be at the full-strength rate (½ lb./½ gallon/acre). The whole drainage was sprayed in 1958, but at no other time. The two areas to be considered for study in 1960 are:

Cross Creek southeast of Stanley
One of the small watersheds northwest of Stanley

Fisheries personnel would want only one study area in the full-strength zone, for caged fish studies. Either of the above-noted areas would be suitable for budworm studies.

(f) Fisheries personnel do not propose to study the effect on fish of spraying along the St. John River west of Fredericton, nor are they able to set up any studies on aquatic insects, due to lack of staff.

(g) Check studies on fish mortality in unsprayed areas could be arranged on the Northwest Miramichi River, where Fisheries Research Board staff will be located in 1960. The appropriate checks would comprise caged fish, as in the studies of sprayed areas (a to e above, or selections therefrom).

(vii) DDT deposit in the watersheds where fish studies are conducted will be measured by the Chemical Control Section. Likewise, the Section will study DDT contamination of the streams near the fish cages. Fettes and Hopewell are to give further attention to the techniques of DDT contamination measurement, which is probably the most difficult and time-consuming feature of the collaborative studies.

(viii) Since the extent of studies on fish seem to be severely limited by staff, Flieger and Brown indicated that assistants could be provided by Forest Protection Limited for several weeks, if supervisors could be provided by Fisheries Research Board or Conservation Service. Fisheries personnel are to make their needs known to Mr. Flieger in the near future.

(ix) Brown felt that the proposed studies on caged fish were minimal, and urged that they be extended to include examination of the free fish population well after the conclusion of spraying. Fisheries personnel believed that such information would be of limited value in the absence of data on pre-spray populations, i.e., populations in 1959. Some work had been done on liberated fish, censusing at intervals after spraying;

....4.

where there were natural populations in the streams, it was necessary to mark the liberated fish for subsequent census. Brown was not convinced that the studies should be limited to caged fish, largely salmon, during the 3-week period following spraying; and believed that full-season census of free fish, including trout, would provide useful information if carried out in half-strength and full-strength spray zones. He wished the matter to be left open in the hope that a more comprehensive program might be set up by fisheries personnel, with assistance from the Province and Forest Protection Limited.

B. Studies of the effectiveness of the operational spray program against the spruce budworm.
Forest Biology Laboratory, Fredericton (D.G.Mott)

Mr. Mott is taking over the studies of the operational program from Dr. Webb, who is transferring to the Winnipeg Laboratory in June. Mott's proposals were discussed at length on March 10. They fall into two broad categories:

(i) Mott will study the factors considered capable of contributing to variability in spray-induced mortality of the spruce budworm, including variations in spray droplet density, phenology of larval development at spray time, emitted rate of DDT per acre, tree crown condition as reflecting previous defoliation, and possibly Stearman vs. Grumman aircraft. Mortality, measured about 10 days after spraying, will be the dependent variable, and spray droplet density per unit area will be the covariate. To provide for three DDT concentration levels, two times of treatment (early vs. late), and two levels of crown condition (severely damaged vs. not damaged), 12 plots would be necessary without replication. The number of plots used will be a multiple of 12, depending on the number of replications, and on the extent to which the whole series is representative of each of the two types of aircraft. Complex variance analysis of the results will be undertaken to determine the significance of the primary variables and their interactions. In addition to the assessment of budworm mortality, this series of plots will yield data on proportion of new foliage saved, and the moth (emerged pupal) population. Check plots will be outside the sprayed area: to the east, and south of the St. John River. Plot locations will be selected in advance from maps showing infestations and scheduled spray operations.

(Note: In spray-droplet assessment per unit area, preliminary tests suggest that ultra-violet examination of oil spots on cards may be satisfactory, avoiding interference from moisture and fading of color that limit the exposure time of dyed cards. This question is being pursued further at the present time).

(ii) In addition to the rather intensive studies in (i), broad studies will be made throughout the sprayed area as a whole, later in the season. These will include pupal counts, parasite counts, and defoliation estimates at a large number of sampling points. Counts will be based on two branches per tree, and the number of tree-units at each sampling point will be determined from sequential tables.

... 5.

2. Studies of Bacillus thuringiensis sprays against the spruce budworm in New Brunswick, 1960.

These studies were discussed briefly March 10, as an extension of the general outline distributed March 2. Mr.Mott of the Fredericton Laboratory will be responsible for plot selection, arrangements for aircraft, spray mixing, deposit assessment, and population studies of the budworm before and after spraying.

Fettes and Angus will collaborate on droplet assessment technique suitable for the water-in-oil emulsion to be used, and Fettes will supply cards to Mott for the field assessment.

Mr. Flieger agreed to supply a spray aircraft, probably a Stearman, for the test. If possible, this will be a "clean" aircraft, to avoid contamination of the B.t. spray with DDT-oil residue in the spray system. Mott should arrange flushing of the spray system, if a "clean" aircraft cannot be supplied.

There was some discussion of plot lay-out. Flieger recommended the use of one-swath plots, for simplification of flying. Unless a nearby road can be used to guide flight, the flight-line should be marked; Fettes suggested smoke puff bombs, and agreed to supply same if needed. Mott is to survey suitable stands near Fredericton, south of the St. John River, and will establish plot lay-out according to available stands.

For adequate experimental control, Mott believed there should be two types of checks, one with no spray, and one with water-in-oil emulsion but no Bacillus thuringiensis content. With two B.t. sprays, this would require a minimum of four plots. Provided that spray application is carefully done, plot replication may be avoided by sample-line replication within plots.

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp
OTTAWA, March 16, 1960

14-0-31
FO 730-1

OTTAWA, August 4, 1960.

MEMORANDUM FOR FILE

DETAILED STUDY OF PESTICIDES

On page 40 of the July, 1960, issue of American Forests there appears an article, entitled "Pests, Pesticides and People", which gives a detailed study of pesticides - effects on animal life, legal implications in the U.S., etc.

H.W.B.

14-0-31

899396

7.9.14

MEMORANDUM TO:

Dr. A. L. Pritchard
Dr. J. L. Kask
Mr. W. W. Mair
Mr. H. W. Beall ✓

September 13, 1960

Subject: Fall Meeting of Interdepartmental Committee on Forest Spraying Operations

This is to let you know that I think our first fall meeting of the Interdepartmental Committee might well be convened about mid-October, at which I expect to be able to present statements on operational and experimental progress in 1960, and a forecast of infestations that may require control action in 1961. Forest Insect Laboratories have been alerted to supply the needed material early in October and it should be possible, therefore, to hold the meeting some time between October 13 and October 20. If there are days in this period that are unsuitable to you, would you please let me know as soon as convenient.

H. L. Prebble,
Director,
Forest Biology Division.

HLP/kp

cc: Dr. J. J. Fetten

14-0-31

HWB/meh

OTTAWA, September 14, 1960.

Dr. M.L. Prebble,
Director,
Forest Biology Division,
Research Branch,
Department of Agriculture,
Central Experimental Farm,
OTTAWA, Ontario.

Dear Dr. Prebble:

Thank you for your letter of September 13th regarding the first fall meeting of the Interdepartmental Committee on Forest Spraying Operations. As far as I know at present, any time between October 13th and October 20th would be quite suitable for me.

Yours very truly,

H.W. Beall,
Chief.

→ 14-0-31

899737

7.9.14

MEMORANDUM TO:

Dr. A. L. Pritchard
Attention: Mr. Burridge

September 23, 1960

Dr. J. L. Kask

Mr. W. W. Mair

Mr. H. W. Beall ✓

Subject: Fall Meeting of Interdepartmental Committee on Forest Spraying Operations

This is further to my memorandum of September 13 relative to the first meeting of the Interdepartmental Committee this fall. As proposed by Mrs. Pearson on my behalf in telephone discussion with you recently, it now appears that it will be distinctly worthwhile to defer our meeting until after October 20, when discussions in Fredericton will be held on the spruce budworm problem, and the possibility of control action in 1961. As October 31 has been confirmed as a suitable date with the members of the committee, this will now confirm the holding of the meeting October 31, starting at 10 o'clock in the Fisheries Department in the Sir Charles Tupper Building, Hog's Back. Mr. Burridge is to have a room put at our disposal and I suggest that he drop a note to the members of the committee so that they will know in what room the meeting is to be held.

With your concurrence, invitations to attend the meeting are being sent to Mr. B. W. Flieger of Forest Protection Limited; to the British Columbia Pest Control Committee; and to Dr. R. M. Belyea, and Mr. R. R. Lejeune of our Fredericton and Victoria laboratories respectively. Since the operations in New Brunswick and British Columbia in 1960 were at reduced DDT dosages, as a result of the recommendations of the Interdepartmental Committee, it seems particularly desirable to have representatives present from these areas, especially as there seems to be a probability that control operations will be necessary in New Brunswick and British Columbia next year.

... 2.

Memo. to Dr. Pritchard, Attn. Mr. Burridge - 2 Ottawa,
Dr. Kask, Mr. Mair, Mr. Beall September 23, 1960

The meeting is being called at 10:00 A.M. because the matters to be discussed may require reconvening in the afternoon.

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp

cc: Dr. J. J. Fottes

14-0-31

899784

7.9.14

September 26, 1960

MEMORANDUM TO:

Dr. J. L. Kask

Mr. W. W. Mair

Mr. H. W. Beall

Subject: Fall Meeting of Interdepartmental Committee on Forest Spraying Operations

This is to inform you that the meeting of the Interdepartmental Committee on Forest Spraying Operations will be held October 31, 10:00 A.M., in Room A227 (second floor), Sir Charles Tupper Building, Riverside Drive, Hog's Back.

M. K. Pearson

(Mrs.) M. K. Pearson
for M. L. Prebble
Director
Forest Biology Division

MKP

cc: Dr. J. J. Fetten
Dr. A. L. Pritchard
Attn: Mr. Burridge

Inter-departmental Committee on Forest Spraying Operations

Meeting of October 31, 1960
(Tupper Building, Ottawa, 10:00 a.m.)

TENTATIVE AGENDA

1. Introductions

2. Proposed order of business

3. Review of Operational Spraying Programs, 1960

   a. Spruce budworm, New Brunswick
   (summary report on budworm control by Nott and Fettes;
   summary report on aquatic fauna, Fish. Res. Bd.;
   summary report on birds;
   comments by Fliegar, Belyea, others;
   discussion)

   b. Spruce budworm, Quebec
   (summary report by Blais; comments and discussion)

   c. Black-headed budworm, British Columbia
   (summary report by Kingborn; effect on aquatic fauna;
   comments by Lejeune, Richmond and others; discussion)

   d. Saddle-backed looper, British Columbia
   (synoptic statement by Lejeune; comments and discussion)

4. Review of Experimental Spraying Projects, 1960

   a. Experiments with Bacillus thuringiensis against forest insects
   (New Brunswick - synoptic statement by Nott, Angus, Heimpel
   British Columbia - synoptic statement by Kingborn, Angus, Heimpel)

   b. Experiments with Bacillus thuringiensis and small mammals
   (Canadian Wildlife Service and University of Ottawa)
   and fish (Fisheries Research Board)

   c. Aerial dispersal of virus suspensions against the Swaine sawfly in Quebec (synoptic statement by Prebble)

   d. Aerial dispersal of insecticides to prevent ambrosia beetle damage in log booms, British Columbia (synoptic statement by Richmond; comments and discussion)

5. Forecast of aerial spray projects in 1961

   (a) operational
   (see synopsis of 1960 infestations prepared by
   Prebble, Oct. 20/60;
   review of more recent information;
   comments and discussion)

   (b) experimental

6. Other business

PRELIMINARY STATEMENT ON COMPARISON OF TWO CONCENTRATIONS OF DDT SPRAY USED AGAINST THE SPRUCE BUDWORM IN NEW BRUNSWICK IN 1960

D. G. Mott, Forest Biology Laboratory, Fredericton
J. J. Fettes, Chemical Control Section, Forest Biology Division, Ottawa

Experiments by the Chemical Control Section, Forest Biology Division, in 1958 and 1959 indicated that a reduction in DDT concentration from 12.5% at 1/2 gallon per acre (the spray concentration and dosage used in New Brunswick spruce budworm aerial spraying operations since 1953) to 6.25% at 1/2 gallon per acre could effect acceptable control of budworm larval populations, providing 10 or more drops of spray were deposited per square centimeter. Studies by Fisheries Research Board suggested that the lower concentration would reduce damage to fish and other aquatic fauna. A decision to test the two spray concentrations operationally in 1960 permitted an assessment of their relative effects on a large scale; a third spray dosage, 6.25% DDT at 3/4 gallon per acre was also employed, and its effectiveness was also assessed.

Two largely independent assessments of the effectiveness of the two spray concentrations were made. Study "A" was conducted by the Chemical Control Section and was mainly an assessment of larval mortality in relation to spray deposit, using line plots in selected areas. Study "B" was conducted by the Forest Biology Laboratory, Fredericton. Point plots were used to assess larval mortality in relation to spray deposit, and in addition resultant changes in pupal and egg populations throughout the whole spray area. Both studies were also designed to compare the effectiveness of the two aircraft types, Stearman and Avenger. Integrated studies of fish and other aquatic fauna were carried out by the Canada Department of Fisheries, Halifax, and the Fisheries Research Board, St. Andrews; they will be reported separately by these agencies.

It should be pointed out that the broad conclusions drawn in this statement are based on a preliminary analysis of data only. While it is doubted that more complete analysis of the large body of data collected in 1960 can materially affect these conclusions, it may be expected to reveal information of interest on a number of facets of the 1960 operation and perhaps explain some of the inconsistencies recorded.

Spray Deposit and Larval Mortality

Table 1 and Figs. 1, 2 and 3 summarize the important findings from studies "A" and "B". Careful assessment of spray deposit cards has shown that only 32% of the area studied received deposits of 10 droplets or more per square centimeter; 68% received less than 10 and 48% received less than 5. At deposits below 10 droplets per square centimeter larval mortality was less with low than with high concentration, while at deposits of 10 droplets or more there was little difference. Generally, higher larval mortality was demonstrated with increasing droplet density. Throughout the whole area studied the combined studies revealed a 7% difference in larval mortality between spray concentrations, in favour of the high concentration. It should be noted, however, that this

difference is largely the result of a 14% difference in mortalities between the two spray concentrations at the lowest droplet density range, which represented roughly half the total area. It seems clear that where about 10 or more droplets per square centimeter of spray were deposited there was little difference in the performance of the two spray concentrations. An important difference between the results measured on the operation of 1960 and earlier experimental results is that mortalities in the 1960 operation were higher at deposits of less than 10 droplets per square centimeter than was experienced in experimental sprayings.

It is of interest to note that in the entire area studied, based on the analysis of about 1,000 spray deposit cards, the average droplet density was between 7 and 9.5 droplets per square centimeter, in spite of the fact that 48% of the area received deposits of less than 5 droplets per square centimeter.

The higher dosage rate of 3/4 gallon per acre of low concentration spray should have resulted in higher droplet density, higher gallons per acre deposited on the ground, and greater larval mortality than the 1/2 gallon per acre dosage rate of the same spray. No consistent differences were, however, apparent in the plots sprayed at this concentration. The area that received the dosage of 3/4 gallon per acre of low concentration spray is included in the summaries given above as part of the low concentration area.

Comparison of spray deposit and larval mortality figures in the areas sprayed by the two aircraft types showed that differences in droplet density were small and not consistent in the two studies, and that resultant larval mortality was very similar with the two aircraft, perhaps slightly in favour of the Stearman (Table 2).

Mortality at Pupal Stage

Table 3 summarizes the results of the pupal survey conducted in Study "B". A consistent effect of population density on the control obtained, as measured at the pupal stage, is revealed; lower control was effected at the lower population levels. Over the entire sprayed area there was a difference in control between the two spray concentrations at the pupal stage of about 10% in favour of high concentration. This difference is comparable to the 7% difference observed in larval mortality (Table 1).

Pupal counts in areas of high population density sprayed with Avenger aircraft at 3/4 gallon per acre of low concentration spray, indicated better control than comparable areas sprayed at 1/2 gallon per acre (83% vs. 72.6% - Table 3). These results are not consistent with those reported above for spray deposit density and larval mortality for the two spray dosages.

Pupal surveys conducted in the areas sprayed by the two aircraft types suggest that control was better with the Avenger when high concentration spray was applied, but better with the Stearman when low concentration spray was applied, at equivalent population densities. These results are at present inexplicible. However, combining areas sprayed with both concentration sprays, results indicate a slight advantage to the Stearman.

Egg Population Sampling

The results of the extensive egg mass survey conducted in Study "B" are summarized in Table 4 in such a way as to facilitate comparison of egg mass populations throughout the Province in 1960 with egg mass populations at the same locations in 1959, both within and without the area sprayed in 1960. In those parts of southern and eastern New Brunswick that were not sprayed in 1960, egg mass populations in 1960 were approximately 1.9 times those of 1959. Within the sprayed area as a whole they were reduced in 1960 to 0.78 of 1959 populations. This represents a reduction of 59% due to spraying. However, within the area treated with low concentration spray at the 1/2 gallon per acre dosage, egg mass populations in 1960 were 1.30 times those of 1959, while in the area treated with low concentration spray at 3/4 gallon per acre they were reduced to 0.49 of 1959 populations, and in the area treated with high concentration spray they were reduced to 0.61 of 1959 populations. These represent reductions due to spraying of 32%, 74% and 68%, respectively. Although the difference in this measure of the effect of the two spray concentrations appears to be large in comparison with those suggested by the larval mortality studies and the pupal surveys, long-term population studies on the spruce budworm reveal that small differences in larval and pupal populations often have a disproportionately large effect on the resulting egg populations. The magnitude of the above differences is not inconsistent with earlier experience.

Protection of Foliage

No clear differences between the two spray concentrations or between the two aircraft types were apparent in 1960 in protection given to balsam fir foliage over the whole area sprayed. It must be remembered that spraying in 1960 was purposely delayed to a time when good protection of foliage could not be expected.

Summary

There is an indication in all of the studies that the high concentration spray did result in a somewhat higher level of insect control than the low concentration spray. It seems clear that where a good deposit of spray was achieved (about 10 droplets or more per square centimeter) the low concentration spray was as effective in killing budworm larvae as the high concentration spray. It also seems clear that spray deposits of this kind were achieved over only about one-third of the operation. On the other hand, nearly one-half of the operational area received deposits of less than 5 droplets per square centimeter and control was lower, especially at the low spray concentration. It is suggested therefore that continued effort be made in future operations to improve the distribution of spray droplets reaching the ground.

The principal aim of aerial spraying against the spruce budworm in New Brunswick has been, except in 1960, the protection of balsam fir foliage and thus the prevention of tree mortality. The timing of the 1960 operation was purposely delayed, however, and generally little foliage protection was obtained. It should be pointed out, therefore, that the relative effectiveness of the two spray concentrations in protecting balsam fir foliage could not be adequately

assessed in the 1960 operation. It is suggested, therefore, that consideration should be given to comparing the two spray concentrations again under operational conditions designed to effect greatest possible protection of foliage. An earlier report from the Forest Biology Laboratory (Sept. 9/60) has already pointed out that any spray operation in 1961 should return to early timing of spraying over most of the area in order to protect 1961 foliage production and prevent tree mortality.

Comparisons made of the relative effectiveness of the low concentration spray applied at 3/4 gallon per acre and the same concentration applied at 1/2 gallon per acre were not entirely consistent. In the studies designed for a direct measurement of larval mortality, no advantage of the 3/4 gallon per acre dosage was established. However, in the more extensive studies comparing pupal population levels and egg population trends there is evidence that the 3/4 gallon per acre dosage yielded better control than the 1/2 gallon per acre dosage.

Comparisons of the two aircraft types were somewhat inconsistent, but suggest a slight advantage in favour of the Stearman.

Statement prepared for Meeting of the Directors
Forest Protection Limited, October 20, 1960.

Table 1. Summary of Larval Mortality Data, Showing Effect of Droplet Density and Concentration of Insecticide.

Number of drops per sq. cm.	Percentage of locations Both studies	Average mortality due to treatment: 12.5 per cent DDT, Study "A"	12.5 per cent DDT, Study "B"	12.5 per cent DDT, Combined (Weighted)	6.25 per cent DDT, Combined (Weighted)	6.25 per cent DDT, Study "A"	6.25 per cent DDT, Study "B"
0 - 5	48	68	49 75	72	58	50	74 66
5 - 10	20	96	22 99	97	88	85	15 91
10+	32	95	30 82	91	95	97	11 91
Average weighted by percentage of locations:				83	76		

% Mott's study (pencil figs above) % of samples with good droplet distribution (10+) was much lower at 6 1/4 % conc. than 12 1/2 %.

Table 2. Comparison of Spray Deposit and Degree of Larval Control Obtained with Stearman and Avenger Aircraft.

Study	Drops/cm.^{2} "A"	Drops/cm.^{2} "B"	Percentage control "A"	Percentage control "B"
Stearman	10.3	6.7	86	87
Avenger	8.9	7.8	84	81

Table 3. Summary of Pupal Survey Data, Showing Effect of Spray Concentration, Aircraft Type and Population Level on Percentage Control.

Spray concentration	Aircraft	Population level (1959 egg masses/ 100 sq. ft.)	Dosage gal./acre	No. of points	No. of pupae	Percentage control
High	Stearman	Low Up to 174	1/2	29	1.872	29.3
"	"	Med. 175-399	1/2	43	3.305	66.5
"	"	High 400 & over	1/2	52	1.332	92.4
High	Avenger	Low	1/2	28	1.608	39.3
"	"	Med.	1/2	38	2.141	78.3
"	"	High	1/2	46	1.087	93.8
Low	Stearman	Low	1/2	27	1.529	42.3
"	"	Med.	1/2	40	1.651	83.3
"	"	High	1/2	-	-	-
Low	Avenger	Low	1/2	38	2.465	6.9
"	"	Med.	1/2	23	2.816	71.5
"	"	High	1/2	38	4.774	72.6
		High	3/4	31	2.957	83.0
Unsprayed		Low		181	2.648	
		Med.		22	9.870	
		High		7	17.444	

	No. points	Observed	Expected	Percentage control
All areas High concentration	236	1.873	11.271	83.4
All areas Low concentration	192	2.735	10.140	73.0

Table 4. Ratio between Egg Masses per 100 Square Feet of Foliage in 1960 and in 1959, in Various Outbreak Sectors and Treatments.

Area	No. of points	Eggs 1959	Eggs 1960	Ratio $\frac{60}{59}$	Per cent reduction due to spraying
Northern	296	8.03	7.49	0.93	
Southern Lightly Infested	123	11.79	24.20	2.05	
East Coast	73	121.7	217.0	1.78	
Check Areas	20	255.5	484.1	1.90	
Avenger Sprayed	170	227.7	179.4	0.79	58
Stearman Sprayed	110	195.4	147.2	0.75	61
Low Concentration Sprayed (1/2 gal.)	94	162.0	211.0	1.30	32
Low Concentration Sprayed (3/4 gal.)	32	236.0	116.0	0.49	74
High Concentration Sprayed	154	249.5	152.4	0.61	68
Entire Sprayed Area	280	215.0	166.8	0.78	59

Per cent Reduction due to Treatment = $\frac{1.90 - \text{Observed ratio}}{1.90}$

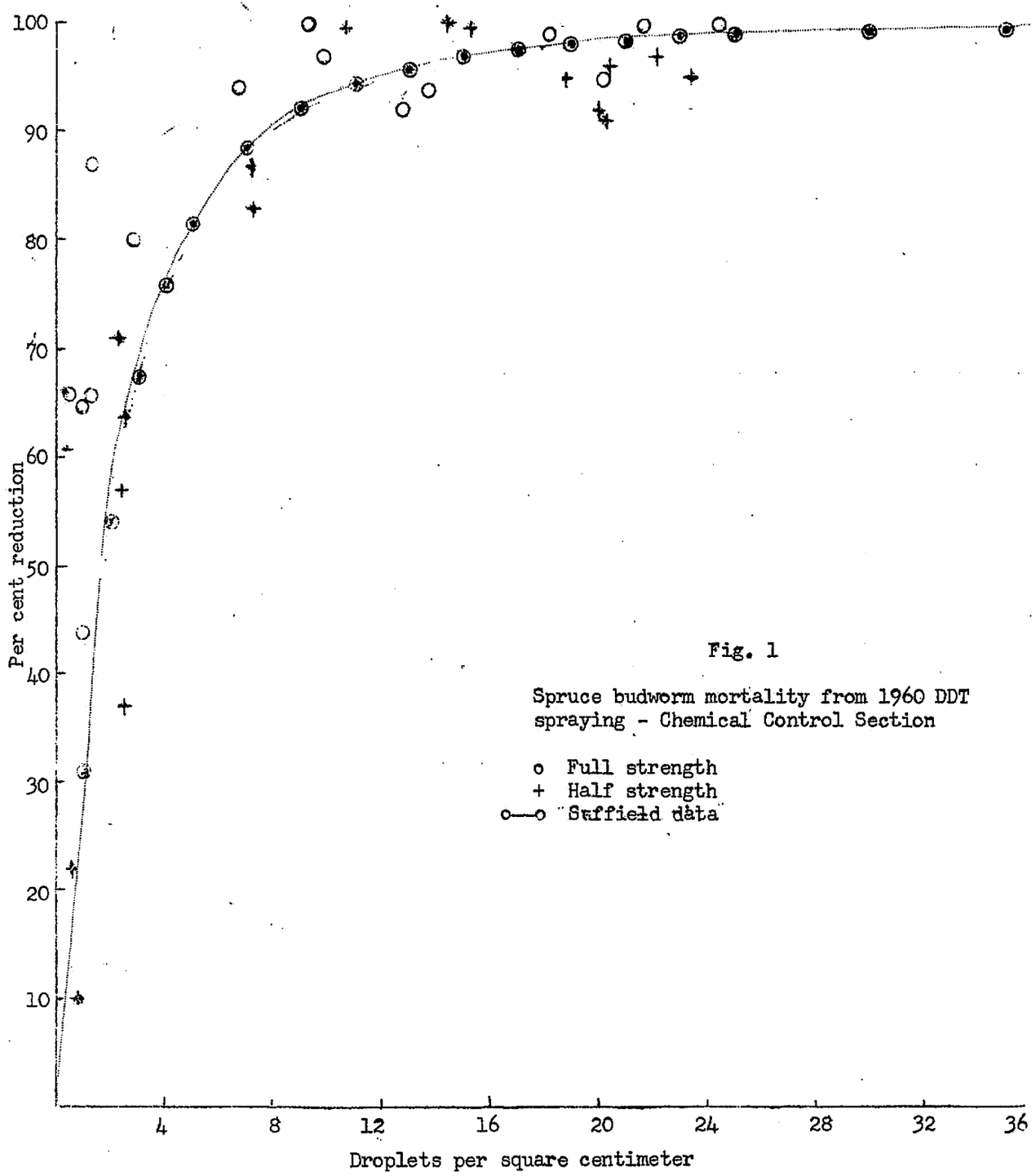


Fig. 1

Spruce budworm mortality from 1960 DDT spraying - Chemical Control Section

o Full strength
\+ Half strength
o—o Suffield data

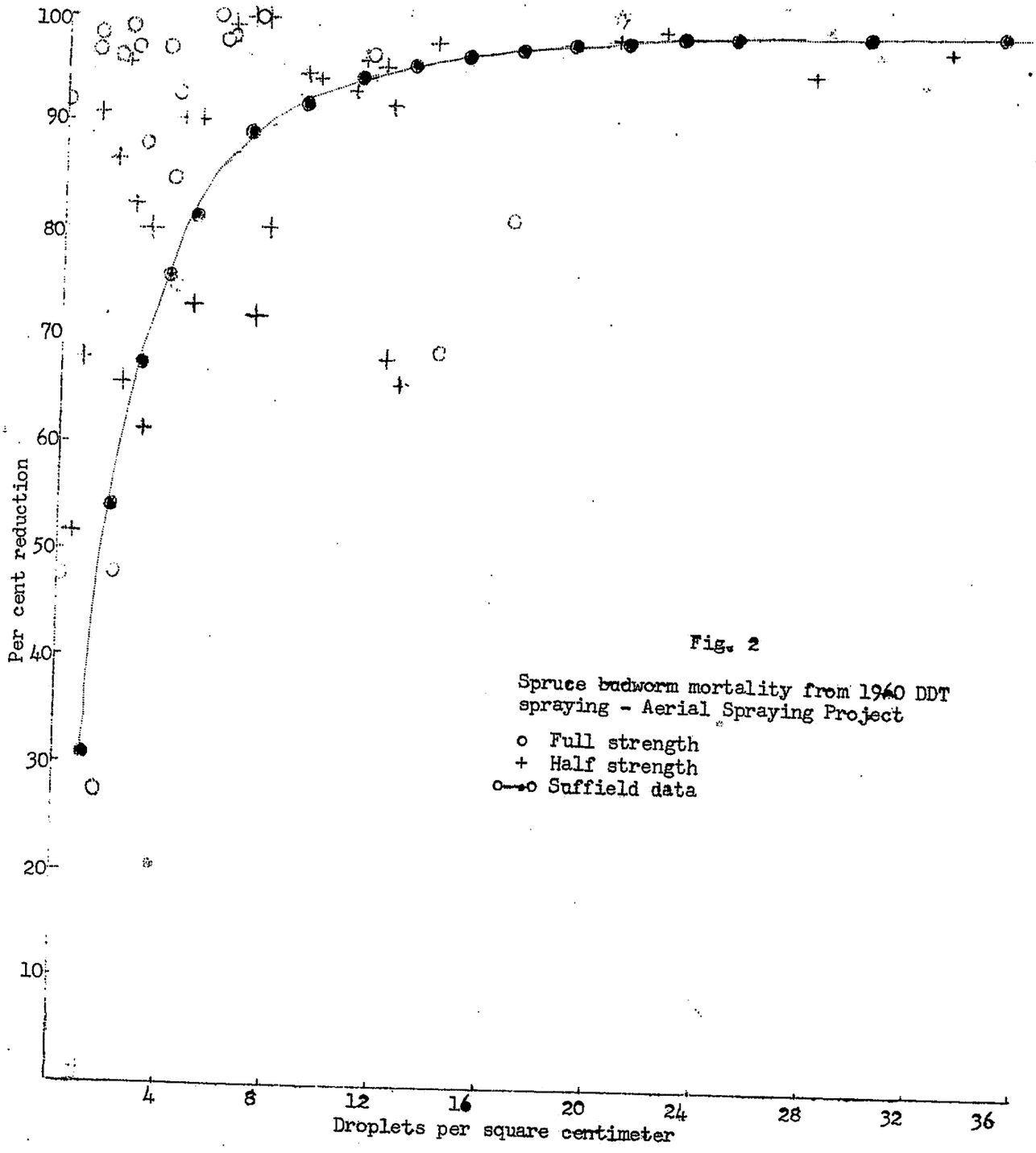
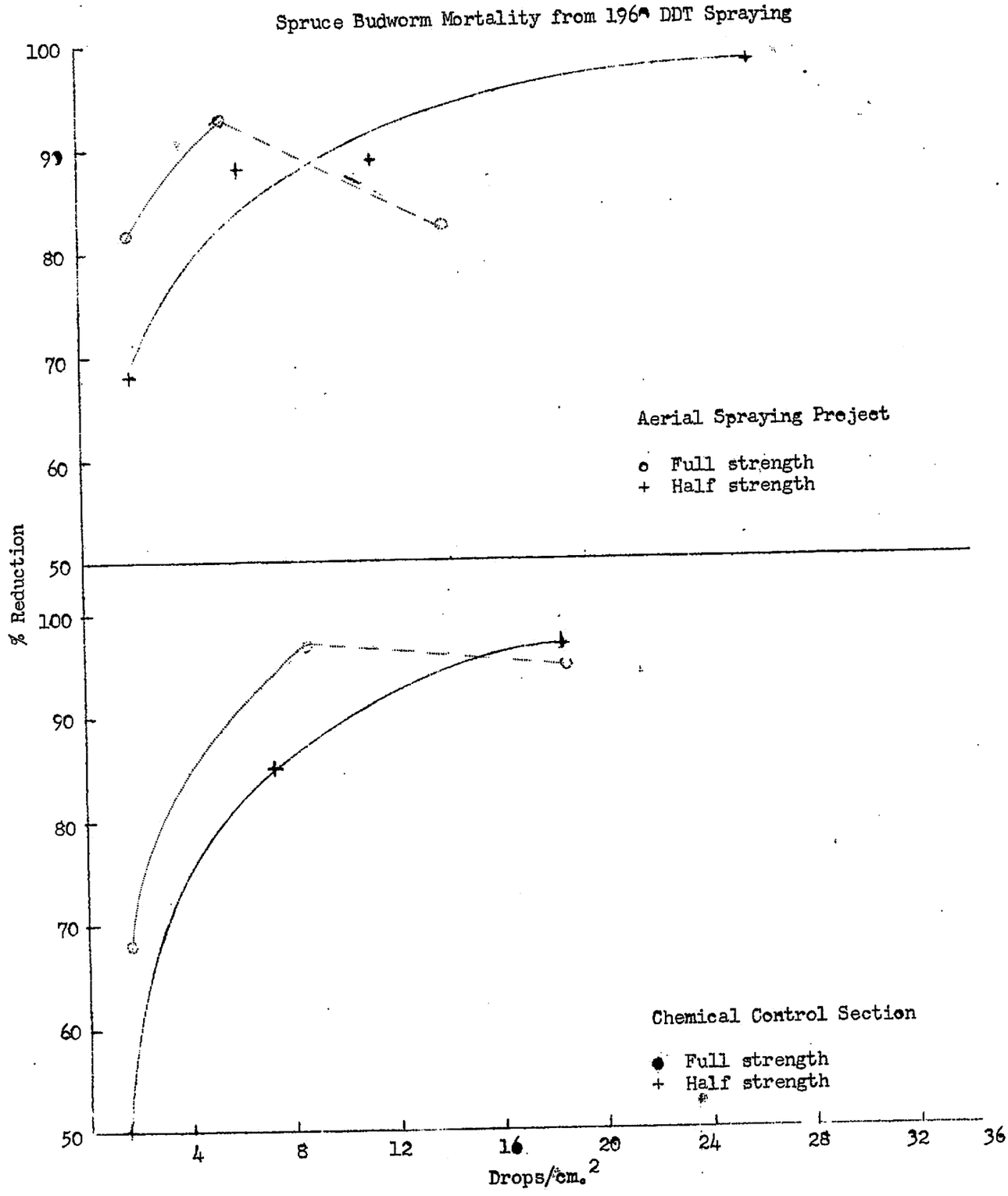


Fig. 2

Spruce budworm mortality from 1960 DDT spraying - Aerial Spraying Project

o Full strength
+ Half strength
o—o Suffield data


Spruce Budworm Mortality from 196[illegible] DDT Spraying
100
90
80
70
60
50
% Reduction
Aerial Spraying Project
o Full strength
+ Half strength
100
90
80
70
60
50
Chemical Control Section
● Full strength
+ Half strength
4
8
12
16
20
24
28
32
36
Drops/cm.2

FORECAST OF INFESTATIONS IN B.C. WHICH MAY REQUIRE

CONTROL ACTION IN 1961

1. Saddle-backed looper, Ectropis crepuscularia Schiff.

A severe outbreak of the saddle-backed looper occurred at Kitimat, B.C., in 1960. The total area of the outbreak is 14,000 acres, and extends from about two miles south of the smelter site to a little over three miles north of the Kitimat Station on the west side of the Kitimat River, and westward up the valley slopes to about 1,500 feet (see map). The major portion of the Moore and Anderson Creek valleys is included. Defoliation within the outbreak area was severe; the understory, suppressed, and most of the intermediate class trees were nearly all completely defoliated, and many dominant and co-dominant trees were severely defoliated. Hemlock is the preferred host, followed by balsam.

About 1,800 acres were sprayed on August 1, 1960, with ½ lb. DDT in fuel oil at the rate of 1 g.p.a. in an effort to prevent complete defoliation of overstory trees in the heaviest portion of the outbreak.

Pupal counts were made in September, 1960, to determine the status of the population. The results are not yet completely analyzed but the pupal population is believed high enough to result in a larval population as heavy as in 1960. It is not yet known if the moths, which emerge in the spring, will remain in the present well-defined area or migrate to adjacent timber stands. If the moths lay their eggs in the same area chemical control probably will be required to prevent extensive tree mortality. As the final decision to spray cannot be made until after the moth flight or after egg counts in the spring, recommendations will probably call for a stand-by control operation.

The Kitimat River is outside of the infestation boundaries but several tributaries of the Kitimat flow through the area that might be treated in 1961.

2. Green-striped forest looper, Melanolophia imitata.

Thirty-six separate areas in which defoliation was caused principally by this insect have been recorded on the west coast of Vancouver Island between Herbert Inlet and Brooks Peninsula (see map). The infestations range in size from 50-60 acres to five square miles, and defoliation varied from light to severe. About 35,000 acres were recorded as receiving detectable defoliation.

As this insect also overwinters in the pupal stage in the ground, we are again faced with the problem of predicting with any degree of accuracy how numerous larvae are likely to be in 1961. Furthermore, many of the infestations are located in areas difficult to survey properly. Preliminary surveys of some of the areas indicate that overwintering pupae are not abundant.

A decision to spray any or all of these areas is likely to be deferred until next spring, but some thought might be given to organizing a "stand-by" arrangement for the summer of 1961, in case larval populations capable of causing damaging defoliation develop in some of the infested stands.

It is probable that in most of these infestations, aerial spraying would involve complications with respect to mortality of aquatic insects and fish.

3. Pine butterfly, Neophasia menapia.

Evidence was obtained during 1960 that fairly heavy larval populations were present in MacMillan Park and surrounding stands of Douglas fir on Vancouver Island. It is our opinion that younger stands of commercial timber that may be infested are not in danger of being killed or severely damaged. On the other hand, trees in MacMillan Park and about 1,000 acres of adjoining timber in the 700-year-old age class are overmature and decadent, and any weakening of vigour caused by insect defoliation may predispose them to attack by bark beetles and wood borers. Furthermore, trees in MacMillan Park have a very high aesthetic value. It is possible, therefore, that MacMillan Park and the 1,000 acres of overmature timber may be sprayed in 1961. However, a final decision will not be made until after a fall egg survey is completed. Total area likely to be involved is about 1,500 acres. Cameron River and Cameron Lake lie in this area.

4. Hemlock looper, Lambdina fiscellaria.

Heavier than normal hemlock looper populations were noted at Dalstrom Point in Holberg Inlet, Vancouver Island. However the area of infestation was small and defoliation light. The area will be examined for eggs this fall but at this time it is not anticipated that direct control action will be necessary in 1961.

An unconfirmed report, which must still be checked, has been received that hemlock looper larvae were present in stands in the Power Creek area on the west coast of Vancouver Island.

5. Black-headed budworm, Acleris variana.

No control operations against this insect are anticipated for 1961. During the late feeding stages in 1960, the larval population on the Queen Charlotte Islands dropped to a low level. Although fall egg surveys have not yet been completed, it is anticipated that eggs will not be numerous. General results of the egg surveys are expected to be available for the first Interdepartmental Committee meeting on October 31.

CHEMICAL CONTROL OF ECTROPIS CREPUSCULARIA SCHIFF.

KITIMAT, B.C., AUGUST 1, 1960.

About 1,800 acres of timber at Kitimat were sprayed on August 1, 1960, in an effort to prevent heavy tree mortality by the saddle-backed looper, Ectropis crepuscularia. The spray was ½ lb. DDT per gallon of fuel oil, applied at the rate of 1 U.S. gallon per gallon. The decision to spray was made on July 29, but it was not known until July 30 that the control operation would be possible. This left time for only limited assessment work.

Thirty-two sample stations within the spray area and 10 check stations

were laid out. All station were sampled on July 31, August 2, August 3, and some 7 to 10 days after spraying. At each station a sample consisted of two 18-inch branches, larval density being calculated on a square foot basis. Spray assessment cards were forwarded to the Chemical Control Section, Ottawa, for analysis.

Results

The GPA deposit was very light. Two stations recorded deposits of 0.28 and 0.29 GPA, all others were less than 0.09. In general there was no significant drop in larval survival, although no larvae were found on August 8 and 9 at the two stations which received the heaviest spray deposit. This does not indicate a high degree of control as pupae were found under these trees in September indicating that some larvae had pupated by August 8. Although the results of a pupal survey in September are not completely analyzed, there appear to be as many pupae in the sprayed area as outside the spray area. Feeding also continued after spray as some sample trees in the spray area were completely defoliated after August 1. However, during a low level helicopter flight over the entire area in September the overstory trees in the spray area appeared in better condition than in the unsprayed area, indicating that the spray did reduce the amount of feeding on the dominant and co-dominant tree classes.

Forest Biology Laboratory,
Victoria, B.C.
October 4, 1960.

PRELIMINARY REPORT ON BLACK-HEADED BUDWORM CONTROL PROJECTS -

QUEEN CHARLOTTE ISLANDS, 1960

I. DDT OPERATIONAL SPRAY (Forest Biology Laboratory, Victoria)

The egg survey conducted during the autumn of 1959 showed that a potentially dangerous budworm population was present on parts of Moresby Island. In view of the poor condition of some trees, control was undertaken on 31,500 acres in the vicinity of Moresby and Skidegate Inlets and Copper River.

A dosage of ¼ lb. DDT per U.S. gallon per acre was used in order to lessen the hazard to fish. Fish damage was also avoided by not spraying directly over the Copper, Pallant, and Deena Rivers.

Egg samples taken in April, 1960, indicated that some winter loss had occurred, but that high numbers of insects were still present.

When branch sampling was begun on June 1, most eggs had not hatched. Earlier control studies have shown that DDT aerial spraying is not effective against this insect until at least 50 per cent of the larvae are in the second instar. On the basis of samples taken from regeneration hemlock, it was forecast that this point would be reached by the last week of June. Subsequent sampling of under- and overstory hemlock in mature stands soon showed that development was not as far advanced as in young stands. Furthermore, the weather remained cool and wet throughout June and most of July, so that it was not until July 10 that budworm on understory hemlock reached the stage for effective spraying.

Bud burst on overstory hemlock did not occur until early July. At the time when large numbers of eggs were hatching on the overstory, the buds had not begun to burst. Samples taken during this period, and subsequent lack of serious defoliation to the overstory indicated that many newly hatched larvae never survived because of the lack of opened buds.

On June 23, two DDT swaths were sprayed over Sachs creek to determine the potential hazard of the ¼ lb. dosage to Coho fry. Although it was anticipated that the spray would not effect control of the budworm at this early date, an attempt was made to ascertain the result. As forecast, control at this early stage was not effective. A few of the larger larvae were killed, but most insects were either in the egg stage or survived because they were protected by the buds that were only just starting to open.

Operational DDT spraying was scheduled to commence on July 11th, but heavy rainfall delayed the start until July 17th. By July 23, the operation was finished. Mechanical difficulties with the aircraft, and unsettled weather during the period slowed operations, and in some areas insecticide was applied in marginal spraying weather.

Spray coverage appeared to be adequate. Of 21 assessment plots, all but one received some deposit. Most check plots were far enough away from the spray block to avoid contamination. One check plot was fully sprayed and a minute deposit was detected on another two.

From hatching to pupation a defoliator population normally diminishes

through parasitism and other natural controls. Cool wet weather accelerated the decline of the budworm population in this situation. In retrospect it can be seen that unfavourable weather for budworm persisted long enough to result in an over-all net decrease in population for the season in both sprayed and unsprayed areas. However, at no time during the operation was it possible to predict with certainty that poor weather would continue. By the end of July, populations in unsprayed stands were very low. Hence it is difficult to determine the actual amount of mortality that was attributable to the spray.

Control, uncorrected for natural mortality, ranged from 70 to 100 per cent. Obviously where untreated populations were undergoing catastrophic natural decline, the theoretical percentage control attributable to the spray was much less than indicated by the foregoing. Evidence that the ¼ lb. treatment was effective can be drawn from several plots sampled three to five days after spraying where population decline was much greater than would be anticipated had the trees been left untreated.

From the meagre evidence that could be salvaged from this collapsing population, it can be stated that there is good probability that ¼ lb. DDT per acre will control the black-headed budworm. An effort should be made to check this finding at an early date, but it is urged that the work be done on an experimental, rather than an operational basis. Experience has demonstrated that when experimental and operational spray programmes are combined, the urgencies associated with the latter invariably work to the detriment of the former.

II. BACTERIAL INSECTICIDE EXPERIMENTS (Insect Pathology Research Institute, Sault Ste. Marie, and Forest Biology Laboratory, Victoria)

Before this season it was not certain that Bacillus thuringiensis would kill the black-headed budworm. During July, water and oil suspensions of the bacterium were hand-sprayed on potted hemlock seedlings infested with budworms. After one week, 98 per cent of the 125 larvae had died, and diagnosis positively established that 58 per cent of these were infected with B.t. The oil treatment gave somewhat better results than the water suspension. Although the spray dosages were high, the test was sufficient to show that this budworm can be killed by the bacterium.

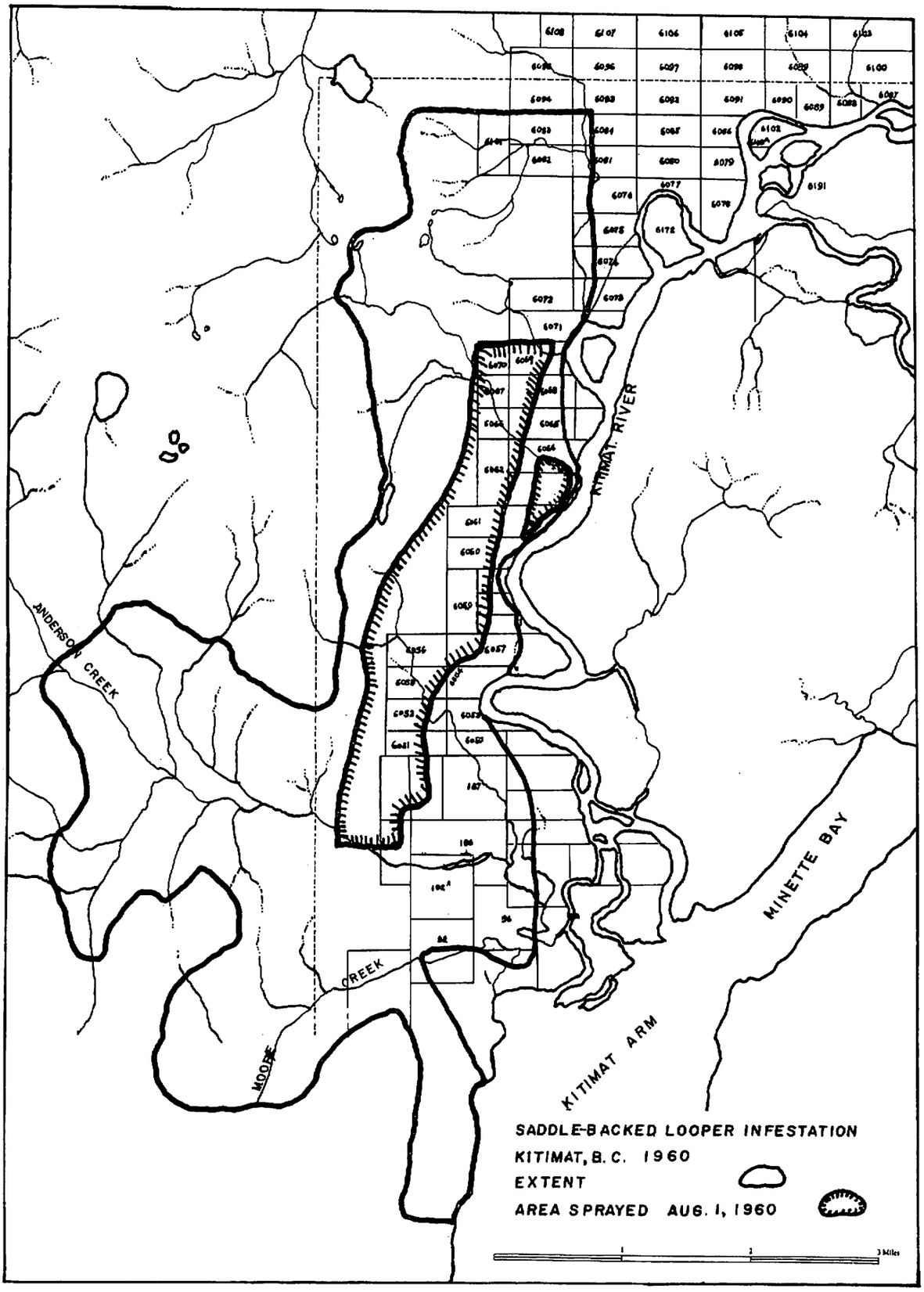
On July 24th, immediately after the DDT operational spraying was complete, two plots in regeneration hemlock stands were sprayed with B.t. suspended in oil. A third plot was sprayed with oil alone as a check. One B.t. plot was sprayed at the nominal rate of 1.3 lb. of Thuricide concentrate (containing 60 billion viable spores per gram) per acre; the other was applied at the rate of 2.8 lb. per acre. Spray was applied with a Grumman Avenger aircraft equipped to deliver 112 gallons per minute. To achieve the light and heavy dosages, two and three passes, respectively were required over the center lines of the plots. Deposits of the bacterium on both plots were heavy, although the spores tended to clump into aggregates readily visible to the naked eye.

Budworm populations in the plots, similar to the general trend in the locality, were low and declining sharply at the time of treatment. A population reduction evaluation of the treatments was thus not possible. However, about 80 per cent of the dead larvae collected from the plots were

infected with B.t. Healthy larvae collected from an unsprayed area were placed on sprayed foliage collected from the plots. Larvae on foliage from the light dosage plot suffered 80 per cent mortality while 90 per cent confined on the foliage from the heavy dosage plot succumbed. Diagnosis showed that all of these larvae were infected with B.t. None of the dead larvae collected from the oil treated check plot contained the bacterium.

Although the lack of large numbers of insects on the plots makes it impossible to compare the efficiency of B.t. with DDT spraying, the experiment has established that black-headed budworm can be killed with B.t. dosages that are within the range of practicability for aerial spraying. On the basis of this initial work, further experimentation can be justified. It is anticipated that the usefullness of the material can be improved with better formulation and application techniques.

Forest Biology Laboratory,
Victoria, B.C.
Sept. 29, 1960.


KITIMAT RIVER
ANDERSON CREEK
MOOSE CREEK
KITIMAT ARM
MINETTE BAY
SADDLE-BACKED LOOPER INFESTATION
KITIMAT, B.C. 1960
EXTENT
AREA SPRAYED AUG. 1, 1960
1
2
3 Miles

TRIALS OF BACILLUS THURINGIENSIS AGAINST SPRUCE BUDWORM IN NEW BRUNSWICK

(Statement for Interdepartmental Committee on Aerial Forest Spraying - Autumn 1960)

D. G. Mott, Forest Biology, Fredericton
T. A. Angus and A. M. Heimpel, Insect Pathology Research Institute, Sault Ste. Marie

Assessments of aerial applications against spruce budworm of a commercial preparation of Bacillus thuringiensis were made by Forest Biology Laboratory, Fredericton, and Insect Pathology Research Institute, Sault Ste. Marie. "Thuricide concentrate" containing thirty billion viable spores of B. thuringiensis per gram was supplied gratis by Bioferm Corporation, Wasco, California. Three aircraft were made available at no cost by Forest Protection Limited.

A water formulation of wettable powder and an oil emulsion were applied on May 30 at a rate of 2 pounds in 1 gallon per acre. Oil-treated, DDT-treated, and untreated conditions were provided for comparisons. Initial deposit, in terms of number of spores per gram of balsam fir needles, was below the recommended lethal level on most sampled trees. Decay of the material to a value below the level at which threshold effects are expected occurred within three days. It has been indicated that improvements can be made in the commercial material in order to yield better deposit.

Appreciable numbers of dead larvae were first detected on the fourth day following treatment, many of which were diagnosed as containing B. thuringiensis. A maximum of 31 per cent control could be demonstrated to have taken place due to treatment. When measured the same way, DDT produced 65 per cent control. In general, there was slight protection from feeding given to the foliage. There was an apparent small elevation in fecundity of adults which was probably not significant. Development of the treated population was slightly delayed.

This material shows promise, particularly since it can be improved, but does not yet have sufficient insecticidal value to warrant operational testing. Trials with improved formulations and higher dosages should be carried out in 1961. Bioferm have indicated their willingness to cooperate in supplying material, but no firm plans have been drawn up by Forest Biology Division.

Infestations of forest insects observed in 1960, that may require chemical control action in 1961

Newfoundland: probably nil

Nova Scotia: probably nil

New Brunswick: Spruce budworm

Populations remain low in the northern part of the province. In the central region, where spraying operations were carried out in 1960, moderate to high egg populations occurred in the fall of 1960 over some 2.2 million acres. Much of the infested area was severely defoliated in 1960, spraying in 1960 having been later, seasonally, than in earlier years. Therefore high hazard occurs over a large area in central New Brunswick, extending from Carleton County to Kent County, with a sizeable area in southeastern Gloucester County and other sizeable areas near Fredericton and the Southwest Miramichi River. Spraying will be necessary in 1961 to prevent extensive timber mortality. The specific areas and the total acreage to be proposed for treatment in 1961 are not yet available. It is anticipated that the acreage to be proposed for treatment will be substantial.

Quebec: Spruce budworm

Infestations have remained low since 1958 throughout most of the Gaspe-Southern St. Lawrence area. A small residual infestation persisted in the Lake Kedgwick-Lake Mistigouguche area, where 33,000 acres were sprayed in 1960. The results were very satisfactory, but surveys in the late summer of 1960 disclosed high egg populations in adjoining areas as follows:

To the east, in upper drainage area of the Patapedia River.... 25,000 acres
To the west, in upper drainage area of the Rimouski River..... 35,000 acres

Total 60,000 acres

It is expected that these infestation pockets will be sprayed in 1961, and possibly some part of the 1960 sprayed area, where small numbers of budworm pupae persisted after the 1960 operation.

Ontario
Manitoba
Saskatchewan
Alberta

probably nil

British Columbia, interior: Satin moth

Small groves of ornamental poplars in the Okanagan Valley may require spraying. If this is undertaken, it will probably be within the boundaries of cities in the valley.

British Columbia, coast:

Saddle-backed looper

Infested forest near Kitimat may require control action in 1961. The 1960 infestation covered an area of some 14,000 acres.

Green-striped forest looper

Localized infestations occur in many places on the west side of Vancouver Island. Some of these infested areas may require protective action in 1961.

Pine butterfly

An infestation occurs in the MacMillan Park (Cathedaral Grove) area of Vancouver Island. Some 1500 acres of old growth forest may require protective action in 1961.

Hemlock looper

Increased looper populations were noted in the Holberg Inlet area of Vancouver Island in 1960. It seems unlikely that direct control will be needed in 1961.

Black-headed budworm

The infestation on the Queen Charlotte Islands receded in the late summer of 1960, and it is unlikely that spraying operations will be needed in 1961.

H. L. Prebble, Ottawa, Oct. 26/60

Synopsis prepared from reports submitted by Forest Biology Laboratories in September and early October.

14-0-31

MEMORANDUM FOR FILE

MEETING OF INTERDEPARTMENTAL COMMITTEE ON
FOREST SPRAYING OPERATIONS
OCTOBER 31, 1960

In addition to members of the Committee, the above meeting was attended by Mr. Flieger of Forest Protection Limited; Dr. Belyea, Dr. Reeks, and Mr. Lejeune of the Forest Biology Division; Dr. Loggie and Dr. Jackson of the Fisheries Department; and Mr. Richmond of the B.C. Loggers Association.

Review of Operational Spraying Programs, 1960

In the New Brunswick operation, Dr. Fettes' previous experiments were confirmed by the fact that at deposits ~~below~~ above 10 droplets per square centimeter there was little difference in larval mortality between the 1/2 lb. DDT per acre and 1/4 lb. per acre dosages. In fact, mortality was satisfactory with the lighter dosage with as few as 5 drops per square centimeter. On the other hand, Mr. Flieger's doubts about the ability of the aircraft to spray with this degree of uniformity were confirmed, since only about 1/3 of the locations sampled received applications at 10 droplets per square centimeter or more, and nearly 1/2 of them received 5 droplets or less.

As regards larval mortality, there was little difference between the 1/2 lb. DDT per gal. solution whether sprayed at 1/2 gallon or 3/4 gallon per acre dosage. However, both pupal population and egg population were lower in the area sprayed with 3/4 gallon per acre. The difference between these criteria of effectiveness is not readily explainable, but may be due to the much more intensive sampling of pupae and eggs than of larval mortality.

Due to lack of staff and advance warning, Dr. Kask said that it was not possible to give the Fisheries aspect of the study as intensive treatment as was desired. In general, the lower concentration killed fewer fish and aquatic insects than the higher concentration. Dr. Loggie has been studying the population of fish generations born in the early years of budworm spraying in New Brunswick and now returning from the sea. In the Miramichi the grilse population was much higher than expected this year. In all other areas the forecasts of reduced population have been borne out.

It is expected that Mr. B.S. Wright will have a report on the woodcock situation in January. Due to the dry weather in New Brunswick the mortality of ducklings was very high so that it was not possible to ascertain the effect of DDT on ducks.

There was little difference in the effectiveness of spray application by Stearman and TBM aircraft. If anything, the Stearman was slightly better. As regards relative costs, Mr. Flieger said that at a haul distance of 25 miles the TBM can do the job of 5 Stearman. The main cost saving in favour of the TBM is the pay of 4 pilots, but the TBM cannot do as good a job in rough country.

Dr. Prebble reported that spraying results in Quebec in 1960 were quite successful but no detailed statement was available.

In British Columbia the black-headed budworm infestation on the Queen Charlottes declined so fast naturally that it was difficult to assess the effect of spraying. Such evidence as there is indicates that 1/4 lb. DDT per acre is satisfactory for the black-headed budworm. There will be no need to spray this area next year, and some doubt was expressed at the meeting as to whether spraying of this insect will be justified at all in future.

The 1/4 lb. per acre dosage did little damage to the fish in B.C. or to aquatic insects. However, the weather was so wet at the time that the heavy run-off on the surface of streams may have avoided the insects and most of the fish.

Review of Experimental Spraying Projects in 1960

Experiments with bacterial insecticides, in particular Bacillus thuringiensis, show promise against the spruce and black-headed budworm, but more study will be needed before operational trials are justified. Mr. Mair reported that B. thuringiensis is not toxic to small mammals.

A virus against Swaine's sawfly proved highly successful in Quebec. Dosages as low as 1/100 of a gallon per acre were 100 per cent effective, but take a longer time to act than higher concentrations.

Mr. Richmond said that a helicopter was used very successfully in applying insecticide to eliminate ambrosia beetles in log booms in British Columbia, and was much cheaper than hand application. Damage to fish was slight.

Forecast of Spray Projects, 1961

New Brunswick

High egg populations exist on some 2.2 million acres in central New Brunswick. Severe defoliation took place in 1960 over much of this area due to deliberate delay in the spraying program to increase the budworm kill. Spraying will be needed in 1961 to prevent extensive timber mortality. Forest Protection Limited has not yet made definite proposals for a spray area, but these will be considered at a meeting of the Directors on November 14th. Dr. Kask thought that all the 1961 spraying should be at 1/4 lb. per acre. Most of the others present felt that operational tests with both concentrations should be repeated, in view of the difficulty of maintaining sufficiently uniform droplet density.

(According to maps produced by Dr. Belyea, of which we have copies on file, three federal areas in which this Branch is interested are now affected to a considerable degree by the budworm infestation:

Camp Gagetown - Hazard reported as low. Egg masses variable but some heavy concentrations in spots in the northern part of the Camp.

Acadia Forest Experiment Station - Both hazard and egg masses high.

McGivney Ammunition Depot - Hazard moderate, egg masses high.

It seems likely that both Acadia and McGivney will be within next year's spray area. Camp Gagetown probably will not be unless specifically requested. Dr. Mott of the Forest Biology Laboratory in Fredericton told me at the C.I.F. meeting that some balsam fir stands at Camp Gagetown might succumb in 1961 because of previous weakening by the balsam woolly aphid. He said he would make a more detailed examination and report on this. It would seem that the Army is contemplating arrangements to have spraying done at the Camp. Mr. Flieger said that the Fredericton airport will almost certainly be used by Forest Protection Limited and that reasonable requests by the Army could be handled from there.)

Quebec

It is expected that about 60,000 acres will be sprayed in 1961 in the upper drainage areas of the Patapedia and Rimouski Rivers where high egg populations now exist. Possibly part of the adjacent area sprayed in 1960 will be re-sprayed also.

(Although the point was not specifically raised to my knowledge by officials of the Quebec Department of Lands and Forests, there was some suggestion at the C.I.F. meeting that Quebec would likely ask the Dominion for financial assistance on this project. The cost of the operation will evidently be of somewhat the same order as that of the 1960 operation in the Queen Charlottes which the federal government did not share in. There is, however, a further consideration in the present instance in that, for all practical purposes, Gaspe and New Brunswick constitute a single infestation. At the Interdepartmental Committee meeting Drs. Prebble, Fettes and Belyea and Mr. Flieger all said that the infestation in the Gaspe, if not checked, would constitute a serious threat to the re-infestation of northern New Brunswick.)

Ontario, Manitoba, Saskatchewan and Alberta

Probably no spraying in any of these provinces.

British Columbia Interior

Small groves of ornamental poplar in the Okanagan Valley may be sprayed.

British Columbia Coast

An infestation of saddle-backed looper near Kitimat may require spraying of about 14,000 acres. This will likely need at least a 2 gallon per acre dosage to reach the insects, as they are mostly concentrated near the forest floor.

The green-striped forest looper occurs on widely scattered areas along the coast totalling about 35,000 acres. Possibly some of these will need spraying.

There is an infestation of the pine butterfly in MacMillan Park (Cathedral Grove) on Vancouver Island and in surrounding stands totalling 1,500 acres. These stands are of great aesthetic value but are overmature and so decadent that they may die from even moderate defoliation. The area will likely be sprayed in 1961.

The status of nearly all the B.C. coast projects will be greatly affected by conditions which will not be definitely known until the spring of 1961. It may therefore be necessary to arrange for "stand by" control operations which would provide for last minute cancellation of spraying contracts in which the contractor would be paid off for a reasonable sum. A proviso of this kind was included in the 1957 spraying contract against the black-headed budworm on Vancouver Island but was not invoked.

H.W.B.

GOVERNMENT OF CANADA

ACTION REQUEST

CGSB 6-GP-12
P.P.&S. Cat. 3433

TO

LOCATION

FOR:

FILE NO.....

- [ ] ACTION
- [ ] APPROVAL
- [ ] COMMENTS
- [ ] DRAFT REPLY
- [x] INFORMATION
- [ ] INVESTIGATION
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- [ ] YOUR REQUEST

PREPARE MEMO TO:.....

REPLY FOR SIGNATURES OF:.....

REMARKS:

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FROM	PHONE	LOCATION	DATE
			Nov 3/6

cc: Mr. H. W. Beall ✓

14-0-31

7.9.14
FZ-16 (1961)

Mr. K. B. Brown,
A/Deputy Minister,
Department of Lands and Mines,
Fredericton, N.B.

November 21, 1960

Dear Ken:

I believe you know that the first preliminary fall meeting of the Interdepartmental Committee on Forest Spraying Operations was held October 31. This was called for the purpose of hearing the results of experimental studies against the spruce budworm, the black-headed budworm, the saddle-backed looper, etc., and attendance was requested of those who had taken part in these experimental studies and in the analysis of comparative data from operational projects in New Brunswick and British Columbia. Also considered by the Committee was a general forecast of forest insect infestations that might require control action in 1961.

In this latter connection, Barney Flieger indicated that while the hazard and population surveys of the spruce budworm in New Brunswick had been completed, it was not expected that Forest Protection Limited would have really definite conclusions regarding the 1961 spray program until about mid-November. He suggested that I should write to you for an outline of the proposals for 1961. This would be of value to me, as soon as available, in my capacity as officer of the Division, and also in my capacity as Chairman of the Interdepartmental Committee.

I believe the Interdepartmental Committee will be meeting again shortly, first to consider in greater detail the evidence accumulated during 1960, and second to make its recommendations for 1961. When the latter topic is being considered I think it would be very appropriate if you and Barney Flieger could take part in the proceedings of the Committee so that the Committee's recommendations would be made in the light of your views on hazards in specific portions of the area proposed for control action in 1961.

.... 2.

I would be grateful if you would also let me have your views on representation of wildlife interests in New Brunswick. Do you think that Bruce Wright should be invited to the next meeting, or could you in your official capacity undertake to discuss affairs with him in Fredericton and represent that topic at the Interdepartmental Committee, along with forestry aspects?

The minutes of the October 31 meeting, along with extensive appendices, are in the process of preparation and should be available for distribution within about two weeks. A copy will be sent to you.

With kindest regards,

Yours sincerely,

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp

P.S. If, as I suspect, the proposals of Forest Protection Limited for control action in 1961 will be based on infestation and hazard maps prepared by the Forest Biology Lab. at Fredericton, it should not be necessary for you to send me copies of the maps as I can get them directly from Dr. Belyea.

M.L.P.

cc: Mr. B. W. Flieger
Dr. R. M. Belyea
Dr. J. L. Kask
Dr. A. L. Pritchard
Mr. W. W. Mair
Mr. H. W. Beall

DEPARTMENT OF LANDS AND MINES
FREDERICTON, N.B., CANADA

COPY/kp

The Government of
The Province of
New Brunswick

November 24, 1960

Dr. M. L. Prebble,
Director, Forest Biology Division,
Research Branch,
Canada Department of Agriculture,
Central Experimental Farm,
Ottawa, Canada.

Dear Malcolm:

Thank you very much for your letter of November 21 and your invitation to attend the proposed meeting of the Interdepartmental Committee. I understand you will let me know when dates have been determined and will also send Barney an invitation.

Since this Department is interested in wildlife and has some responsibility for its protection, I would naturally take that into consideration in anything I would have to say on the subject of aerial spraying. I would not, however, attempt to speak for Bruce Wright and think it would be best to give him an opportunity to present his views to the Committee in either verbal or written form.

The Directors of Forest Protection Limited have recommended spraying in 1961 on an area of approximately 1,700,000 acres. This will include the areas of high hazard in the part of the Province where fir predominates. In certain areas where there have been persistent budworm populations for several years it is proposed to spray twice, early and late, timed with the development of fir and red spruce foliage. It is also proposed to make extensive trials of spraying in the areas where spruce predominates and in areas where the balsam wooly aphid is present in order to determine how best results can be obtained and whether the benefits justify the costs. This may add approximately 100,000 acres to the area mentioned above.

This plan is conditional on Federal participation in the cost of the operation. A request has been forwarded to the Minister of Forestry and has been acknowledged by him but no commitment has been received. If the Federal Government does not agree to participate then the Directors of Forest Protection Limited will meet again to reconsider the whole situation.

... 2.

You will be interested in the fact that Forest Protection Limited has recommended use of the "half-strength" insecticide for the main operation. Trials may be made with stronger insecticides in areas where there is more red spruce.

I realise that this lack of definite information will be unsatisfactory to you but suggest that it might be unwise to delay consideration by the Interdepartmental Committee until plans have been finalized here since the season is getting late and we will be forced to move as rapidly as possible if and when we receive authority.

I believe your staff in Fredericton is reasonably well informed concerning the plans and will be able to provide further information concerning details.

Yours very truly,

(Sgd) Ken

K. B. Brown
Acting Deputy Minister

KBB/hg

14-0-31

901311

7.9.14
FB-16(1961)

MEMORANDUM TO:

Dr. A. L. Pritchard
Dr. J. L. Kenk
Mr. H. W. Beall
Mr. W. W. Muir

November 28, 1960

Following the recent meeting of the Interdepartmental Committee on Forest Spraying Operations I wrote to Mr. K. B. Brown, Acting Deputy Minister of Lands and Mines, New Brunswick, regarding plans for spray operations in New Brunswick in 1961. A copy of his reply of November 24 is attached.

I have also just received from Dr. Balyea a map showing the main areas proposed by Forest Protection Limited for spraying in 1961.

I expect to be in touch with the members of the Committee by 'phone in the near future with regard to the desirability of holding another meeting of the Interdepartmental Committee soon.

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp

cc: Dr. R. H. Balyea
Dr. J. J. Fetten

GOVERNMENT OF CANADA

ACTION REQUEST

CGSB 6-GP-12
P.P.&S. Cat. 3433

TO Q. [signature]

LOCATION Mrs. Lyon Ottawa

FOR: File FILE NO.....

☐	ACTION	☐	NOTE & FORWARD
☐	APPROVAL	☐	NOTE & RETURN
☐	COMMENTS	☐	REPLY, PLEASE
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☐	INVESTIGATION	☐	TRANSLATION
☐	MORE DETAILS	☐	YOUR REQUEST
☐	NOTE & FILE		

PREPARE MEMO TO:.....

REPLY FOR SIGNATURES OF:.....

REMARKS: Mr. Brown's letter throws further light on N.B. shipping returns for 1961

FROM	PHONE	LOCATION	DATE
[signature]			Nov 29

14-0-31

FILE No.

Hall

CANADA

DEPARTMENT OF FISHERIES
OTTAWA

December 1, 1960.

Mr. H. W. Beall,
Chief,
Forestry Operations Division,
Department of Northern Affairs
and National Resources,
238 Sparks Street,
O T T A W A.

Dear Mr. Beall:

Enclosed please find a copy of the notes from the October 31 meeting of the Interdepartmental Committee on Forest Spraying Operations. Also included are Appendices quoted from and referred to in the notes.

Yours very truly,

E. W. Burridge,
Acting Secretary,
I. C. F. S. O.

Encl.

GOVERNMENT OF CANADA

ACTION REQUEST

CGSB 6-GP-12
P.P. & S. Cat. 3433

TO [redacted]

LOCATION [redacted]

FOR: [redacted]

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- [ ] YOUR REQUEST

PREPARE MEMO TO:.....

REPLY FOR SIGNATURES OF: Oelbaum

REMARKS:

for 1961 survey projects by provinces, in Appendix X (last 2 pages).

FROM	PHONE	LOCATION	DATE
[redacted]			Feb 2/60

14-0-31

NOTES OF A MEETING OF THE INTERDEPARTMENTAL COMMITTEE FOR FOREST SPRAYING OPERATIONS HELD AT 10 A.M. ON OCTOBER 31, 1960 IN ROOM A-227 OF THE SIR CHARLES TUPPER BUILDING, OTTAWA.

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1. Introductions:

Those present -

Dr. M. L. Prebble	-	Department of Agriculture, Chairman
Mr. H. W. Beall	-	Department of Northern Affairs and National Resources
Mr. W. W. Mair	-	Department of Northern Affairs and National Resources
Dr. J. L. Kask	-	Fisheries Research Board of Canada
Mr. E. W. Burridge	-	Department of Fisheries
Dr. J. J. Fettes	-	Department of Agriculture
Dr. R. M. Belyea	-	Department of Agriculture
Mr. R. R. Lejeune	-	Department of Agriculture
Mr. W. A. Reeks	-	Department of Agriculture
Dr. R. R. Logie	-	Department of Fisheries
Mr. K. Jackson	-	Department of Fisheries
Mr. H. A. Richmond	-	B. C. Loggers' Association
Mr. B. W. Flieger	-	Forest Protection Limited

2. Proposed order of business:

Dr. Prebble opened the meeting by presenting the following agenda for consideration and adoption -

1. Introductions
2. Proposed order of business
3. Review of Operational Spraying Programs, 1960
   a. Spruce budworm, New Brunswick
      (summary report on budworm control by Mott and Fettes;
      summary report on aquatic fauna, Fish. Res. Bd.;
      summary report on birds;
      comments by Flieger, Belyea, others;
      discussion)
   b. Spruce budworm, Quebec
      (summary report by Blais; comments and discussion)

Need for next meeting: Why should so many pests & all fly. die naturally in unsprayed controls? (Fig 2) Copy III
Answer: Because they must feed, boil and work slightly through cages & eventually die of starvation.

c. Black-headed budworm, British Columbia

(summary report by Kinghorn; effect on aquatic fauna; comments by Lejeune, Richmond and others; discussion)

d. Saddle-backed looper, British Columbia

(synoptic statement by Lejeune; comments and discussion)

4. Review of Experimental Spraying Projects, 1960

a. Experiments with Bacillus thuringiensis against forest insects

(New Brunswick - synoptic statement by Mott, Angus, Heimpel
British Columbia - synoptic statement by Kinghorn, Angus, Heimpel)

b. Experiments with Bacillus thuringiensis and small mammals

(Canadian Wildlife Service and University of Ottawa) and fish (Fisheries Research Board)

c. Aerial dispersal of virus suspensions against the Swaine sawfly in Quebec (synoptic statement by Prebble)

d. Aerial dispersal of insecticides to prevent ambrosia beetle damage in log booms, British Columbia (synoptic statement by Richmond; comments and discussion)

5. Forecast of aerial spray projects in 1961

(a) operational
(see synopsis of 1960 infestations prepared by Prebble, October 26, 1960; review of more recent information; comments and discussion)

(b) experimental

6. Other business

To accompany the agenda Dr. Prebble distributed a synopsis of results of programs carried out to assess the control of spruce budworm by D.D.T. spraying in New Brunswick, a preliminary report on the effectiveness of D.D.T. spraying against black-headed budworm in British Columbia, the results of laboratory

and field studies of the effectiveness of Bacillus thuringiensis on budworms carried out by Forest Biology Laboratories, and a forecast of forest insect infestations in 1961.

3. Review of Operational Spraying Programs 1960

3a. Spruce budworm, New Brunswick

Dr. Fettes reviewed the results of the 1960 studies (see Appendix I) and brought out the following principle conclusions (two independent studies yielded comparable results):

(i) Larval mortality higher at droplet density of 10 or more per/sq/cm. and that control was adequately high at densities of 5-10 drops per/sq/cm. at both DDT concentrations.

(ii) At dosages of less than 5 drops per/sq/cm. control was in general inadequate but somewhat higher at the 12½% than at the 6¼% DDT concentration.

(iii) In an overall comparison of all droplet densities the 12½% DDT concentration gave mortality in general 7% higher than the 6¼% DDT but most of this difference derived from low deposit density study points.

(iv) In larval mortality studies there was no significant difference between dosages of ½ or ¾ U.S. gallons of 6¼% DDT formulation per acre.

(v) Pupal studies agreed in general with larval studies indicating about 10% higher overall control with the 12½% DDT concentration than with the 6¼% DDT concentration.

(vi) The percentage control was greater at high than at low population densities.

Dr. Belyea indicated that there had been a general two-fold increase in egg populations in unsprayed areas, from 1959 to 1960, and that in sprayed areas egg population trends were substantially less in areas sprayed at 12½ per cent DDT than in those sprayed at 6¼ per cent DDT.

Mr. Flieger made the following points in discussion:

(i) He was not surprised that no significant difference had been found in performance of the Stearman and Grumman aircraft since the aircraft had been calibrated to deliver the required dosages of DDT.

(ii) In planning a program the most important bases for choice of aircraft in a particular area are cost, payload,

speed, manoeuvrability and availability, and he did not believe these bases for selection would be changed.

(iii) Pilot performance is a very important factor influencing spraying operations but this had not been taken into account in the comparative studies that had been reported and would be very difficult to assess. Competent Grumman pilots are difficult to obtain.

(iv) He felt that the results summarized in Appendix I represented an oversimplification of a complex situation and that more detailed reporting in future might facilitate prediction of infestation intensity in each area, emphasis being placed on surviving populations.*

(v) He felt that it was somewhat unfortunate that the results of the two independent studies in New Brunswick in 1960 had been merged in Appendix I and thought that the importance of droplet density had been overemphasized, particularly since he felt that in large-scale control programs the operator could not ensure the uniform droplet dispersal suggested to be necessary for adequate control.

As a consequence of Mr. Flieger's remarks, a summary of the data of Study A by the Chemical Control Section is presented in Appendix II. These data are the result of studies on line plots one mile in length in the three dosage areas. A division of the lines into sections representing various droplet density levels shows clearly the impact of droplet density on insect control, and also provides a measurement of the variability in deposit throughout the study area. These records show the importance of striving for a more uniform distribution of adequate droplet density throughout the control area, the volume of spray emitted from the aircraft being sufficient to attain such deposit.

Referring to studies on aquatic fauna, Dr. Kask felt that, despite lack of sufficiently early warning and the consequent diversion of personnel from other projects, a remarkably creditable study program had been carried out in 1960 by the Fisheries Department and the Fisheries Research Board. The most important outcome of these studies was that fewer fish and aquatic insects had been killed at lower than at higher concentrations of DDT.

* Note by Chairman: The original field data, compilations, and maps are on file in the Fredericton Forest Biology Laboratory and the Chemical Control Section, and are available for inspection and study by those concerned with the details of operational planning for spraying, and are so used. With many hundreds of sampling stations throughout millions of acres, synoptic tables and reports must be used in broad comparative studies such as are made by this committee.

E R R A T U M

Notes of the October 31 meeting of the Interdepartmental Committee for Forest Spraying Operations

Page 5, under Dr. Logie's observations and recommendations change no. (ii) to read -

"Muzroll Brook was the only one of the streams studied by Dr. Ide in 1960 that had never been sprayed. In this stream he found a much larger population of aquatic insects than in any other and this was particularly noticeable in the caddis fly group. The inference to be drawn is that DDT spraying has a pronounced and longlasting effect on the insects of a sprayed stream which is particularly marked in the case of the caddis fly, one of the most important food organisms for young fish."

Dr. Logie reviewed the results of these studies, that are included in Appendix III in greater detail. The principal conclusions were:

(i) Mortality of caged fish had generally been lower in areas treated at half-strength DDT than in areas treated at full strength.

(ii) About 90 per cent mortality of aquatic invertebrates had occurred in streams treated at full- and half-strength DDT.

(iii) Electroseining indicated that the effects upon fish were less serious at half-strength DDT spraying than at full strength.

Arising out of the 1960 studies, Dr. Logie made the following observations and recommendations:

(i) Some of the recorded fish mortality was inconsistent with anticipated dosages over the streams; but it has been subsequently pointed out by Dr. Fettes that the recorded salmon fry mortality is consistent with the records of spray deposit.

(ii) Dr. Ide found that there had been a drastic decline of insects in Muzroll Brook following spraying in 1957. Since that time some forms have repopulated the stream fairly quickly, but the population of caddis flies has been eradicated.

(iii) Since he considered that the results based on caged fish may not be typical, and since populations of aquatic insects are known to vary widely at different times of the year, he recommended that future studies should be based upon sampling of aquatic insects and fish in a single or limited number of streams, before spraying and for a protracted period afterwards, closely observing numbers and condition of survivors.

Mr. Beall asked if data were on hand on salmon populations returning to the rivers from generations sprayed earlier. Dr. Kask stated that in general the return runs from earlier-sprayed generations were declining.

With regard to the possible effect of the 1960 spraying program in New Brunswick on birds, Dr. Prebble had written to Mr. B. S. Wright of the Northeastern Wildlife Station and had been informed that woodcock samples (wings) will be gathered until early November and then sent to the Patuxent Wildlife Research Refuge in Maryland for analysis as to age and sex. Mr. Wright does not expect to have his report completed before mid-January. In samples from previous years, Mr. Wright has found appreciably smaller percentages of immature woodcock in sprayed areas than unsprayed areas. The Northeastern

Wildlife Station had a census crew working on duck populations in the Portobello area in 1960 but the results were complicated by extensive drought. Mr. Flieger stated that he had sent two men by canoe into the Portobello area shortly after the spraying operation and many ducklings had been observed.

3b. Spruce budworm, Quebec

Dr. Prebble reported that about 33,000 acres of budworm-infested forest in the Lake Kedgwick-Lake Mistigougueche area had been sprayed at ½ lb. DDT per ½ gallon of spray per acre. The control was estimated at 90 per cent. Egg populations were generally low in the sprayed area in the fall of 1960, but quite high in adjacent areas that had not been sprayed in 1960.

3c. Black-headed budworm, British Columbia

The results of the control program are summarized in Appendix IV. Mr. Lejeune concluded that, despite complications introduced by a generally declining population, there is evidence that the black-headed budworm can be controlled by ¼ lb. DDT in 1 gallon of spray per acre.

Dr. Prebble and Mr. Lejeune referred to the difficulty of being certain that spraying operations were really necessary in black-headed budworm outbreaks, owing to the history of a rather rapid collapse of infestations. Mr. Richmond referred to extensive timber mortality in the Salmon River area of Vancouver Island in the mid-1940's, that had been attributed to the black-headed budworm, and believed that the indistry would wish to spray severe infestations rather than run the risk of timber mortality.

Mr. Jackson in reviewing the Department of Fisheries' assessment studies in the Queen Charlotte Islands (see Appendix V), stated that the Sachs Creek experimental spray project was undertaken to pre-assess the effect on fish and aquatic insects of treating an area with ¼ lbs. DDT per U. S. gallon (of fuel oil without an emulsifier) per acre. From pre-assessment studies it was found that:

(i) Caged fish at Station A, downstream of the spray area and below a floating charcoal baffle, yielded no more than holding mortality, indicating that charcoal baffles have promise as a practical method of removing DDT from streams within a spray area.

(ii) Of the fish at Stations B & C in the spray area, retained in covered and uncovered and stacked live-boxes, the only significant mortality occurred in the upper box (0 to 6 inches) of the stacked series indicating the presence of thin lethal surface layer on the stream produced by this particular spray formulation

(iii) No dead aquatic insects were observed during or following the spray operation.

Mr. Jackson stated that before the main spray program was commenced a field and air reconnaisance of the area was undertaken. During the operation smoke markers and other devices were used to mark salmon streams. As a result of these precautions spraying of salmon streams was kept to a minimum. Mr. Jackson added that much credit for the avoidance of fish kill in the Queen Charlotte Islands' budworm control project must go to the B. C. Loggers' Association and the Forest Biology Laboratory personnel.

3d. Saddle-backed looper, British Columbia

A synopsis of the 1960 control operation covering about 1,800 acres is included in Appendix VI. Mr. Lejeune reported that unsatisfactory insect kill was recorded and was attributed to inadequate spray coverage and to late application in relation to insect development.

Dr. Fettes felt that owing to the heavy canopy a higher dosage than one gallon per acre may be needed to penetrate to the lower crown levels where early feeding is heaviest. Little is known of the concentration of DDT required to control the saddle-backed looper, but studies by the Chemical Control Section are planned to compare control of looper achieved with various concentrations of DDT using the black-headed budworm as a standard.

Mr. Richmond stated that if higher dosages are required, the B. C. Loggers' Association would be concerned with the possibility of injuring fish and would take every precaution to ensure that airdrift at the time of spraying would be away from the Kitimat River.

Mr. Jackson stated that there had been very close co-operation between the B. C. Loggers' Association and the Fisheries Department in connection with spraying operations on the West Coast and they wished such co-operation to continue. Mr. Richmond stated that the Loggers' Association felt that its efforts in establishing good relations might be jeapordized by unapproved forest spraying operations carried out by private individuals or municipalities and hoped that some regulatory control might be exercised through the B. C. Forest Service. Dr. Kask made the suggestion that such difficulties could be overcome if the Federal Government took responsibility for carrying out forest spraying operations, due consideration being given to the various resource interests. Dr. Prebble doubted whether this would be feasible owing to limitations on the Federal Government in letting contracts for roads, airstrips, hiring of aircraft, and purchasing of materials without tendering,

and this would be difficult where time was limited. Mr.Beall felt that responsibility rested with the Provincial Governments which controlled the forest resources. Mr. Richmond felt that the local industry and the Provincial Government could work out appropriate arrangements for collaboration with the fisheries interests, the Forest Biology Division being responsible for assessing hazard and making recommendations for control operations.

4. Review of Experimental Spraying Projects, 1960

4a. Experiments with Bacillus Thuringiensis against forest insects

Referring to trials carried out against the spruce budworm in New Brunswick (Appendix VII) Dr. Prebble noted that rather disappointing results were obtained in 1960, evidently owing to inadequate deposits of the Thuricide on the budworm-infested trees.

Regarding the trials in British Columbia (Appendix VIII) Mr. Lejeune reported somewhat more encouraging results, although he stressed that quantitative data were difficult to obtain owing to decline of the black-headed budworm populations. The spray formulations had been improved before the British Columbia trials and it appeared that dosages within the range of practicability for aerial spraying might be effective against the black-headed budworm.

Dr. Prebble noted that Dr. Fisher of the Bioferm Corporation was seeking further improvement in Thuricide formulations and that the Forest Biology Division hoped to be able to carry out additional studies in 1961. Mr. Richmond stated that the B. C. Loggers' Association was very interested in the trials with Bacillus thuringiensis and would be glad to support additional experimental studies.

4b. Experiments with Bacillus thuringiensis and small mammals

Mr. Mair reported that laboratory tests of the toxicity of Thuricide to white mice, rats and guinea pigs had been conducted in 1960 at Ottawa University. It was concluded that Thuricide was not toxic to the mammals exposed.

Mr. Jackson stated that the results of bioassay tests carried out on coho salmon fry at the Nanaimo Biological Station had established that the Thuricide preparation had been demonstrated to be toxic to fish, but much less so than DDT. Median tolerance limits of DDT-&Thuricide-oil preparation were estimated at 0.08 mg/L and 50 mg/L respectively (see Appendix IX). No mortality attributable to Thuricide was found in caged fish experimentally exposed in the Queen Charlotte Islands.

change on p. 2 of App. IX, and 9.08 on p. 3

4c. Aerial dispersal of virus suspensions against the Swaine sawfly in Quebec

Dr. Prebble stated that virus suspensions applied from aircraft in Quebec had been found to be very effective against the sawfly. The virus was applied in oil-water suspensions, or as water suspensions with latex and blood plasma, polyhedral bodies being at a concentration of 1 million per cc. The oil suspensions provided most satisfactory, good control having been achieved in parts of the forest where recorded dosage on deposit cards was as low as 1/100 gallon per acre.

4d. Aerial dispersal of insecticides to prevent ambrosia beetle damage in log booms, British Columbia

Mr. Richmond stated that prior to recent development of application of benzene hexachloride by helicopter, spraying had been done by hand - a slow and costly operation. In 1960, 30 million board feet of logs had been sprayed at the rate of 10 lbs. of gamma isomer BHC per 10 gallons of spray per acre of boomed logs. The cost was approximately 17½¢ per 1,000 board feet. Ambrosia beetle attach had been prevented.

Mr. Jackson stated that injury to fish had been confined to the upper water levels under the log booms and had not extended to fish caged a short distance away from the booms. He also stated that results of experiments in 1960 might allow the Department of Fisheries to relax limitations on log-boom-spraying except in places where fish are expected to be abundant, e.g. in river estuaries at time of juvenile downstream migration, or the outlets of lakes at the same period. Mr. Richmond noted that the Department of Fisheries has recommended that spraying of log booms in lakes and rivers be completed before mid-April to avoid damage to salmon fry, necessitating speedy application which is now possible through the use of helicopters.

5. Forecast of aerial spray projects in 1961

The information available at the time of the meeting is summarized in Appendix X.

Mr. Flieger noted that plans for spraying operations in New Brunswick in 1961 would not be formulated until about mid-November when Forest Protection Limited would be giving further study to the status of the infestation in New Brunswick. Dr. Prebble undertook to write to Mr. Brown of the Department of Lands and Mines for a statement of plans as soon as possible after mid-November.

Dr. Kask said that he considered it important to know, particularly for New Brunswick, whether DDT spraying

is likely to be carried out on an annual basis. This knowledge is necessary both to the Department of Fisheries and the Fisheries Research Board for planning and financing of assessment programs. Dr. Logie noted that in a recent report from the Fredericton Laboratory there was a reference to the possibility that the 1960 decade might tend to be dryer and more favourable for budworm population increase than the 1950 decade. Dr. Prebble pointed out that there was no certainty that this would necessarily happen. Mr. Flieger remarked that present methods of predicting future infestations did not permit spraying plans to be made even a full year in advance.

In response to a query from Dr. Kask, Dr. Prebble stated that forest spraying operations could not be equated on current annual timber production alone. Timber would normally be harvested each year from possibly one or two per cent of the infested area but nevertheless it is vitally important to prevent destruction of trees over huge areas in order that continuous timber production may be possible. If huge areas were permitted to be killed the fire hazard would be extreme and the next tree generation would again present huge areas of even-aged forest becoming highly susceptible more or less simultaneously.

Dr. Logie stated that continued spraying of large areas in New Brunswick could profoundly influence management of Atlantic salmon and although the results of spraying might not be reflected immediately, continuous spraying would probably cause ultimate reduction of populations of adult salmon. He considered that studies should be undertaken to determine the effect of spraying on the reduction of salmon stocks. Dr. Kask stated that if spraying had to be carried out he would appeal for it to be done as carefully as possible. It is not a question of "fish versus trees" but the question of employing all possible expedients to preserve two valuable resources.

In response to a query from Mr. Mair, Dr. Fettes, Dr. Prebble and Mr. Flieger brought out that in the matter of concentration and dosage of insecticide, a compromise was required as to flying costs and degree of control to be expected.

In closing the meeting, Dr. Prebble drew attention to the fact that the Committee's function is advisory to the several Federal Government Departments involved. The Interdepartmental Committee would meet in the near future to study the available data in greater detail and would prepare its recommendations. Negotiations regarding the operations to be conducted in New Brunswick in 1961 would be initiated by the Department of Fisheries directly with the New Brunswick Department of Lands and Mines.

APPENDIX I

PRELIMINARY STATEMENT ON COMPARISON OF TWO CONCENTRATIONS OF DDT SPRAY USED AGAINST THE SPRUCE BUDWORM IN NEW BRUNSWICK IN 1960

D. G. Mott, Forest Biology Laboratory, Fredericton
J. J. Fettes, Chemical Control Section, Forest Biology Division, Ottawa

Experiments by the Chemical Control Section, Forest Biology Division, in 1958 and 1959 indicated that a reduction in DDT concentration from 12.5% at 1/2 gallon per acre (the spray concentration and dosage used in New Brunswick spruce budworm aerial spraying operations since 1953) to 6.25% at 1/2 gallon per acre could effect acceptable control of budworm larval populations, providing 10 or more drops of spray were deposited per square centimeter. Studies by Fisheries Research Board suggested that the lower concentration would reduce damage to fish and other aquatic fauna. A decision to test the two spray concentrations operationally in 1960 permitted an assessment of their relative effects on a large scale; a third spray dosage, 6.25% DDT at 3/4 gallon per acre was also employed, and its effectiveness was also assessed.

Two largely independent assessments of the effectiveness of the two spray concentrations were made. Study "A" was conducted by the Chemical Control Section and was mainly an assessment of larval mortality in relation to spray deposit, using line plots in selected areas. Study "B" was conducted by the Forest Biology Laboratory, Fredericton. Point plots were used to assess larval mortality in relation to spray deposit, and in addition resultant changes in pupal and egg populations throughout the whole spray area. Both studies were also designed to compare the effectiveness of the two aircraft types, Stearman and Avenger. Integrated studies of fish and other aquatic fauna were carried out by the Canada Department of Fisheries, Halifax, and the Fisheries Research Board, St. Andrews; they will be reported separately by these agencies.

It should be pointed out that the broad conclusions drawn in this statement are based on a preliminary analysis of data only. While it is doubted that more complete analysis of the large body of data collected in 1960 can materially affect these conclusions, it may be expected to reveal information of interest on a number of facets of the 1960 operation and perhaps explain some of the inconsistencies recorded.

Spray Deposit and Larval Mortality

Table 1 and Figs. 1, 2 and 3 summarize the important findings from studies "A" and "B". Careful assessment of spray deposit cards has shown that only 32% of the area studied received deposits of 10 droplets or more per square centimeter; 68% received less than 10 and 48% received less than 5. At deposits below 10 droplets per square centimeter larval mortality was less with low than with high concentration, while at deposits of 10 droplets or more there was little difference. Generally, higher larval mortality was demonstrated with increasing droplet density. Throughout the whole area studied the combined studies revealed a 7% difference in larval mortality between spray concentrations, in favour of the high concentration. It should be noted, however, that this

difference is largely the result of a 14% difference in mortalities between the two spray concentrations at the lowest droplet density range, which represented roughly half the total area. It seems clear that where about 10 or more droplets per square centimeter of spray were deposited there was little difference in the performance of the two spray concentrations. An important difference between the results measured on the operation of 1960 and earlier experimental results is that mortalities in the 1960 operation were higher at deposits of less than 10 droplets per square centimeter than was experienced in experimental sprayings.

It is of interest to note that in the entire area studied, based on the analysis of about 1,000 spray deposit cards, the average droplet density was between 7 and 9.5 droplets per square centimeter, in spite of the fact that 48% of the area received deposits of less than 5 droplets per square centimeter.

The higher dosage rate of 3/4 gallon per acre of low concentration spray should have resulted in higher droplet density, higher gallons per acre deposited on the ground, and greater larval mortality than the 1/2 gallon per acre dosage rate of the same spray. No consistent differences were, however, apparent in the plots sprayed at this concentration. The area that received the dosage of 3/4 gallon per acre of low concentration spray is included in the summaries given above as part of the low concentration area.

Comparison of spray deposit and larval mortality figures in the areas sprayed by the two aircraft types showed that differences in droplet density were small and not consistent in the two studies, and that resultant larval mortality was very similar with the two aircraft, perhaps slightly in favour of the Stearman (Table 2).

Mortality at Pupal Stage

Table 3 summarizes the results of the pupal survey conducted in Study "B". A consistent effect of population density on the control obtained, as measured at the pupal stage, is revealed; lower control was effected at the lower population levels. Over the entire sprayed area there was a difference in control between the two spray concentrations at the pupal stage of about 10% in favour of high concentration. This difference is comparable to the 7% difference observed in larval mortality (Table 1).

Pupal counts in areas of high population density sprayed with Avenger aircraft at 3/4 gallon per acre of low concentration spray, indicated better control than comparable areas sprayed at 1/2 gallon per acre (83% vs. 72.6% - Table 3). These results are not consistent with those reported above for spray deposit density and larval mortality for the two spray dosages.

Pupal surveys conducted in the areas sprayed by the two aircraft types suggest that control was better with the Avenger when high concentration spray was applied, but better with the Stearman when low concentration spray was applied, at equivalent population densities. These results are at present inexplicible. However, combining areas sprayed with both concentration sprays, results indicate a slight advantage to the Stearman.

Egg Population Sampling

The results of the extensive egg mass survey conducted in Study "B" are summarized in Table 4 in such a way as to facilitate comparison of egg mass populations throughout the Province in 1960 with egg mass populations at the same locations in 1959, both within and without the area sprayed in 1960. In those parts of southern and eastern New Brunswick that were not sprayed in 1960, egg mass populations in 1960 were approximately 1.9 times those of 1959. Within the sprayed area as a whole they were reduced in 1960 to 0.78 of 1959 populations. This represents a reduction of 59% due to spraying. However, within the area treated with low concentration spray at the 1/2 gallon per acre dosage, egg mass populations in 1960 were 1.30 times those of 1959, while in the area treated with low concentration spray at 3/4 gallon per acre they were reduced to 0.49 of 1959 populations, and in the area treated with high concentration spray they were reduced to 0.61 of 1959 populations. These represent reductions due to spraying of 32%, 74% and 68%, respectively. Although the difference in this measure of the effect of the two spray concentrations appears to be large in comparison with those suggested by the larval mortality studies and the pupal surveys, long-term population studies on the spruce budworm reveal that small differences in larval and pupal populations often have a disproportionately large effect on the resulting egg populations. The magnitude of the above differences is not inconsistent with earlier experience.

Protection of Foliage

No clear differences between the two spray concentrations or between the two aircraft types were apparent in 1960 in protection given to balsam fir foliage over the whole area sprayed. It must be remembered that spraying in 1960 was purposely delayed to a time when good protection of foliage could not be expected.

Summary

There is an indication in all of the studies that the high concentration spray did result in a somewhat higher level of insect control than the low concentration spray. It seems clear that where a good deposit of spray was achieved (about 10 droplets or more per square centimeter) the low concentration spray was as effective in killing budworm larvae as the high concentration spray. It also seems clear that spray deposits of this kind were achieved over only about one-third of the operation. On the other hand, nearly one-half of the operational area received deposits of less than 5 droplets per square centimeter and control was lower, especially at the low spray concentration. It is suggested therefore that continued effort be made in future operations to improve the distribution of spray droplets reaching the ground.

The principal aim of aerial spraying against the spruce budworm in New Brunswick has been, except in 1960, the protection of balsam fir foliage and thus the prevention of tree mortality. The timing of the 1960 operation was purposely delayed, however, and generally little foliage protection was obtained. It should be pointed out, therefore, that the relative effectiveness of the two spray concentrations in protecting balsam fir foliage could not be adequately

assessed in the 1960 operation. It is suggested, therefore, that consideration should be given to comparing the two spray concentrations again under operational conditions designed to effect greatest possible protection of foliage. An earlier report from the Forest Biology Laboratory (Sept. 9/60) has already pointed out that any spray operation in 1961 should return to early timing of spraying over most of the area in order to protect 1961 foliage production and prevent tree mortality.

Comparisons made of the relative effectiveness of the low concentration spray applied at 3/4 gallon per acre and the same concentration applied at 1/2 gallon per acre were not entirely consistent. In the studies designed for a direct measurement of larval mortality, no advantage of the 3/4 gallon per acre dosage was established. However, in the more extensive studies comparing pupal population levels and egg population trends there is evidence that the 3/4 gallon per acre dosage yielded better control than the 1/2 gallon per acre dosage.

Comparisons of the two aircraft types were somewhat inconsistent, but suggest a slight advantage in favour of the Stearman.

Statement prepared for Meeting of the Directors
Forest Protection Limited, October 20, 1960.

Table 1. Summary of Larval Mortality Data, Showing Effect of Droplet Density and Concentration of Insecticide.

Number of drops per sq. cm.	Percentage of locations Both studies	Average mortality due to treatment					
		12.5 per cent DDT			6.25 per cent DDT		
		Study "A"	Study "B"	Combined (Weighted)	Combined (Weighted)	Study "A"	Study "B"
0 - 5	48	68	75	72	58	50	66
5 - 10	20	96	99	97	88	85	91
10+	32	95	82	91	95	97	91
Average weighted by percentage of locations:				83	76		

Table 2. Comparison of Spray Deposit and Degree of Larval Control Obtained with Stearman and Avenger Aircraft.

Study	Drops/cm.^{2}		Percentage control	
	"A"	"B"	"A"	"B"
Stearman	10.3	6.7	86	87
Avenger	8.9	7.8	84	81

Table 3. Summary of Pupal Survey Data, Showing Effect of Spray Concentration, Aircraft Type and Population Level on Percentage Control.

Spray concentration	Aircraft	Population level (1959 egg masses/ 100 sq. ft.)	Dosage gal./acre	No. of points	No. of pupae	Percentage control
High	Stearman	Low Up to 174	1/2	29	1.872	29.3
"	"	Med. 175-399	1/2	43	3.305	66.5
"	"	High 400 & over	1/2	52	1.332	92.4
High	Avenger	Low	1/2	28	1.608	39.3
"	"	Med.	1/2	38	2.141	78.3
"	"	High	1/2	46	1.087	93.8
Low	Stearman	Low	1/2	27	1.529	42.3
"	"	Med.	1/2	40	1.651	83.3
"	"	High	1/2	-	-	-
Low	Avenger	Low	1/2	38	2.465	6.9
"	"	Med.	1/2	23	2.816	71.5
"	"	High	1/2	38	4.774	72.6
		High	3/4	31	2.957	83.0
Unsprayed		Low		181	2.648	
		Med.		22	9.870	
		High		7	17.444	

	No. points	Observed	Expected	Percentage control
All areas High concentration	236	1.873	11.271	83.4
All areas Low concentration	192	2.735	10.140	73.0

Table 4. Ratio between Egg Masses per 100 Square Feet of Foliage in 1960 and in 1959, in Various Outbreak Sectors and Treatments.

Area	No. of points	Eggs 1959	Eggs 1960	Ratio $\frac{60}{59}$	Per cent reduction due to spraying
Northern	296	8.03	7.49	0.93	
Southern Lightly Infested	123	11.79	24.20	2.05	
East Coast	73	121.7	217.0	1.78	
Check Areas	20	255.5	484.1	1.90	
Avenger Sprayed	170	227.7	179.4	0.79	58
Stearman Sprayed	110	195.4	147.2	0.75	61
Low Concentration Sprayed (1/2 gal.)	94	162.0	211.0	1.30	32
Low Concentration Sprayed (3/4 gal.)	32	236.0	116.0	0.49	74
High Concentration Sprayed	154	249.5	152.4	0.61	68
Entire Sprayed Area	280	215.0	166.8	0.78	59

$$\text{Per cent Reduction due to Treatment} = \frac{1.90 - \text{Observed ratio}}{1.90}$$

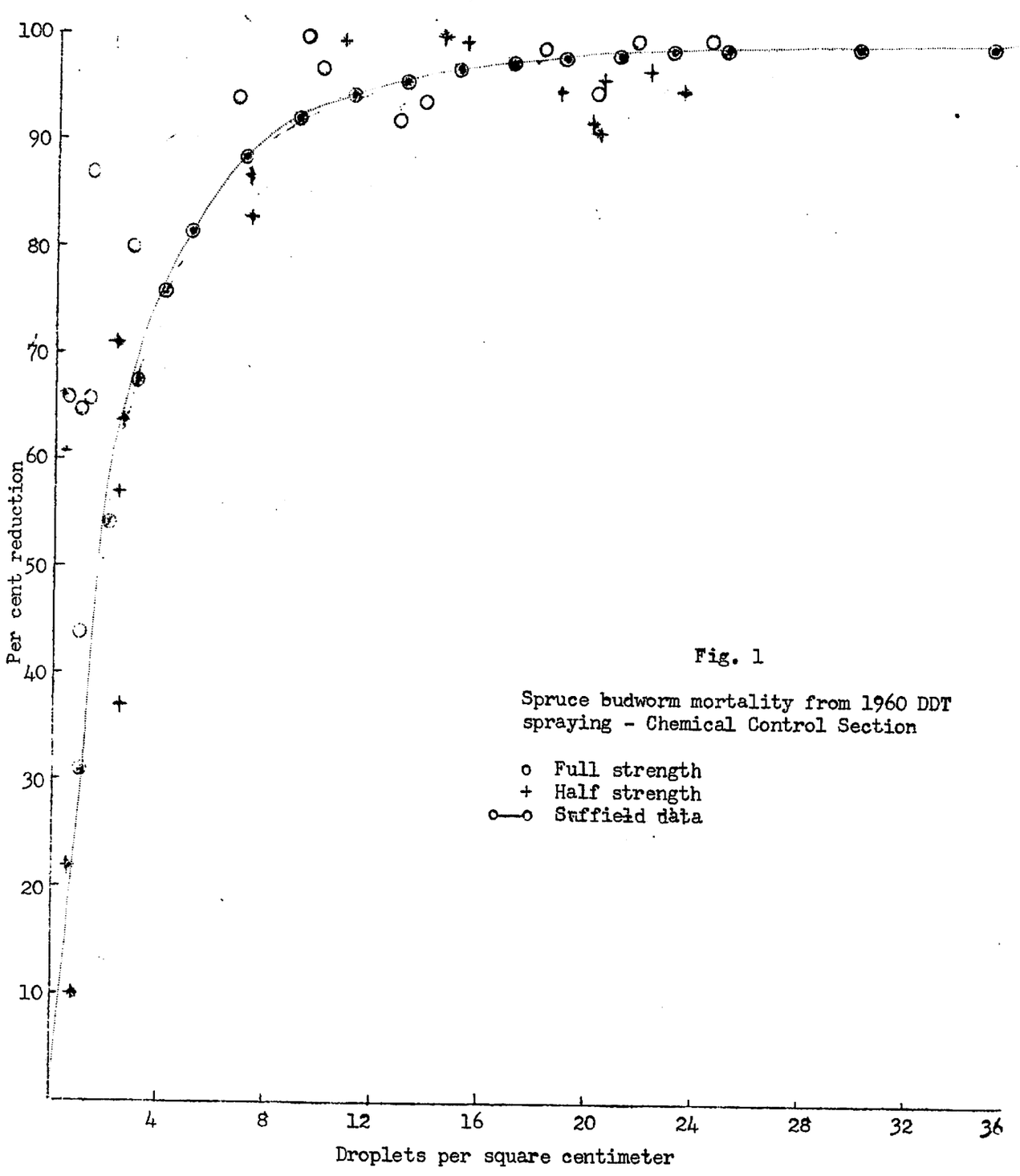


Fig. 1

Spruce budworm mortality from 1960 DDT spraying - Chemical Control Section

o Full strength
\+ Half strength
o—o Swffield data

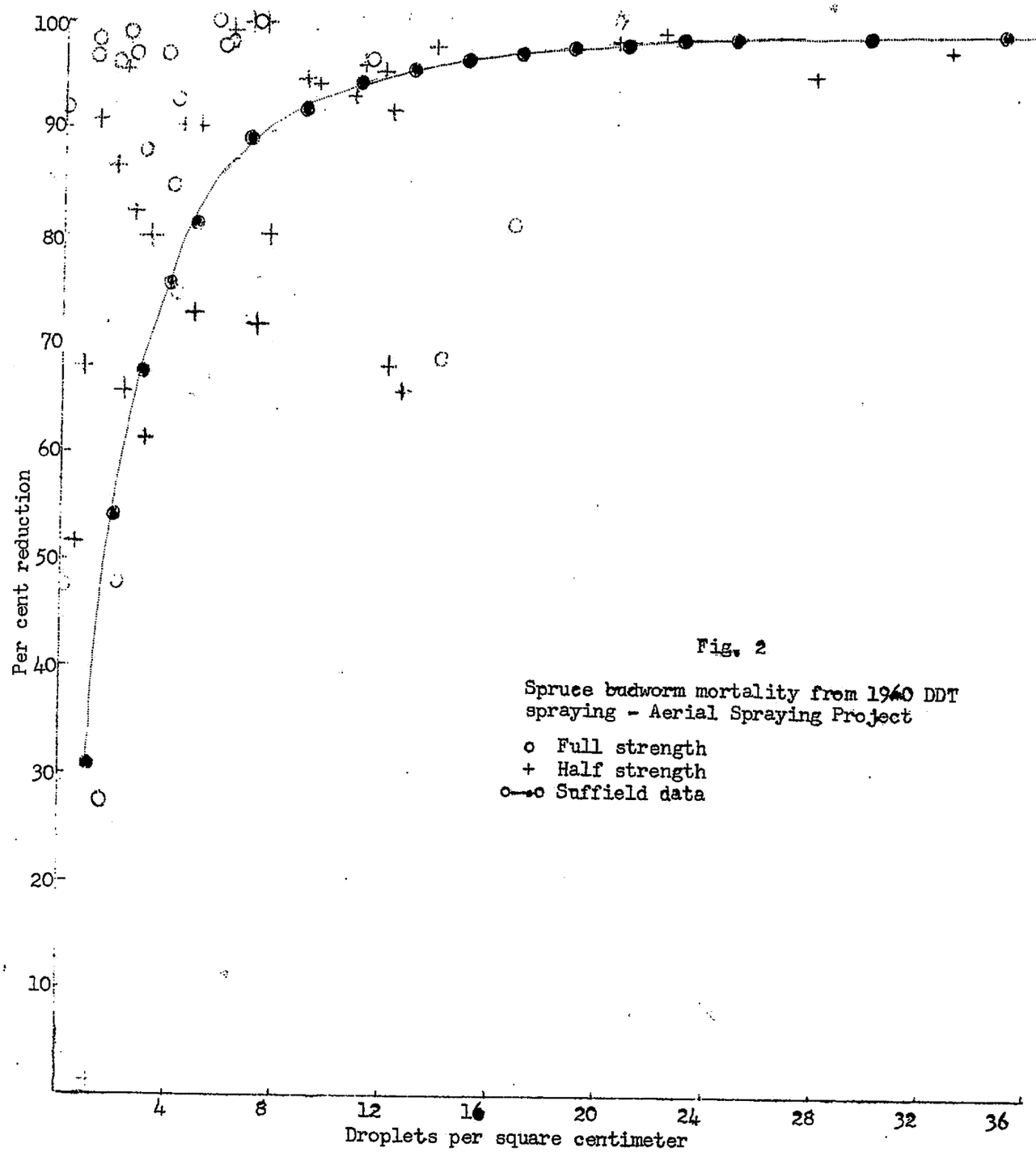
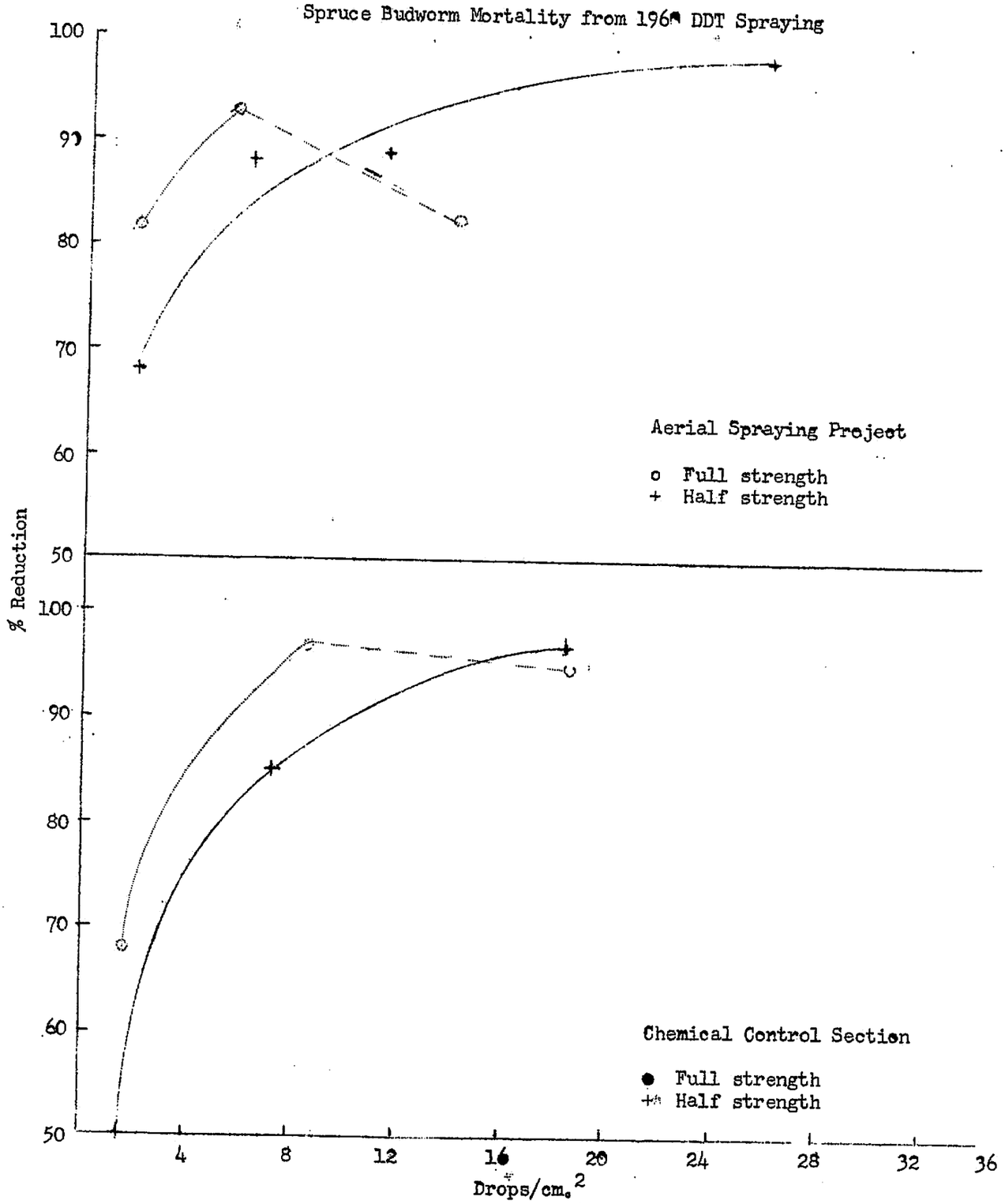


Fig. 2

Spruce budworm mortality from 1960 DDT spraying - Aerial Spraying Project

o Full strength
+ Half strength
o—o Suffield data


Spruce Budworm Mortality from 1964 DDT Spraying
100
90
80
70
60
50
% Reduction
Aerial Spraying Project
o Full strength
+ Half strength
100
90
80
70
60
50
Chemical Control Section
● Full strength
+ Half strength
4
8
12
16
20
24
28
32
36
Drops/cm.2

APPENDIX II

SUMMARY OF DATA FROM STUDY "A", CHEMICAL CONTROL SECTION, COMPARING CONTROL OF THE SPRUCE BUDWORM EFFECTED BY TWO CONCENTRATIONS OF DDT. (NEW BRUNSWICK, 1960)

6¼% DDT (½ strength) ½ gal./acre (Plot 1, Stewart Bk, Stearman a/c)

LINE A

Line Section(1)	No. Stations	Drops/cm^2	Approx. GPA	Expected Density(2)	Observed Density	% Control
1	2	20.3	0.1	0.146	.013	91
2	7	0.4	0.02	0.038	.013	66
3	28	18.8	.24	0.081	.004	95
Line Total	37	15.4	.22	0.074	.006	92
LINE B						
Line Total	40	15.2	.22	0.164	.0014	99.8
Plot Total	77	15.1	.22	0.119	.005	96

6¼% DDT (½ strength) ½ gal./acre (Plot 4, Muzroll Bk, Grumman a/c)

LINE A

Line Section	No. Stations	Drops/cm^2	Approx. GPA	Expected Density	Observed Density	% Control
1	6	20.0	0.28	0.133	0.011	92
2	18	7.1	0.12	0.135	0.017	87
3	4	2.3	0.08	0.154	0.045	71
4	6	10.7	0.13	0.142	0.0005	99.6
5	5	0.5	tr.	0.142	0.110	22
Line total	39	8.3	0.12	0.142	0.029	80
LINE B						
1	24	7.4	0.19	0.162	0.028	83
2	4	0.4	tr.	0.132	0.051	61
3	2	20.4	0.3	0.284	0.011	96
Line Total	30	7.3	0.17	0.168	0.030	82
Plot Total	69	7.8	0.15	0.155	0.030	81

(1) Consecutive sections along one-mile lines (A and B) with similar droplet densities, yielding averages shown in third column. Sampling stations at 2-chain intervals.

(2) Expected density is based on pre-spray population density and rate of decline observed during same period in unsprayed areas.

6¼% DDT (½ strength) ¾ gal./acre (Plot 5, Big Hole Bk, Grumman a/c)

LINE A

Line Section	No. Stations	Drops/cm^2	Approx. GPA	Expected Density	Observed Density	% Control
1	22	2.5	0.01	0.111	0.070	37
2	6	23.4	0.22	0.134	0.007	95
3	2	0.8	0.01	0.137	0.123	10
Line Total	30	6.6	0.05	0.117	0.060	49
LINE B						
1	9	2.4	0.10	0.133	0.057	57
2	3	14.4	0.32	0.153	0.000	100
3	14	2.5	0.09	0.128	0.046	64
4	15	22.1	0.22	0.121	0.004	97
Line Total	41	9.8	0.16	0.132	0.033	75
Plot Total	71	7.9	0.10	0.125	0.047	62

12½% DDT (full strength) ½ gal./acre (Plot 3, Cross Ck, Stearman a/c)

LINE A

Line Section	No. Stations	Drops/cm^2	Approx. GPA	Expected Density	Observed Density	% Control
1	8	12.7	0.27	0.136	0.011	92
2	25	1.0	tr.	0.144	0.080	44
3	8	6.7	0.35	0.103	0.006	94
Line Total	41	4.4	0.12	0.135	0.052	61
LINE B						
1	9	1.0	0.03	0.097	0.034	65
2	24	9.9	0.39	0.133	0.004	97
3	7	2.9	0.26	0.164	0.018	89
Line Total	40	6.6	0.29	0.130	0.013	90
Plot Total	81	5.5	0.21	0.133	0.033	76

12½% DDT (full strength) ½ gal./acre (Plot 2, Tay R., Grumman a/c)

LINE A

Line Section	No. Stations	Drops/cm^2	Approx. GPA	Expected Density	Observed Density	% Control
1	3	24.4	tr.	0.261	0.000	100
2	6	2.8	tr.	0.295	0.059	80
3	21	20.1	0.13	0.129	0.006	95
4	4	0.4	tr.	0.086	0.029	66
5	7	13.7	0.20	0.109	0.007	94
Line Total	41	14.8	0.10	0.161	0.016	90
LINE B						
1	1	21.7	tr.	0.373	0.000	100
2	12	1.3	tr.	0.164	0.055	66
3	5	18.2	0.20	0.199	0.002	99
4	18	3.1	0.02	0.222	0.025	89
5	3	9.3	0.53	0.123	0.000	100
6	2	1.3	0.05	0.144	0.016	87
Line Total	41	5.2	0.12	0.195	0.028	82
Plot Total	82	10.0	0.11	0.178	0.022	86

EFFECTS OF THE 1960 DDT SPRAYINGS IN CENTRAL NEW BRUNSWICK ON YOUNG SALMON, YOUNG TROUT AND AQUATIC INSECTS

A preliminary report to the Interdepartmental Committee on Forest Spraying Operations, to be held in Ottawa on October 31, 1960

In 1958 and 1959, in Kent and York Counties respectively, New Brunswick, small-scale field studies were made of the effects of various strengths of DDT insecticide on young salmonid fishes and aquatic invertebrates. The tests were arranged in collaboration with the Forest Biology Division of the Department of Agriculture, whose main interest was to determine the effectiveness of budworm control. The fisheries data indicated that DDT insecticide applied by aircraft at the rate of ¼ lb. DDT per acre had less serious short-term effects than regular ½ lb. DDT per acre on the survival of both young fish and the aquatic insect fauna comprising their main food. The volume of oil in which weights of DDT are mixed is important in describing insecticide dosages for budworm control. At the present state of our knowledge, however, it is assumed that for fisheries purposes the weight of DDT applied per acre is the important criterion of 'strength'.

With considerable difficulty arrangements were made to carry out similar field checks in 1960 within the area of over 2 million acres to be sprayed by Forest Protection Limited. At the time of submission of estimates for 1959-60 it was expected that no full-scale spraying would occur in 1960 because the recent budworm outbreak appeared to have collapsed. By fall 1959, however, a large woodland area in the St. John and Miramichi drainages was found to have high budworm hazard and subject to further DDT spraying. On the basis of the 1958 and 1959 experiments the Interdepartmental Committee on Forest Spraying Operations recommended that half-strength insecticide be substituted for the regular mixture. In January 1960 a compromise was reached assuring that the Miramichi part of the affected area would be sprayed with reduced concentration of DDT (southern part with ¼ lb. DDT per acre; northern part with 3/8 lb. DDT per acre), while the larger portion in the St. John drainage would receive full strength (½ lb. DDT per acre). Steps were then taken to find staff and equipment to permit some comparison of the effects of the different concentrations on fishes and their food.

The following were the main participants in the fisheries field work:

Observations on caged young salmon and trout:

H.Edwards, R.Macdonald (Department of Fisheries)
May 24 - July 15

C.J. Kerswill (Fisheries Research Board);
June 1-11
Three students provided by the N.B. Government;
June-July

Studies of aquatic invertebrates by Surber sampling and small stationary weirs:

F.P. Ide (under F.R.B. contract); May 24-June 21
R.H. Peterson (F.R.B. student assistant); May-August

Observations on native trout in streams before and after spraying:

J.W. Saunders (Fisheries Research Board); June 1-11

Autumn seining assessment of young fish populations:

Regular F.R.B. seining crews under supervision of P.F. Elson

The Department of Fisheries provided the experimental young hatchery fish for the holding cages, materials for the cages, and two vehicles for daily transportation of the field staff. The cages were constructed by Fisheries Research Board staff at Chatham, N. B., under supervision of E. J. Schofield.

In October 1960 five samples of 100 salmon parr were collected by electro-seining under P. F. Elson's supervision in full-strength, half-strength areas and unsprayed control areas, taken to St. Andrews and placed in tanks to compare the extent of delayed mortality that may be related to DDT intake. Preliminary results indicate greater autumn mortality among fish from full-strength sprayed streams.

The main sites for observations on caged fish specimens and for aquatic insect sampling are mapped in Figure 1, in relation to the 1960 spray areas as planned but not necessarily as sprayed.

Observations on caged young salmon and trout

On May 25 and 26, hatchery-produced young salmon and trout in lots of 50 and 100 were placed in cages at five places in the spray area and in the Sevogle River, Miramichi watershed, outside the spray area. (Figure 1). The sites were selected to provide a comparison among areas to be sprayed with full-strength insecticide (Cross Creek at two points), three-quarter strength (Big Hole Brook) and half-strength (Stewart Brook and Muzroll Brook). No attempt was made to use two stations within each strength type to compare results of spraying by different kinds of aircraft as was necessary for the budworm studies.

Behaviour and survival of the fish were observed on daily visits until mid July. The data for salmon parr, trout fingerlings

and salmon fry up to June 25 are summarized in Tables I, II and III. Data on trout fry cannot be tabulated conveniently because of irregular survival of the control, likely related to the early stage of development when transported from the distant hatchery. Cumulative daily mortalities of salmon fry and salmon parr up to July 15 are plotted in Figure 2, with spray dates shown by arrows. Areas under the curves are blocked in to permit comparison of cumulative mortalities up to June 25 for salmon fry and up to June 18 for salmon parr. Both fry and parr showed erratic swimming movements several days in advance of death as is typical of DDT poisoning, but these effects occurred later in fry than in parr.

By June 18, 8 days or longer after spraying first occurred, there were considerable differences in survival among the various lots of salmon parr and trout fisherlings, with minimum mortalities in the controls (Tables I, II, and Figure 2). Differences among survival of salmon fry were apparent one week later, by June 25 (Table III and Figure 2). Apparently the Stewart Brook watershed received much heavier DDT application than planned, and possibly full strength. The Stewart Brook mortalities by June 25 (88%, 40%, 96%), considering mortalities elsewhere in similar lots of fish, bear this out. Mortalities in the single remaining half-strength check area, Muzroll Brook, were consistently among the lowest of all by June 25 (47%, 22%, 26%). Big Hole Brook mortalities of salmon parr fell between the maximum at Cross Creek and the minimum at Muzroll Brook, as expected, but the Big Hole Brook trout fingerlings and salmon fry mortalities were less than expected. Some of these apparent inconsistencies may be explainable when water analyses for DDT have been completed by the Department of Agriculture.

It may be concluded that short-term survival after DDT spraying was considerably better in areas receiving reduced concentration than in full-strength areas. The data for salmon fry and salmon parr as shown in Figure 2, allowing for the inconsistencies in spraying that are inherent in full-scale commercial type operations, support the conclusion as well as could be expected. The unplotted trout fingerling data of Table II are similarly good.

Possibly the unexpectedly longer survival of fry than parr in 1960 may be related to the fact that they were still in the sac-fry stage when transferred to the cages and less advanced than in the 1959 tests. It is suspected that feeding of caged fish on poisoned drifting or bottom material may contribute more to short-term mortality than mere exposure to DDT suspended in water. Young caged salmonoids, particularly early fry, may escape a lethal dose by not feeding, and possibly through remaining close to the floor of the cages where the supporting framework may provide protection against DDT drifting with the current. It has not yet been possible to undertake research that might provide an answer to this and other similarly important questions.

C. J. Kerswill, H. Edwards.

Observations on aquatic insects

Before spraying occurred in 1960, a series of five samples of bottom organisms was taken at each of the eight stations shown in Figure 1, using a foot-square Surber sampler. The pre-spray samples were taken as close to actual spraying date as possible, and postponement of scheduled spraying from May 31 to June 5, through unfavourable weather, necessitated additional pre-spray sampling. In addition, small 12 inch by 15 inch weirs of 25-mesh bronze cloth were staked out three per station and scraped clean daily before spraying, then collected daily for drifting organisms and detritus after spraying.

The collected organisms, preserved in alcohol, have been identified, counted, and their volume measured by displacement. The complex tables of data are unsuitable for this report, but four rows of the 20-row table showing results of analyses of 125 Surber samples are given in abbreviated form in Table IV for illustration.

It was found that reductions in the invertebrate fauna that could seriously affect the diets of young salmon and trout occurred in all sprayed areas regardless of the concentration of insecticide used. In the control stream there was no evidence of similar reduction during the same period, and increases usually occurred through hatching. The severity of the kill of organisms seemed to relate to the distance downstream of the sampling stations and to higher water temperatures, rather than to the strength of spray applied from the air. Reductions in fauna between pre- and post-spray samples ranged from 97% to as low as 6%. Some of the stations on streams in the half-strength area, notably those far downstream, showed a greater reduction than stations in full-strength areas, particularly those higher up near the source. These points are brought out by Table V, showing percentage reduction in total numbers of organisms in pre-spray and post-spray samples.

F. P. Ide

Observations on effects of DDT on trout and other populations in small streams

Operation of a fyke net on two small streams in the Miramichi area, Stewart Brook and upper Cross Creek, revealed a small downstream movement of trout following (within 12 hours) aerial spraying of DDT. There was also a prominent downstream movement of crayfish (Cambarus bartonii). Salmon, eels, dace and chub, although present in the streams, did not move downstream in number after the spraying.

On one occasion a school of trout in a pool of upper Cross Creek was under observation when the spray was released about

100 yards upstream. When the spray entered the pool the school immediately broke up. However, the following day the school was back in its original position in the pool. It would appear that the trout avoided the oil slick. Two months later, on August 10, C. J. Kerswill observed a larger school of trout here, apparently in good condition.

J. W. Saunders

Observations on relation between strength of DDT spray and remaining populations of young salmon

(a) Early mortality. There appears to be a direct relationship between strength of spray applied and the numbers of young salmon found by electroseining census in late summer (Table VI). With full-strength spray, underyearlings are almost eliminated in the year of spraying; half-strength spray is followed by about one third to one half a normal population of underyearlings. Older parr also appear to have experienced better survival with lighter spray, best shown by the Caine survival rate of over 90% from 1959 small parr to 1960 large parr. In the upper Southwest Miramichi ample young salmon of all ages appear to have survived for the first summer following half-strength spraying. This forms a decided contrast with the low survival in the similar upper Northwest Miramichi following full strength spraying in 1954.

(b) Delayed mortality. There is another side to the after-effects of spraying. It will be noted from Table VI that the surviving fish in sprayed areas tend to be relatively thin, i.e., have a low condition factor. This in turn has been observed to be accompanied by additional mortality as the water approaches freezing temperatures in the autumn. Such mortality has been observed in every stream subjected to full-strength spraying for which records have been sought, but not in other streams.

On October 5, 1960, intensive electroseining in the full-strength sprayed Nashwaak showed parr present at a rate of about 2.7 per 100 sq. yd. At the same time 13 dead parr were recovered by merely walking along 200 yards of stream. The dead parr were extremely thin and the live parr also were noticeably thinner than in late summer. While no precise figures are available it is thought that one third to one half or more of the summer population (9.0 per 100 sq. yd.) would be subject to such autumn mortality.

On October 6 intensive electroseining in the half-strength sprayed Cains indicated parr were noticeably less abundant than in early September. No dead parr were observed in the river.

In summary, there seems to be grounds for believing that (1) full-strength DDT spray drastically reduces crops of young

salmon; (2) half-strength spray has much less harmful effects and about half the population may survive immediate ill effects. Whether or not such improvement will extend beyond the first post-spray winter remains to be seen.

P. F. Elson

Summary of 1960 results

1. Caged young hatchery-produced Atlantic salmon and brook trout held in streams sprayed in June 1960 with different concentrations of DDT-in-oil insecticide suffered moderate to heavy mortality within two weeks of spraying by comparison with similar controls held in an unsprayed stream. Mortality among samples held in areas receiving half-strength applications (¼ lb. DDT per acre) were generally less than in full-strength areas (½ lb. DDT per acre).

2. Aquatic invertebrates that are the main food of young salmonid fishes were seriously reduced in numbers in both half-strength and full-strength areas, greater reduction occurring with increasing distance from the sources of streams entirely sprayed. Preliminary analysis of pre-spray and post-spray bottom sampling data indicates that around 90% reduction in numbers of organisms, related to spraying, may occur with either half-strength or full-strength applications.

3. Free-living native trout appeared to avoid the oil slick immediately after full-strength spraying over a small brook. The school broke up but by the next day had reformed. A still larger school was observed at the same place two months later.

Trout have more brains than salmon?

4. Electroseining assessment in August 1960 of native young salmon populations in sprayed and unsprayed streams of central New Brunswick showed serious reductions in numbers and condition of fish in sprayed areas. Effects were less severe in areas that had received half-strength application than in full-strength areas. It remains to be seen whether or not such improvement lasts beyond the first post-spray winter.

Suggestions re future programs

If respraying of the same area in central New Brunswick occurs in 1961, it will likely be desirable to carry out similar checking of effects on fishes to those undertaken in 1960. If as suggested by forest biologists somewhat earlier spraying, mainly to control defoliation, is planned, it may be possible, depending on weather conditions, to follow the effects of more uniform spray application than in 1960 and get better data on immediate mortality using caged fish. It will be necessary to repeat the electroseining assessment of young salmon populations regardless of the 1961 spray program, and this would be handicapped by further spraying of the same areas in 1961; however,

repetition of the same strengths on areas as in 1960, or respraying at lower concentration than before, should provide a better chance of useful information than respraying half-strength areas with full strength.

Because of the extent of variability of effects of spraying on aquatic invertebrates within individual streams in 1960, it is recommended that in future this phase of the studies be restricted to two streams about 20 miles in length, and that the effects of spraying at different concentrations be determined by sampling at a series of stations scattered from source to mouth on each stream.

Although the fisheries part of the investigation in 1961 will likely have to be undertaken again largely by diversion of existing Fisheries Research Board and Department of Fisheries staff from other projects, it is suggested that serious consideration be given to setting up a suitable group whose main responsibility would be investigation and management of insecticide spraying as an important long-term phase of stream pollution. The best available information shows that spraying of insecticides to control spruce budworm or other pests will be a continuing fisheries problem into the indefinite future.

If suitable staff and facilities were available for long-term DDT studies with fish, it would be desirable to arrange experimental sprayings of selected watersheds regardless of the level of budworm infestation. This would permit evaluation of various protective measures, e.g. spraying only in alternate years or at greater intervals, exemption of spraying within different distances of streams of various size, addition of materials to the insecticide or streams to increase alkalinity or turbidity. Concurrent laboratory studies would be desirable to indicate the sensitivity of different kinds and sizes of fish exposed to various mixtures, how fish get a lethal does under a variety of conditions, the effects of diverse treatments on the ability of fish to withstand stress, and solutions to many similar problems of great practical importance.

C. J. Kerswill,
October 18, 1960

(Based on reports by several authors as shown, and discussion with fisheries and forestry personnel.)

Table I. Caged salmon parr mortalities, 1960 DDT spraying
100 parr, 3"-3½" long placed in cages May 25-26, 1960

Site	Proposed spray concentration (not actual)	Percent mortalities by weeks ending May 28	June 4	June 11	June 18	June 25
Cross Creek (upper)	1/2 lb/acre	3	14	44	82	88
Cross Creek Sta.	1/2 lb/acre	0	10	15	24	30
Big Hole Brook	3/8 lb/acre	0	1	9	54	61
Stewart Brook	1/4 lb/acre	0	1	5	74	88
Muzroll Brook	1/4 lb/acre	0	11	18	38	47
Control (N.W.M.)	---	0	5	12	17	22

Table II. Caged trout fingerling mortalities, 1960 DDT spraying
50 fingerlings, 3"-5" long, placed in cages May 25-26, 1960

Site	Proposed spray concentration (not actual)	Percent mortalities by weeks ending May 28	June 4	June 11	June 18	June 25
Cross Creek (upper)	1/2 lb/acre	0	0	22	42	57
Cross Creek Sta.	1/2 lb/acre	0	2	22	44	54
Big Hole Brook	3/8 lb/acre	0	0	2	14	14
Stewart Brook	1/4 lb/acre	2	2	2	26	40
Muzroll Brook	1/4 lb/acre	0	6	10	11	22
Control	---					

Table III. Caged salmon fry mortalities, 1960 DDT spraying
100 fry, 1½" long, placed in cages May 25-26, 1960

Site	Proposed spray concentration (not actual)	Percent mortalities by weeks ending May 28	June 4	June 11	June 18	June 25
Cross Creek (upper)	1/2 lb/acre	0	5	5	19	85
Cross Creek Sta.	1/2 lb/acre	1	4	12	28	61
Big Hole Brook	3/8 lb/acre	6	11	14	15	22
Stewart Brook	1/4 lb/acre	2	2	21	53	96
Muzroll Brook	1/4 lb/acre	0	7	7	20	26
Control	---	0	0	0	2	5

Table IV. Analysis of 125 bottom samples before and after 1960 DDT spraying, showing numbers occurring in 5 Surber samples

	Control	Stewart Bk.	Muzroll Bk.		Big Hole Bk.	Cross Creek		
			Upper	Lower		Upper	Mid	Lower
Ephemeroptera (Mayflies)	145-329	78-21	49-42	898-19	186-75	99-32	175-151	266-13
Trichoptera (Caddisflies)	143-180	7-0	6-3	191-10	5-4	3-7	25-29	24-2
Total number all organisms	820-1092	93-34	70-66	1470-46	226-142	154-70	232-211	339-17
Percent reduction	0	63	6	97	87	55	9	95

Table V. Effects of spray on the fauna of the streams by a comparison of immediate pre-spray and post-spray numbers listed in diminishing order of effect.

	Percentage reduction pre--post spray	Spray strength category	Thermal character	Distance downstream from source in miles
Muzroll Brook No. 1	97	half	warm	25
Cross Creek No. 1	95	full	warm	18
Taxis River	87	half	warm	18
Stewart Brook	63	full	warm	7
Cross Creek No. 3	55	full	cold	7
Big Hole Brook	37	three-quarter	interm.	13
Cross Creek No. 2	9	full	interm.	14
Muzroll Brook No. 2	6	half	unknown	11

Table VI. Mean numbers per 100 sq. yd. and mean size of young salmon in DDT sprayed streams. K = "Condition Factor" = 100 x weight (gm.) ÷ length^3 (cm.)

	Full-strength DDT				Half-strength DDT			"E"
	Control		½ lb/gal/acre		Control	¼ lb/gal/acre		Control
	N.W. Miramichi above 1953	Tomogonops 1960	N.W. Miramichi above 1954	Tomogonops ★Nashwaak 1960	Cains 1959	Cains 1960	★Juniper 1960	Pollett July 1960
Underyearlings								
Numbers	31.9	20.1	0.0	0.13	28.8	9.1	30.8	---
Length (cm.)	4.4	5.0	No data	No data	★★	5.0	4.5	4.3
Weight (gm.)	0.9	1.5				1.2	0.8	0.9
K	0.984	1.174				0.936	0.890	1.095
Small parr (10 cm. or less; mostly 1+)								
Numbers	38.7	26.3	6.3	10.9	4.2	6.4	33.4	---
Length (cm.)	7.5	8.8	★★	9.2	★★	8.0	8.6	9.8
Weight (gm.)	4.2	7.6		7.6		4.8	6.0	11.0
K	0.957	1.125		0.965		0.936	0.925	1.143
Large parr (over 10 cm.; mostly 2+)								
Numbers	18.8	16.3	8.0	9.0	2.7	3.9	19.2	---
Length (cm.)	11.1	11.4	★★	11.1	★★	11.3	11.0	12.5
Weight (gm.)	13.5	16.5		13.1		13.7	13.5	23.2
K	0.971	1.098		0.944		0.932	0.959	1.126

★ New in 1960
★★ Data not yet processed

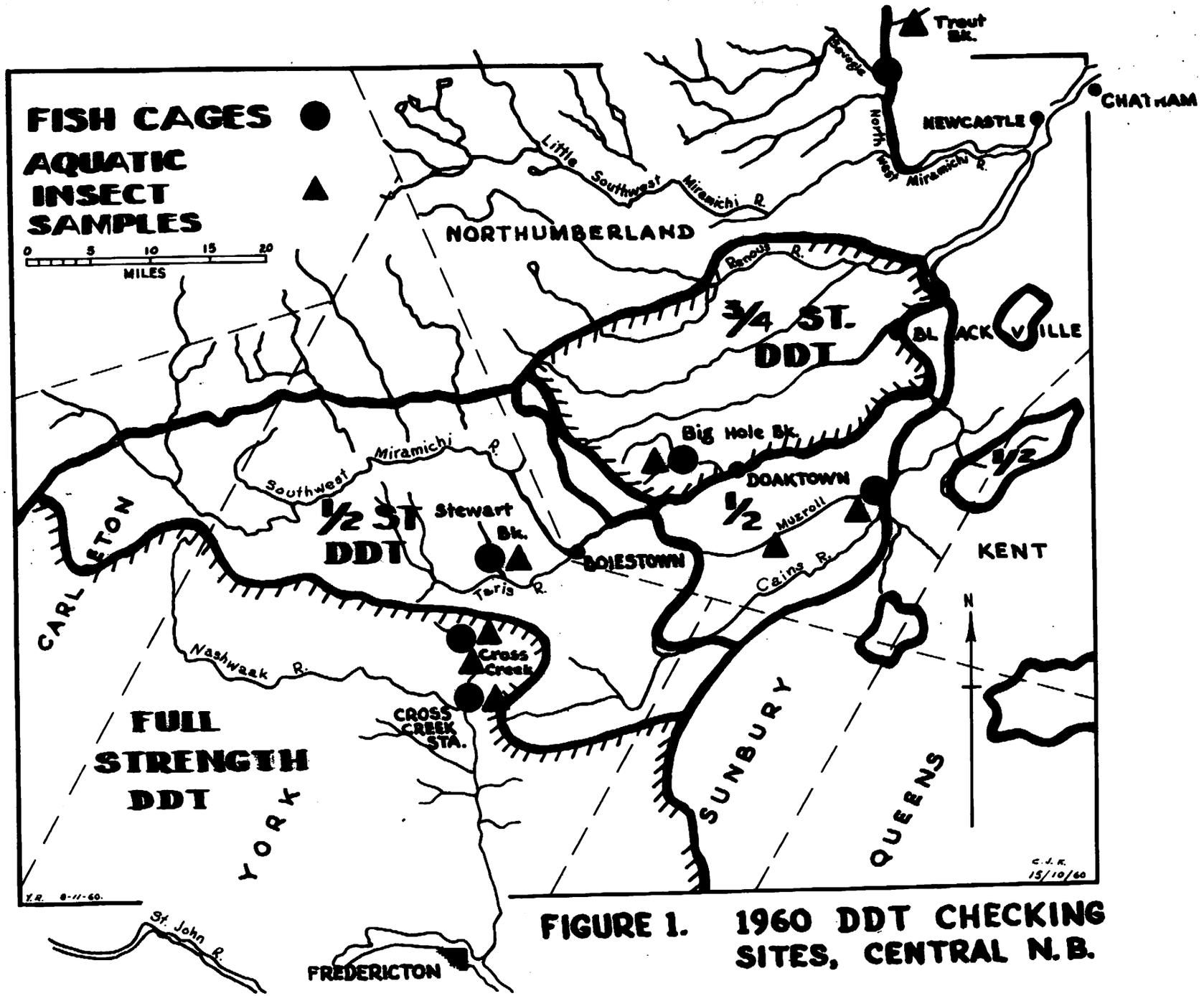


FIGURE 1. 1960 DDT CHECKING SITES, CENTRAL N.B.

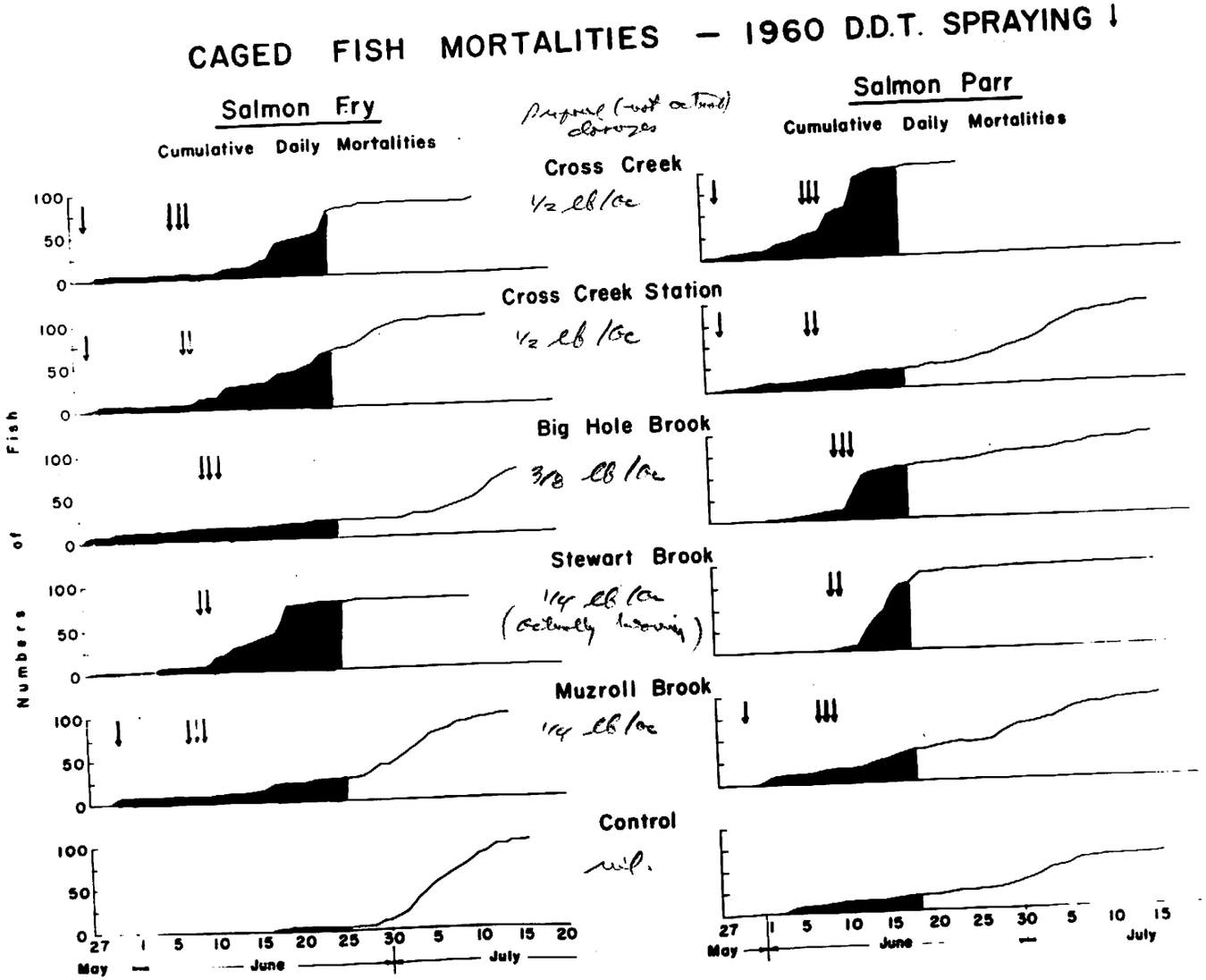

CAGED FISH MORTALITIES — 1960 D.D.T. SPRAYING
Salmon Fry
Cumulative Daily Mortalities
Salmon Parr
Cumulative Daily Mortalities
Cross Creek
½ lb/ac
Cross Creek Station
½ lb/ac
Big Hole Brook
⅜ lb/ac
Stewart Brook
¼ lb/ac
Muzroll Brook
¼ lb/ac
Control
Numbers of Fish
100
50
0
27 1 5 10 15 20 25 30 5 10 15 20
May June July

FIGURE 2.

APPENDIX IV

PRELIMINARY REPORT ON BLACK-HEADED BUDWORM CONTROL PROJECTS -

QUEEN CHARLOTTE ISLANDS, 1960

I. DDT OPERATIONAL SPRAY (Forest Biology Laboratory, Victoria)

The egg survey conducted during the autumn of 1959 showed that a potentially dangerous budworm population was present on parts of Moresby Island. In view of the poor condition of some trees, control was undertaken on 31,500 acres in the vicinity of Moresby and Skidegate Inlets and Copper River.

A dosage of ¼ lb. DDT per U.S. gallon per acre was used in order to lessen the hazard to fish. Fish damage was also avoided by not spraying directly over the Copper, Pallant, and Deena Rivers.

Egg samples taken in April, 1960, indicated that some winter loss had occurred, but that high numbers of insects were still present.

When branch sampling was begun on June 1, most eggs had not hatched. Earlier control studies have shown that DDT aerial spraying is not effective against this insect until at least 50 per cent of the larvae are in the second instar. On the basis of samples taken from regeneration hemlock, it was forecast that this point would be reached by the last week of June. Subsequent sampling of under- and overstory hemlock in mature stands soon showed that development was not as far advanced as in young stands. Furthermore, the weather remained cool and wet throughout June and most of July, so that it was not until July 10 that budworm on understory hemlock reached the stage for effective spraying.

Bud burst on overstory hemlock did not occur until early July. At the time when large numbers of eggs were hatching on the overstory, the buds had not begun to burst. Samples taken during this period, and subsequent lack of serious defoliation to the overstory indicated that many newly hatched larvae never survived because of the lack of opened buds.

On June 23, two DDT swaths were sprayed over Sachs creek to determine the potential hazard of the ¼ lb. dosage to Coho fry. Although it was anticipated that the spray would not effect control of the budworm at this early date, an attempt was made to ascertain the result. As forecast, control at this early stage was not effective. A few of the larger larvae were killed, but most insects were either in the egg stage or survived because they were protected by the buds that were only just starting to open.

Operational DDT spraying was scheduled to commence on July 11th, but heavy rainfall delayed the start until July 17th. By July 23rd, the operation was finished. Mechanical difficulties with the aircraft, and unsettled weather during the period slowed operations, and in some areas insecticide was applied in marginal spraying weather.

Spray coverage appeared to be adequate. Of 21 assessment plots, all but one received some deposit. Most check plots were far enough away from the spray block to avoid contamination. One check plot was fully sprayed and a minute deposit was detected on another two.

From hatching to pupation a defoliator population normally diminishes

through parasitism and other natural controls. Cool wet weather accelerated the decline of the budworm population in this situation. In retrospect it can be seen that unfavourable weather for budworm persisted long enough to result in an over-all net decrease in population for the season in both sprayed and unsprayed areas. However, at no time during the operation was it possible to predict with certainty that poor weather would continue. By the end of July, populations in unsprayed stands were very low. Hence it is difficult to determine the actual amount of mortality that was attributable to the spray.

Control, uncorrected for natural mortality, ranged from 70 to 100 per cent. Obviously where untreated populations were undergoing catastrophic natural decline, the theoretical percentage control attributable to the spray was much less than indicated by the foregoing. Evidence that the ¼ lb. treatment was effective can be drawn from several plots sampled three to five days after spraying where population decline was much greater than would be anticipated had the trees been left untreated.

From the meagre evidence that could be salvaged from this collapsing population, it can be stated that there is good probability that ¼ lb. DDT per acre will control the black-headed budworm. An effort should be made to check this finding at an early date, but it is urged that the work be done on an experimental, rather than an operational basis. Experience has demonstrated that when experimental and operational spray programmes are combined, the urgencies associated with the latter invariably work to the detriment of the former.

APPENDIX V

INTERIM REPORT ON THE EFFECTS OF DDT ON RESIDENT COHO FRY POPULATIONS OF MORESBY ISLAND STREAMS

Surveys conducted during 1959 by the Forest Biology Service of the Department of Agriculture revealed the presence of a potentially hazardous budworm population on parts of Moresby Island. Consequently, the decision was made to implement a control programme on 31,500 acres of mature and immature hemlock during late June and early July of 1960.

Three major salmon producing streams, the Pallant, Deena, and Copper Rivers, as well as several minor contributors, flow through the designated spray areas (see map). The Pallant and Deena contribute an average of two to five thousand coho annually, while the average annual escapement to the Copper is estimated at 10,000 fish. These rivers do support other species of anadromous salmonids, but seaward migration was complete by the time of spraying.

In view of the important salmon producers involved, and considering the drastic mortality suffered in similar-sized streams during the 1957 Port Hardy budworm control programme, a reduction of dosage from one pound DDT per U. S. gallon per acre to one-quarter pound DDT per U. S. gallon per acre was decided upon. A further precaution was taken by deleting the emulsifier used in 1957 from the final formulation.

In addition, preliminary reconnaissance flights over the entire control areas were made by the Project Co-ordinator, H. A. Richmond, Skyway pilots involved, the Department representatives to define boundaries around each major drainage area. These boundaries were described by natural landmarks in an effort to prevent direct spraying of the Pallant, Deena, and Copper Rivers. Terrain and forest conditions prevented use of this method over the other, much smaller, salmon-producing streams.

PRE-CONTROL ASSESSMENT

An attempt was made to determine the potential hazard of the one-quarter pound DDT dosage to coho fry by application of two swaths of the formulation in the Sachs Creek drainage area. Four livebox stations were established in the following manner; Station A, downstream from the spray area, Station B, slightly above the downstream limit of the spray area, Station C, at the approximate centre of the spray area, and Station D, upstream from the upper limit of the spray area.

Each station consisted of one standard covered livebox containing 110 coho fry, one standard open livebox containing a like number of fry, and a vertical series of liveboxes confining 25 fry to 6 inches, 25 between 6-12 inches, and 50 between 12-30 inches below the surface.

Bottom samples for aquatic insects and other invertebrates were taken periodically before and after treatment at Stations A, B, and D; spray assessment cards were placed at each station; and a charcoal collection system was constructed in the stream between Stations A and B. The charcoal has not yet been analyzed for oil and DDT content.

Spray was applied on June 23, and spray assessment cards showed that sufficient spray to effect budworm control was applied throughout the length of the treatment area. Spray assessment cards showed Station A received a light dosage (wind drift), Station B a medium dosage, Station C a heavy dosage, and Station D, which was meant to be a control, was definitely contaminated by wind drift.

The mortalities recorded in each type of livebox for each station are shown in Tables I to IV. Coho fry were stocked in Stations A and B eleven days prior to spraying, and in C and D eight days prior to spraying. The figures listed as holding mortality for each type of livebox were calculated from data obtained from all Stations within the spray areas prior to spraying, as well as from data obtained from control streams outside the spray areas. The figures listed as combined mortalities include holding mortality and mortality attributable to the effects of DDT.

Station A, as previously mentioned, was located downstream from the spray area, and downstream some 200 yards from the charcoal collection baffle. An examination of Table I shows that the combined mortalities did not exceed the calculated holding mortality at any time. Similar effects were recorded at Station B, above the charcoal collection baffle and inside the lower limit of the treatment area, with the exception of the top livebox of the vertical series. Here, after five days, the combined mortality became markedly greater than the holding. It is noted that mortality attributable to DDT occurred only to coho fry confined to the surface six inches of water in this particular case.

A more pronounced mortality attributable to DDT was obtained from Station C. In this case, where a maximum dosage occurred, definite mortality occurred within twenty-four hours to the fish in the top box of the vertical series, and to fish in the open livebox. The probable reason for mortality in the open livebox is that the water level had dropped to the point that there was no more than eight inches of water in this box. Thus, similar results to those obtained from the top box of the vertical series might well be expected. Mortality in the other three liveboxes compared with that obtained in Stations A and B.

Station D, planned as a control station, was above the upstream limit of the treatment area, but was contaminated by wind drift. However, spray deposition in the immediate area was very light and insufficient to be considered a critical dosage. Mortalities in all liveboxes except the covered remained below the calculated holding mortality as listed in Table IV.

Bottom organism samples have not as yet been analyzed; however field observations indicated that noticeable changes in normal population trends did not occur after spraying.

TABLE 1 - PRE-CONTROL DDT MORTALITY ASSESSMENT

STATION A - Sachs Creek

Days After	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	1.1	0	.8	0	12.2	0	(17.3)	0	9.2	0
2	2.0	0	.9	0	22.2	0	22.3	0	13.7	2.0
3	(2.4)	0	1.8	0	23.5	0	31.6	8.0	15.7	2.0
4	2.7	0	(3.6)	0	25.5	0	39.6	8.0	25.7	2.0
5	(2.9)	0	(5.4)	0	(26.3)	0	(42.0)	(10.0)	(26.9)	(5.0)
6	3.1	0	(7.2)	0	(27.1)	0	(44.4)	12.0	(28.1)	7.0
7	(5.3)	0	(9.0)	(.9)	(27.9)	(8.0)	(47.8)	(24.0)	(29.3)	(15.0)
8	7.2	0	(10.8)	1.8	(28.7)	16.0	(49.2)	36.00	(30.5)	23.0
9	(9.6)	(3.2)	12.6	(4.5)	29.5	(28.0)	51.6	(42.0)	31.7	(28.0)
10	(12.0)	6.4		7.3		40.0		48.0		33.0

TABLE II - PRE-CONTROL DDT MORTALITY ASSESSMENT

STATION B - Sachs Creek

Days After	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	1.1	0	.8	0	12.2	11.5	(17.3)	0	9.2	0
2	2.0	0	.9	0	22.2	11.5	22.3	0	13.7	0
3	(2.4)	0	1.8	0	23.5	23.0	31.6	0	15.7	0
4	2.7	0	(3.6)	0	25.5	26.8	39.6	0	25.7	0
5	(2.9)	0	(5.4)	0	(26.3)	(36.4)	(42.0)	0	(26.9)	(1.0)
6	3.1	0	(7.2)	0	(27.1)	46.0	(44.4)	0	(28.1)	2.0
7	(5.3)	0	(9.0)	(.9)	(27.9)	(47.9)	(47.8)	(4.0)	(29.3)	(7.0)
8	7.2	0	(10.8)	1.8	(28.7)	49.8	(49.2)	8.0	(30.5)	12.0
9	(9.6)	(.9)	12.6	(2.7)	29.5	(53.1)	51.6	(12.0)	31.7	(18.0)
10	(12.0)	1.8		3.6		57.5		16.0		24.0

TABLE 111 - PRE-CONTROL DDT MORTALITY ASSESSMENT

STATION C - Sachs Creek

Days After	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	.9	2.9	(.5)	1.9	5.4	24.0	6.8	12.0	(3.9)	0
2	(.9)	4.8	(.6)	4.8	5.8	28.0	(9.3)	12.0	(6.1)	0
3	(1.0)	4.8	.6	6.7	9.2	40.0	12.3	16.0	8.2	2.0
4	1.1	4.8	.8	10.6	12.2	44.0	(17.3)	24.0	9.2	8.0
5	2.0	(4.8)	.9	(11.6)	22.2	(44.0)	22.3	(26.0)	13.7	(11.0)
6	(2.4)	4.8	1.8	12.5	23.5	44.0	31.6	28.0	15.7	14.0
7	2.7	(4.8)	(3.6)	(13.4)	25.5	(44.0)	39.6	(32.0)	25.7	(14.0)
8	(2.9)	4.8	(5.4)	14.4	(26.3)	44.0	(42.0)	36.0	(26.9)	14.0
9	3.1	(5.3)	(7.2)	(15.9)	(27.1)	(52.0)	(44.4)	(44.0)	(28.1)	(17.0)
10	(5.3)	5.7	(9.0)	17.3	(27.9)	60.0	(47.8)	52.0	(29.3)	20.0

TABLE IV - PRE-CONTROL DDT MORTALITY ASSESSMENT

STATION D - Sachs Creek

Days After	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	.9	3.6	(.5)	0	5.4	8.0	6.8	0	(3.9)	0
2	(.9)	4.6	(.6)	0	5.8	8.0	(9.3)	0	(6.1)	0
3	(1.0)	4.6	.6	0	9.2	8.0	12.3	0	8.2	0
4	1.1	5.6	.8	0	12.2	8.0	(17.3)	4.0	9.2	0
5	2.0	(5.6)	.9	0	22.2	(8.0)	22.3	(4.0)	13.7	0
6	(2.4)	5.6	1.8	0	23.5	8.0	31.6	4.0	15.7	0
7	2.7	(6.4)	(3.6)	(.5)	25.5	(8.0)	39.6	(8.0)	25.7	0
8	(2.9)	7.3	(5.4)	.9	(26.3)	8.0	(42.0)	12.0	(26.9)	6.0
9	3.1	(7.8)	(7.2)	(.9)	(27.1)	(10.0)	(44.4)	(16.0)	(28.1)	(11.0)
10	(5.3)	8.2	(9.0)	.9	(27.9)	12.0	(47.8)	20.0	(29.3)	16.0

The major conclusions arising from this Pre-Control assessment are: (a) the possibility of damage to resident fish stocks would be lessened if major streams were not sprayed directly; and (b) the possibility that non-emulsified spray can be collected from small streams in sufficient quantity to be practical should be further investigated.

The quantity of material observed floating as a "slick" at Sachs Creek was much less than the amount observed in 1957 following the calamitous DDT spraying in the Port Hardy area. Also on the Keogh River, coho fry and trout were observed feeding voraciously on floating dead insects which had fallen into the river. This was not observed at Sachs Creek. No dead indigenous salmonids or aquatic insects were found following spraying in Sachs Creek, although a deliberate search was made. While marked mortality attributable to spraying was noted for upper liveboxes in the stacks at Stations B and C, which were most heavily exposed, it is interesting to note that differences were small or negative between holding and combined mortalities at all stations for the open and covered conventional liveboxes and for stacked liveboxes deeper than 6" below the surface. It would appear that unless the fish were forced to remain near the surface that they did not come into contact with lethal concentrations of DDT. Although salmonids are known to make excursions to and from the surface in feeding, the absence of an observed mortality of indigenous fish, the apparent absence of effect on aquatic insects, and the survival of fish held in conventional liveboxes free to select a preferred depth suggests that few fish were contacted by lethal DDT concentrations and that an added margin of safety might be obtained in future by skimming DDT off the surface of many small streams and rivers with strategically placed charcoal baffles.

CONTROL PROGRAMME

From the results of the Sachs Creek preliminary assessment, it could be epxected that the hazard to resident salmonids was relatively light at dosages of ¼ lb. per U. S. gallon per acre. However, as a precaution it was decided to define landmark boundaries around the Pallant, Deena and Copper River drainage basins. Portions of the planned spray area near the Copper River were eliminated, and other areas equally infested by budworm and not influencing salmon-producing streams were substituted. As well, during the operation smoke bombs were utilized to pinpoint streams and establish ground wind drift conditions.

Spray assessment cards were placed at one-half mile intervals along the banks of the Copper River, and spotted at various points on the Deena and Pallant, as well as at each livebox station. Stations were established in the three major systems as well as in three small streams within the spray area (Sachs Creek, Canyon Creek, and MacMillan Creek). Control stations were placed in Haans Creek, Big Point Creek, Braverman Creek, and Copper River (upstream from the spray area). Bottom samples were taken at or near each livebox station periodically before and after treatment.

After delay due to poor weather, spraying commenced on July 17 and the operation was completed by July 23. As a result of the previously described precautions, none of the three major river systems were directly sprayed. Small amounts of drift were recorded throughout, but in insufficient quantities to be considered as dosages effective on budworm. It is possible that had weather conditions been ideal rather than marginal, that even these minor drift effects could have been eliminated.

Tables V to X compare mortality in contaminated stations with the holding mortalities which occurred prior to spraying and in the four control stations.

The results obtained from each station in the treated area are discussed briefly as follows:

Station 1. Lower Copper River. This station was located approximately one mile from tidal influence. Spray assessment cards located in the area showed a very light deposit when examined two hours after spraying. This deposition was typical throughout the six miles of river passing through the spray area. An examination of Table V shows negative differences between combined and holding mortalities for the covered and open conventional liveboxes. Combined mortality in the vertical series was observed at all levels. The heavy mortality in the 0 - 6' livebox might be attributed to DDT but the mortality in the lower liveboxes is unexplainable.

Station 2. Middle Copper River. This station was located approximately in the middle of the spray area. Again assessment cards in the area recorded only traces of spray, of less than the amount considered necessary for effective treatment of budworm infested areas. As may be observed from Table VI, combined mortality in all five liveboxes was greater than the calculated holding mortality, but it is considered that it would be misleading to consider that the high combined mortality could in this case be attributed to the effect of DDT. This station was placed in a position where there was considerable velocity change during high water just prior to treatment, and added to this stress was the fact that the coho fry had been held for 15 days prior to treatment. A small stream on the opposite bank of the Copper River, which contained large numbers of coho salmon and steelhead trout fry was examined both before and after treatment. At no time were dead or distressed fish observed. This stream was checked within 2 hours of spraying, and no feeding on dead floating insects was observed. The fact that resident fish survived is opposed to the fact that experimentally exposed fish died, and although the contradiction is explainable it is considered that data obtained from this station was inconclusive.

Station 3. Deena River. This station was positioned approximately one mile upstream from tidal influence. Spray assessment cards placed in the area showed very slight traces of spray, similar in amount to that observed in the Copper River stations. Again, as could be expected from the Sachs Creek assessment, combined mortality exceeding holding mortality was noted for the top livebox of the vertical series, but for all other liveboxes it was less.

TABLE V - CONTROL PROGRAMME ASSESSMENT

STATION 1 - LOWER COPPER RIVER

Days after	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	(2.9)	2.9	(5.4)	0	(26.3)	20.0	(42.0)	32.0	(26.9)	34.0
2	3.1	3.6	(7.2)	0	(27.1)	44.0	(44.4)	36.0	(28.1)	36.0
3	(5.3)	(5.4)	(9.0)	0	(27.9)	(49.6)	(47.8)	(42.4)	(29.3)	(40.4)
4	7.2	(7.2)	(10.8)	0	(28.7)	(55.2)	(49.2)	(48.8)	(30.5)	(44.8)
5	(9.6)	(9.0)	12.6	0	29.5	(60.8)	51.6	(55.2)	31.7	(49.2)
6	(12.0)	(10.8)	(14.0)	0		(66.4)		(61.6)		(43.6)
7	(14.4)	12.7	(15.4)	.9		72.0		68.0		58.0
8	(16.8)		(16.8)							
9	(19.2)		(18.2)							
10	(21.6)		(19.5)							

TABLE VI - CONTROL PROGRAMME ASSESSMENT

STATION 2 - MIDDLE COPPER

Days After	Cumulative % Mortality in Live Boxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	2.7	.9	(3.6)	5.6	25.5	20.0	39.6	44.0	25.7	12.0
2	(2.9)	1.8	(5.4)	9.1	(26.3)	36.0	(42.0)	64.0	(26.9)	20.0
3	3.1	(5.2)	(7.2)	(12.4)	(27.1)	(41.0)	(44.4)	(65.6)	(28.1)	(31.6)
4	(5.3)	(8.6)	(9.0)	(15.7)	(27.9)	(45.0)	(47.8)	(67.2)	(29.3)	(43.2)
5	7.2	(12.1)	(10.8)	(19.0)	(28.7)	(50.0)	(49.2)	(68.8)	(30.5)	(54.8)
6	(9.6)	(15.6)	12.6	(22.2)	29.5	(55.0)	51.6	(70.4)	31.7	(66.4)
7	(12.0)	19.1	(14.0)	25.5		60.0		72.0		78.0
8	(14.4)		(15.4)							
9	(16.8)		(16.8)							
10	(19.2)		(18.2)							

Station 4. Pallant River. This station was located two hundred yards above tidal influence. Due to the shallow nature of the available pool, the vertical series of liveboxes had to be placed at the edge of the current. It is possible that high water levels experienced shortly before the treatment date unduly stressed the confined fish. Spray assessment cards in the area showed greater contamination than elsewhere, but still could not be considered an effective dosage for budworm control. Mortality recorded in the five liveboxes in Table VIII shows a trend paralleling that observed at Sachs Creek in the open, covered and surface vertical livebox; however, unexpected mortality greater than the calculated holding mortality was recorded in the 6 to 12 inch, and in the 12 to 30 inch liveboxes, but this dissimilarity may be attributed to stress occasioned by high velocity at Pallant River.

Station 5. MacMillan Creek. The limited depth of this stream precluded placement of a vertical livebox series. The open livebox used was placed in approximately 12 inches of water in a density overgrown portion of the stream. Spray assessment cards located on the road nearby showed that an effective dosage for budworm was deposited in the area. Results listed in Table IX show a small positive difference between combined and holding mortality. Examination of the stream in the vicinity of the station following spraying failed to reveal any signs of distressed or dead fish or insects.

Station 6. Sachs Creek. A complete station was re-stocked at the same position as Station A (Preliminary Assessment). In this instance, the DDT deposition was very light, and contamination of the stream was due to wind drift only as there was no direct spraying in the immediate vicinity of the station. The results listed in Table X indicate no effect upon penned fish.

Thuricide Experiment. After completion of the budworm control program plots of immature hemlock were sprayed with 1.7 and 2.8 lbs. of Thuricide per acre. Small streams containing resident coho and steelhead fry flowed through both plots. In each stream, a livebox containing 60 coho fry was installed the day before treatment and bottom samples were taken. The liveboxes were checked periodically during the week following treatment, and no deaths were recorded in either stream.

An encouraging interim report from the Forest Biology Laboratory has been received, indicating that excellent coverage was obtained, and that a good control of budworm larvae was obtained.

DISCUSSION AND CONCLUSIONS

Field observations gave no indication of losses of resident fish and although the data on the abundance of aquatic organisms has not been completely analyzed, it would not appear that these have not been affected. The results of this programme contrast sharply with the very heavy mortalities of penned fish recorded during the 1957 control programme, at which time very heavy oil slicks and large numbers of dead and distressed aquatic insects and resident fish were observed. It seems to be indicated that if there was any mortality attributable to this ¼ lb. per acre DDT

TABLE VII – CONTROL PROGRAMME ASSESSMENT

STATION 3 - DEENA RIVER

Days After	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	(.2)	0	.1	0	9.2	1.60	12.3	20.0	8.2	2.0
2	.3	0	.2	0	12.2	28.0	(17.3)	20.0	9.2	2.0
3	(.4)	(.2)	.3	0	22.2	(38.4)	22.3	(21.6)	13.7	(2.8)
4	.5	(.3)	.4	0	23.5	(48.8)	31.6	(23.2)	18.7	(3.6)
5	.5	(.5)	.5	0	25.5	(59.2)	39.6	(24.8)	25.7	(4.4)
6	.8	(.7)	(.5)	0	(26.3)	(69.6)	(4.20)	(26.4)	(26.9)	(5.2)
7	.9	.9	(.5)	0	(27.1)	80.0	(44.4)	28.0	(28.1)	6.0
8	(1.0)		(.6)		(27.9)		(47.8)		(29.3)	
9	(1.1)		.6		(28.7)		(49.2)		(30.5)	
10	1.1		.8		29.5		51.6		31.7	

TABLE VIII - CONTROL PROGRAMME ASSESSMENT

STATION 4 - PALLANT RIVER

Days After Spraying	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	.8	.9	1.1	0	12.2	0	(17.3)	8.0	9.2	2.0
2	.9	(1.4)	2.0	0	22.2	(20.0)	22.3	(20.0)	13.7	(9.0)
3	1.8	1.8	(2.4)	0	23.5	40.0	31.6	32.0	15.7	16.0
4	(3.6)	(3.4)	2.7	0	25.5	(48.8)	39.6	(41.6)	25.7	(21.6)
5	(5.4)	(5.1)	(2.9)	0	(26.3)	(57.6)	(42.0)	(51.2)	(26.9)	(27.2)
6	(7.2)	(6.7)	3.1	0	(27.1)	(66.4)	(44.4)	(60.8)	(28.1)	(32.8)
7	(9.0)	(8.4)	(5.3)	0	(27.9)	(75.2)	(47.8)	(70.4)	(29.3)	(38.4)
8	(10.8)	10.0	7.2	0	(28.7)	84.0	(49.2)	80.0	(30.5)	44.0
9	12.6		(9.6)		29.5		51.6		31.7	
10	(14.0)		(12.0)							

TABLE IX - CONTROL PROGRAMME ASSESSMENT

STATION 5 - MACMILLAN CREEK

	Cumulative % Mortality in Livebox	
	Open Livebox	
Spraying	Holding	Combined
1	(.6)	.9
2	.6	(1.8)
3	.8	2.7
4	.9	(5.4)
5	1.8	(8.2)
6	(3.6)	(10.9)
7	(5.4)	(13.7)
8	(7.2)	16.4
9	(9.0)	
10	(10.8)	

TABLE X - CONTROL PROGRAMME ASSESSMENT

STATION 6 - SACHS CREEK (STN. A)

Days After	Cumulative % Mortality in Liveboxes									
	Covered		Open		0 - 6"		6" - 12"		12" - 30"	
Spraying	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined	Holding	Combined
1	.3	0	.2	0	5.8	0	(9.3)	0	(6.1)	2.0
2	(.4)	0	.3	0	9.2	0	12.3	0	8.2	2.0
3	.5	(.15)	.4	(.30)	12.2	(.67)	(17.3)	0	9.2	(2.0)
4	.5	(.30)	.5	(.60)	22.2	(1.34)	22.3	0	13.7	(2.0)
5	.8	(.45)	(.5)	(.90)	23.5	(20.0)	31.6	0	15.7	(2.0)
6	.9	(.60)	(.5)	(1.2)	25.5	(2.67)	39.6	0	25.7	(2.0)
7	(1.0)	(.75)	(.6)	(1.5)	(26.3)	(3.34)	(42.0)	0	(26.9)	(2.0)
8	(1.1)	.9	.8	1.8	(27.1)	4.0	(44.4)	0	(28.1)	2.0
9	1.1		.9		(27.9)		(47.8)		(29.3)	
10	2.2		1.8		(28.7)		(49.2)		(30.5)	

application, that it was light. While simple subtractions of holding mortality from combined mortality sometimes show high mortality attributable to DDT in top vertical liveboxes (e.g. Sachs Creek, Station C, 30 per cent and Pallant River, Station 4, 55 per cent), the trend towards smaller and negative differences was pronounced for lower liveboxes in the vertical series and these probably best reflect the effect upon fish following spraying, especially since these results agree with the observed survival of resident fish of the same size and species. However, the fact that there were marked mortalities at Stations C and B at Sachs Creek in the upper liveboxes illustrates that there could be real danger to salmon fry associated with careless DDT applications at ¼ lb. per acre, and that all possible care should be taken to plan future programmes to minimize the quantity of DDT entering streams inhabited by salmon and trout.

A great deal of credit for the apparent avoidance of a serious kill of salmon and trout on Northern Moresby Island must go to the B. C. Loggers' Association for reducing the dosage of DDT to ¼ lb. per acre in accordance with the recommendations of this Committee, and for the effective liaison between the Department, the Association and the Forest Biology Laboratory.

APPENDIX VI

CHEMICAL CONTROL OF ECTROPIS CREPUSCULARIA SCHIFF.

KITIMAT, B.C., AUGUST 1, 1960

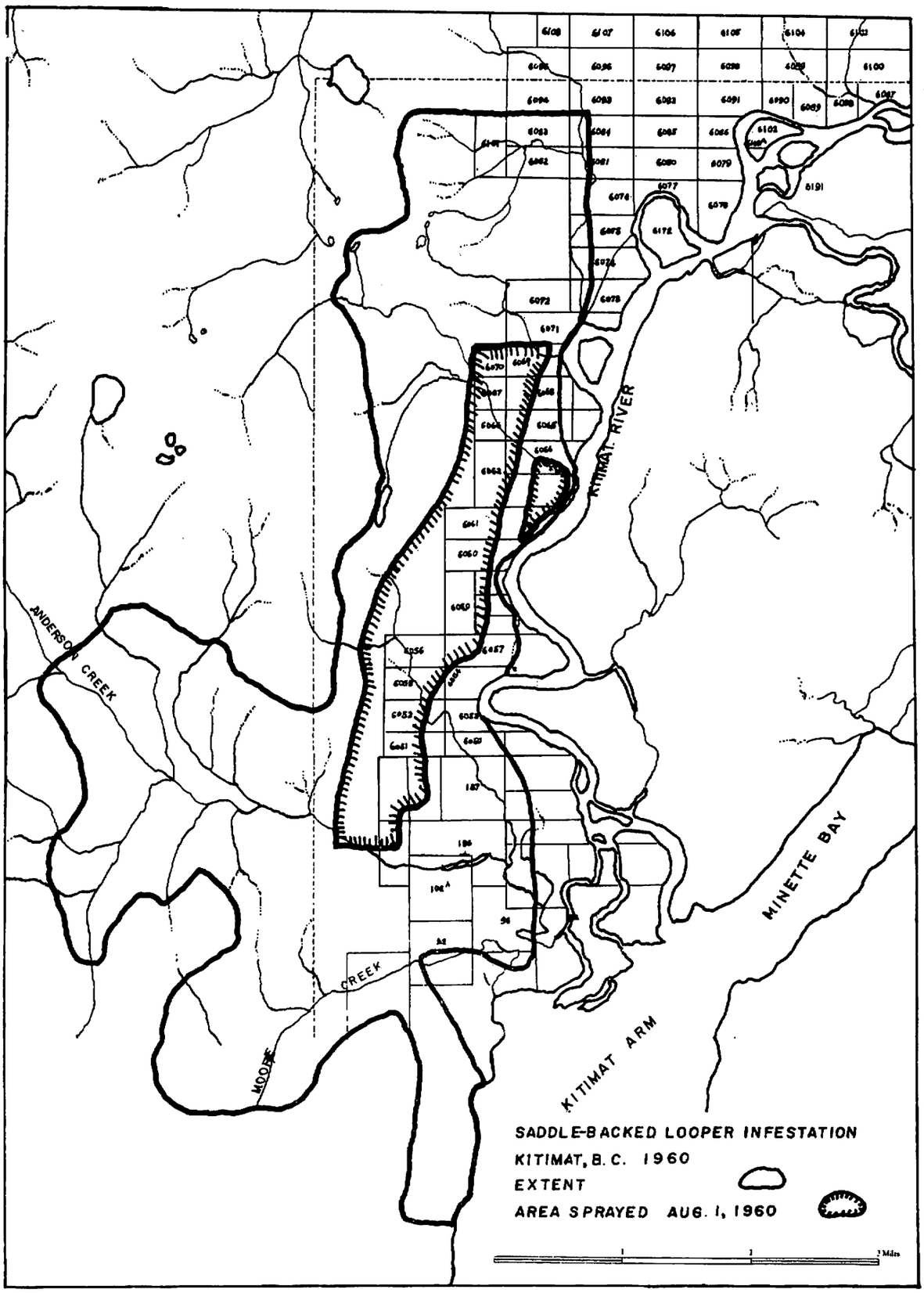
About 1,800 acres of timber at Kitimat were sprayed on August 1, 1960, in an effort to prevent heavy tree mortality by the saddle-backed looper, Ectropis crepuscularia. The spray was ½ lb. DDT per gallon of fuel oil, applied at the rate of 1 U.S. gallon per gallon. The decision to spray was made on July 29, but it was not known until July 30 that the control operation would be possible. This left time for only limited assessment work.

Thirty-two sample stations within the spray area and 10 check stations were laid out. All stations were sampled on July 31, August 2, August 3, and some 7 to 10 days after spraying. At each station a sample consisted of two 18-inch branches, larval density being calculated on a square foot basis. Spray assessment cards were forwarded to the Chemical Control Section, Ottawa, for analysis.

Results

The GPA deposit was very light. Two stations recorded deposits of 0.28 and 0.29 GPA, all others were less than 0.09. In general there was no significant drop in larval survival, although no larvae were found on August 8 and 9 at the two stations which received the heaviest spray deposit. This does not indicate a high degree of control as pupae were found under these trees in September indicating that some larvae had pupated by August 8. Although the results of a pupal survey in September are not completely analyzed, there appear to be as many pupae in the sprayed area as outside the spray area. Feeding also continued after spray as some sample trees in the spray area were completely defoliated after August 1. However, during a low level helicopter flight over the entire area in September the overstory trees in the spray area appeared in better condition than in the unsprayed area, indicating that the spray did reduce the amount of feeding on the dominant and co-dominant tree classes.

Forest Biology Laboratory,
Victoria, B.C.,
October 4, 1960.


KITIMAT RIVER
ANDERSON CREEK
MOORE CREEK
KITIMAT ARM
MINETTE BAY
SADDLE-BACKED LOOPER INFESTATION
KITIMAT, B.C. 1960
EXTENT
AREA SPRAYED AUG. 1, 1960
1
2
3 Miles

APPENDIX VII

TRIALS OF *BACILLUS THURINGIENSIS* AGAINST SPRUCE BUDWORM IN NEW BRUNSWICK

(Statement for Interdepartmental Committee on Aerial Forest Spraying - Autumn 1960)

D. G. Mott, Forest Biology, Fredericton
T. A. Angus and A. M. Heimpel, Insect Pathology Research Institute, Sault Ste. Marie

Assessments of aerial applications against spruce budworm of a commercial preparation of *Bacillus thuringiensis* were made by Forest Biology Laboratory, Fredericton, and Insect Pathology Research Institute, Sault Ste. Marie. "Thuricide concentrate" containing thirty billion viable spores of *B. thuringiensis* per gram was supplied gratis by Bioferm Corporation, Wasco, California. Three aircraft were made available at no cost by Forest Protection Limited.

A water formulation of wettable powder and an oil emulsion were applied on May 30 at a rate of 2 pounds in 1 gallon per acre. Oil-treated, DDT-treated, and untreated conditions were provided for comparisons. Initial deposit, in terms of number of spores per gram of balsam fir needles, was below the recommended lethal level on most sampled trees. Decay of the material to a value below the level at which threshold effects are expected occurred within three days. It has been indicated that improvements can be made in the commercial material in order to yield better deposit.

Appreciable numbers of dead larvae were first detected on the fourth day following treatment, many of which were diagnosed as containing *B. thuringiensis*. A maximum of 31 per cent control could be demonstrated to have taken place due to treatment. When measured the same way, DDT produced 65 per cent control. In general, there was slight protection from feeding given to the foliage. There was an apparent small elevation in fecundity of adults which was probably not significant. Development of the treated population was slightly delayed.

This material shows promise, particularly since it can be improved, but does not yet have sufficient insecticidal value to warrant operational testing. Trials with improved formulations and higher dosages should be carried out in 1961. Bioferm have indicated their willingness to cooperate in supplying material, but no firm plans have been drawn up by Forest Biology Division.

II. BACTERIAL INSECTICIDE EXPERIMENTS

(Insect Pathology Research Institute,
Sault Ste. Marie, and Forest Biology
Laboratory, Victoria)

Before this season it was not certain that Bacillus thuringiensis would kill the black-headed budworm. During July, water and oil suspensions of the bacterium were hand-sprayed on potted hemlock seedlings infested with budworms. After one week, 98 per cent of the 125 larvae had died, and diagnosis positively established that 58 per cent of these were infected with B.t. The oil treatment gave somewhat better results than the water suspension. Although the spray dosages were high, the test was sufficient to show that this budworm can be killed by the bacterium.

On July 24th, immediately after the DDT operational spraying was complete, two plots in regeneration hemlock stands were sprayed with B.t. suspended in oil. A third plot was sprayed with oil alone as a check. One B.t. plot was sprayed at the nominal rate of 1.3 lb. of Thuricide concentrate (containing 60 billion viable spores per gram) per acre; the other was applied at the rate of 2.8 lb. per acre. Spray was applied with a Grumman Avenger aircraft equipped to deliver 112 gallons per minute. To achieve the light and heavy dosages, two and three passes, respectively were required over the center lines of the plots. Deposits of the bacterium on both plots were heavy, although the spores temded to clump into aggregates readily visible to the naked eye.

Budworm populations in the plots, similar to the general trend in the locality, were low and declining sharply at the time of treatment. A population reduction evaluation of the treatments was thus not possible. However, about 80 per cent of the dead larvae collected from the plots were infected with B.t. Healthy larvae collected from an unsprayed area were placed on sprayed foliage collected from the plots. Larvae on foliage from the light dosage plot suffered 80 per cent mortality while 90 per cent confined on the foliage from the heavy dosage plot succumbed. Diagnosis showed that all of these larvae were infected with B.t. None of the dead larvae collected from the oil treated check plot contained the bacterium.

Although the lack of large numbers of insects on the plots makes it impossible to compare the efficiency of B.t. with DDT spraying, the experiment has established that black-headed budworm can be killed with B.t. dosages that are within the range of practicability for aerial spraying. On the basis of this initial work, further experimentation can be justified. It is anticipated that the usefullness of the material can be improved with better formulation and application techniques.

Forest Biology Laboratory,
Victoria, B. C.
Sept. 29, 1960

APPENDIX IX

Toxicity of Bacillus thuringiensis to young salmon

Synopsis of results, 1960

Biological Station
Nanaimo, B. C.

Tests of a Bacillus thuringiensis preparation ("Thuricide") were conducted in fresh water against young coho salmon (Oncorhynchus kisutch) averaging approximately 5 cm. in length.

Test fish were held at 10°C prior to testing. Experiments were conducted at 10°C in Sections I, II and IV at 25°C in Section III.

Median lethal times were estimated on the basis of ten fish per experiment and response time has been considered as a measure of resistance to conditions imposed.

Thuricide was formulated as follows:

	g./L
Thuricide Concentrate SO-75	234.0
Wetting Agent #3	40.1
Water	59.8
Furnace Oil #2	646.0

Dilutions of the Thuricide mixture were made on the basis of milligrams dry weight of Thuricide per litre of test solution. All tests were conducted in 45 L. test volumes.

Tests were continued for a total exposure time of 1 week or 10,080 minutes.

Section I.

Dilutions of the Thuricide formulation were set up at 8.35, 21.55, 58.04, 153.4 and 405.6 mg. Thuricide SO-75 per litre. Median response times for this series are illustrated in Figure 1.

Section II.

Dilutions of the Thuricide formulation were set up as in Section I but the Thuricide Concentrate SO-75 was substituted with water. Median response times for the two concentrations in which significant mortality occurred are illustrated in Figure 1.

Section III

Based on the proportions of Thuricide SO-75, wetting agent and furnace oil in the 153.4 mg/L. test concentration of Section I, a 2^3 fractional factorial series was undertaken to provide information on those components or combinations of components which were contributing significantly to a change in resistance time. In order to effect a measurable control, tests were conducted at 25°C (test animals acclimated to 10°C), normally lethal to this species. A significant lowering of resistance time was found for wetting agent, furnace oil and Thuricide, the greatest main effects being attributable to the latter two. Of the interactions, one was just significant, namely that for "furnace oil x Thuricide".

Section IV

Subsequent to the above tests, it was discovered that the Thuricide SO-75 preparation had a wetting agent already incorporated into it in the dry state. A further series was then conducted on the Thuricide SO-75 preparation contrasted with a new sample, Thuricide SO-143, obtained from the Bioferm Corporation, the latter stated to have no wetting agent incorporated into it. Tests indicated a slight lowering of resistance time for the SO-75 preparation over the SO-143 preparation, which if it were a true change, could not be classed as significant. The reduction in resistance time obtained by comparing the SO-75 preparation with the control in Section III could not then be attributable to the wetting agent incorporated into the powder, but to the SO-75 preparation itself.

Discussion

The fact that the Thuricide preparation was at all toxic was viewed with some surprise by the manufacturer, who provided evidence from other institutions that the preparation was considered non-toxic to several other species of fishes. An examination of the evidence indicated it to be complementary to our own tests. The response in these tests may be considered as a function of concentration and of exposure time. If either concentration or exposure time approach a minimum, the response approaches zero. Thus high concentrations with short exposure times or low concentrations with long exposure times may produce zero response. The arguments presented contrary to the results reported herein tend to fall in these limiting response ranges and therefore do not refute the results indicated.

Although Thuricide has been found to be toxic to underyearling coho salmon it should be borne in mind that the potency of the Thuricide preparation as a piscicide appears to be far lower than that of DDT, the present "standard". Comparing these results with those obtained in 1957 for coho underyearlings under comparable test conditions, the 48-hr. median tolerance limit of a DDT-oil-emulsifier preparation was about 0.08 mg/l., while that for the Thuricide-oil-wetting agent preparation is 50 mg/L.

The results of tests on the toxicity of Thuricide, although they are limited in scope, indicate a promising departure from the order of toxicity to fish of other compounds tested here, namely DDT, DDD, malathion, Sevin and Korlan.

Summary and Conclusions

Tests of a Bacillus thuringiensis--furnace oil--wetting agent preparation were conducted at 10°C on coho salmon juveniles. The preparation was toxic from a concentration equivalent to 405.6 mg. Thuricide SO-75 per litre to a lower limiting concentration approximating the lowest concentration tested, namely 8.35 mg. Thuricide SO-75 per litre, when the total exposure time was 10,080 minutes.

Replacement of the Thuricide component in the preparation with water and subsequent testing indicated that the Thuricide was contributing markedly to the response measured, the median resistance time of samples of fish exposed to the preparation.

A fractional factorial series of tests indicated that the lowering of resistance time attributed to Thuricide in the first two series of experiments was indeed a real and significant effect. A significant lowering of resistance time was also noted for the wetting agent, furnace oil and furnace oil x Thuricide interaction. Of these, the Thuricide and furnace oil effects were highly significant. The tests in this series were conducted on fish acclimated to 10°C and tested at 25°C, a normally lethal situation, so that the resistance times for the controls would be finite.

Since the Thuricide SO-75 sample tested contained a wetting agent to which the Thuricide response might have been attributable, a comparison of the SO-75 preparation was made with Thuricide SO-143, another preparation containing no wetting agent. No significamt difference in the response to these two preparations was obtained. The reduction in resistance time attributed to the Thuricide was thus not a spurious response to wetting agent.

Although the Thuricide preparation is concluded to be toxic, its potency appears to be much lower as a piscicide than the "standard" material in use, DDT. Comparable 48-hr. median tolerance limits of DDT- and Thuricide-oil preparations have been estimated at 9.08 mg/L. and 50 mg/L. respectively. A promising departure from the high order of toxicity of DDT is indicated on the basis of these findings.

October 25, 1960

Nanaimo, B. C.

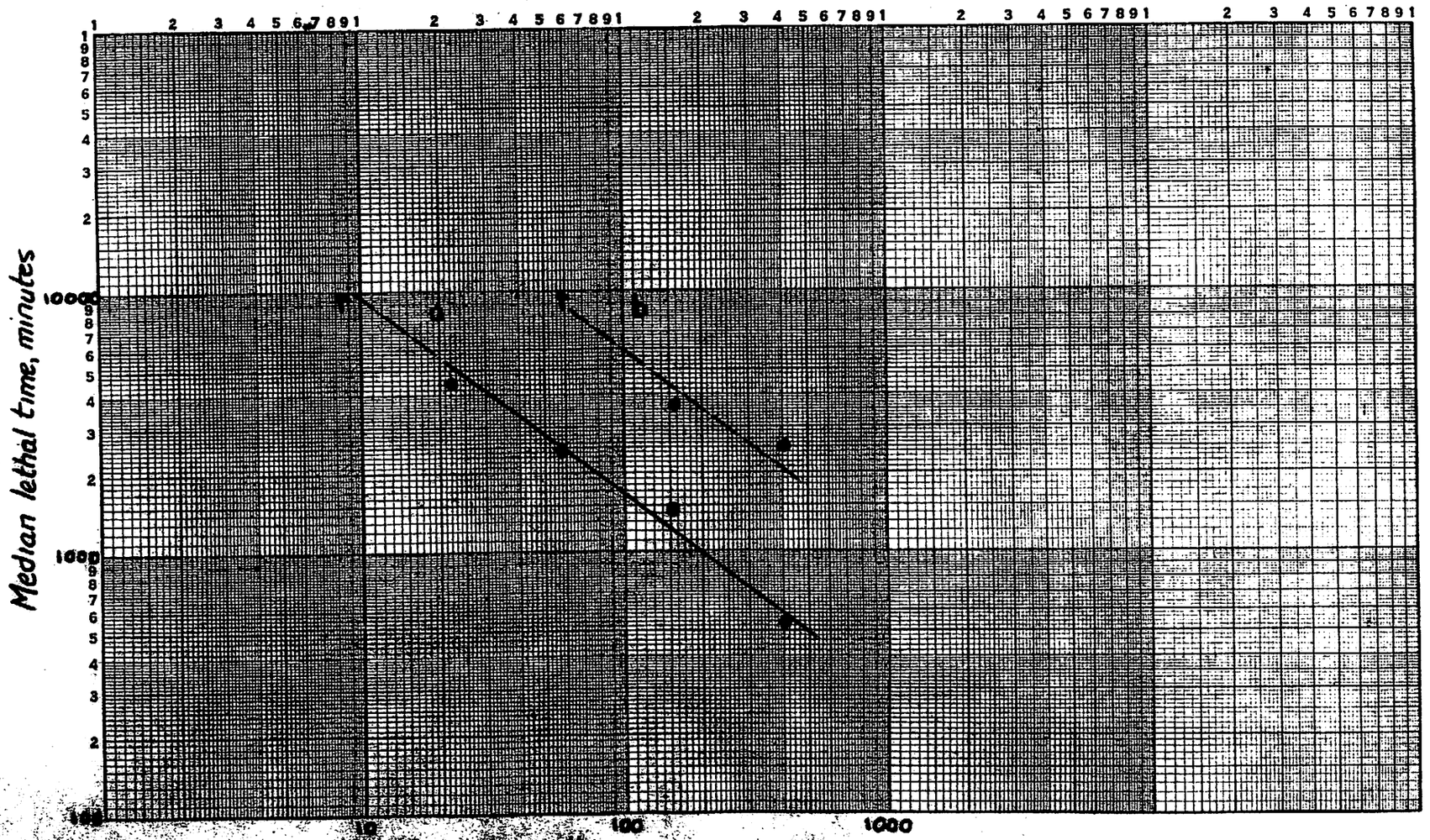


Fig. 1. Median response times for dilutions of Thuricide (as mg./L of 50-75 concentrate)
a) Normal preparation. b) Thuricide component replaced by water.

APPENDIX X

INFESTATIONS OF FOREST INSECTS OBSERVED IN 1960,
THAT MAY REQUIRE CHEMICAL CONTROL ACTION IN 1961

Newfoundland: probably nil

Nova Scotia: probably nil

New Brunswick: Spruce budworm

Populations remain low in the northern part of the province. In the control region, where spraying operations were carried out in 1960, moderate to high egg populations occurred in the fall of 1960 over some 2.2 million acres. Much of the infested area was severely defoliated in 1960, spraying in 1960 having been later, seasonally, than in earlier years. Therefore high hazard occurs over a large area in central New Brunswick, extending from Carleton County to Kent County, with a sizeable area in southeastern Gloucester County and other sizeable areas near Fredericton and the Southwest Miramichi River. Spraying will be necessary in 1961 to prevent extensive timber mortality. The specific areas and the total acreage to be proposed for treatment in 1961 are not yet available. It is anticipated that the acreage to be proposed for treatment will be substantial.

Quebec: Spruce budworm

Infestations have remained low since 1958 throughout most of the Gaspe-Southern St. Lawrence area. A small residual infestation persisted in the Lake Kedgwick-Lake Mistigougueche area, where 33,000 acres were sprayed in 1960. The results were very satisfactory, but surveys in the late summer of 1960 disclosed high egg populations in adjoining areas as follows:

To the east, in upper drainage area of the Patapedia River..... 25,000 acres
To the west, in upper drainage area of the Rimouski River ..... 35,000 acres

Total 60,000 acres

It is expected that these infestation pockets will be sprayed in 1961, and possibly some part of the 1960 sprayed area, where small numbers of budworm pupae persisted after the 1960 operation.

Ontario
Manitoba
Saskatchewan
Alberta

probably nil

British Columbia, interior: Satin moth

Small groves of ornamental poplars in the Okanagan Valley may require spraying. If this is undertaken, it will probably be within the boundaries of cities in the valley.

British Columbia, coast:

Saddle-backed looper

Infested forest near Kitimat may require control action in 1961. The 1960 infestation covered an area of some 14,000 acres.

Green-striped forest looper

Localized infestations occur in many places on the west side of Vancouver Island. Some of these infested areas may require protective action in 1961.

Pine butterfly

An infestation occurs in the MacMillan Park (Cathedral Grove) area of Vancouver Island. Some 1,500 acres of old growth forest may require protective action in 1961.

Hemlock looper

Increased looper populations were noted in the Holberg Inlet area of Vancouver Island in 1960. It seems unlikely that direct control will be needed in 1961.

Black-headed budworm

The infestation on the Queen Charlotte Islands receded in the late summer of 1960, and it is unlikely that spraying operations will be needed in 1961.

M. L. Prebble, Ottawa, Oct. 26/60

Synopsis prepared from reports submitted by Forest Biology Laboratories in September and early October.

COPY

CANADA DEPARTMENT OF FORESTRY
FOREST BIOLOGY DIVISION

Forest Biology Laboratory
College Hill, Fredericton, N. B.

December 6, 1960

Mr. H. D. Heaney,
Canada Department of Forestry,
P. O. Box 428,
Fredericton, N. B.

Dear Mr. Heaney:

This will confirm discussions in my office this morning of tentative plans by Forest Protection Ltd. and the N. B. Dept. of Lands and Mines for spruce budworm aerial spraying in 1961. As explained to you, the present spray plan excludes the Acadia Forest Experiment Station from treatment in 1961 on the basis that the quantity of balsam fir and the general forest values in the general area of the Station do not warrant treatment. This general area does, however, represent an area of high hazard for damage by the budworm in 1961, as indicated on hazard maps prepared by us in 1960 (copy of which was sent to you). We think, therefore, that balsam fir on the Station property is in danger of dying if it is not treated in 1961.

At a meeting with B. W. Flieger and K. B. Brown on Friday last I was asked to bring the above information to your attention and to suggest to you that if, in the light of it, you feel that the Acadia Station property should be sprayed in 1961, you should make appropriate representations directly to Forest Protection Ltd. through Mr. Flieger; Mr. Brown asked that a copy of any representation be sent to him, and I would also appreciate a copy to complete my file.

Mr. Flieger's address is as follows:

Mr. B. W. Flieger, Manager,
Forest Protection Limited,
43 Roseberry Street,
Campbellton, N. B.

RMB:rmb

Yours sincerely,

cc - Mr. B. W. Flieger
Mr. K. B. Brown

(sgd) Richard M. Belyea
Richard M. Belyea,
Officer-in-Charge.

Mr. Beall to note

File: 14-0-31

DRR:EBC

Forest Research Division

Ottawa, December 7th, 1960.

Mr. H. D. Heaney,
District Forest Officer,
P.O. Box 428,
Fredericton, N. B.

Sir:

Mr. Beall has advised me that there will be a meeting in Ottawa on Friday, December 16th of the Interdepartmental Committee on Aerial Spraying. We do not know what recommendations will be made by the New Brunswick Forest Protection Limited for spraying areas infested by the spruce budworm. Should there be a recommendation that the area occupied by the Acadia Forest Experiment Station be sprayed, we would like to be aware of your recommendations in this regard. Would you kindly therefore advise me as soon as convenient whether you think spraying should or should not be carried out at Acadia, if it is recommended. I presume that you will contact Dr. Belyea and obtain his views and probably be able to reach an agreement with him with regard to your recommendations.

It is not likely that I will be attending the meeting. Mr. Beall usually represents the Forestry Department. I would like to be able to advise him, however, a day or two before the meeting.

Yours faithfully,

D. R. Redmond,
Chief.

14-0-81

DASD/bfc

Forestry Operations Division

OTTAWA, December 7, 1960.

Mr. H. D. Heaney,
District Forest Officer,
P.O. Box 428,
FREDERICTON, New Brunswick.

--- Attention: Mr. E. N. Doyle ---

Sir:

The Interdepartmental Committee on Forest Spraying Operations is holding a meeting on December 16th, regarding the proposed aerial spraying operation in New Brunswick in 1961.

From previous correspondence, Mr. Doyle indicated that on the Camp Gagetown Area, the Army authorities were planning to take protective measures against the spruce budworm of certain areas within the Camp Gagetown Area. For the purpose of the above mentioned meeting, I am wondering if any further information is available regarding the Army's intentions for a spray program within the area.

While attending the Annual Meeting of the Canadian Institute of Forestry in Quebec, I had the opportunity to speak to Dr. Mott of the Forest Biology Division regarding the spruce budworm infestation on the Camp Gagetown Area. At that time he indicated he would make further studies of the situation there. Any further information which Dr. Mott might now have on the infestation, would also be appreciated.

Yours faithfully,

H. W. Beall,
Chief.

14-0-31

901616

7.9.14

MEMORANDUM TO:

December 7, 1960

Dr. A. L. Pritchard
Dr. J. L. Kenk,
Mr. W. W. Mair,
Mr. H. V. Donald

Subject: Next Meeting of Interdepartmental Committee on Forest Spraying Operations

At the Meeting of the Interdepartmental Committee, October 31, it was agreed that another meeting should be held as soon as the proposals for 1961 spraying operations in New Brunswick were at hand. On November 28 I sent you a copy of a letter from Mr. K. B. Brown, Acting Deputy Minister of Lands and Mines, New Brunswick. Subsequent to that time I have received additional information and maps from Dr. Belyea, Officer-in-Charge of our Laboratory at Fredericton, re the proposed 1961 spraying program. Therefore information is at hand for the attention of the Interdepartmental Committee, and after Mrs. Pearson's canvass of members by 'phone this morning I am suggesting that the next meeting of the Committee be held at 9:30 a.m. December 16 in Room A-227, Sir Charles Tupper Building, Riverside Drive. Dr. Pritchard has kindly arranged to reserve this room for our use. This December 16 meeting should, I believe, be confined to members of the Interdepartmental Committee and such immediate advisers as committee members may feel it necessary to have at hand. In this connection I propose to ask Dr. Fettes and Dr. Belyea to attend because of their close contact with the experimental program, the operational program in 1960, and the proposed operational program in 1961. At this meeting I think we should consider carefully the results of the earlier program, and arrive at any recommendations that seem to be pertinent to the 1961 program, keeping in mind the information supplied by Mr. Brown in his letter of November 24.

As a result of experience in the winter of 1959-60 I think it is desirable that representatives of the Province of New Brunswick and Forest Protection Limited be asked to sit with the Committee after the meeting of December 16, and accordingly I recommend that a second

... 2.

meeting of the Committee be held December 19, at 2:00 p.m., at which viewpoints and proposals could be exchanged between members of the Committee and the New Brunswick representatives. Dr. Pritchard has also made arrangements to reserve A-227 in the Upper Building for the afternoon of December 19. Believing this to represent the views of the other members of the Committee I have written to Mr. Brown and Mr. Flieger, as per attached copies. In the absence of Mr. Mair from his office, I have not extended an invitation to Mr. Bruce Wright to attend the meeting in the afternoon of December 19, but will attempt to contact Mr. Mair by 'phone on December 8 so that an invitation may go out promptly if Mr. Mair agrees that Wright should be invited.

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp

7. 9. 14

Mr. K. B. Brown,
Acting Deputy Minister,
Department of Lands and Mines,
Province of New Brunswick,
Fredericton, N.B.

December 7, 1960

Dear Ken:

Further to my letters of November 21 and 28, this will let you know that a Meeting of the Interdepartmental Committee on Forest Spraying Operations has been called for December 19, 2:00 p.m., in Room A-227, of the Sir Charles Tupper Building, Riverside Drive, Ottawa. You are cordially invited to be present. I expect that Barney Flieger will also attend and if we can be of any assistance in providing transportation to the Tupper Building it is only necessary to give Dr. Fettes or me a 'phone call on your arrival in Ottawa.

I am not certain at the moment whether Bruce Wright should be invited, but I will be in touch with Mr. Hair, Chief, Canadian Wildlife Service, on his return to his office tomorrow and will follow his advice regarding an invitation to Mr. Wright.

I am very hopeful that the discussion on December 19 may lead to sympathetic understanding of the various problems involved and that the meeting will, therefore, prove to be useful to all concerned.

Yours sincerely,

M. L. Prebble,
Director,
Forest Biology Division.

Forest Biology Hdqrs.
Telephone No.
9-4-5783

MLP/kp
cc: Dr. A. L. Pritchard
Dr. J. L. Kask
Mr. W. W. Hair
Mr. H. W. Beall
Mr. B. W. Flieger
Dr. R. M. Belyea, Dr. J. J. Fettes

7.9.14

Mr. B. W. Flieger,
Canadian International Paper Co. Ltd.,
Sun Life Bldg.,
Montreal 2, P.Q.

December 7, 1960

Dear Barney:

You will remember that at the October 31 Meeting of the Interdepartmental Committee on Forest Spraying Operations it was agreed that the committee would meet again in the near future, at which proposals for spraying operations in New Brunswick in 1961 could be examined in somewhat greater detail.

You are cordially invited to a meeting of the Interdepartmental Committee December 19, 2:00 p.m. in the Sir Charles Tupper Building, Riverside Drive, Room A-227. This is where we met in October and if we can be of assistance to you in transportation to the Tupper Building please let me or Dr. Fettes know on your arrival.

In the meantime members of the Committee will have an opportunity to study the information supplied earlier, along with the map of the proposed spraying operations in 1961. I hope that the discussion in the afternoon of December 19 will be profitable to all concerned.

Yours sincerely,

Forest Biology Divn.
Telephone No.
9-4-5783

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp

cc: Dr. A. L. Pritchard
Dr. J. L. Kask
Mr. W. W. Mair
Mr. H. W. Beall
Mr. K. B. Brown
Dr. R. M. Belyea
Dr. J. J. Fettes

COPY

CANADA DEPARTMENT OF FORESTRY
FOREST BIOLOGY DIVISION

Forest Biology Laboratory
College Hill, Fredericton, N. B.

December 7, 1960

Mr. H. D. Heaney,
Canada Department of Forestry,
P. O. Box 428,
Fredericton, N. B.

Dear Mr. Heaney:

This will confirm our discussions of yesterday regarding spruce budworm conditions in the Camp Gagetown area and present tentative plans of Forest Protection Limited and the N. B. Department of Lands and Mines for aerial spraying in that general area in 1961.

With regard to spruce budworm and tree conditions in the Camp area I would reiterate information sent to Mr. L. G. Davis of your staff by Mr. Mott in early August and amplified in later discussion with your staff. In general, the Camp area is free from serious tree damage (it is not included in our moderate or high hazard areas as mapped in 1960). Egg sampling in 1960, however, indicated three spots within the northern part of the Camp where fairly high egg numbers were recorded (please check 1960 egg mass survey map).

I am attaching hereto a map showing the part of the Camp property included for spraying in the tentative spray plan for 1961. Messrs. Flieger and Brown have indicated that this spray boundary was drawn largely to bring into the treated area the three spots showing high egg numbers referred to above.

It is clear that aerial spraying of the whole Camp area in 1961 could not be justified on the basis of budworm conditions as they were defined in 1960. In the northern quarter of the area where fairly high budworm egg numbers were recorded in 1960, however, present status of budworm

/2

attack and future prospects for further attack warrant attention on the basis that trees in this part of the Camp are of value to the Army. Thus, the present plans of F.P.L. and Lands and Mines for spraying in 1961 in the Camp area seem to us to be quite reasonable.

I trust this information might be of use to you in any negotiations that develop with Camp authorities regarding budworm spraying in the Camp area.

Yours sincerely,

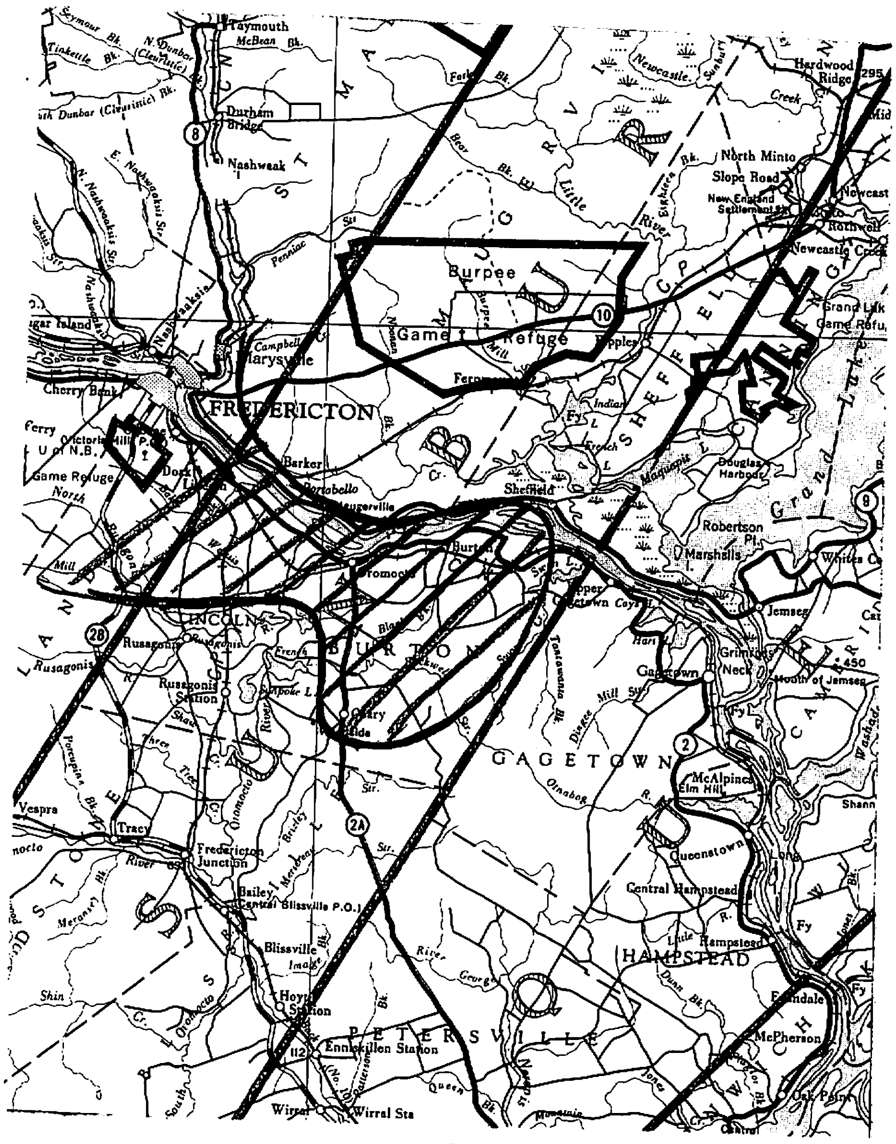
RMB:rmb

(sgd) Richard M. Belyea

Richard M. Belyea,
Officer-in-Charge.

Att:

cc - Mr. B. W. Flieger
Mr. K. B. Brown



Taymouth
Durham Bridge
Nashwaak
Burpee
Game Refuge
Marysville
FREDERICTON
Cherry Bank
Barker
Portobello
Maugerville
Sheffield
North Minto
Slope Road
New England Settlement
Rothwell
Newcastle Creek
Hardwood Ridge
Grand Lake
Douglas Harbour
Robertson Pt.
Marshalls
Jemseg
Grimross Neck
Mouth of Jemseg
Gagetown
Upper Gagetown
Burton
Oromocto
Geary
Lincoln
Rusagonis
Rusagonis Station
Tracy
Vespra
Fredericton Junction
Bailey
Central Blissville P.O.
Blissville
Hoyt Station
Enniskillen Station
Wirral Sta
McAlpines
Elm Hill
Queenstown
Central Hampstead
HAMPSTEAD
Hampstead
McPherson
Oak Point
G A G E T O W N
Game Refuge
U of N.B.

14-0-31

CANADA

DEPARTMENT OF FORESTRY

901683

Forest Research Division
Maritimes District

P. O. Box 428,
Fredericton, N. B.

December 8, 1960.

Dr. D. R. Redmond,
Chief, Forest Research Division,
Department of Forestry,
Ottawa, Ontario.

Sir:

Attached to this letter you will find a copy of a letter to me from Dr. R. M. Belyea, referring to discussions held with him on December 6.

Although the Acadia Forest Experiment Station is not included in the 1961 spray plan, it is evident that Dr. Belyea feels that it should be sprayed.

You will note that Mr. Flieger and Mr. Brown suggested that if we feel the Station property should be sprayed, we should get in touch with Forest Protection Limited. Before doing this, I feel that this should be discussed with Mr. Beall and be considered in the light of whether or not Canada will participate in sharing costs of the 1961 aerial spraying program.

If Canada participates in the costs, I assume there will be no other costs to us for spraying at the Acadia Station, but if not of course, we would most certainly be charged for this service and we have made no provision in our 1961 estimates for such an emergency. If it is decided that Canada participates in the costs, would you please authorize me to make a request for spraying to Mr. Flieger. In the past all such requests have gone directly to the Province, but Mr. Brown acquiesces in the procedure outlined in Dr. Belyea's second paragraph.

Yours faithfully,

H. D. Heaney,
District Forest Officer.

Att:

14-0-31

CANADA

DEPARTMENT OF FORESTRY

Forestry Operations Division
Maritimes District

P. O. Box 428,
Fredericton, N. B.

December 8, 1960.

Mr. H. W. Beall,
Chief, Forestry Operations Division,
Department of Forestry,
Ottawa, Ontario.

901679

Sir:

I am attaching to this letter a copy of a letter received from Dr. R. M. Belyea today.

It is apparent from Dr. Belyea's letter that he feels the extension of the 1961 spray area to include the northwest part of the Camp Gagetown area, is reasonable, but he also feels that there is no justification for spraying the whole Camp area to protect it from the budworm.

I assume that we need not enter into any discussions with Camp authorities, as the Department of National Defence will no doubt make its own decisions and carry on its own negotiations in connection with the budworm spraying program.

Yours faithfully,

H. D. Heaney,
District Forest Officer.

Att:

14-0-31

7.9.14

Mr. B. S. Wright,
Northeastern Wildlife Station,
c/o University of New Brunswick,
Fredericton, N.B.

December 8, 1960

Dear Bruce:

Subject: Interdepartmental Committee on Forest Spraying Operations

There will be a further meeting of the Interdepartmental Committee in Ottawa, December 19, to consider the proposed spraying operations against the spruce budworm in New Brunswick in 1961. Since our earlier meeting at the end of October proposals have been advanced by Forest Protection Limited, based on hazard maps and population forecasts by the Forest Biology Laboratory at Fredericton. Therefore it will now be possible to look at the proposed program much more meaningfully than was the case at the end of October.

You are cordially invited to attend the meeting December 19, 2:00 p.m., in the Sir Charles Tupper Building, Riverside Drive, Ottawa. The Tupper Building is rather hard for a stranger to find, so I extend to you the same invitation that has been given to Mr. Ken Brown and Barney Flieger - if you 'phone me on your arrival in Ottawa I will see that you are picked up and delivered at the Tupper Building.

Yours sincerely,

M. L. Prebble,
Director,
Forest Biology Division.

Forest Biology Division
Hdqrs. Telephone No.1
9-4-5763

MLP/kp
cc: Dr. A. L. Pritchard
Dr. J. L. Kask
Mr. W. W. Mair
Mr. H. W. Beall ✓
Mr. K. B. Brown
Mr. B. W. Flieger
Dr. R. M. Belyea

Forestry Operations
Division

14-0-31

HWB/mes

OTTAWA, December 9, 1960.

Mr. H.D. Heaney,
District Forest Officer,
P.O. Box 428,
FREDERICTON, N.B.

Sir:

Thank you for your letter of December 8th enclosing Dr. Belyea's letter dealing with the budworm infestation at Camp Gagetown. Dr. Belyea's conclusions certainly appear reasonable and, if the present plans of Forest Protection Limited are carried out, it would seem that no additional spraying is necessary.

From your last paragraph I am not sure whether this information has been made available to the Camp authorities. If he has not already done so, I would suggest that Mr. Davis acquaint the military authorities with the budworm situation and Dr. Belyea's recommendations. I would agree with you that this department need not be involved in any negotiations carried out by the Department of National Defence in connection with any spray application which may be undertaken independently of that proposed by Forest Protection Limited. However, the question of when and where spraying is necessary from a forestry standpoint is one in which we are definitely involved, as I see it, since we are responsible for forest management on the Camp area. I would hope, therefore, that the information we have, and the advice we are able to give, will be made available to National Defence officials at the Camp.

Yours faithfully,

H.W. Beall,
Chief.

14-0-31

901689

7.9.14

MEMORANDUM TO:

Dr. A. L. Pritchard
Dr. J. L. Kask
Mr. W. W. Mair
Mr. H. W. Beall

December 9, 1960

This is to confirm an alteration of time of the December 19 meeting of the Interdepartmental Committee on Forest Spraying Operations from the afternoon to 9:00 a.m. This change was necessary because of travel difficulties involving representatives from Fredericton.

I have been informed by Dr. Pritchard that Room A-227 will be available in the morning of December 19.

M. L. Prebble,
Director,
Forest Biology Division.

MLP/kp

Mr Beall

File: 14-0-31

DRR:EBC

Forest Research Division

Ottawa, December 12th, 1960.

Mr. H. D. Heaney,
District Forest Officer,
P.O. Box 428,
Fredericton, N. B.

Sir:

Thank you for your letter of December 8th and the copy of Dr. Belyea's letter of December 6th to you.

Mr. Beall will be in attendance at the Interdepartmental Committee on Aerial Spraying on Monday, December 19th and will, at that time, bring up the question of spraying the Acadia Forest Experiment Station. I provided Mr. Beall with a memorandum pointing out the advisability of spraying the Station to protect research plots on silviculture, management, and tree breeding.

Although you did not state that you thought the Station should be sprayed, I gathered from the tone of your letter that you would agree with Dr. Belyea. Presumably you do not disagree.

Yours faithfully,

DRR

D. R. Redmond,
Chief.

MEMORANDUM • GOVERNMENT OF CANADA

TO : Mr. H. W. Beall [initialled] YOUR FILE No:

FROM : D. R. Redmond OUR FILE No: 14-0-31

SUBJECT: DATE: December 12th, 1960.

Dr. Belyea, Officer-in-Charge of the Forest Biology Laboratory, Fredericton, has advised Mr. Heaney, District Forest Officer at Fredericton, that the Acadia Forest Experiment Station represents an area of high hazard for damage by the spruce budworm in 1961 and that the entomologists think that balsam fir on the Station property is in danger of dying if it is not treated in 1961.

2. A considerable number of forest research projects, dating back over a long period of years, are being conducted at the Acadia Forest Experiment Station. This research covers the fields of silviculture, regulation and management, and tree improvement. Much of this research is based on remeasurement of permanent sample plots that have been under observation for well over twenty years. Failure to protect these plots from the ravages of the spruce budworm will mean that much of the value of the research that will be derived from them will be lost. The results of this research are of special benefit to those companies of New Brunswick who are participants in the spraying program.

3. It is my opinion that Forest Protection Limited should be requested to include the area of the Acadia Forest Experiment Station in their program of spraying against the spruce budworm in 1961.

D.R.R. [signature]
D. R. R.

H.B. - Necessary to [illegible] to get Cabinet approval to Fed. financial participation [illegible] Acadia if we [illegible] will be included in spray program. HWB

CGSB Standard 6—GP—22; P P & S Cat. No. 3590

CANADA

DEPARTMENT OF FORESTRY

Forestry Operations Division
Maritimes District

901786

P. O. Box 428,
Fredericton, N. B.

December 12, 1960.

Mr. H. W. Beall,
Chief, Forestry Operations Division,
Forestry Department,
Ottawa, Ontario.

Sir:

This will acknowledge your letter of December 9 in answer to mine of December 8 dealing with budworm infestation at Camp Gagetown.

As suggested in your second paragraph, Mr. Davis today is seeing the military authorities and letting them know of Dr. Belyea's recommendations, and giving them all the information which we have.

In your letter of December 7, which you marked to the attention of Mr. Doyle, you requested further information about the infestation within the Camp Gagetown area. I believe that my letter of December 8, which was attached to Dr. Belyea's, answers your request for further information.

Yours faithfully,

H. D. Heaney,
District Forest Officer.

Col. Kelly advises DND H.Q. doesn't know anything about spraying proposals at C.G.

CANADA

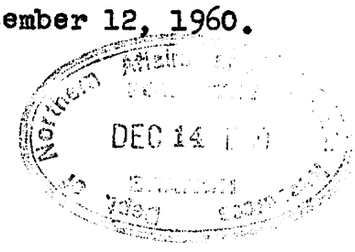
DEPARTMENT OF FORESTRY

Forest Research Division
Maritimes District

901783

P. O. Box 428,
Fredericton, N. B.

December 12, 1960.



Dr. D. R. Redmond,
Chief, Forest Research Division,
Department of Forestry,
Ottawa, Ontario.

Sir:

I believe your letter of December 7 has already been answered by mine of December 8, with which I enclosed Dr. Belyea's recommendations in connection with spraying the Acadia Forest Experiment Station. As was pointed out in my letter and Dr. Belyea's letter, the Acadia Station is not included in the 1961 spray program as drawn up by Forest Protection Limited. Although Forest Protection Limited realize that the infestation is active in that general area, they felt that forest values were not sufficient to have it included.

We, however, most certainly recommend that the Acadia Station area be included, in view of Dr. Belyea's forecast of further mortality if the area is not treated.

Yours faithfully,

H. D. Heaney,
District Forest Officer.

14-0-51

HWB/bfc

Forestry Operations Division

OTTAWA, December 15, 1950.

Mr. H. D. Heaney,
District Forest Officer,
P.O. Box 428,
FREDERICTON, New Brunswick.

Sir:

Thank you for your letter of December 12th, regarding forest insect spraying at Camp Gagetown.

Would you please let me know as soon as possible of any plans the Army may have for spraying in this Area during the coming summer and keep us advised on any developments that may occur in this connection.

Yours faithfully,

H. W. Beall,
Chief.

14-0-31

OTTAWA, December 16, 1960.

MEMORANDUM FOR FILE

INTERDEPARTMENTAL COMMITTEE ON FOREST SPRAYING OPERATIONS

A meeting of the Committee was held on December 16th. The following are the main points that arose of interest to this department, other than those relating to Forest Biology:

(1) The Fisheries Department is not opposed to federal financial contribution to the New Brunswick spraying operation in 1961.

(2) Although the Acadia Forest Experiment Station was not included in Forest Protection Limited's spray plan for 1961, it is included in one of several extensions to that plan recommended by Dr. Belyea. Dr. Belyea's proposals were acceptable to the Committee. Dr. Belyea said he believed that both Mr. K.G. Brown and Mr. Fleiger would be agreeable to including the Acadia Station in the spray program on the request of this department. There will be an opportunity to speak to both of them about this on Monday, the 19th, when they will be attending another meeting of the Interdepartmental Committee.

(3) The north end of Camp Gagetown is included in Forest Protection Limited's spray plan, although Dr. Belyea thinks that this is not particularly necessary next year. However, as Forest Protection Limited will probably want to make use of the Army's airstrip at Blissville, it is likely that this area will be included. There is also a possibility that the Army may make independent arrangements with Forest Protection Limited for spraying other parts of the Camp to control biting insects. Dr. Belyea thinks that if this is done it will not likely harm any parasites or predators of the balsam woolly aphid that may be in the area. Colonel Miller of N.D.H.Q. knows nothing of any plans for such spraying at Gagetown. I have asked Mr. Heaney to keep us advised.

(4) The McGivney Ammunition Depot is definitely included in the 1961 spray plan.

H.W.B.

Interdepartmental Committee on Forest Spraying Operations
Ottawa, December 19, 1960

(Meeting called to consider certain aspects of proposed spray program in New Brunswick, 1961)

AGENDA

1. Outline of proposed spray program, 1961

   a. Division of infested area into two major zones
      Zone 1 (i) location; acreage; additions proposed by Forest Biology Laboratory, by Forest Operations Division, etc.; exclusions proposed by other agencies.
      (ii) concentration of DDT in spray mixture; application rate; timing of spraying; factors governing repeat spraying.

      Zone 2 - location; acreage; proposed action.

   b. Possible extensions of area to be sprayed, based on new information in early summer of 1961.

   c. Hazards to fish and wildlife, precautions, etc.

2. Investigations to be carried out in 1961.

   a. Forest Biology Division
   e) - Forest Research Division
   b. Fisheries Research Board and Fisheries Department

   c. Canadian Wildlife Service, Northeastern Wildlife Station

   d. Forest Protection Limited (with special reference to Zone 2)

3. Means of improving liaison among Fisheries Research Board, Fisheries Department, Forest Biology Laboratory and Forest Protection Limited during spraying operations, with particular reference to safeguarding investigational program.

4. Other matters.

Flieger says Quint, of A.T.B., would be welcome to visit spray opn.

MEMORANDUM • GOVERNMENT OF CANADA

TO : Dr. J.D.B. Hamilton and Dr. D.R. Redmond

YOUR FILE No:

FROM : H.W. Beall

OUR FILE No: 14-0-31

SUBJECT: Interdepartmental Committee on Forest Spraying Operations

DATE: Dec. 19/60.

Following the meeting of the above Committee this morning Mr. K.B. Brown said that it would be in order for our Minister, if he so desires, to inform the Cabinet that he and the Manager of Forest Protection Limited have agreed to the extension of the 1961 spray program to include the Acadia Forest Experiment Station.

2. All that is required in the way of a request is a letter from Mr. Heaney to Mr. Fleiger, with a copy to Mr. Brown, asking that the Acadia Station be included.

H.W.B.

Minister so advised 20/12/60

CGSB Standard 6—GP—22; P P & S Cat. No. 3590

MEMORANDUM • GOVERNMENT OF CANADA

TO : Dr. J.D.B. Harrison and Dr. D.R. Redmond

YOUR FILE No:

FROM : H.W. Beall

OUR FILE No: 14-0-31

SUBJECT: Interdepartmental Committee on Forest Spraying Operations

DATE: Dec. 19/60.

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CGSB Standard 6—GP—22; P P & S Cat. No. 3590

DR. HARRISON

DEC 19 1960

14-0-31

OTTAWA, December 16, 1960.

MEMORANDUM FOR FILE

INTERDEPARTMENTAL COMMITTEE ON FOREST SPRAYING OPERATIONS

A meeting of the Committee was held on December 16th. The following are the main points that arose of interest to this department, other than those relating to Forest Biology:

(1) The Fisheries Department is not opposed to federal financial contribution to the New Brunswick spraying operation in 1961.

(2) Although the Acadia Forest Experiment Station was not included in Forest Protection Limited's spray plan for 1961, it is included in one of several extensions to that plan recommended by Dr. Belyea. Dr. Belyea's proposals were acceptable to the Committee. Dr. Belyea said he believed that both Mr. K.G. Brown and Mr. Fleiger would be agreeable to including the Acadia Station in the spray program on the request of this department. There will be an opportunity to speak to both of them about this on Monday, the 19th, when they will be attending another meeting of the Interdepartmental Committee.

(3) The north end of Camp Gagetown is included in Forest Protection Limited's spray plan, although Dr. Belyea thinks that this is not particularly necessary next year. However, as Forest Protection Limited will probably want to make use of the Army's airstrip at Blissville, it is likely that this area will be included. There is also a possibility that the Army may make independent arrangements with Forest Protection Limited for spraying other parts of the Camp to control biting insects. Dr. Belyea thinks that if this is done it will not likely harm any parasites or predators of the balsam woolly aphid that may be in the area. Colonel Miller of N.D.H.Q. knows nothing of any plans for such spraying at Gagetown. I have asked Mr. Heaney to keep us advised.

(4) The McGivney Ammunition Depot is definitely included in the 1961 spray plan.

H.W.B.

Meeting, Int'l Committee on Rec. Spraying Operns.
Dec 19/60
[illegible] & Committee, Messrs R W Brown
& B W Flieger present.

1 a (i) [Zone 1] Brown & Flieger agreed to [illegible] proposal of Belyea ([illegible]), with extended area which includes Acadia [illegible] somewhat at N & E sides (where mostly B spruce) but ~~[illegible]~~ [illegible] entire Acadia F.E.S. area with adequate [illegible], in spray program.

[illegible] areas needed for spraying in Camp Gagetown should be sprayed, mostly [illegible] [Camp H.Q.] & cleared areas. If D.N.D. wants any additional part of Camp sprayed [for other purposes], this would be outside ~~[illegible]~~ joint spray program & subject to separate arrangements by D.N.D.

(ii) Clear that ~~[illegible]~~ [illegible] [2 sprayings] ~~[illegible]~~ in 1961, on account of high continuing population after 1st application, ~~might~~ run to 500,000 acres. Total area of Zone 1, without [illegible], is abt 1.7 million acres. ([illegible] 2 million including [illegible].)

Zone 2 – total area about 1½ million acres. ([illegible] E of Zone 1, [illegible] lines on Belyea's map, where [spruce content high, or] economic values low, & no firm decision as to how much, if any, to be sprayed.) Certainly the whole Zone 2 would [not?] be sprayed.

(b) [illegible] FPH, where control areas, etc. outside spray plan are, to be taken into account in making changes.

B Wright made no specific proposals at meeting.
4 of his 5 woodcock areas ~~could be~~ [are] in 1961 plan as it now stands.
Waterfowl study area is not in plan.

Henry – send us copy of spray ~~plan~~ map as soon as possible. [illegible] of [illegible] by Brown for [illegible].
[illegible] ~~[illegible]~~ to advise Henry to write.
[illegible] [illegible] some [illegible] [illegible] [illegible] damage.

Brown – 1. Should Henry write Flieger re Acadia, Camp [illegible], or at [illegible] level?
1a. [illegible] ~~[illegible]~~ Acadia will be [illegible]?
2. Will 500,000 [illegible], with [illegible]? How [illegible] from 1960 530,000?
3. [illegible] Flieger [illegible] if [illegible] contribution. Would [illegible] our agreement to [illegible].

2 a ~~Ruddell~~ proposed that small area be sprayed at full strength in 1961, so that if anything goes wrong, can determine whether reduced concentration had anything to do with it, & establish criterion of reduced spray. Suitable area can be found near centre of ~~the~~ Zone 2. Acadia FES [illegible], but ... said [illegible] to ... some damage here as ~~the~~ main program, so ... will ... conditions of [illegible] area.

For Biol. don't propose extensive tests of droplet density & effect on population, as felt past work have demonstrated this adequately.

(c) Fisheries ~~intend~~ to carry out much the same program as last year. More intensive study of aquatic insects needed, in co-operation with entomologists in Agriculture.

(d) More use will be made of TBMs in 1961, in interests of economy. Also[illegible] will be reserved for more difficult topographical conditions. Continued efforts will be made to improve uniformity of droplet density, but Fliegers [illegible] of [illegible] charge there.

No evidence yet of budworm becoming resistant to DDT. Ratio of parasites & predators to budworms continues to improve.

3. Fisheries will supply F.P.L. with maps showing check areas, to be protected if changes in program occur.

4. Brown said Stoney & he had discussed possibility of research into ecology, etc of results of spraying. (F ~~[illegible]~~ Div. project).