# THE GREEN-STRIPED FOREST LOOPER INFESTATION, QUEEN CHARLOTTE ISLANDS

## PART I. SURVEYS, AUTUMN, 1964

by

R.L. Fiddick, E.G. Harvey and G.T. Silver

## PART II. EXPERIMENTAL CONTROL WITH PHOSPHAMIDON

by

J.M. Kinghorn and H.A. Richmond

FOREST RESEARCH LABORATORY

VICTORIA, BRITISH COLUMBIA

INFORMATION REPORT BC-X-I

DEPARTMENT OF FORESTRY

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## INTRODUCTION

The green-striped forest looper, *Melanolophia imitata* Wlk., outbreak on the Queen Charlotte Islands was first detected in late November, 1963. By February, 1964, it was decided that further surveys were required to determine the extent and intensity of the outbreak and the outlook for 1964. An appraisal survey of Graham Island was carried out on March 16-24, and a report prepared on the results[1/]. The outbreak extended over 100,000 acres of hemlock-cedar-lodgepole pine stands on Graham Island. In 1963 there was severe defoliation of cedar and hemlock on 35,000 acres but the lodgepole pine was undamaged; defoliation was not evident on Sitka spruce in the spruce-hemlock type. Chemical control action was not initiated in 1964, although an experimental spray project was undertaken (Part 11). The results of summer and autumn surveys to determine the status and trend of the outbreak are outlined herein.

## METHODS

An aerial survey of Graham Island was carried out on September 1, 1964, by J.M. Kinghorn and E.G. Harvey, Department of Forestry, The fixed wing aircraft was supplied by the B.C. Forest Service,

Plots were established within the infestation area to study the effect of defoliation on tree mortality and recovery. The trees were re-examined in the fall after feeding was completed. Estimates of defoliation were recorded by crown levels,

A pupal and damage survey was carried out September 28 - October 3. One-foot-square duff samples were taken at the base of the tree and at a point mid-way between the base of the tree and the periphery of the crown on opposite sides of each tree, Three hemlock trees were sampled at each location, Pupal populations are the average number of pupae per square foot for the 12 samples, Defoliation estimates were made of 10 hemlock trees and up to 10 cedar where available, at each sample point.

A report on the spray program is included as a separate section of this report,

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1/ Fiddick, R.L., E.G. Harvey and G.T. Silver. Report on the green-striped forest looper, Queen Charlotte Islands,, Forest Entomology and Pathology Laboratory, Victoria, B.C. April, 1964.

# RESULTS

## Extent and Intensity of Defoliation

The extent of defoliation changed considerably compared with 1963. Mapping from the air was very difficult; defoliation was light in many localities and the cold, wet summer resulted in needles remaining green rather than turning red as is normal for defoliation damage, Consequently the area outlined on the map should be regarded as the limits within which defoliation occurred in 1964. The area infested, in acres, is shown below:

| Degree of defoliation | Port Clements Cape Ball | South-east of Tlell | West side Masset Sd. | Total |
|---|---|---|---|---|
| Light to medium | 64,880 | 5,400 | 6,480 | 76,760 |
| Heavy | 5,880 | 240 | 0 | 6,120 |
| Total | 70,760 | 5,640 | 6,480 | 82,880 |

This represents a decline of 20,000 acres infested compared with that of 1963.

The average defoliation of trees in the seven plots generally increased. There was a small increase in total defoliation of cedar in three of the plots, and an increase in defoliation of hemlock in five plots (Table 1). The heaviest damage, most of which occurred in 1963, was in Lot 1828 at Port Clements where total defoliation of both species exceeded 90 per cent,

Significant defoliation occurred during 1964 at a number of localities sampled in October, particularly at Mayer Lake, north of Port Clements, on Kumdis Island, and the west side of Masset Sound (Table 2). Feeding had occurred extensively despite the cool, wet weather which prevailed most of the summer,

## pupal counts

Pupal samples were taken at 47 localities throughout the infestation area and around the borders of the 1964 defoliation, The average number of pupae per square foot of duff is shown in Table 2 together with the per cent defoliation of cedar and hemlock at each sample point. Comparisons with pupal counts and defoliation estimates taken in the spring of 1964 are shown where the same points were sampled,

The pupal counts were much lower than recorded for the previous generation, In many localities where very high populations existed in the spring no pupae were found in October, The highest counts were recorded in the forest stands around Masset Inlet and Masset Sound, mainly on

Kumdis Island, at at Cook Point in a new outbreak area, Only two localities, Cook Point and Lot 1525 Kumdis Island contained 2 or more pupae per square foot, and three points, Lot 340 along Kumdis Slough, at Hogan Point, and Lot 1808 on Kumdis Island, contained over 1 pupa per square foot.

Parasitism in 377 pupae collected in February was slightly more than 19 per cent, It is not believed that field parasitism was heavier, Adults emerged successfully from the overwintering pupae and moth flights were heavy. Larval emergence was late, the first larvae being in early July, There was no indication of parasitism or disease in the Lame, Cool wet weather retarded larval development but feeding continued for several weeks before the population began to decline. It is possible that the late larval emergence and its retarded development, attributed to the cold wet weather extended the larval period well beyond its normal range and the larvae were unable to complete their development.

## DISCUSSION

The green-striped forest looper population OR the Queen Charlotte Islands collapsed in most areas in 1964. Several new areas of defoliation were mapped from the air in August. The most significant aspect of the infestation trend was the movement of some of the population west across Masset Inlet into an area some 6,000 acres in extent. This migration probably occurred during the adult stage, Defoliation in the newly infested area was not heavy and the trees have not suffered any permanent damage.

Total defoliation over much of the original infestation area was quite heavy. The tops of many trees were stripped and many trees were almost completely defoliated, Some of these heavily defoliated trees will probably die, Any mortality which occurs will be most prevalent in the areas from Port Clements east to Mayer Lake and Cape Ball. A study of the trees in the mortality plots in Lot 1828 during the next few years will give a clearer indication of the severity of the damage.

Pupal counts in the fall of 1964 were extremely bow throughout most of the infestation, Only two localities, Kumdis Island and west of Masset Sound, had more than 2 pupae per square foot, This population is not considered serious at the present time, However, under favourable weather conditions the residual population is high enough to build up to outbreak proportions very quickly,

Unfavourable weather conditions are believed responsible for the green-striped forest looper population decline, Adults emerged from the overwintering pupae in May and larvae began feeding in early July. Defoliation records show that considerable feeding occurred before the population declined to the relatively low level indicated by pupal counts, Et is therefore believed that the cool wet weather retarded development and resulted in heavy larval mortality.

Light to medium defoliation can be expected in 1965 in areas west of Masset Sound, along Kumdis Slough, and on Kumdis Island,

## SUMMARY

1. The green-striped forest looper infestation declined throughout most of the area infested in 1963. The infestation spread to the west side of Masset Sound in 1964, causing light to medium defoliation on over 6,000 acres.

2. Light to medium defoliation can be expected in a few localities in 1965, notably on the west side of Masset Sound, Kumdis Island, and along Kumdis Slough.

3. Heavy defoliation has occurred, and some tree mortality can be expected north of Port Clements and around Mayer Lake,

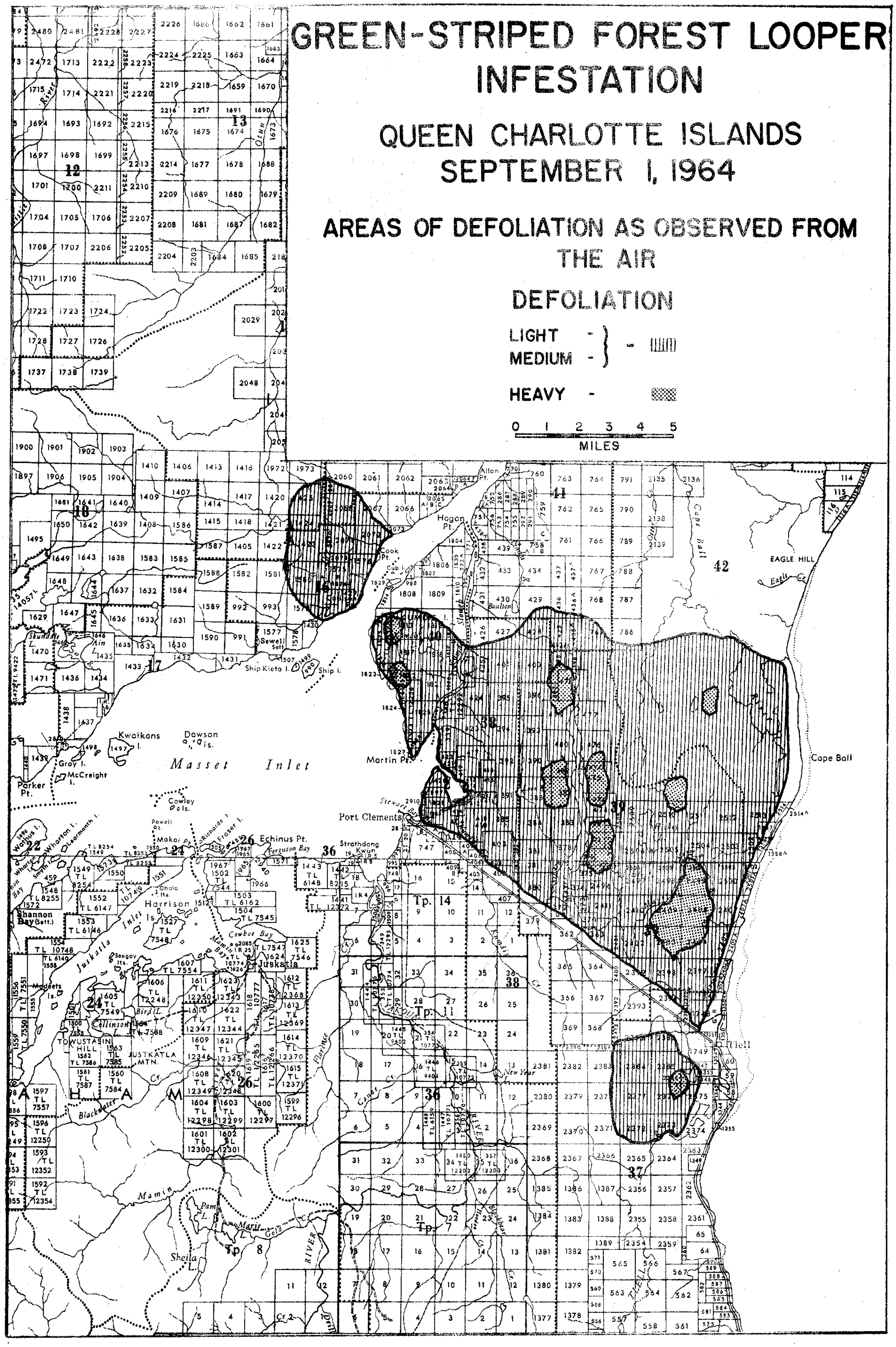
4. The population, although at a low level, is high enough to initiate an increase under favourable weather conditions, Surveys will be required in 1965 to definitely determine the trend of the infestation,

## ACKNOWLEDGMENTS

A helicopter was supplied by the B.C. Forest Service for ferrying crews during the fall survey,

D.H. Ruppel, J.W.E. Harris, J.M. Kinghorn and W. Nijholt, of the Forest Entomology and Pathology Laboratory, Victoria, assisted with the pupal and damage appraisal survey in October,

Mr. H.A. Richmond assisted with the spring and autumn survey through the co-operation of the Pest Control Committee of the British Columbia Loggers' Association,


GREEN-STRIPED FOREST LOOPER
INFESTATION
QUEEN CHARLOTTE ISLANDS
SEPTEMBER 1, 1964
AREAS OF DEFOLIATION AS OBSERVED FROM THE AIR
DEFOLIATION
LIGHT
MEDIUM
HEAVY
0 1 2 3 4 5
MILES
Masset Inlet
Port Clements
Cape Ball
EAGLE HILL
Martin Pt.
Kwaikans I.
Dawson Is.
McCreight I.
Parker Pt.
Cowley Is.
Echinus Pt.
Harrison Is.
Juskatla
Tlell

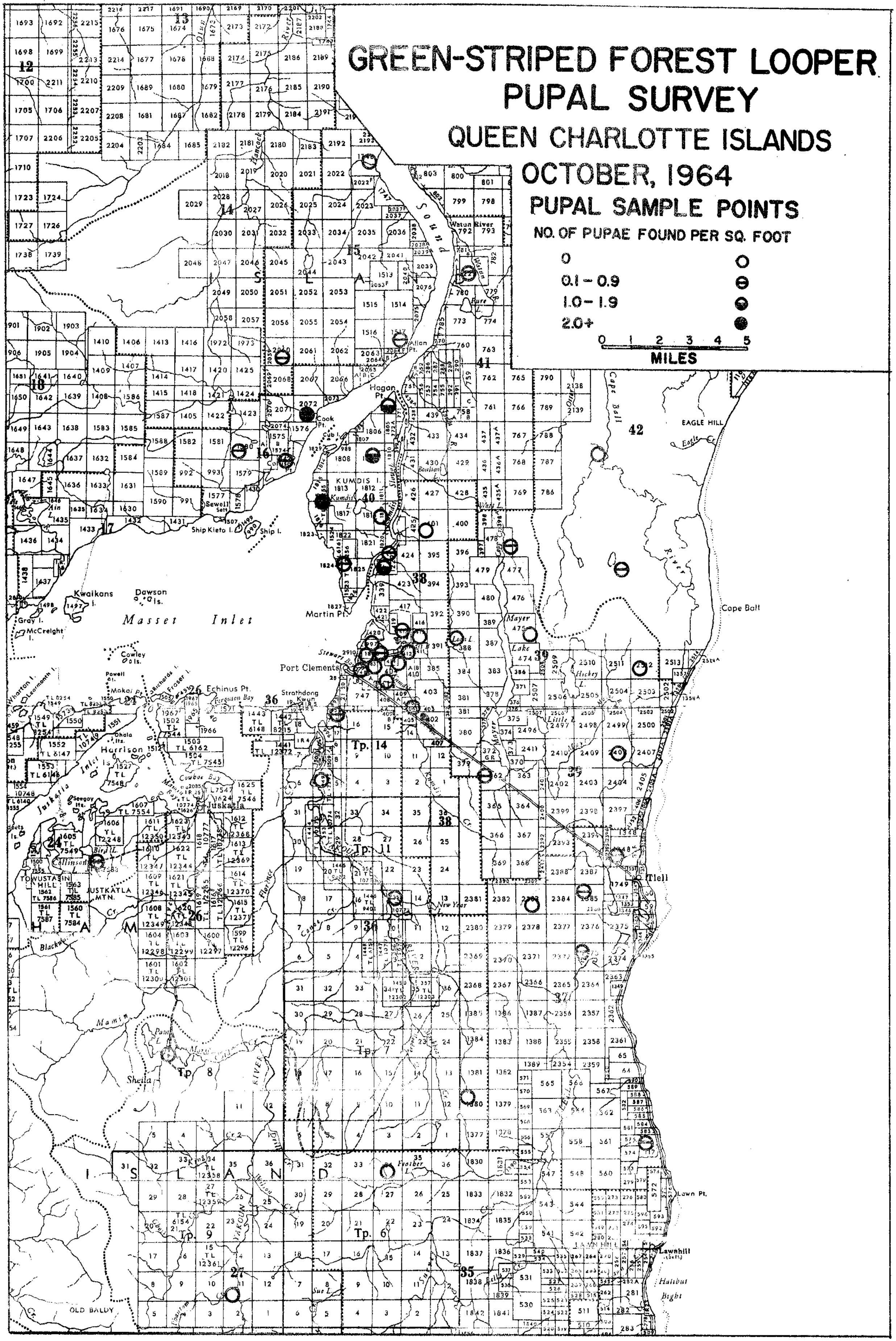

GREEN-STRIPED FOREST LOOPER
PUPAL SURVEY
QUEEN CHARLOTTE ISLANDS
OCTOBER, 1964
PUPAL SAMPLE POINTS
NO. OF PUPAE FOUND PER SQ. FOOT
0
0.1 – 0.9
1.0 – 1.9
2.0+
0 1 2 3 4 5
MILES
Masset Inlet
Port Clements
Cape Ball
EAGLE HILL
Tlell
Lawnhill
Halibut Bight
OLD BALDY
Juskatla
Martin Pt.
Echinus Pt.

Table 1

Estimates of defoliation in study plot, Queen Charlotte Islands, 1964.

| Plot no. | Locality | Tree host | No. trees | Date (1964) | % defoliation by crown levels: Top 1/3 | Mid 1/3 | Lower 1/3 | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | Port Clements West end of Lot 1828 | cedar | 108 | March | 98 | 96 | 92 | 95 |
| | | | 107 | Oct. | 98 | 97 | 95 | 96 |
| | | hemlock | 76 | March | 84 | 88 | 79 | 87 |
| | | | 77 | Oct. | 94 | 92 | 88 | 91 |
| 2 | Port Clements - Masset Rd. Lot 412 | cedar | 5 | March | 22 | 12 | 6 | 13 |
| | | | 5 | Oct. | 59 | 51 | 37 | 49 |
| | | hemlock | 51 | March | 27 | 16 | 9 | 18 |
| | | | 51 | Oct. | 59 | 50 | 39 | 50 |
| 3 | Lot 401 | cedar | 15 | May | 68 | 51 | 33 | 51 |
| | | | 15 | Oct. | 53 | 48 | 48 | 49 |
| | | hemlock | 48 | May | 59 | 40 | 23 | 41 |
| | | | 48 | Oct. | 65 | 57 | 45 | 54 |
| 4 | Lot 404 | cedar | 14 | May | 61 | 48 | 33 | 47 |
| | | | 14 | Oct. | 54 | 48 | 51 | 51 |
| | | hemlock | 69 | May | 53 | 42 | 31 | 42 |
| | | | 69 | Oct. | 56 | 44 | 39 | 46 |
| 5 | Port Clements East end of Lot 1828 | cedar | 26 | May | 58 | 46 | 34 | 46 |
| | | | 26 | Oct. | 77 | 41 | 41 | 44 |
| | | hemlock | 78 | May | 49 | 35 | 21 | 35 |
| | | | 78 | Oct. | 51 | 39 | 26 | 37 |
| 6 | East of Kumdis Creek, Lot 405 | cedar | 13 | May | 67 | 57 | 47 | 57 |
| | | | 13 | Oct. | 30 | 33 | 45 | 33 |
| | | hemlock | 79 | May | 48 | 37 | 25 | 37 |
| | | | 79 | Oct. | 33 | 27 | 23 | 28 |
| 7 | South end of Mayer Lake | cedar | 59 | May | 38 | 28 | 17 | 28 |
| | | | 59 | Sept. | 28 | 26 | 25 | 27 |
| | | hemlock | 32 | May | 39 | 28 | 17 | 28 |
| | | | 32 | Sept. | 22 | 20 | 20 | 21 |

Table 2

Number of green-striped forest looper pupae per square foot of duff, Graham Island, 1964. Figures for March are shown only where comparative.

| Locality | Ave. no. pupae per square foot | | Per cent defoliation | | |
|---|---|---|---|---|---|
| | March | October | Host | March | October |
| Lot 1746, west side Masset Sound | 0.17 | 0 | H | 0 | 0 |
| Lot 225, Watun River | 0.58 | 0.17 | H<br>C | Tr.<br>Tr. | 59<br>52 |
| Lot 1517, Allan Pt. Masset Sound | 0.17 | 0.83 | H | 0 | 6 |
| Lot 2060, near head-waters Hancock River | ns[1/] | 0.83 | H<br>C | ns<br>ns | 28<br>15 |
| Lot 2072, Cook Point | ns | 2.68 | H<br>C | ns<br>ns | 39<br>23 |
| Lot 1580, north of Sewell | ns | 0.33 | H<br>C | ns<br>ns | 6<br>2 |
| Lot 1429, Collison Pt. | ns | 0.58 | H | ns | 13 |
| Lot 1804, N. end of Kumdis Island | 1.00 | 1.08 | H | Tr. | 7 |
| Lot 1808, Kumdis Island | 0.17 | 1.33 | H<br>C | 0<br>0 | 23<br>10 |
| Lot 1819, E. side of Kumdis Island | 3.33 | 0 | H | 11 | 13 |
| Lot 1525, Kumdis Island | ns | 2.0 | | ns | ns |
| Lot 1825, Kumdis Island | 0.42 | 0.50 | H | 0 | ns |

Table 2 (Cont'd)

| Locality | Ave. no. pupae per square foot | | Per cent defoliation | | |
|---|---|---|---|---|---|
| | March | October | Host | March | October |
| Lot 401, north of Port Clements | 8.08 | 0 | H | 38 | 75 |
| | | | C | 42 | 73 |
| Lot 478, north end of Mayer Lake | 3.33 | 0.08 | H | 66 | 78 |
| | | | C | 62 | 66 |
| Fork of Cape Ball River | 1.83 | 0 | H | 12 | 0 |
| | | | C | 32 | 0 |
| Lake between Cape Ball and Mayer Lake | 14.50 | 0.17 | H | 40 | 74 |
| | | | C | 66 | 70 |
| Lot 475, Mayer Lake | 5.92 | 0 | H | 56 | 78 |
| | | | C | 65 | 52 |
| Lot 2512, E. of Hickey Lake | 4.58 | 0 | H | 41 | 78 |
| | | | C | 42 | 72 |
| Lot 388, Loon Lake | 1.83 | 0 | H | 55 | 59 |
| | | | C | 28 | 37 |
| Lot 2408, south of Hickey Lake | 2.17 | 0 | H | 19 | 58 |
| | | | C | 36 | 42 |
| Lot 1748, Tlell | 1.42 | 0.33 | H | 5 | 4 |
| | | | C | ns | 2 |
| Lot 2383, east of New Pear Lake | 0.17 | 0 | H | 26 | 32 |
| | | | C | 30 | 24 |
| Lot 2385, south-west of Tlell | ns | 0.17 | H | ns | 74 |
| | | | C | ns | 72 |
| Lot 2373, south of Tlell | ns | 0.08 | H | ns | 17 |
| | | | C | ns | 18 |

Table 2 (Cont'd)

| Locality | Ave. no. pupae per square foot | | Per cent defoliation | | |
|---|---|---|---|---|---|
| | March | October | Host | March | October |
| Lot 117, north of Lawn Point | 1.17 | 0.17 | H | 0 | 0 |
| Lot 1380, Blackbear Creek | 0 | 0 | H<br>C | 0<br>22 | 19<br>40 |
| Lot 34, Heather Lake | ns | 0 | | ns | Tr |
| Lot 11, Phantom Creek | ns | 0 | H | ns | 0 |
| Branch 30, Marie Lake | 0.17 | 0 | H<br>C | 0<br>0 | 0<br>0 |
| T.L. 7588, Bird Lake | 0 | 0.08 | H<br>C | 0<br>0 | 0<br>0 |
| Lot 355, Yakoun River | 0.08 | 0 | H<br>C | 0<br>0 | 5<br>7 |
| Lot 349, Yakoun River | 0.17 | 0 | H<br>C | 0<br>0 | 2<br>Tr. |
| Lot 995, S.W. of Port Clements | 0.75 | 0.08 | H | Tr. | 0 |
| Lot 362, S.W. corner Mayer Lake | 2.25 | 0.17 | H | 21 | 21 |
| Lot 405, Kumdis Creek | 7.92 | 0 | H | 35 | 28 |
| Lot 413, Kumdis Bay | 6.92 | 0.08 | H<br>C | 21<br>ns | 45<br>18 |
| Lot 412, Kumdis Bay | 8.83 | 0 | H | 34 | 49 |

Table 2 (Cont'd)

| Locality | Ave. no. pupae per square foot | | Per cent defoliation | | |
|---|---|---|---|---|---|
| | March | October | Host | March | October |
| Lot 1828, east end Port Clements | 5.33 | 0.17 | H<br>C | 45<br>38 | 37<br>44 |
| Lot 1828, center Port Clements | 10.75 | 0 | | ns | ns |
| Lot 1828, west end Port Clements | 3.75 | 0 | H<br>C | 87<br>89 | 91<br>96 |
| Lot 340, north end | ns | 0.08 | H<br>C | ns<br>ns | 8<br>12 |
| Lot 340, south end | ns | 1.33 | H | ns | 27 |
| Lot 404, Kumdis Bay | ns | 0 | H<br>C | ns<br>ns | 76<br>69 |

1/ ns - not surveyed

## PART 11. EXPERIMENTAL CONTROL WITH PHOSPHAMIDON

by

J.M. Kinghorn[1] and H.A. Richmond[2]

Although operational control of the whole green-striped forest looper infestation was not undertaken during 1964, part of the area was used to test the effect of phosphamidon against this species. Part of the spray programme could be considered operational in that the forest owner, MacMillan, Bloedel and Powell River Ltd., wished to protect valuable infested pole-sized timber on its Tree Farm Licence lands.

Phosphamidon was chosen as the experimental insecticide because, unlike DDT, its hazard to fish and fish foods is extremely low. Furthermore, the compound has shown considerable promise as an alternate to DDT in the control of hemlock looper and spruce budworm outbreaks. More experience was needed to help ascertain its insecticidal efficiency and its effect on other forest fauna.[3]

It was intended to determine the value of the treatment through an end-season assessment of defoliation and pupal populations in treated and nearby untreated forests, rather than through a detailed appraisal of the immediate effects of the spray. As outlined in Part I of this report, the sharp decline in larval population in both sprayed and unsprayed forests made any interpretation of treatment results by defoliation or pupal estimates almost meaningless.

Some short-term assessment work was attempted before, during, and after treatment, Methods and results of these studies are described in this section of the report, along with a description of the operational aspects of the project.

### MATERIALS AND METHODS

Sufficient technical grade phosphamidon was added to water to give 0.8 lb. of pure insecticide per U.S. gallon of finished spray, A Bell G2-A helicopter was used to apply the spray and was calibrated to emit one U.S. gallon per acre at a ground speed of 60 m.p.h. and pass interval of 100 feet, All formulating and application work was conducted by the contractor, Okanagan Copter Sprays Ltd. Since the job was small, each aircraft load was mixed individually in the aircraft's tanks. For areas where deposit assessment was feasible, 0.5 per cent methylene blue was added to

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[1] Research Officer, Forest Research Laboratory, Victoria, B.C.

[2] Consulting Forest Entomologist, B.C. Loggers' Association.

[3] Studies by personnel of the B.C. Fish and Game Branch which are reported elsewhere, indicate that the treatment was deleterious to birds in the treated forest, but that other wildlife appeared to be unaffected,

intensify the droplet stains. Deposits were collected at selected sample points on 2" x 3" white "Kromekote" cards mounted in wire holders.

Originally it was intended to treat the insects when most had just hatched, but almost continual rain delayed treatment until July 21 when the population was almost equally composed of second and third instar larvae,

Spraying was started at the first opportunity after equipment was on site, Five hundred acres in the northern, inaccessible spray block were treated during the afternoon of July 21. Although mid-day spraying is generally unsatisfactory, meteorological conditions were more suitable on that afternoon than they had been for over two weeks, The air was calm, and a low, heavy overcast held the relative humidity near 75 per cent. Gonditions the following morning were similar, but a westerly gusting breeze hampered spraying of the shoreline forest of Lot 2910. Further inland, the breeze was not as serious, although periodic gusts at times disbursed spray off the target areas, Spraying was started at 7:30 a.m. and was completed by 11:00 a.m. A total of 1,600 acres were treated as shown in Figure 1. About 50 acres in Lot 415 were sprayed with one-half dosage (0.4 lb. phosphamidon per U.S. gallon of water per acre),

Assessment Methods

Spray deposits and insect population samples were checked at nine selected points in the treated blocks and at three points in surrounding unsprayed forests, At each sample point, three 18" x 18" canvas trays were set beneath dominant or co-dominant trees; two were beneath hemlock and one was under a cedar, Dead and dying larvae dropping from the trees were tallied for a week following treatment. On July 29 the trays were cleared of frass and then left unattended for one month, which was the time required for surviving larvae to complete their development, Frass that had accumulated during the month was collected on September 2 and oven dried, Later, each tray sample was screened to remove most of the extraneous debris and the volume of the residue measured to obtain relative estimates of surviving population, Without a great deal more work, estimates of the absolute surviving population were not possible by this method, but the values obtained provide gross indications of survival when compared one with another,

Pupal samples taken for the general survey described in Part I were also used to assess the spray project, Additional points, not required for the general survey, were sampled in the treated area to supplement frass tray data.

Caged larvae were also used to help assess effectiveness of the treatment, Two colonies of one hundred lame each were contained on hemlock foliage in cages that were temporarily opened to free fall of spray in a clearing in Lot 1828, Pour other colonies of 90 lame each were made up of loopers collected July 28 from spray-free hemlock trees, Two of these colonies were fed foliage cut from treated trees along a roadside of Lot 2910 on July 29; one colony was given cedar, the other hemlock, Sufficient foliage was collected to supply these colonies with contaminated foliage for three weeks. As checks, the other two colonies were fed clean hemlock and cedar foliage, All caged larvae were kept on fresh foliage until they died or pupated.

## RESULTS

### Spray Deposit

When the aircraft was calibrated, deposit patterns obtained were somewhat unsatisfactory, Figure 2 shows the deposit in drop stains per sq. cm. of the best test pattern, There were too few droplets per unit area, and a high proportion of the stains in the central part of the swath were over 600 µ in diameter, The practical significance of this observation is that the chemical was not as efficiently dispersed as would have been possible with a more finely and uniformly atomized spray,

Most of the treated forests were dense hemlock–cedar–lodgepole pine stands carrying an overstory complement of from 200 to 400 trees per acre, Where defoliation was not severe, penetration of the spray through the crown canopy was low. Spray deposits on cards placed between trees were barely detectable, whereas cards along adjacent roadways or in nearby natural openings showed that the area had received full spray coverage, By comparison, cards in stands severely defoliated in 1963 (80–100 per cent) picked up fairly good deposits. Even in such places, however, the larger droplets were screened out by the sparsely clad, but dense stand.

A series of cards placed at two–chain intervals for 0.6 mile along the main road in Lot 412 showed a variable, and only moderate series of deposits (Fig. 3). The helicopter flight passes crossed the roadway diagonally from south to north.

### Larval and Frass Tray Collections

Dead and dying larvae began to fall from the trees within twelve hours after spraying. All trays within the treated area were in stands sprayed on July 22, Of the dead and visibly affected larvae taken from the trays up to July 29, 41 per cent fell within one day, 57 per cent within two days, and 90 per cent within four days. Undoubtedly more continued to be poisoned during early August, but the rate of mortality definitely slowed by the end of July, Numbers of larvae collected in frass trays at the several sample points are shown in Table 3.

Numbers of dead Larvae on trays do not by themselves reveal the proportion of population that survived. Frass that continued to fall after larval drop had decreased gives a rough indication of the magnitude of the surviving population, The total volume of frass that collected on the trays during August helped show the differences in survival for the duration of the larval stage (Table 3). In heavily defoliated stands on Lot 1828 west and 2910 north, larval mortality was high and frass drop during August was very slight, Also, in a moderately defoliated dense stand (Lot 404) where spray deposit was relatively heavy and subsequent larval mortality high, frass drop was negligible. By contrast, in dense, lightly defoliated stands where detectable spray deposit was light, larval mortality was only moderate, and the August frass total was substantial, At one point originally intended as a check (Lot 746 east), spray drifted across the road from Lot 746 west and caused some larval mortality, but judging from the high volume of frass that fell subsequently, many if not most of the larvae survived, Nevertheless, survivors were not numerous enough to cause tree-killing defoliation; damage did not approach the severity that occurred during 1963 in stands of Lot 1828 and around Mayer Lake.

According to the frass values for the three check plots, larvae were less numerous in these untreated areas than in most of the treated forest prior to spraying. Accordingly, contrasts between defoliation of sprayed versus unsprayed stands was barely discernible,

**Pupal** Samples

Pupae recovered were so few in both treated and most surrounding untreated blocks that they contribute little to the assessment of the spray project because obviously, untreated populations also declined sharply. One exception is a sample taken in the southern half of Lot 340 where 1.33 pupae per sq. ft, of duff were recorded although defoliation there was not severe. The sample might indicate that the treatment was not effective, but it more likely represents an accidental skip in spray coverage,

Caged Insect Tests

As Figure 4 shows, the sprayed insects caged on sprayed foliage were decimated within four days. Deposits on cards adjacent to the opened cages received an average deposit of 8.7 drops per sq. cm.

The right half of Figure 4 shows the fate of unsprayed larvae fed contaminated foliage starting six days after it was sprayed. Mortality of lame fed on clean hemlock was low, but those fed on unsprayed cedar was considerable, Some of the insects, which had been collected from hemlock, may have failed to adapt to the new diet; on the other hand, diseases may have been responsible for the high natural mortality in this colony, O. N. Morris of the Victoria laboratory, later diagnosed a polyhedral virus disease in cadavers of late instar lame preserved from this colony. When mortalities of the colonies fed sprayed foliage are corrected for natural mortality of the untreated colonies by Abbot's formula, the following values are obtained:

| Date | Per cent mortality | |
|---|---|---|
| | Hemlock | Cedar |
| August 4 | 88.4 | 48.6 |
| August 11 | 95.9 | 86.7 |

## DISCUSSION AND CONCLUSIONS

Looper populations in surrounding unsprayed forests declined so sharply that meaningful conclusions about the overall effect cannot be validly drawn from our observations. There can be no doubt that phosphamidon applied in the manner described will kill Melanolophia larvae, particularly where spray contacts the larvae directly, The proportion of the population decimated is quite another matter, however, and leaves some doubt as to whether or not phosphamidon, particularly at this rate of application over dense undefoliated stands, can kill enough of a healthy, vigorous population to avert serious damage, Although the caged insect tests indicated that untreated insects can be killed by feeding on contaminated foliage, the numbers of larvae that obviously survived (judging by frass drop), suggest that the treatment effected only moderate control.

Melanolophia larvae are "open" feeders, and as such should be susceptible to aerial sprays. From our limited observations of the insect-during the cool weather of 1964, it seemed apparent that the larvae were not nearly as migratory over the trees as are larvae of the hemlock looper, Vertical movement of larvae from base of tree crowns to tops did not appear to be common, If larvae naturally moved quickly to the tree tops, the chances of their contacting, or feeding upon heavily treated foliage would be greatly improved, Since this does not seem to be their usual habit, loopers in the lower tree crowns would be sheltered from direct contact with spray and would feed until maturity on almost uncontaminated foliage. A potentially dangerous proportion of the population would thus survive. In the event that chemical control of this insect in this age class of forest should become necessary in the future, and regardless of the insecticide that may be employed, it is suggested that the volume of carrier dfluent per acre be at least doubled, and that aircraft flight speed and height be reduced to the point where spray is partly driven into the crown canopy. The treatment as applied in 1964 may be capable of killing enough of the population to avert tree mortality, but the reservoir of insects left might be high enough to maintain the same level of population in the succeeding generation, The more costly spray technique suggested here might prove to be the less costly insurance,

Table 3

Assessment data. Control of the green-striped forest looper with phosphamidon. Graham Island, 1964.

| Sample point | Spray deposit drops per sq. cm. | | Total dead & dying larvae in 3 trays | August frass total (c.c.) | Pupae per sq. ft. of duff |
|---|---|---|---|---|---|
| | Near trays | Nearby openings | | | |
| 1828 West (Plot 1) | 4.5 | 22.4 | 187 | 16 | 0 |
| 1828 East (Plot 2) | 1.0 | 10.1 | 119 | 75 | 0.17 |
| 2910 | 4.9 | 37.3 | 334 | 13 | 0 |
| 746 West | - | - | 93 | 104 | 0 |
| 746 East | - | - | 98 | 197 | 0 |
| 412 (Plot 2) | 0.4 | 9.5 | 34. | 63 | 0 |
| 404 (Plot 4) | 1.3 | 9.5 | 226 | 20 | 0 |
| 413 | 5.1 | 11.9 | 68 | 59 | 0.08 |
| 415 (Half dose) | 007 | 8.4 | 22 | 83 | 0 |
| Unsprayed check points | | | | | |
| 401 (Plot 3) | 0 | 0 | 2 | 85 | 0 |
| 405 (Plot 6) | 0 | 0 | 1 | 63 | 0 |
| 362 (Plot 7) | 0 | 0 | 0 | 51 | 0.17 |

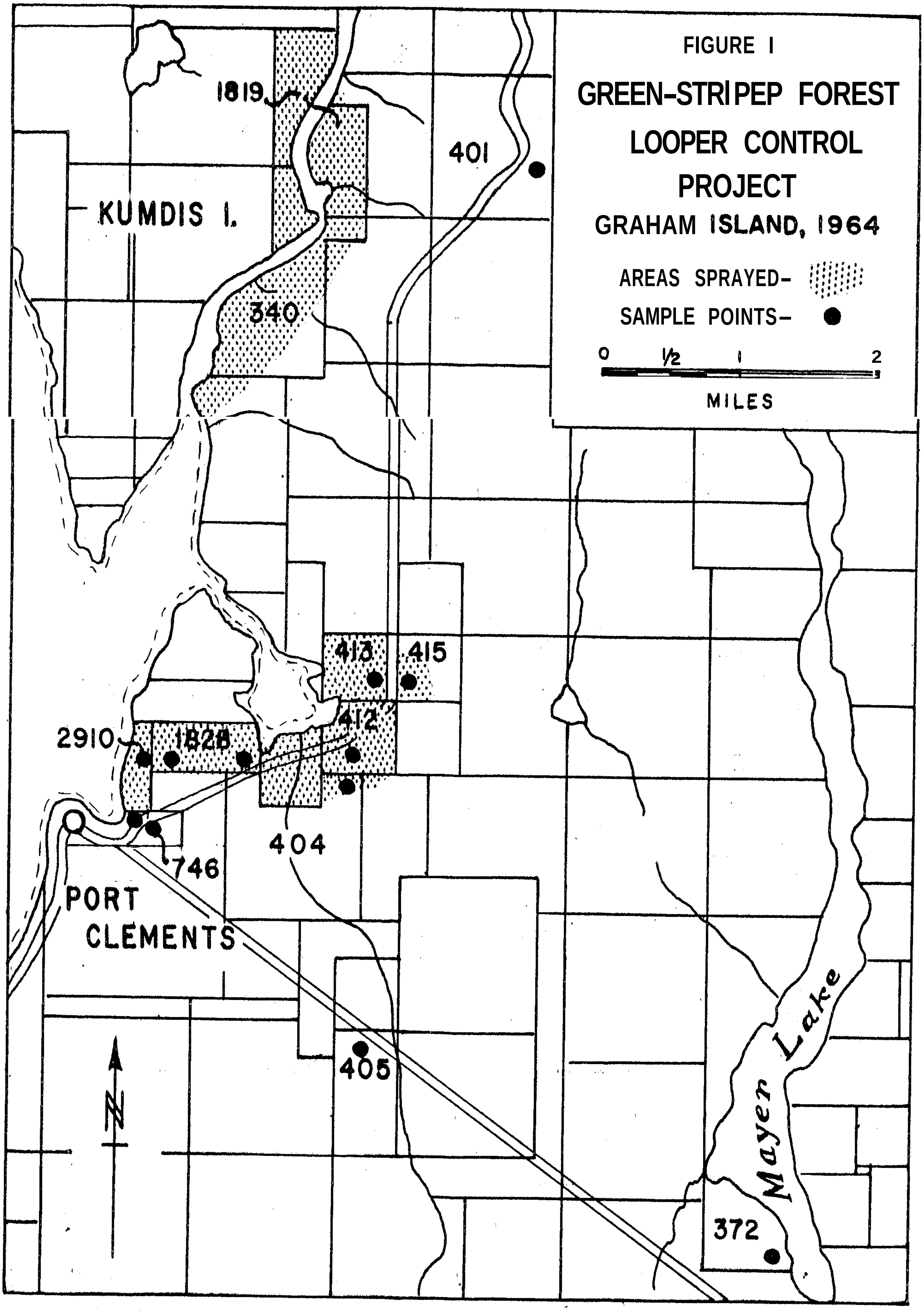
FIGURE I
GREEN-STRIPEP FOREST
LOOPER CONTROL
PROJECT
GRAHAM ISLAND, 1964
AREAS SPRAYED-
SAMPLE POINTS-
0
1/2
1
2
MILES
KUMDIS I.
1819
401
340
413
415
412
2910
1828
404
746
PORT
CLEMENTS
405
Mayer Lake
372
N

FIGURE 2

TEST PATTERN

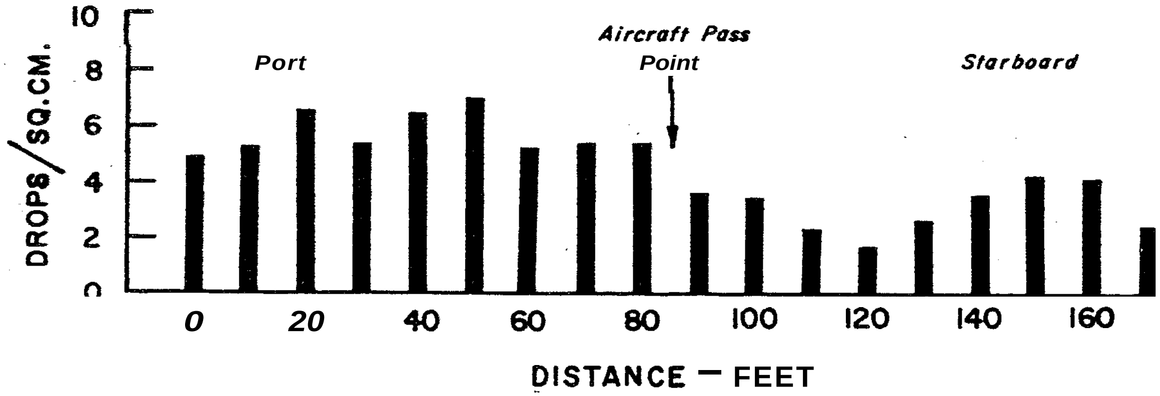


FIGURE 3

ROADSIDE DEPOSITS

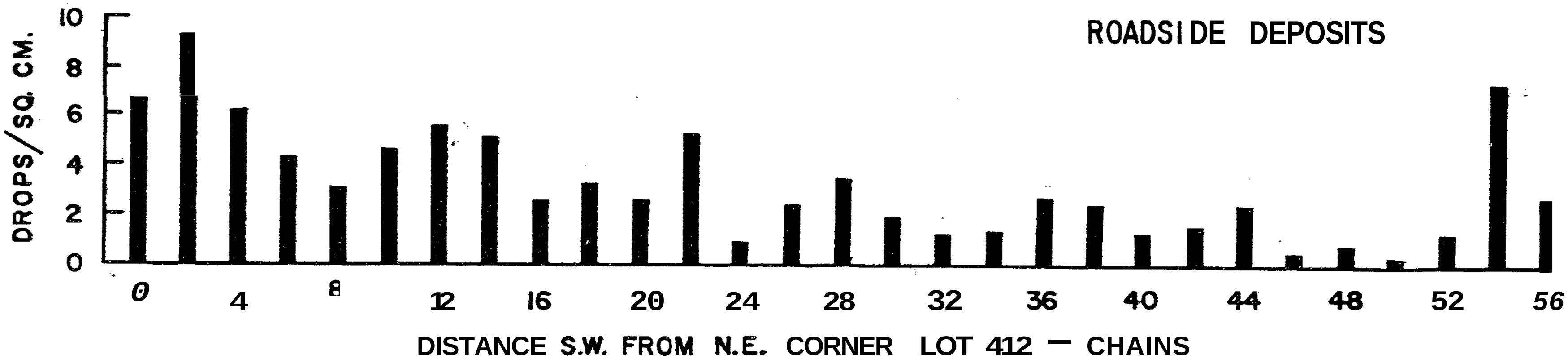

FIGURE 4

CAGED INSECT TESTS