THE GREEN-STRIPED FOREST LOOPER ON VANCOUVER ISLAND[1]

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Introduction

The green-striped forest looper, *Melanolophia imitata* Wlk., was not regarded as a potentially dangerous forest insect until it caused heavy defoliation in 1960 on the west coast of Vancouver Island. As this is the first record of *M. imitata* causing serious damage to forested regions in British Columbia the results are worthy of a historical note.

The moths of this looper emerge in April or May, mate, and each female lays an average of 80 eggs. The sex ratio is approximately 1:1. The larvae feed from June to September. Western hemlock, *Tsuga heterophylla* (Raf.) Sarg., is the preferred host. Foliage of all ages is eaten but one-year-old needles are preferred. When feeding is completed the larvae drop to the ground and the insects overwinter as pupae in the duff.

Methods

Data on annual population fluctuations were obtained by analysing random 3-tree beating samples collected on the west coast of Vancouver Island. The extent and intensity of defoliation in 1960 was obtained by aerial surveys. Plots and sample points were established in localities selected to represent light, medium, and heavy defoliation, and records were obtained on defoliation and tree mortality.

The method adopted for pupal counts, based on preliminary sampling to obtain data on the distribution of pupae, was to take four one-foot-square duff samples from beneath each tree. These were taken along a straight line, two on the exposed side of the tree and two on the shaded side. Sample positions were against the base of the tree and midway between the base of the tree and the periphery of the crown. Three trees were sampled at each area. The average number of pupae in the 12 samples was considered representative of the pupal population in each area.

Results

Extent and Intensity

Survey records show that in 1951 larval populations of the green-striped forest looper increased along the west coast of Vancouver Island. The build-up reached its height in 1952 on the south side of Barkley Sound, but defoliation did not exceed 30 per cent and that only in one small area. The population decreased in 1953, and remained at a low level until 1957.

The population of the green-striped forest looper started to increase again in 1957 as shown by the occurrence of larvae in collections (Table 1). Both occurrence and number of larvae increased in 1958, and by 1959 high populations were present in the west coast drainages of Vancouver Island, two of which are shown in Table 1. The outbreak reached a peak in 1960, particularly in drainages 005 and 023. Survey activities on the west coast were seriously curtailed in 1960 due to boat troubles, so no collections were made in the infestation area during the larval period. Heavy defoliation was reported in early September, and aerial surveys later in September recorded defoliation ranging from light to heavy in 32 localities extending from Herbert Inlet to Nasparti Inlet. The total area of visible feeding was calculated at

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TABLE 1.—Summary of Green-striped Forest Looper Larvae Found in Beating Samples From Drainage Divisions on the West Coast of Vancouver Island.

Year	% samples including larvae		Av. no. larvae/ sample containing larvae	
	DD 005[1]	DD 023[2]	DD 005	DD 023
1956	0	0	—	—
1957	20	14	2	4
1958	47	82	2	14
1959	88	72	45	31
1960	85	0	59	—
1961	61	61	58	7

[1] Alberni Inlet to Escalante Pt.

[2] Escalante Pt. to south of Cape Cooke on Brooks Peninsula.

22,755 acres, of which 4,640 had sustained heavy, 13,120 acres medium, and 4,995 acres light defoliation. The defoliation limits established during the aerial survey were 0-25, 25-50, and over 50 per cent for light, medium, and heavy, respectively. The infested areas ranged from 30 to 6,340 acres.

Visual estimates of defoliation on plot trees, and pupal counts made in the same localities, are shown in Table 2. The average number of pupae in areas of medium and heavy defoliation was about the same. There was, however, no way of knowing what 2.0 pupae per square foot meant in terms of expected larval population or defoliation. Although chemical control was not recommended, the need for such action was considered a possibility in 1961.

Efforts were made in the spring of 1961 to appraise the anticipated outbreak. Of 75 pupae collected and caged for adult emergence, only four produced moths, twenty were parasitized, and the remainder died of other causes. The moth flight at the end of May was very light, and only a small number of eggs was found in limited sampling. At this point it was believed that the 1961 population would be too small to cause appreciable defoliation. The predicted drop in larval numbers was confirmed by the reduced numbers obtained in beating samples (Table 1), and by the relative number of larvae per sample collected from the same points in 1960 and 1961. Some of these were (1961 in brackets): White Pine Cove, 444 (11); Herbert Inlet, 262 (4); Beddingfield Bay, 460 (40); Millar Channel, 486 (120); and Tofino Inlet, 215 (28).

Natural Control

Parasites — The effect of parasites on the large population of 1960 is not fully known as no samples were

TABLE 2.—Defoliation and Numbers of Green-striped Forest Looper Pupae at Sample Plots. September, 1960.

Locality	Degree of defoliation represented[1]	Percentage defoliation (western hemlock)	Av. no. pupae per sq. ft. of duff
Ououkinsh Inlet	light	21	0.44
Port Eliza	medium	54	0.46
Millar Channel	"	32	2.02
Beddingfield Bay	"	40	1.92
Eelstow Passage	heavy	50	1.46
Villaverde Is.	"	91	2.06
Bligh Is.	"	81	0.50

[1] Defoliation limits determined by aerial survey.

obtained from most of the more heavily infested areas. Of 563 larvae collected up to early September and reared, only 28 or five per cent died of parasites. Of 133 larvae collected after mid-September, 70 per cent died of parasites, and of a total of 317 pupae collected, 104 or 32.8 per cent were parasitized.

The figure of 70 per cent larval parasitism may be unreliable. As these collections were made late in the season, many healthy larvae might have already dropped to the duff and pupated, leaving the retarded parasitized larvae on the trees. The figure of 32.8 per cent pupal parasitism appears to be more reasonable, and is supported by collections made in the spring in which 26.7 per cent of the pupae died of parasites.

Seven hymenopterous parasites were reared from the 1960 collections. *Dusona pilosa* (Walley) and *Astiphromma strenuum* Holmberg were the major larval parasites and were recovered only from larvae. Other species reared from larvae were *Euceros thoracicus* Cresson, *Meteorus* sp., and *Zele* sp. *Aoplus cestus* (Cresson) was the most numerous pupal parasite, followed by *Gravenhorstia alaskensis* Ashmead. Three *E. thoracicus* Cresson were also reared from pupae. It is not certain if the numbers of parasites recovered from rearings are related to their importance as control factors in the field population.

Disease—On May 5, 1960, while searching for pupae, small orange fruiting bodies about ½ inch long were observed protruding from the duff. In every case these grew out from a *Melanolophia* pupa. The fructifications were identified as the perfect state of *Cordyceps militaris* (Fr.) Link. The fruiting bodies were plentiful in early May but appeared only in shaded locations at the end of the month. Sampling was not intensive enough to determine the control exerted, but it is believed that *C. militaris* caused considerable pupal mortality, and was probably one of the factors involved in the population decrease in 1961.

Defoliation and Tree Mortality

Defoliation estimates, made by crown levels and crown classes, show that feeding was, without exception, heaviest in the upper crown levels of all classes of trees. Trees of all crown classes from suppressed to dominant were fed upon, but defoliation was heaviest in the intermediate trees.

Mortality, in the plots analysed, was restricted to trees which were 90 per cent or more defoliated. Most of the remaining trees in this defoliation class were top-killed; in some instances the upper 2 3 of the crown was dead in 1961. Although no mortality occurred among trees with less than 90 per cent total defoliation, top-kill occurred among those which were less than 50 per cent defoliated.

Aerial and ground surveys indicated that mortality occurred only in the stands which had been heavily defoliated in 1960. The heaviest damage occurred on Villaverde Island where loss was calculated at 7,300 cu. ft. per acre for the 260 acres. Average tree mortality for the remainder of the area was calculated at 116 cu. ft per acre. Total mortality, up to the fall of 1961, was estimated at 2,400,000 cu. ft. of western hemlock. This figure could be conservative as some trees which were heavily defoliated may die in the next one or two years.

Discussion

The rapidity with which the green-striped forest looper population increased to tree-killing proportions and then collapsed, allowed little time to obtain specific data on sampling techniques. With the exception of the occurrence and average number of larvae per collection no data were obtained to show correlation between

population levels and defoliation. Although pupal counts were made in the fall of 1960, there was no way of determining if the numbers found represented a potentially dangerous population. Because of the reduced population in the spring of 1961 it was not feasible to develop a method for sampling eggs.

A number of natural control factors contributed to the decrease of the population. Larval parasites, although not numerous enough to exert any great degree of control, were present in appreciable numbers. Pupal parasitism accounted for about 30 per cent mortality in the overwintering population, but does not account for the heavy pupal mortality and the resulting low moth emergence. *Cordyceps* is an unknown factor, but could have played a significant role in the collapse of the outbreak.

One of the aspects in the outbreak which is difficult at this time to explain is the severe tree mortality on Villaverde Island. Aerial surveys, supported by ground observations, indicate that tree mortality was relatively light on Bligh Island, although it is near Villaverde Island and also received heavy defoliation.

The nature of the recent infestation points out one of the great difficulties in dealing with looper outbreaks. The population started to increase throughout most of Vancouver Island (in fact throughout most regions of the Vancouver Forest District) in 1958, and reached a level in 1959 which must now be regarded as dangerously high. Populations remained high or increased in 1960 only in isolated localities along the west coast of Vancouver Island; elsewhere the number of larvae dropped. Defoliation heavy enough to be observed from the air occurred in 32 localities, totalling less than 23,000 acres, scattered along 80 lineal miles of inaccessible coast line. Of this area only 4,640 acres were heavily defoliated, and over three-quarters of the total tree mortality of 2,400,000 cu. ft. occurred on a few small islands of only 260 acres. If future outbreaks follow a similar pattern very comprehensive and detailed surveys would be required to detect and take action to prevent such heavy mortality from occurring again on other small islands or inlets along the coast.

Summary

The green-striped forest looper which started to increase in 1957 reached severe outbreak proportions in 1960 in a large number of small separate localities along the west coast of Vancouver Island. The population decreased to a low level in 1961. Tree mortality, up to the fall of 1961, was estimated at 2,400,000 cu, ft. of western hemlock.

This species must be added to the growing list of defoliators capable of causing damage to forests in British Columbia.

Note on the reference collection of inflated larvae at the Forest Entomology Laboratory, Vernon, B.C.

Over the past few years the reference collection of inflated larvae of lepidopterous and hymenopterous tree defoliators has been expanded greatly. The collection is chiefly used as a reference aid in identifying larvae taken in Survey collections or submitted by persons in forest industry and related fields.

Represented in the collection are:

	Lepidoptera	Hymenoptera
Families	34	6
Genera	209	20
Species	350	23

The collection contains most common and many uncommon defoliators found in the forests of interior British Columbia. The lepidopterous families are represented by a varied number of species; for example, the collection contains 130 species of Geometridae, 75 species of Noctuidae and 15 species of Notodontidae. The total number of inflated larvae is about 1,530.

This note is published to make local entomologists aware of the existence of the collection and to invite them to use it.

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