

A PRELIMINARY STUDY OF THE WANDERING
OF STARVED LARCH SAWFLY LARVAE

by

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ABSTRACT

The maximum distances starved larch sawfly larvae crawled, with a light source as stimulus, were: I Instar - 12 inches; II Instar - 24 inches; III Instar - 129 inches; and IV Instar - 256 inches (this limit was imposed by the apparatus.) Distances in relation to the starting point at which approximately two-thirds had fallen off were: I Instar - at starting point; II Instar - six inches; III Instar - 45 inches; and IV Instar - 105 inches. The amount of wasted effort in the wandering pattern of starved larvae searching for food on defoliated branches varied from practically none to over one-half. Nearly all larvae went up the tree in search of food even if it was defoliated.

1. INTRODUCTION

Food shortage of larch sawfly larvae is one mortality factor that is difficult to assess. Complete defoliation of tamarack will halt further larval development, but even before this it is quite probable that a number of larvae will perish before reaching available foliage. Early instar larvae are probably most vulnerable to local shortages in food supply, while fifth instar larvae are least vulnerable.

Development of a technique for assessing the amount of mortality attributable to starvation during each instar appears unlikely. However, it may be possible to determine what degree of local defoliation must occur to cause larval mortality. A limited study on the wandering of starved larch sawfly larvae was initiated in 1959. This study had two objectives: 1) to determine how far larvae could crawl in search of food; and 2) to determine the pattern of larval wandering.

2. CRAWLING DISTANCE

Artificial conditions were used to study this phase of the project. A long enclosure with a light source at one end was constructed (Fig. 1). Four parallel larval paths were formed by piecing together straight sections of branches supported over a series of troughs by small needles. Pans containing foliage were placed under the opening in each trough to catch any larvae that fell. Larvae were released at the dark end of the apparatus.

First instar larvae were left on the needles on which they were feeding, and all other foliage removed. The twig was then clipped to the end of the artificial branch. Second, third and fourth instar larvae were placed in small uncorked vials taped to the upper side of the artificial branches.

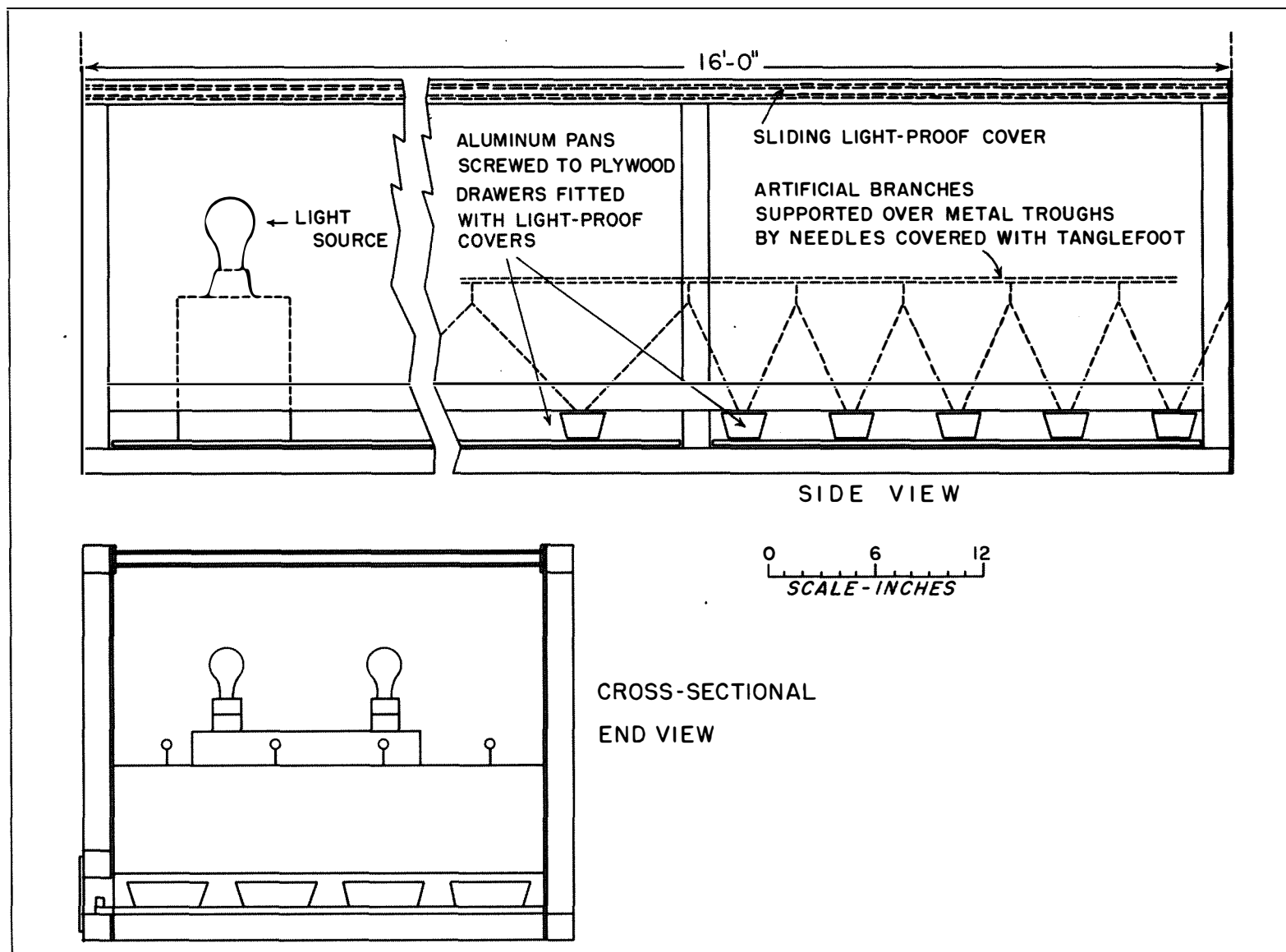


Fig. 1.— Apparatus used to determine how far larch sawfly larvae are capable of crawling

The results shown in Table 1 are inconclusive, since the vial method of release and the method of providing food appeared unsatisfactory. Apparently some of the larvae fell out of the vials without getting on to the artificial branch, and the smoothness of the aluminum pans containing foliage may have prevented some of the larvae from resuming feeding.

The maximum distance crawled was 12 inches for first instar larvae, 24 inches for second instar larvae and 129 inches for third instar larvae. The maximum of 256 inches for fourth instar larvae was imposed by the apparatus. It might otherwise have been greater.

Except for first instar larvae, those falling off at the starting point must be disregarded, as they may not have reached the branch successfully. Of the larvae that were known to have successfully started on the larval paths, approximately two-thirds had fallen off as follows: I Instar - at starting point; II Instar - six inches from starting point; III Instar - 45 inches from starting point; and IV Instar - 105 inches from starting point. The loss of larvae that are searching for food therefore appears to be considerable, even if the distances involved are not near the limit of larval wandering. Unless the larvae lodge on the foliage of lower branches there is little chance of them being able to resume feeding. Movement of branches by wind would probably increase the numbers falling off before crawling the maximum distance.

3. PATTERN OF LARVAL WANDERING

The distance of larval wandering presented in the previous section was obtained by providing a direct stimulus in the form of the light source. In nature, without this direct stimulus, there may be aimless wandering back and forth, which would reduce the effective

Table 1

Numbers of larvae recovered at different distances from the release point

Distance from release point (inches)*	I Instar			II Instar			III Instar			IV Instar		
	Feeding	Living (not feeding)	Dead	Feeding	Living (not feeding)	Dead	Feeding	Living (not feeding)	Dead	Feeding	Living (not feeding)	Dead
First trial												
0				12	2	6	1	21	0	3	1	0
6				2	0	1	0	0	0	2	0	0
12				1	0	1	1	0	0	4	0	0
18				0	0	0	1	0	0	1	0	0
24				1	0	0	2	0	0	0	0	0
33				0	0	0	2	0	0	2	0	0
45				0	0	0	2	0	0	1	0	0
57				0	0	0	3	0	2	0	0	0
69				0	0	1	2	0	0	9	0	0
81				0	0	0	0	0	0	2	0	0
93				0	0	0	0	0	0	0	0	0
105				0	0	0	0	0	0	1	2	0
117				0	0	0	0	0	0	3	1	2
129				0	0	0	1	0	0	0	0	0
141				0	0	0	0	0	0	0	0	0
153				0	0	0	0	0	0	0	4**	0
Second trial												
0	0	0	7	6	0	7	0	2	1	1	4	0
6	0	0	2	0	0	2	0	0	0	1	0	0
12	0	0	2	0	0	0	1	0	0	1	1	1
18	0	0	0	0	0	0	2	0	0	0	1	0
24	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	2	0	0	0	1	0
45	0	0	0	0	0	0	0	8	1	0	1	0
57	0	0	0	0	0	0	0	2	1	0	0	1
69	0	0	0	0	0	0	0	0	0	0	2	0
81	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	1	0
117	0	0	0	0	0	0	0	0	0	0	1	0
129	0	0	0	0	0	0	0	0	0	2	0	0
141	0	0	0	0	0	0	0	0	0	0	1	0
153	0	0	0	0	0	0	0	0	0	0	0	0

* Distance to mid-point between edges of troughs

** Four larvae at end of stick. One was lost. The remaining three were re-started. One fell off at starting point, another crawled 24 inches before falling and the other crawled the entire 153 inches.

distance.

Approximately natural conditions were used for this phase of the study. A small tree (89 inches in height to base of leader) was dug up and placed in a pan of water. All foliage was removed from three branches located 28 (Branch I), 53 (Branch II) and 26 (Branch III) inches above the root collar. Fifth instar larvae which had been deprived of food for about one hour were released on these branches and their movements mapped (Figs. 2-37).

The upper part of the tree was foliated when the larvae making the paths shown in Figs. 18-21 and 23-28 were released. All of these larvae crawled towards the main stem with little wasted effort. With the exception of the paths shown in Figs. 18 and 19, where the larvae fed on foliage left at the base of the branch, all larvae started up the tree in search of food, by-passing foliage on the main stem and moving onto branches.

Branches above the release area were then completely defoliated, except for needles on the new shoots, to see if larvae would ascend in the absence of foliage. With the exception of the paths shown in Figs. 12 and 33, all larvae did go up the tree. Some larvae (Figs. 14-17, 32, and 34) made relatively direct paths to the main stem. Others (Figs. 4, 6, 10, and 13) wasted considerable effort, which reached even greater proportions in the paths shown in Figs. 3, 5, 11, and 29, where over half of the effort was wasted in aimless wandering.

Some larvae (Figs. 7-9, 12 and 33) started at the base of the branch and moved onto it in search of food. All of these larvae turned back towards the main stem before reaching the end of the branch, and, with the exception of the path shown in Fig. 7, explored the branch

with relatively little wasted effort.

Observation of the paths of larvae shown in Figs. 3-8, were continued until the larvae resumed feeding. All of them crawled to the upper part of the crown (1 - 15 inches from base of leader) and started feeding on needles on the new shoots. Some became restless and moved from shoot to shoot in search of more suitable food. One larva crawled down the tree and resumed feeding on a foliated lower branch. Another started down, but observations were terminated before it had completed its wandering.

4. DISCUSSION

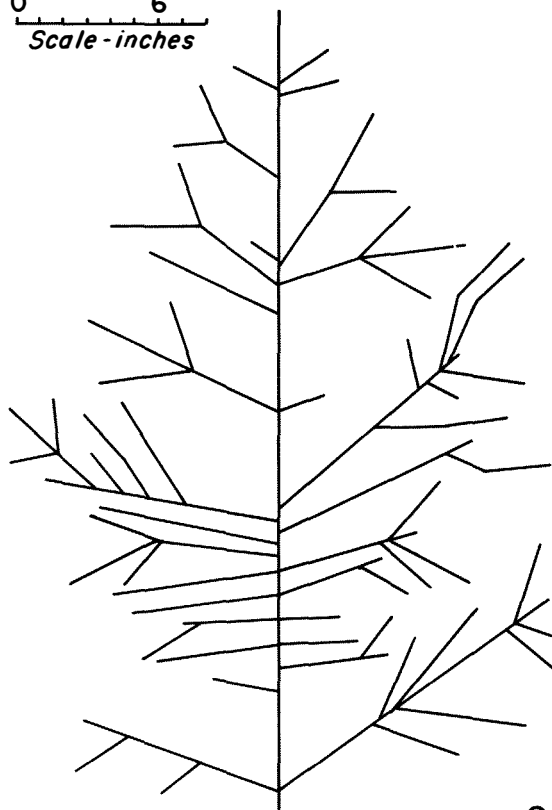
Several modifications in techniques are indicated from the results of this preliminary study. The apparatus for determining wandering capabilities of the various instars appears basically satisfactory, but two minor modifications are necessary. The first of these is a change in the method of release. The use of partially defoliated twigs instead of vials appears to be required. Also, the bottom of the pans containing foliage should be covered with some material such as thin felt, to provide a surface on which the larvae can crawl more easily.

Studies on the pattern of larval wandering should be augmented with additional information on light conditions, direction of sun in relation to the branch, temperature and perhaps humidity. The length of time since previous feeding should also be known, and the distance covered during various time intervals should be recorded. Without this supplementary information it is difficult to place any logical interpretation on the results obtained.

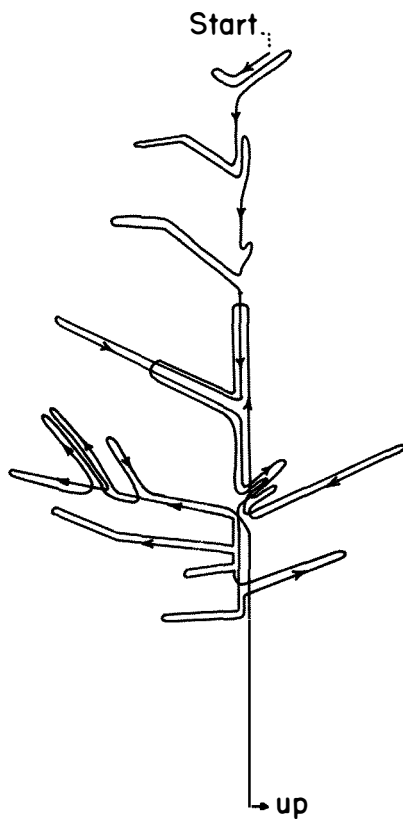
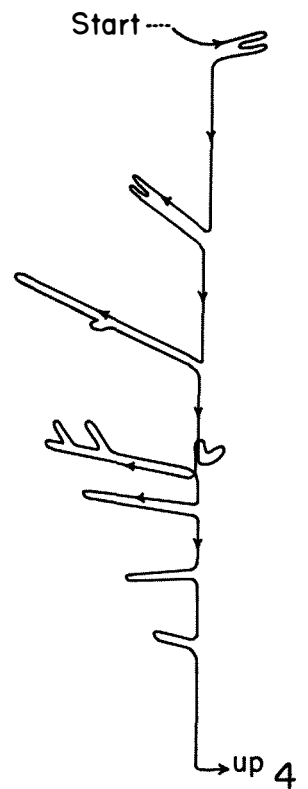
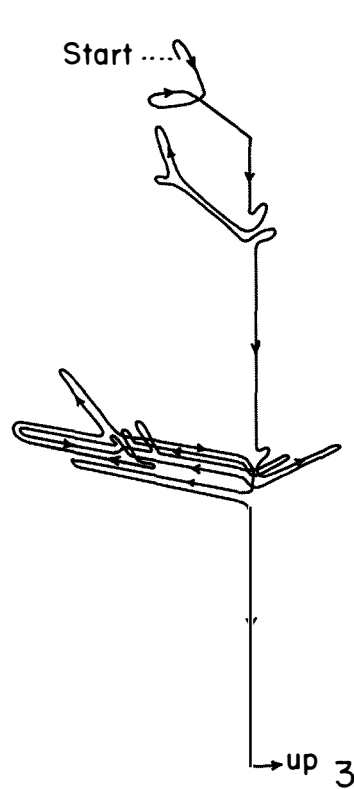
The paths shown in Figs. 3 - 21 were made by larvae that were released in reverse order to that indicated, i.e., number 21 was one of

the first larvae and number 3 was one of the last. It is obvious from the results that larvae do not utilize any scent trails left by preceding larvae, as some of the most complex trails were left by the last group of larvae released. Supplementary information might indicate why there is such a wide variation in behaviour, it may be related to climatic conditions, or it may be simply variation in larval behaviour.

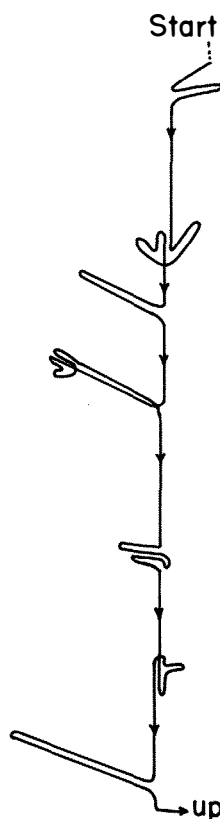
0 6
Scale - inches



2

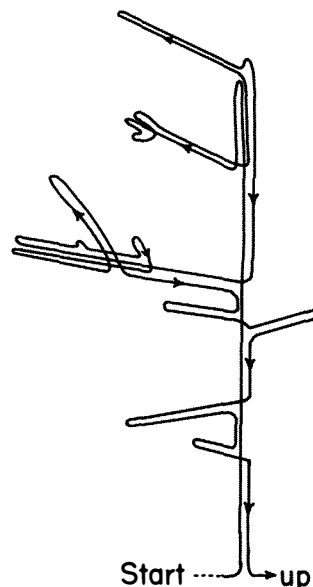


5



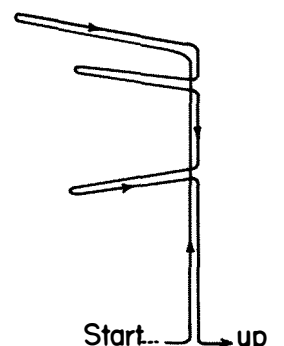
6

Same larva as
shown in Fig. 31



7

Same larva as
shown as Fig. 30

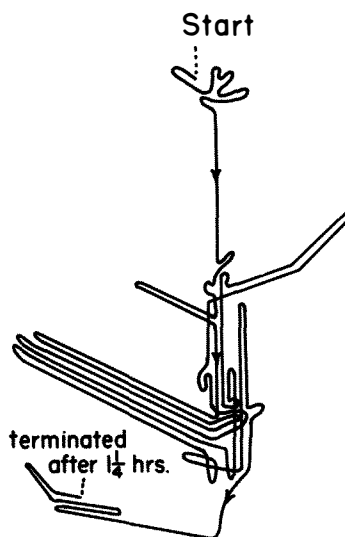
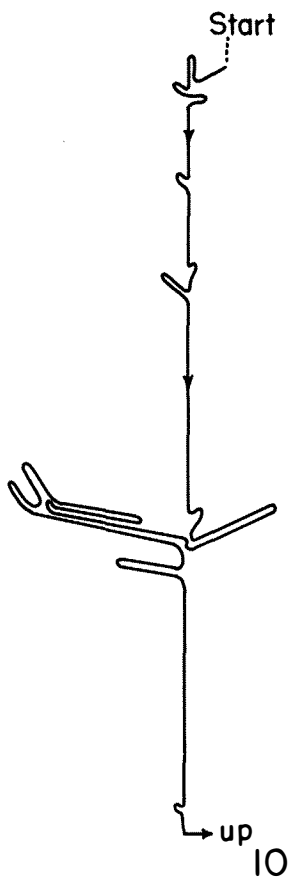
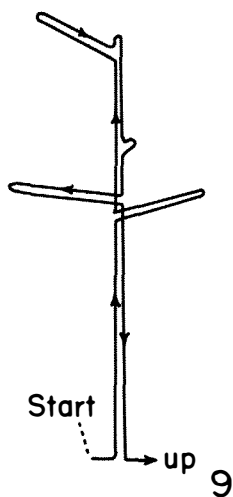


8

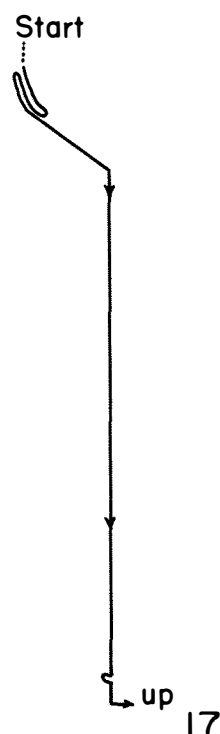
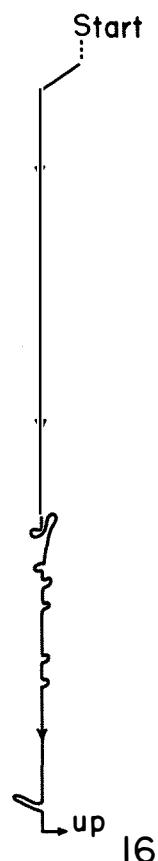
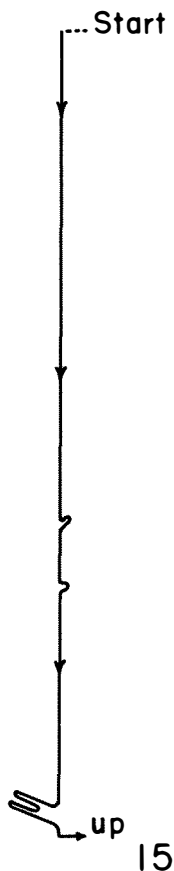
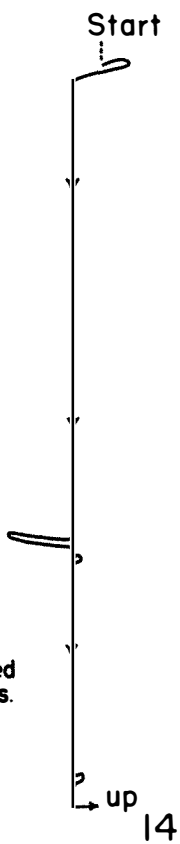
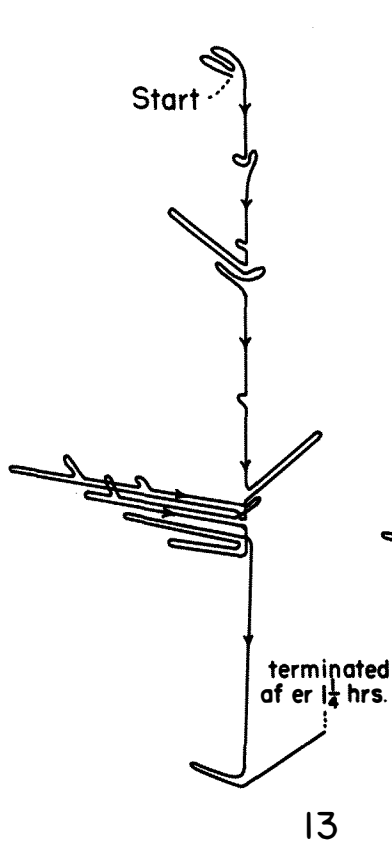
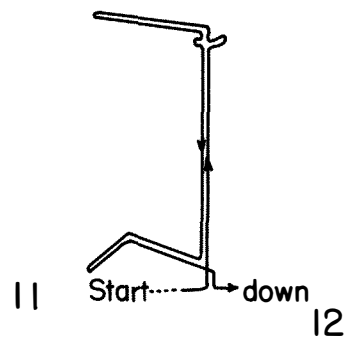
Figs. 2-8.- Larval wandering of the larch sawfly on a tamarack branch. Fig.2- schematic scale drawing of Branch 1. Figs. 3 to 8 - larval paths on Branch 1

0 6
Scale - inches

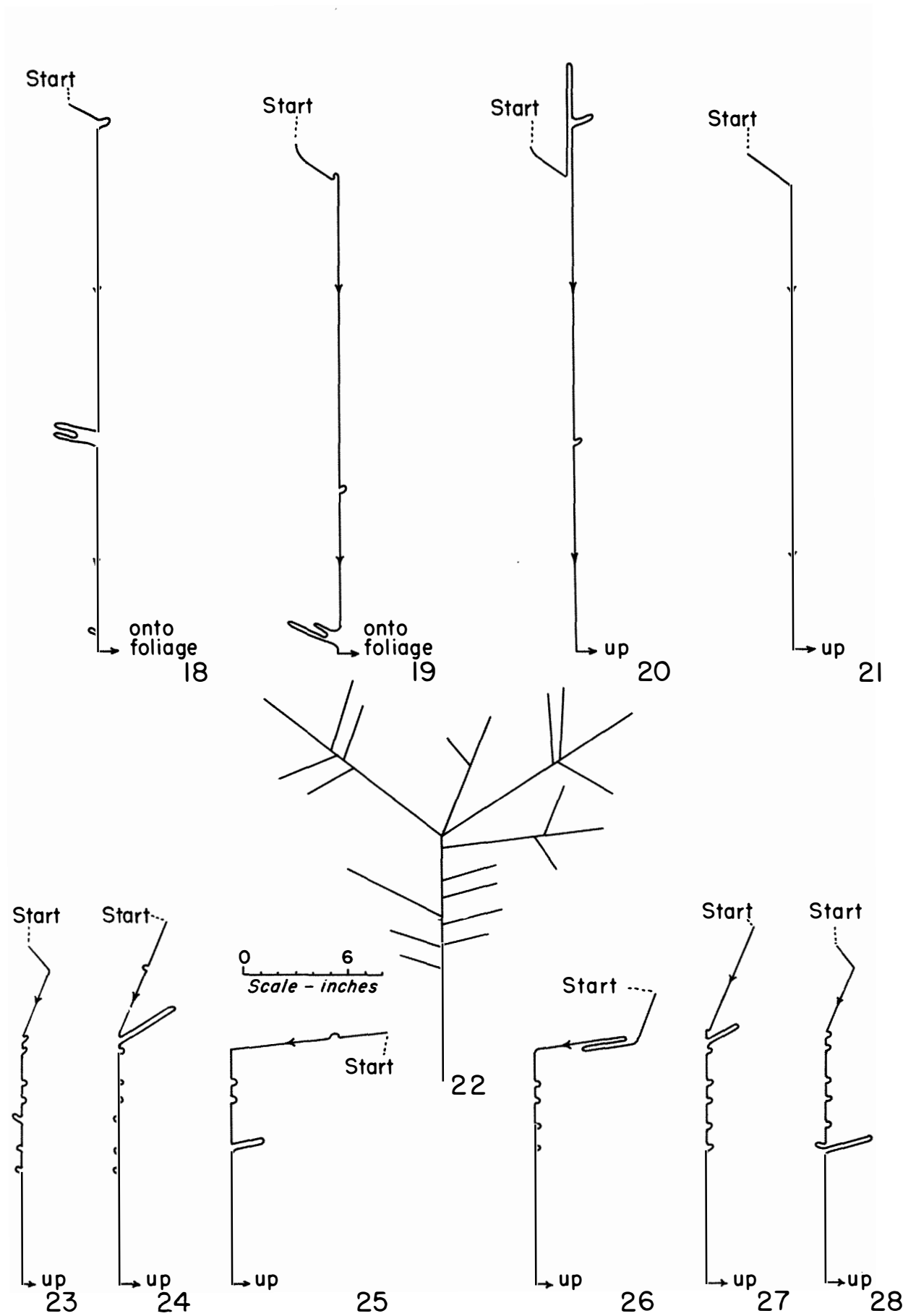
Same larva as
shown in Fig. 34



Same larva as
shown in Fig. 32

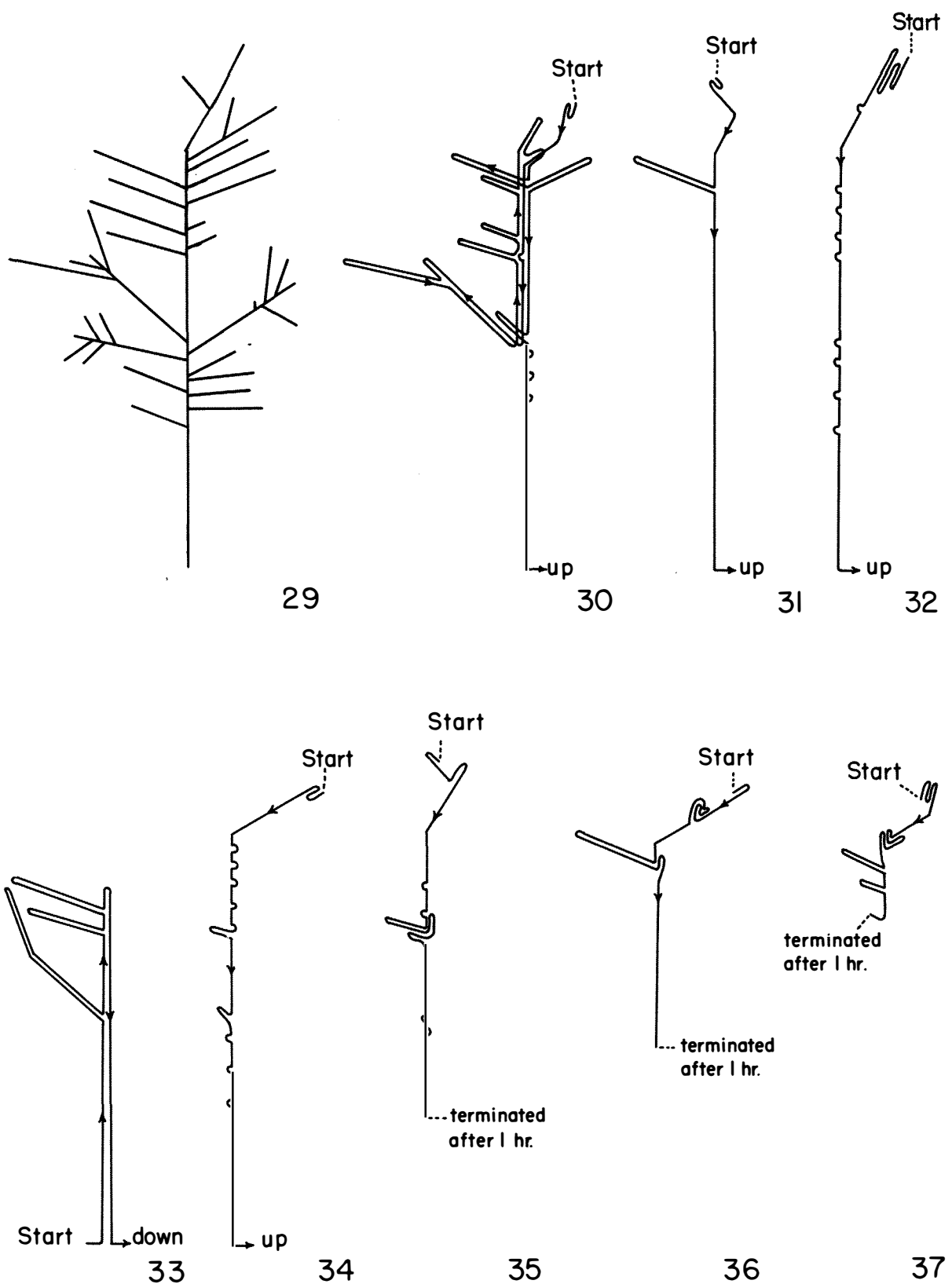


Figs. 9 - 17.- Larval paths on Branch 1



Figs. 18 - 28.- Figs. 18 to 21 - larval paths of the larch sawfly on Branch 1. Fig. 22 - schematic scale drawing of Branch 2. Figs. 23 to 28 - larval paths on Branch 2

0 6
Scale - inches



Figs. 29 - 37.- Wandering of larch sawfly. Fig. 29 - schematic scale drawing of Branch 3. Figs. 30 to 37 - larval paths on Branch 3