DESCRIPTIONS OF ERANNIS VANCOUVERENSIS WITH LIFE HISTORY NOTES (Lepidoptera: Geometridae)

by
David Evans

FOREST RESEARCH LABORATORY
VICTORIA, BRITISH COLUMBIA
INFORMATION REPORT BC-X-27

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Introduction

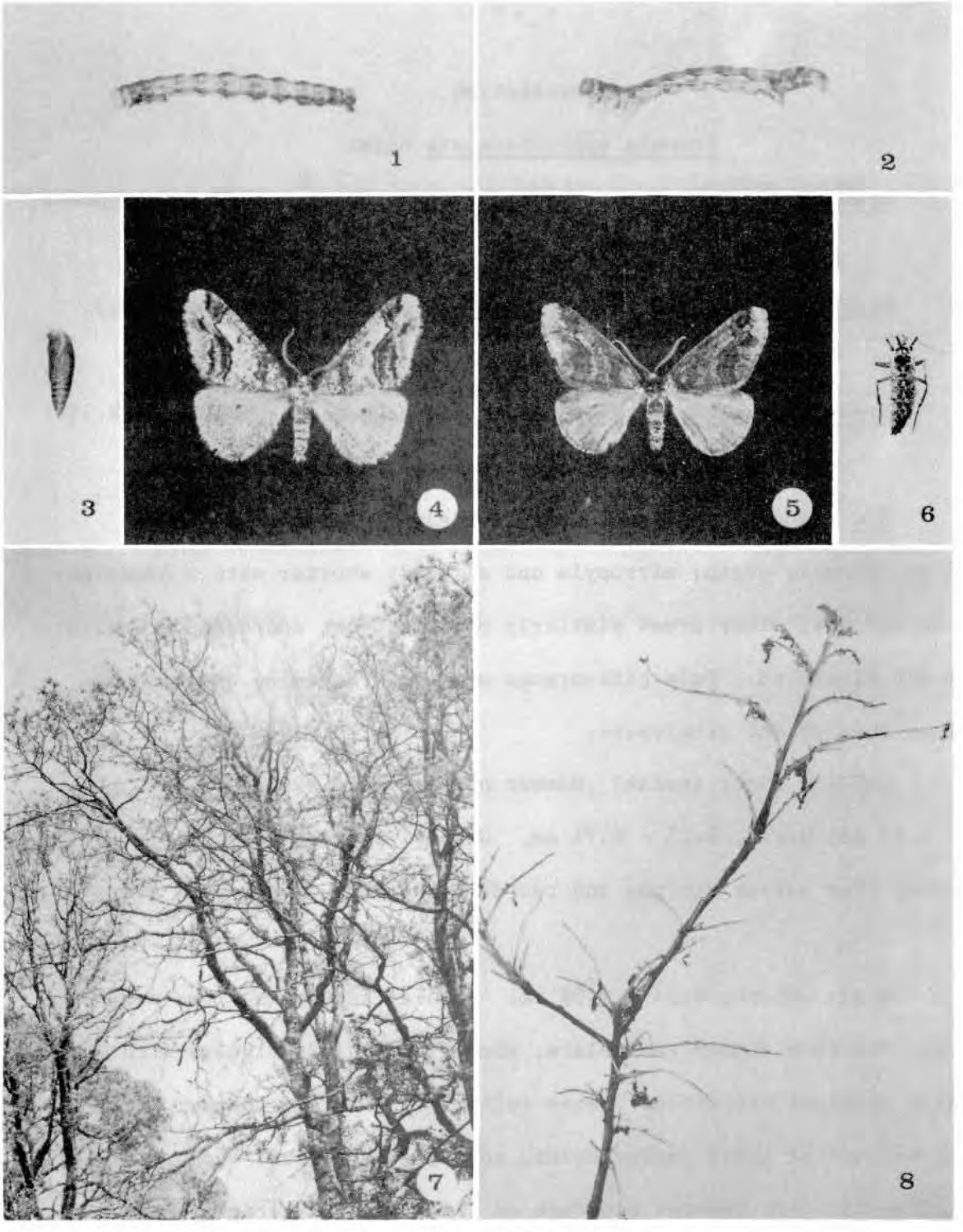
Erannis vancouverensis Hulst, sometimes known as the maple looper or mottled umber moth, was described in 1896 from specimens collected at Victoria, British Columbia, as a variety of the European species, E. defoliaria (Clerck), which is a recognized orchard pest in western Europe. E. vancouverensis is found from northwestern British Columbia south to central California, and eastward to the nearer slopes of the Rocky Mountains. It may cause severe defoliation of deciduous trees in localized areas. The period of heaviest larval feeding coincides with the expansion of the new leaf growth early in the spring. Damage to young leaves of ornamental, shade and orchard trees is more noticed than the injury to forest trees. Since 1941 infestations have been reported in British Columbia from Victoria, Vancouver, and the Lillooet and Skeena River Valleys; in the latter area an estimated 200 acres of poplar and willow were defoliated (Leech 1947). Literature concerning the species is meagre. Table I shows the relative abundance of Erannis throughout the coastal area of British Columbia during 1949-68, as indicated by Forest Insect Survey samplings. During the preparation of this paper approximately 1300 larvae, including 180 individual rearings, and 80 pupae were examined. Approximately 130 adults were studied, including those dissected for egg capacity and others used for genitalic slides.

TABLE I

Incidence of *Erannis vancouverensis* larvae in Forest Insect Survey collections

Year	1949	'50	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	1968
No. host trees sampled*	55	99	56	60	38	28	25	33	41	56	91	37	72	37	54	42	58	56	28	22
No. collections of *Erannis*	4	11	1	0	0	4	2	5	3	17	20	3	6	1	2	1	3	6	2	5
No. specimens of *Erannis*	8	24	1	0	0	9	2	41	59	1059	983	6	209	1	2	5	5	12	4	10
Av. no. *Erannis* per collection	2	2	1	0	0	2	2	8	20	62	49	2	37	1	1	5	2	2	2	2
Per cent parasitized or diseased	10	18	100	0	0	85	25	33	70	80	86	0	22	0	0	0	0	13	0	0

* Apple, birch, broadleaf maple, garry oak.



Figs. 1-6, Erannis vancouverensis, natural size
1, Fifth-instar larva, dorsal view. 2, Fifth-instar larva, lateral view. 3, Male pupa. 4, Adult male: Victoria, B. C., Dec. 14, 1956, off garry oak, Forest Insect Survey. 5, Adult male: Klemtu, B. C., Oct. 30, 1950, off wild apple, Forest Insect Survey. 6, Adult female: Fraser Canyon, B. C., Nov. 9, 1956, off mountain alder, Forest Insect Survey.

Fig. 7, Defoliation of garry oak.

Fig. 8, Defoliated oak twig with diseased cadavers of Erannis.

Description

Erannis vancouverensis Hulst

Erannis defoliaria var. vancouverensis Hulst, 1896, Trans. Amer. Ent. Soc. 23: 363.

Erannis defoliaria ab. vancouverensis, Dyar, 1902, Bull. U.S. Nat. Mus. No. 52, p. 330.

Erannis vancouverensis, Barnes and McDunnough, 1917, Check list of the Lepidoptera of boreal America, p. 119.

EGG: Number examined, approximately 200. About 0.35 mm x 0.55 mm, bluntly ovoid; micropyle end slightly shorter with a hammered-metal appearance; other areas similarly patterned but depressions smaller, deeper and elongated. Pale pink-orange when new, becoming brownish and darker as development progresses.

LARVA: First instar: Number of specimens examined, 85. Length, 1.80 - 4.51 mm; width, 0.25 - 0.74 mm. General appearance: pale olive-brown with fine darker stripes and two dark thoracic spots; pale glossy head.

Head: Width, 0.34 - 0.38 mm. Cranial suture shallow; oral area produced. Surface finely reticulate, minutely dimpled; clypeus with shallow irregular vertical striation. Setae relatively long and coarse; setal bases obvious because of their darker color, scarcely depressed. Color: pale shiny olive-tan with browner blotches on the sides and vertex; oral areas brown; ocelli near-black. Ocelli relatively large; I-IV evenly spaced with interspaces approximately three-quarters ocellar width; ocelli V and VI about equidistant from IV, with interspaces twice as long as the others. Clypeus with the basal suture subtruncate; labrum vertically ridges, deeply and roundly notched; mandibles with six teeth, inner surface with three ridges; labial palpi with the first two segments subequal in length, together about

as long as segment three, which is approximately twice as long as wide; hypopharynx approximately twice as wide as long at its base, one pair stubby papillae, each with one seta about as long as the spinneret; spinneret long, thin, pointed, approximately four times as long as its basal width.

Body: Ground color pale brownish-chartreuse with irregular lines of pale yellow-brown: double dorsal line, lateral line and supraspiracular stripe, all darker at intersegments, latter two also darker at lower margins; subspiracular and subventral stripes, and a fine double ventral line. Thoracic shield visible as two small subpentagonal subdorsal patches, conspicuous by their dark-brown pigmentation. Anal shield approximately semicircular, nearly smooth, mid- (setal)- section irregularly pigmented dark brown (Fig. 11). Thoracic legs dark brown, ventral prolegs with a brown triangular patch on the outer side; anal prolegs with a double brown stripe down the front and a vertically triangular brown area posteriorly. Approximately 18 crotchets on each leg, arranged in heteroideous mesoseries, including three larger crotchets at each end of the rows (Fig. 13). All body setae small and dark; papillae small but surrounded by conspicuous irregular brown patches. Spiracles subcircular, pale but edged brown.

Second instar: Number of specimens examined, 68. As instar I except for the following differences: Length, 4.21 - 7.25 mm; width, 0.70 - 0.96 mm. General appearance: pale yellow with brownish-grey lines and a tan head.

Head: Width, 0.64 - 0.72 mm. Oral area relatively less produced, but still protuberant. Surface scarcely dimpled, clypeus nearly smooth. Color, pale tan with large darker irregular blotches. Ocellar interspaces I-III approximately equal to ocellar width, interspaces IV and V about twice ocellar width. Clypeus with the basal suture arcuate; labrum more massive but less deeply emarginate than in first instar; labial palpi with segments

one and three subequal in length, middle (second) segment slightly shorter, and wider than long; hypopharynx conelike, nearly as wide as long, papillae end spinneret relatively small.

Body: Ground color pale brownish-yellow with lines of mid-brown-grey as follows: double dorsal, double lateral, double supraspiracular, spiracular, wide subspiracular and wide subventral. Throacic shield about half the width of its segment, pale orange-brown with darker margins. Anal shield sub-truncate in outline (four marginal angles), with little dark pigmentation, setae dispersed marginally. Thoracic legs with the tips much darker than the body. Ventral prolegs with the triangular marking larger and lighter than previously; anal prolegs with large triangular pigmented areas down the front-outside and rear. Approximately 30 crotchets on each leg, smaller ones more numerous than in instar I. The following setae are present in addition to those of the first instar (Figs. 9 and 10): on T2 and T3: L2, L3; on A1: L3, SV2, SV3; on A2-5: L3, L4, SV3; on A6: SV1, SV3; on A7: L3, SV3; on A8: L3.

Third instar: Number of specimens examined, 99. As instar II except for the following differences: Length, 6.15 - 9.91 mm; width, 0.90 - 1.15 mm. General appearance: wide irregular dark-grey lines on a cream-yellow background; head, shields and anal prolegs sand-beige.

Head: Width, 1.14 - 1.25 mm. Sand-beige, blotches larger, darker and more elongate than in instar II. Clypeus with the basal suture sub-angulate; labrum narrowly notched; labial palpi with all segments subequal in length.

Body: Colored as preceding instar but cream-yellow ground color nearly obscured by wide dark brown-grey lines, except along the spiracular line which is pale grey and irregular. Thoracic shield about three-quarters the width of its segment, each section sub-triangular

in outline, lower margins shaded dark grey. Anal shield sub-truncate (two marginal angles), irregular dark pigmentation medially and basally. Thoracic legs pale brown-yellow. Sclerotized areas on ventral and anal prolegs larger and less angular than in instar II, and paler than the legs.

Fourth (penultimate) instar: Number of specimens examined, 85. As instar III except for the following differences: Length, 7.76 - 16.15 mm; width, 1.01 - 1.32 mm. General appearance: irregular near-black lines on a yellow background; head, shields and legs brown-orange.

Head: Width, 1.80 - 1.96 mm. Frons with indistinct horizontal wrinkles, clypeus vertically striate at its base. Brown-orange in color. Ocellar interspaces IV and V approximately three times ocellar width. Mandibles with the cutting edge nearly entire, the teeth apparent only because of the transverse grooves on the outer surface.

Body: Color: yellow dorsum, lateral areas much darker, near-white supraspiracularly and below; spiracular stripe broken and irregular, double subspiracular and double subventral lines thickly shaded dark brown-grey. Thoracic shield nearly as wide as its segment, sub-rectangular in shape, brown-orange. Anal shield semi-elliptic, also brown-orange, base with dark broken median and marginal lines. Ventral prolegs with a brown triangular patch up the front; anal prolegs with a dark brown-orange stripe up the front and a brown-orange shield-like area over the outer side of the leg. Each proleg with approximately 17 pairs of crotchets, arranged biordinally, each series with six large crotchets at each end. Each spiracle widely edged dark brown, surrounded by a conspicuous orange blotch.

Fifth (ultimate) instar (Figs. 1 and 2): Number of specimens examined, 115. Length, 16.40 - 40.95 mm; width, 1.57 - 4.22 mm. General appearance: rose-beige dorsum (yellow-brown during first half of the instar),

with five irregular double dark-brown lines; venter yellow; head, ends of body, spiracular areas and legs pale orange-brown.

Head: Width, 2.53 - 3.02 mm. Approximately as wide as high; cranial and epicranial sutures moderately impressed; oral area slightly produced. Surface densely, finely rugose with small bubble-like protubernaces; apex of frons smooth; clypeus with fine irregular vertical striation. Setae relatively long and fine; setal bases small and dark. Color, pale orange-brown,darkerdorsally; oral area paler, mouthparts dark brown. Ocelli relatively small; ocellar interspaces I-III each approximately equal to the ocellar width; interspaces IV and V approximately three times ocellar width; space between ocelli four and six approximately twice ocellar width. Clypeus with the basal suture sub-arcuate; labrum moderately and roundly notched, surface shallowly rugose. Mandibles hoof-like with only one shallow emargination slightly above the lower margin (between first and second tooth of previous instars); inner surface with one large diagonal ridge, lower section flat and nearly smooth, upper section concave and pitted, with one transverse ridge. Labial palpi with the first two segments subequal in length; segment three about half the length of segment two, and much smaller. Hypopharynx sub-conical, bulbous, slightly longer than wide; two short papillae; spinneret small, sharply tapered, approximately twice as long as wide.

Body: Surface densely and finely spinose, conspicuously more so in the anal area. An irregular linear pattern colored as follows: double black dorsal line constricted at intersegments and enclosing dark yellow-brown areas; pale rose-beige sub-dorsal stripe; dark rose-beige lateral and supraspiracular stripes, divided by a pale rose-beige stripe, all edged brown-black, most conspicuous along the lower margins; spiracular

area orange-brown, yellow above at intersegments; venter yellow with an orange-brown subspiracular line and a beige subventral stripe, both edged darker. Pattern on first thoracic segment practically obliterated by the pale orange-brown thoracic shield, which is nearly the full width and length of the segment. Ninth abdominal segment with little pattern. Anal shield approximately four-fifths as long as wide, terminus sub-triangulate, surface irregularly dimpled (Fig. 12). All legs brownish-yellow. Anal legs with a brownish horizontal band along the outer post-midsection. Ventral and anal prolegs each with approximately 17 pairs of crotchets, arranged in biordinal homoideous mesoseries (Fig. 14). All body setae relatively long, pale brown; papillae inconspicuously pale with darker margins. Spiracles elliptic, pale in color; peritremes sub-circular, dark brown.

PUPA: Male (Fig. 3): Number examined, 42. Length, 11.14 - 16.45 mm; maximum diameter, 2.96 - 4.75 mm. Appearing slightly humped because of the decurved dorsum sloping anteriorly from A2, the slender abdomen and the relatively straight plane of the ventral surface. Typically obtect, all appendages fused; A5, A6 and A7 movable. Head, entire thorax, A9 and A10 finely rugose; balance of abdominal segments less rugose and moderately covered with deep sub-circular pits, except along posterior margins which have minute transverse striation. Setae fine, pale brown. Thoracic spiracle at the lower corner of T2, prominently produced to a flap-like bud, darkly pigmented, vertically elliptic from a side view, ear-like as seen from above. Eyes not prominent, but adfrontal area bulbous. Wings, antennae and metathoracic legs extending nearly to the posterior margin of A4; mesothoracic legs and maxillae slightly shorter, prothoracic legs more so. The antennae submarginal to the wing costae, but

the latter mostly concealed by the mesothoracic legs; antennae appearing relatively wide and straplike, with fine transverse corrugation. A1 spiracle not visible; spiracles on A2 and A3 at wing margin; A8 spiracle small and slit-like. A9 nearly smooth and unmarked except for the genital pore: a longitudinal slit approximately half the width of A9 near the posterior margin and surrounded by a broadly cordate callosity. A10 approximately 1.5 times as long as wide; irregularly constricted and extended to a smooth bifurcate cremaster; dorsum irregularly serrate at the base, sub-basal groove preceding a rugose midsection; venter with depressed anal area and diagonal rugostriation.

Female: Number examined, 37. Appearing as the male except for the following differences: Length, 9.94 - 15.04 mm; maximum diameter, 2.95 - 4.58 mm. Genital pore small and flat, on the anterior of A9.

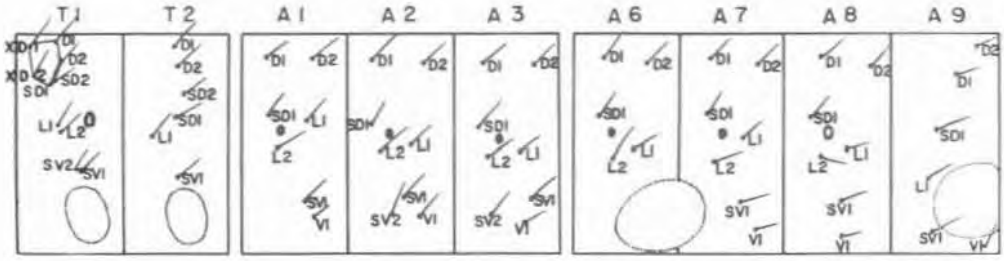
ADULT MALE (Figs. 4 and 5): Number of specimens examined, 63. Body slender, slightly tapered, 10.95 - 15.15 mm long. Antennae approximately 8.00 mm long and 0.75 mm wide; about 41 segments, each segment light brown with two pair of fine decurved fimbriate pectinations which are longest about one-third along antennal length and gradually shortened toward each end; antenna base and dorsum scaled in mixed shades of grey-brown. Length of frons subequal to its dorsal width, lower margin slightly narrower with long fine incurved seal-brown scales. Vertex pale seal-brown with a caplike tuft of cream-colored scales. Eyes rather small but about two-thirds spherical, dark brown. Dorsum of thorax scaled grizzled-brown, long, dense and dark in front, and long fine fanlike tufts above the wing bases. Abdomen with variegated lustrous seal-brown scales, more yellowish basally and apically, with more dark spots laterally and apically; apical tufts very short. Maxillae short and pale yellow-brown.

Labial palpi stubby, spurlike; approximately 0.96 mm long; segments 1 - 3 in the approximate ratio of 7:3:2; finely scaled in variegated grey-brown. Genae fringed with long dark brown-grey scales. Coxae and venter of thorax with long fine variegated grey-brown scales. Abdomen paler ventrally than dorsally, but dark markings more numerous and conspicuous. Fore-tibia about .6 the length of the femur, most of its inner distal half shielded by a wide flat brown leaf-like spur, incurved and slightly twisted; first tarsal segment slightly longer than the tibia. Mid and hind tibiae slightly longer than their femora, each with one pair of distal spurs, the hind tibia also with a medial pair; first tarsal segments on these legs considerably shorter than the tibia. Femur scaled brown-grey on the outer side, pale yellow-brown on the inner side; tibia brown-black with a mid and distal band of cream-yellow; tarsal segments similarly dark with light distal ends.

Wingspan, 31.02 - 39.60 mm. Pale silvery-grey with variegated brownish stipple; veins shaded yellow-brown. Forewing elongate with apex and humeral angle well rounded; costal margin scarcely curved; radial and humeral margins also nearly straight and appearing to be of nearly equal lengths. Costal, basal and humeral areas finely stippled; wide shadowy transverse anterior line, irregularly angulate, often wider mid-costally. A small but conspicuous discal spot, elliptic and near-black. Transverse posterior line conspicuous, near-black, irregularly fine and appearing deeply indented at cell M1, especially along the lower margin of that cell. Sub-marginal area by the transverse line darkly fasciate, usually appearing yellow-brown with broken dark brown-grey margins. Veins at the radial margin frequently dark, giving the marginal fringe a banded appearance. Rear-wings relatively large. Allover fine dark stipple, darker radially and humerally. Small dark discal spot. Undersurface of wings indistinctly

marked as the upper surface, but dully colored with no contrasting pattern; rearwing more densely stippled.

ADULT FEMALE (Fig. 6): Number of specimens examined, 45. Wingless; body plump, slightly tapered, anterior abdominal segments appearing humped; length, 7.95 - 15.41 mm. Head relatively smaller than that of the male. Antennae with approximately 41 segments, terete and completely scaled dark grey-brown variegated to near-white. Frons slightly wider than long, nearly black. Vertex also near-black with a cap of ivory-colored scales. Eyes only slightly more than hemispherical. Dorsum of thorax with appressed scales, ivory in color with subdorsal black areas. Abdomen finely scaled pale brownish-ivory with many black markings, tending toward dorsal and lateral stripes; A1 with a conspicuous black dorsal area; apex fringed black. Maxillae shorter than in the male; labial palpi smaller and nearly black. Fore-tibia shorter than the femur, lacking a spur; first tarsal segment of the fore-leg much shorter than the tibia. Legs otherwise resembling those of the male except for their predominantly darker color. Balance of the body coloring also as the male but more strongly contrasted and scales fine and appressed. Wings visible as two tiny appressed flaps; the anterior one black and the posterior one ivory-white.



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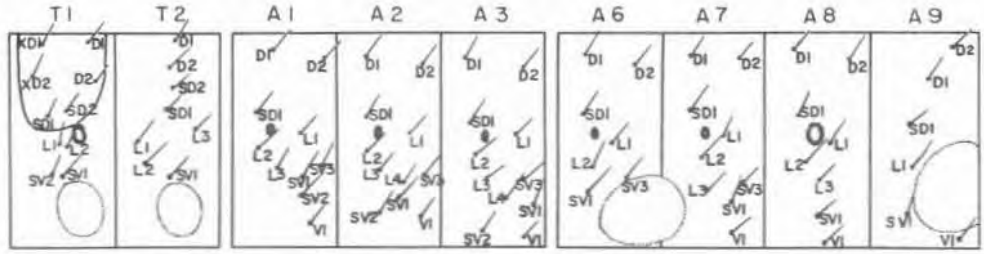

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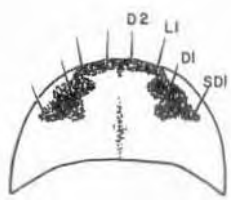

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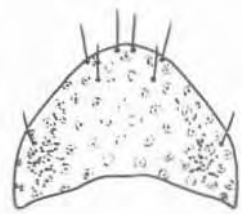

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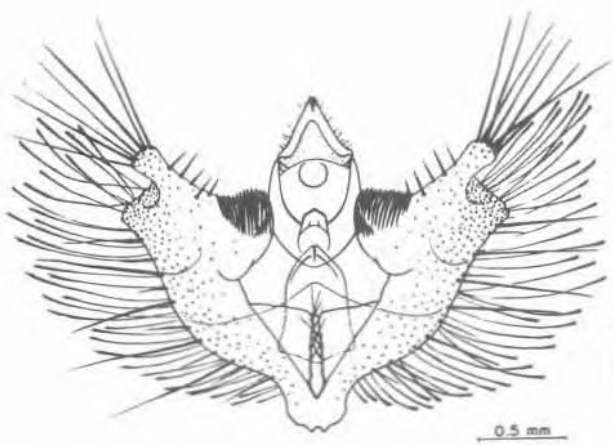

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Figs. 9-17, Erannis vancouverensis. 9, Setal pattern of first-instar larva, thoracic and abdominal segments abbreviated T and A, respectively. 10, Setal pattern of fifth-instar larva. 11, Anal shield of first-instar larva. 12, Anal shield of fifth-instar larva. 13, Crotchets of proleg of first-instar larva. 14, Crotchets of proleg of fifth-instar larva. 15, Adult male genitalia. 16, Aedeagus of male genitalia. 17, Adult female genitalia.

Male genitalia (Fig. 15): Length, 1.78 - 2.08 mm. Harpe, excluding the curved knob-like projection of the clasper from the posterior dorsal corner, approximately 2.7 times as long as wide and not extending to the tip of the uncus; widest about one-third from its base, then incurved to a wide truncated terminus; the ventral margin with a few sparse long spines and a thick fringe of long hairs, many scale-like, three or four long tufts on the posterior margin. Clasper slightly pigmented, long dark hairs on the terminus, short thick spines sparsely and irregularly along the dorsal margin which is recurved to a darkly pigmented wide comb-like flange. Saccus approximately as wide as long, appearing slightly enlarged anteriorly. Juxta wide and flap-like, sub-angulate and fringed with long fine hairs. Anellus bullet-shaped, approximately twice as long as wide; the posterior sub-margin and median section slightly creased. Gnathos elongate-crescent shaped; petal-like cochlear curled post-ventrally. Scaphium cone-like as viewed from above or below, decurved claw-like in profile; upper surface with sparse hair of moderate length; socius present only as a relatively narrow flange. Aedeagus (Fig. 16) nearly as long as overall length of genitalia, approximately six times as long as wide; ductus seminalis well behind the anterior end, which is slightly crooked and bluntly rounded, posterior third slightly expanded, flattened and pigmented to a scoop-like form from which the ejaculatory duct may puff out; cornutus spindle-shaped, finely elongate, recurved and deeply pigmented.

Female genitalia (Fig. 17): Length, 4.15 - 5.91 mm. Bursa and ductus bursae each approximately one quarter the total length of the genitalia, bursa sub-globular, ductus bursae somewhat striate. Ostium relatively large and sub-triangular, with the darkly pigmented antrum appearing lip-like along the ventral margin. Genital plate lily-shaped,

the dorsal anterior margin with several short longitudinal wrinkles, the post-ventral margin tooth-like and recurved. Abdominal segment eight appearing nearly square in slide specimens; anterior apophyses apparently arising from its anterior corners, each one approximately one-third the total length of the genitalia, slightly crooked and a little tapered. Abdominal segment nine about twice as wide as long. Anal papillae cone-like, together approximately half as wide as long, outer surface with long fine hair; posterior apophyses appearing from the anterior margin, extending nearly straight and even as far as the bursa.

Notes on Life History

The life cycle of this species is characterized by the seemingly unseasonable appearance of the adults which may emerge mid-September to early April. In the relatively temperate climate along the south coast of British Columbia adults emerge during late October to mid-December, with occasional sporadic winter emergence until mid-March. Farther south in the San Francisco Bay area, emergence is later, from early November to late March, and typically reaches its peak during February. In the inland or eastern part of its range, Erannis usually emerges during late September and October, although in northern Idaho adults have also been collected as late as May.

Caged moths may live as long as 20 days under simulated field conditions. Egg capacity per female is approximately 145 (by dissection), and most of these eggs are laid in small scattered clusters concealed on the bark and twigs of the host tree, most frequently on the terminals of exposed and higher branches that are not too shaded. They overwinter there and hatch after leaf buds have opened, usually during May or June. The young larvae tend to be gregarious for a few days and are relatively light feeders, removing small sections of margin and/or surface from the

leaves. As the larvae grow they disperse over nearby branches but seldom leave their original tree. Leaves on infested trees characteristically appear frayed and tattered and, as feeding starts before the leaves are mature, the amount of defoliation often seems exaggerated (Fig. 7).

The larval period lasts about seven weeks, instars one to five averaging approximately 10, 9, 7, 6 and 14 days , respectively. The fully grown larva drops to the ground and spins a loose shelter in the leaf litter where pupation occurs in about four days. The pupal period averages about five months, but varies between three and eight months, the time for males usually being about two weeks less than for females.

Host plants are commonly broadleaf maple Acer macrophyllum Pursh, garry oak Quercus garryana Douglas, apple Malus spp. and birch Betula spp., in order of preference. Other hosts are red alder Alnus rubra Bong., vine maple A. circinatum Pursh, willow Salix spp., rose Rosa spp., trembling aspen Populus tremuloides Michx., cherry Prunus spp. and black cottonwood P. trichocarpa Torr. and Gray. Erannis may be found on many more deciduous trees and shrubs, and also seems to thrive on such conifers as western hemlock Tsuga heterophylla (Raf.) Sarg. and western white pine Pinus monticola Douglas.

A tachinid fly, Winthemia occidentalis Reinhardt, is the principal parasite identified from Erannis; another tachinid, Madremyia saundersii (Williams), is common; Hyposoter fuscitarsus (Viereck) (Hymenoptera: Ichneumonidae) has been recorded, and others have been collected occasionally. Winthemia may cause upwards of 70 per cent larval mortality in dense populations; most attacked are second-instar larvae, which die during the fifth instar, the maggots soon leaving the bodies in order to pupate. This species usually overwinters as pupae,

the adults emerging early in the spring. Madremyia larvae develop and emerge as adults during one summer season. A larval polyhedrosis virus, (Fig. 8), is another important factor in infestation populations, sometimes accounting for as much as 40 per cent mortality. These combined forces may be capable of controlling concentrated populations of Erannis, which may be the main reason why the species is not more destructive on the Pacific coast.

Summary

Erannis vancouverensis may have been introduced on Vancouver Island from European nursery stock. A west coast population is present from northern British Columbia to central California, and has occasionally been reported at infestation levels. The larvae feed on the young leaves of several species of deciduous trees. During 1949-1968 collections of insect material made by Forest Biology field rangers contained from 0 to 1059 individuals of this insect annually. Adults usually emerge during late autumn, and occasionally during winter months or early spring. Adult females are wingless. Winter is passed in the egg stage, but sometimes as a pupa. The larval stage has five instars. Virus disease and parasitism by tachinid flies contribute to the control of this species.

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