

BIOLOGICAL AND SYSTEMATIC CONSIDERATIONS ON THE
"EMARGINANA GROUP" OF THE GENUS *EPINOTIA*
(TORTRICIDAE)¹

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In his revision of the Eucosminae, Heinrich (1923) considered the three Nearctic members of the genus *Epinotia* Hübner with an emarginate termen of the forewing to constitute a distinctive species group. In his treatment he gave only a few features required to separate the species, presented photographs of genitalia preparations which do not illustrate diagnostic features, and gave no biological information other than host records.

In this paper I will illustrate the male genitalia of these three species, and give additional distributional and biological information for the group based on material in the California Insect Survey, University of California, Berkeley, California. Discussions of the biological features of *E. emarginana* and *E. crenana* are based on notes taken by J. A. Powell and the author. In addition, a lectotype is selected for *Epinotia emarginana* (Walsingham).

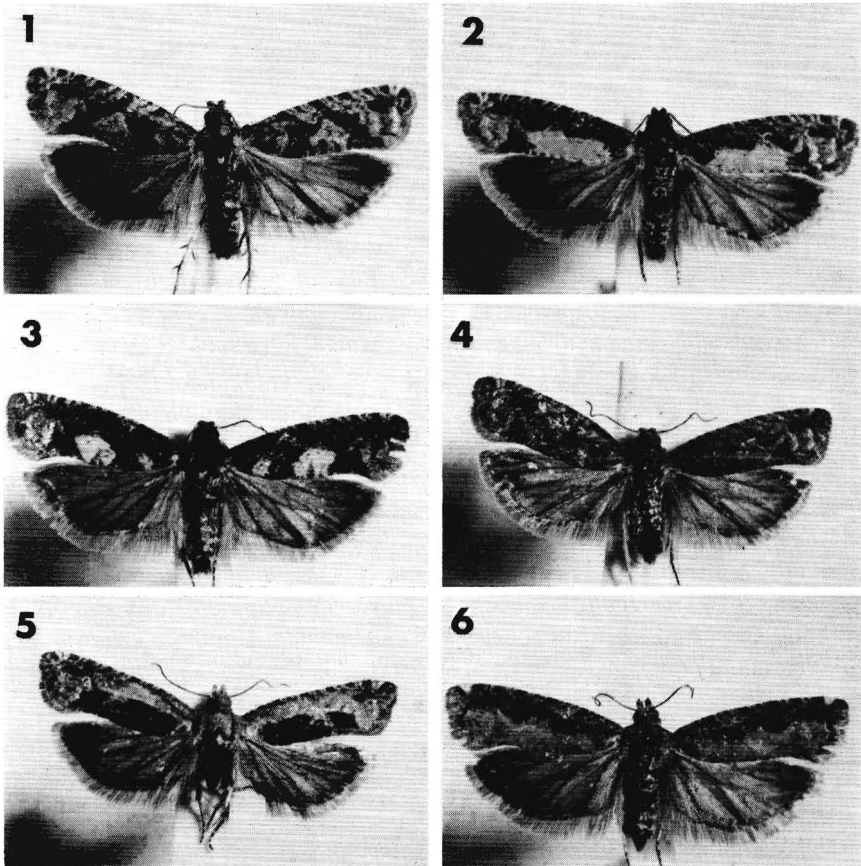
Epinotia emarginana (Walsingham)

Proteopteryx emarginana Walsingham, 1879, Illus., Lepid. Heter. Brit. Mus., 4:68.
Epinotia emarginana; Heinrich, 1923, U.S. Nat'l Mus. Bull. 123:218-219; MacKay, 1959, Can. Ent. Supp. 10:113; Powell, 1962, Pan-Pac. Entomol. 38:134; Powell, 1964, Univ. Calif. Publ. Entomol. 32:33, 51.

The late N. S. Obraztsov examined the type series of this species in the British Museum (Natural History), and selected a lectotype, but he did not publish this designation. In order to fix the specific identity of this species I designate the specimen indicated by Obraztsov to serve as the **lectotype** of this species. This individual is a male syntype and bears the following data: "above Potter's Valley, Mendocino Co., California 13. VI 1871 Wlsm slide 11604." A photograph of the genitalia of the lectotype is shown as Figure 7.

This "species" presents a number of perplexing problems. All of these relate to the possibility that two sibling species are included under the name *emarginana*. The information which indicates this possibility is biological and will be presented after a discussion of the morphological features of *emarginana*.

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Figs. 1-6. Examples of *Epinotia emarginana* polymorphs. 1, 2, Males, Strawberry Canyon, Alameda Co., Calif., 16 April 1960, r. f. *Quercus agrifolia* (J. Powell); 3, male, Applegate vic., Placer Co., Calif., 24 April 1961, r. f. *Quercus kelloggii* (J. Powell); 4, female, Orinda, 1 mile north, Contra Costa Co., Calif., 19 April 1967, r. f. *Quercus agrifolia* (P. Opler); 5, female, Fairfax, 2 miles south, Marin Co., Calif., 30 April 1967, r. f. *Quercus agrifolia* (P. Opler); 6, female, Applegate vic., Placer Co., Calif., 24 April 1961, r. f. *Quercus wislizenii* (J. Powell).

Morphologically this species differs from the other two members of the complex in maculation features, scaling of the labial palpi, and characteristics of the male genitalia.

The coloration of the legs, hind wings and abdomen is relatively invariable. The legs have the femur tan scaled. The pro- and mesothoracic tibiae are brown with a few tan scales intermixed, while the mesothoracic tibiae are pale tan. The tarsomeres are brown basally and edged with

pale tan distally. The hind wing is brown. The abdomen is brown dorsally and pale gray-tan ventrally.

While the above features are relatively constant, the coloration of the head, dorsal surface of the thorax, and particularly that of the forewings is extensively polymorphic. The color and pattern of these latter features appear to be determined by a number of independently operating genes or sets of genes. Thus there appears to be no definable set of polymorphs. In fact, it is almost impossible to find two individuals with nearly identical wing color and pattern. The ground color varies from tan, gray, various shades of brown, chestnut to black; the wing pattern may be obsolescent, with a large patch on the inner margin, several patches in the wing median, or a general mosaic of various colors. Several frequent morphs are shown in Figures 1-6. Throughout this melange of variation the pattern of the costal margin, apex, and outer margin tends to remain constant. The costal margin usually has seven white, cream, or silvery outwardly angled marks, each of which is divided by a small patch of dark scales. On the posterior half of the forewing just in from the outer margin are two parallel patches of scales which appear silvery in reflected light. The fringe on the outer margin is of white-tipped brown scales.

Because of the pattern of scaling, the labial palpi of *E. emarginana* are distinctively shaped when viewed laterally. The dorsal margin is convexly curved, the outer margin truncated, and the ventral margin straight (Fig. 13).

The male genitalia of *E. emarginana* are characterized by the absence of a gnathos, by the recurved arms of the socii, which are dentate dorsally, by the blunt uncus, by the neck incurvation (*sensu* Heinrich, 1923) at the ventral margin which extends half the width of the valva and by the rounded valval tips (Fig. 16).

The female genitalia are illustrated in Figure 19; the female genitalia of the other two species differ little from that of *E. emarginana* and are not illustrated.

Biological information suggests that two sibling species may be involved in populations presently referred to *emarginana*, although intensive morphological comparisons have not supported this thesis. Of the two putative entities one utilizes species of *Quercus* (Fagaceae) as hosts, while the other feeds on *Arctostaphylos* and *Arbutus* (Ericaceae).

The life cycles are similar for both host types, but apparently are temporally out of phase. Larvae are found on *Quercus* primarily during April but have been found as early as 16 March and as late as 10 May. During this time the larvae show a preference for the flowering parts, but will

also feed on young foliage. Larvae associated with *Arctostaphylos* were collected on young foliage between 19 May and 6 June. The larvae on *Arbutus* represent a single lot collected in flowers of *Arbutus menziesii* Pursh on 14 April.

Upon reaching maturity the larvae drop from the hosts and pupate. The cocoons are covered with detritus and soil particles. Eclosion occurs about three weeks later; moths originating from oak emerging during April and May, those from manzanita, during June.

The newly emerged adults are not functionally reproductive and possess an inordinate amount of fat body material. Adults collected in the fall still display this pre-reproductive condition. Beginning in January, six to eight months after eclosion, and continuing into April mated females may be found in the field. At this time males are rare, although the collection of a pair *in copula* on 6 March supports the thesis that mating does not occur until after winter has passed. Eggs are laid on twigs or leaves of the host. Females collected on 8 January and 6 February laid eggs while caged in the laboratory.

Presumably if two species are involved, differential timing of reproductive maturation, and mating could serve as an isolating mechanism. However, if mating and oviposition of a single species is occurring in a continuum, the early developing females presumably find *Quercus* to be preferable oviposition substratum while late developing females find *Arctostaphylos* to be the suitable oviposition substratum.

The following constitute rearing records for this species based on material in the California Insect Survey. Data for adults reared from Fagaceae and Ericaceae are listed separately.

Records from Fagaceae. Alameda Co.: Berkeley, IV-14-58 r. f. *Q. agrifolia*, 1 ♀ emgd. V-5-58 (J. Lannon); Strawberry Cyn., IV-16-60, IV-6-67, IV-11-68 r. f. *Q. agrifolia* JAP 60D3, 67D15, 68D126, 49 ♂ ♂ 44 ♀ ♀ emgd. V-8/15-60, V-10-67, V-5/18-68 (J. Powell, P. Opler). Contra Costa Co.: Antioch, 2 mi. E., IV-8-67 r. f. *Q. agrifolia* JAP 67D61, 1 ♂ emgd. V-4-67 (P. Opler); Orinda, 1 mi. N., IV-19-67, IV-9-68 r. f. *Q. agrifolia*, *Q. kelloggii*, JAP 67D75, D 81, 68D87, 6 ♂ ♂ 4 ♀ ♀ emgd. V-15/16-67, V-5/14-68 (P. Opler); Russell Farm, 4 mi. NE Orinda, IV-7-67, IV-8-67 r. f. *Q. agrifolia* JAP 67D15, 68D105, 5 ♂ ♂ 4 ♀ ♀ emgd. V-12-67, V-3/12-68 (P. Opler); Walnut Creek, V-10-67 r. f. *Q. lobata* JAP 67E21, 1 ♀ emgd. V-30-67 (J. Powell). Fresno Co.: Kings Canyon Nat'l Prk., IV-16-60 r. f. oak in chapparal, 1 ♂ emgd. V-19-60 (W. E. Ferguson). Glenn Co.: Elk Crk., 10 mi. NW, IV-21-68 r. f. *Q. dumosa*, *Q. wislizenii* var. *frutescens* JAP 68D167-168, 2 ♂ ♂ 2 ♀ ♀ emgd. V-16/20-68 (P. Opler). Marin Co.: Fairfax, 2 mi. S, IV-29-67 r. f. *Q. agrifolia* JAP 67D134, 1 ♂ 1 ♀ emgd. V-29/VI-2-67 (P. Opler); Inverness, 2 mi. SE, IV-13-68 r. f. *Q. agrifolia* JAP 68D130, 1 ♂ 1 ♀ emgd. V-16/18-68 (P. Opler). Placer Co.: Applegate, vic., IV-24-61 r. f. *Q. kelloggii*, *Q. wislizenii* JAP 61D9, 2 ♂ ♂ 3 ♀ ♀ emgd. V-18/24-61 (J. Powell); Rocklin, IV-18-68 r. f. *Q. wislizenii* JAP 68D142, 3 ♂ ♂ 2 ♀ ♀ emgd. V-12/18-68 (P. Opler). San Francisco Co.: Golden Gate Park, IV-15-66, IV-5-68 r. f. *Q. agrifolia* JAP 66D15, 68D50, 2 ♂ ♂ emgd. V-15-66, V-18-

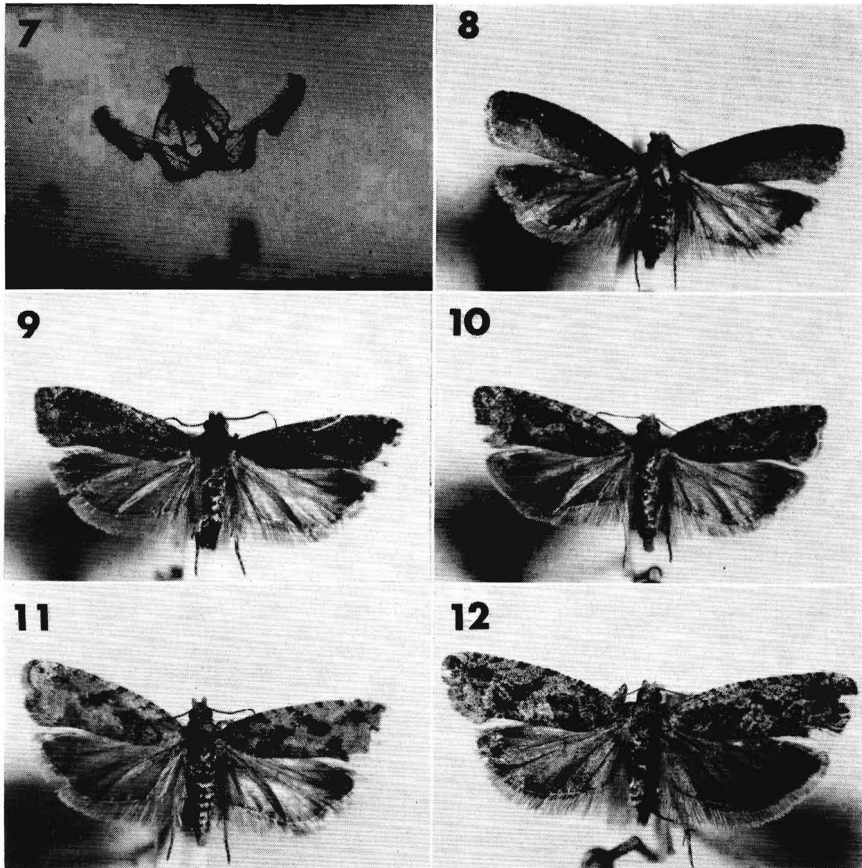


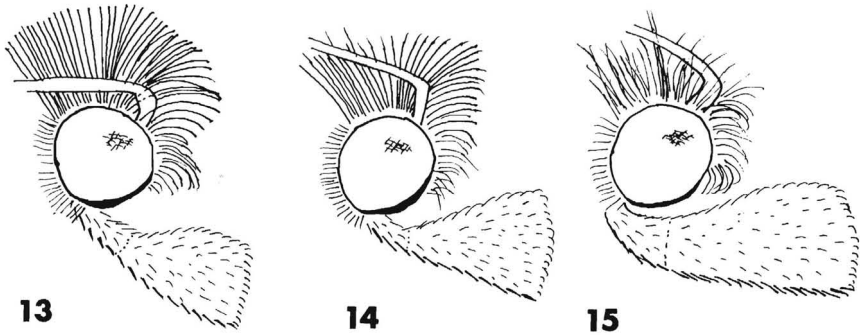
Fig. 7. Male genitalia from lectotype of *Proteopteryx emarginana* Wlsm.

Figs. 8–11. Polymorphs of *Epinotia crenana*. 8, Female, Berkeley Hills, 1400', Contra Costa Co., Calif., 15 April 1968, r. f. *Salix* sp. (P. Opler); 9–11, male and two females, Pacific Grove, Monterey Co., Calif., 15 April 1962, r. f. ornamental *Salix* (J. A. Chemsak).

Fig. 12. *Epinotia cercocarpana*, female, Crook Creek lab., 10, 150', White Mountains, Mono Co., Calif., 4 July 1961, r. f. *Cercocarpus ledifolius* (J. Powell).

68 (P. Opler). Santa Barbara Co.: Santa Cruz Isd., Prisoner's Harbor, III-16-69 r. f. *Q. agrifolia* JAP 68C52, 10 ♂♂ 9 ♀♀ emgd. IV-10/27-69 (P. Opler & J. Powell). Shasta Co.: O'Brien, Shasta Lk. Rec. Area, JAP 68D159, D161, 6 ♂♂ 5 ♀♀ emgd. V-16/23-68 (P. Opler); Project City, IV-20-68 r. f. *Q. douglasii*, *Q. lobata* JAP 68D162-3, 2 ♂♂ emgd. V-16-68 (P. Opler). Tehama Co.: Redding, 10 mi. E, IV-20-68 r. f. *Q. wislizenii* JAP 68D156, 1 ♂ emgd. V-18-68 (P. Opler).

Records from Ericaceae. Contra Costa Co.: Berkeley Hills, IV-14-66 r. f. *Arbutus menziesii* JAP 66D18 emgd. V-9-66 (J. Powell & J. Wolf). Marin Co.: Alpine Lake, VI-4-56, VI-6-57 r. f. *Arctostaphylos* sp. JAP 57F8 emgd. VI-27-56,



Figs. 13-15. Schematic view of heads of *Epinotia* spp. showing shape of labial palpi. 13, *E. emarginana*; 14, *E. crenana*; 15, *E. cercocarpana*.

VII-1-57 (J. Powell). Mendocino Co.: Booneville, vic., VI-1-57 r. f. *Arctostaphylos* JAP 57F1 emgd. VI-21/VII-1-57 (J. Powell); Leggett, V-19-66 r. f. *Arctostaphylos* JAP 66E17, emgd. VI-14/23-66 (J. Powell & J. Wolf).

Epinotia crenana (Hübner)

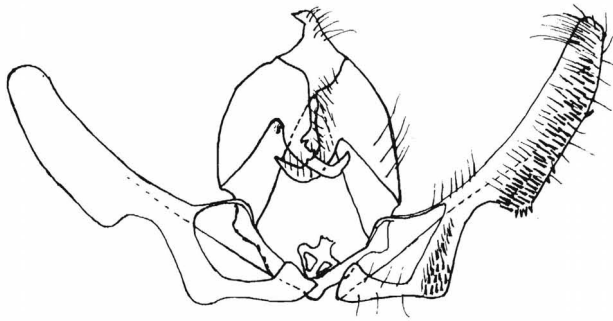
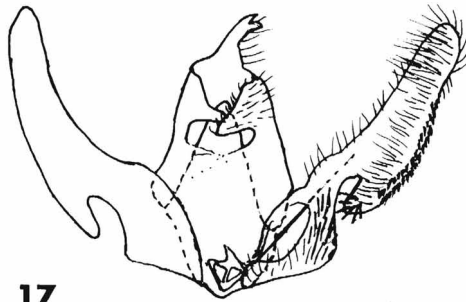
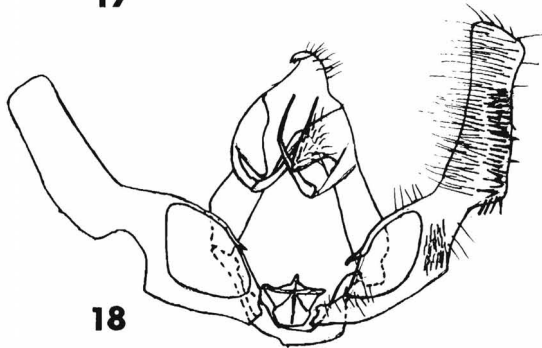
Tortrix crenana Hübner, 1827, Samm. Eur. Schmett. Tort. Fig. 242.
Epiblema crenana; Staudinger and Rebel, 1901, Cat. Lepid. 2, #2133.
Eucosma crenana; Dyar, 1904, Proc. Ent. Soc. Wash. 6:117.
Proteopteryx columbia Kearfott, 1904, Can. Ent. 36:112.
Proteopteryx columbia mediostriana Kearfott, 1904, Can. Ent. 36:114.
Epinotia crenana; Heinrich, 1923, U.S. Nat'l Mus. Bull. 123:219; MacKay, 1959, Can. Ent. Supp. 10:110; Powell, 1962, Pan-Pac. Entomol. 38:134.

This Holarctic species possesses a range of polymorphism less extensive than that displayed by *E. emarginana*. *E. crenana* lacks the distinct costal marks and reflective patches of *E. emarginana*. Dull browns and tans are the colors most often shown by the various morphs, while white and reddish are generally lacking. One macular feature which is frequently present in *crenana*, but lacking in the other two species, is a thin black streak on the costal half of the forewing two-thirds of the distance from the base. Some typical morphs of *crenana* are shown in Figures 8-11.

The labial palpi of *E. crenana* when viewed laterally have the dorsal and ventral margins flaring and truncated distally (Fig. 14).

Genitally this species is quite distinct (Fig. 17). In addition to the invasion of the cucullus by the neck incurvation mentioned by Heinrich (1923, p. 198), the uncus is notched with two acuminate projections distally, the socii are triangulate and the gnathos is strongly reduced.

The larvae of *crenana* feed exclusively on *Salix* species (Salicaceae). The larvae are found in shelters on young foliage or as inquilines in the

**16****17****18**

Figs. 16–18. Male genitalia of *Epinotia* spp. 16, *E. emarginana*. (PAO prep. 115); 17, *E. crenana*. (JAP prep. 49); 18, *E. cercocarpana*. (JAP prep. 2463).

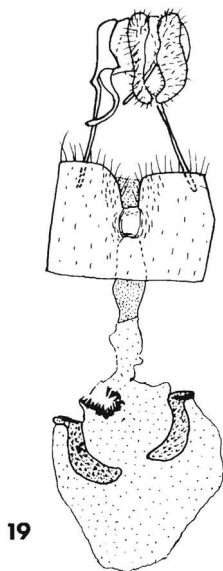


Fig. 19. Female genitalia of *Epinotia emarginana*. (PAO prep. 65).

leaf and petiole galls of tenthredinids. Larval collection dates, which range from 8 March to 17 September, indicate that *crenana* is multiple-brooded.

Distribution. Holarctic; British Columbia and Manitoba constituted the known distribution in North America at the time of Heinrich's revision (1923). The California Insect Survey has reared material from several localities in California and Nevada as follows: **California.**—Alameda Co.: Berkeley, Univ. Calif. Campus, III-11-58 r. f. *Salix* JAP 58C7 emgd. IV-8-58 (J. Powell). Contra Costa Co.: Berkeley Hills, 1400', NE Oakland, IV-15-68 r. f. *Salix* sp. JAP 68D137 emgd. V-18/23-68 (P. Opler); El Sobrante, III-8, IV-26-58 r. f. *Salix* JAP 58C2, D13, emgd. V-8/26, V-26/VI-9-58 (J. Powell). Monterey Co.: Pacific Grove, IV-15-62 r. f. ornamental *Salix* JAP 62D9 emgd. by V-22-62 (J. A. Chemsak). Los Angeles Co.: Pacific Palisades, V-56 r. f. *Salix* leaf galls (W. Hovanitz). Santa Clara Co.: San Jose, IV-16-61 r. f. *Salix lasiolepis* leaf gall emgd. VI-25-61 (L. R. O'Brien). **Nevada.**—Washoe Co.: 2 mi. SW Reno Hot Spg., 6100', IX-17-65 r. f. *Euura* petiole gall on *Salix lasiandra* emgd. X-28-65 (E. L. Smith).

Epinotia cercocarpana (Dyar)

Eucosma cercocarpana Dyar, 1903. Proc. Ent. Soc. Wash. 5:297.

Epinotia cercocarpana; Heinrich. 1923. U.S. Nat'l Mus. Bull. 123:219.

E. cercocarpana is characterized by its nonpolymorphic, mottled with black gray appearance (Fig. 12). The vestiture of the head, thorax and forewing is composed of white, black, and white-tipped black scales.

The forewing maculation is somewhat variable, but cannot be termed polymorphic. There is usually a small white triangular patch on the costal margin at the apex, a triangular black or dark gray patch on the inner margin near its junction with the outer margin, and an outwardly directed black bar beginning on the costal margin halfway from the base and extending nearly to the triangular black patch. In five of seven specimens the scaling of the thoracic tergites is black on the posterior half and gray on the anterior half.

In lateral view the labial palpi appear to be convexly curved dorsally and slightly flaring ventrally due to the pattern of scaling (Fig. 15).

In addition to triangular *socii* mentioned by Heinrich (1923, p. 198), there are several other distinctive features in the male genitalia of the moth (Fig. 18). The gnathos arms are separate, narrow, and strongly recurved, the neck incurvation of the valva is the shallowest of any of the species in this group and the valvae are truncate distally.

Distribution. The species was previously known only from the type of locality, Platt Cyn., Douglas Co., Colorado. New distributional data are as follows: **Arizona.**—Mojave Co.: Hualpai Mtn. Park, VI-2-68, at B/W light (P. Opler & J. Powell). **California.**—Inyo Co.: Crooked Crk. Lab., 10,150', White Mtns. VII-4-61 r. f. *Cercocarpus ledifolius* JAP 61G1.1 emgd. VIII-31-61 (J. Powell). Tuolumne Co.: Strawberry, VIII-20-60 (D. Q. Cavagnaro). **Colorado.**—El Paso Co.: Rock Crk. Cyn., Colorado Springs VII-16-59, VII-15-60 (Margot May). Jefferson Co.: Golden, X-25-67 (no collector, Bryant Mather Collection).

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Literature Cited

- HEINRICH, CARL. 1923. Revision of North American Moths of the subfamily Eucosminae of the family Olethreutidae. U.S. Nat'l Mus. Bull. 123.