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NOTES ON NEARCTIC *EUCOSMA* HÜBNER: A NEW SPECIES, A RESURRECTED SPECIES, AND THREE NEW SYNONYMIES (TORTRICIDAE)

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ABSTRACT. Three new synonymies are proposed in Nearctic *Eucosma*: *E. fandana* Kearfott (= *E.* gandana Kearfott), *E. snyderana* Kearfott (= *E. sperryana* McDunnough), and *E. irroratana* (Walsingham) (= *E. perdricana* (Walsingham)). *Eucosma kandana* Kearfott is resurrected as a valid species name after having been treated for more than eighty years as a junior synonym of *perdricana*. *Eucosma curlewensis*, new species, is described from southern Idaho, Utah, Nevada, and southern California. Reviews are included of five additional taxa: *E. invicta* (Walsingham), *E. subinvicta* Kearfott, *E. spaldingana* Kearfott, *E. hazelana* Klots, and *E. handana* Kearfott, each of which bears some resemblance to one or more of the aforementioned species. Lectotypes are designated for *invicta*, *spaldingana*, *perdricana*, *irroratana*, and *handana*. Adults and genitalia of each species are illustrated, though females of *hazelana* and *irroratana* are currently not known.

Additional key words: Olethreutinae, Eucosmini

Species described by early North American tortricid specialists commonly were based on few representatives of the proposed new taxa, often on a single specimen. The attendant lack of understanding of variation resulted in the creation of a large number of synonyms, some of which are only now being recognized. This paper addresses several such problems in the genus *Eucosma* Hübner. It also proposes a name for a new species of *Eucosma* from western United States.

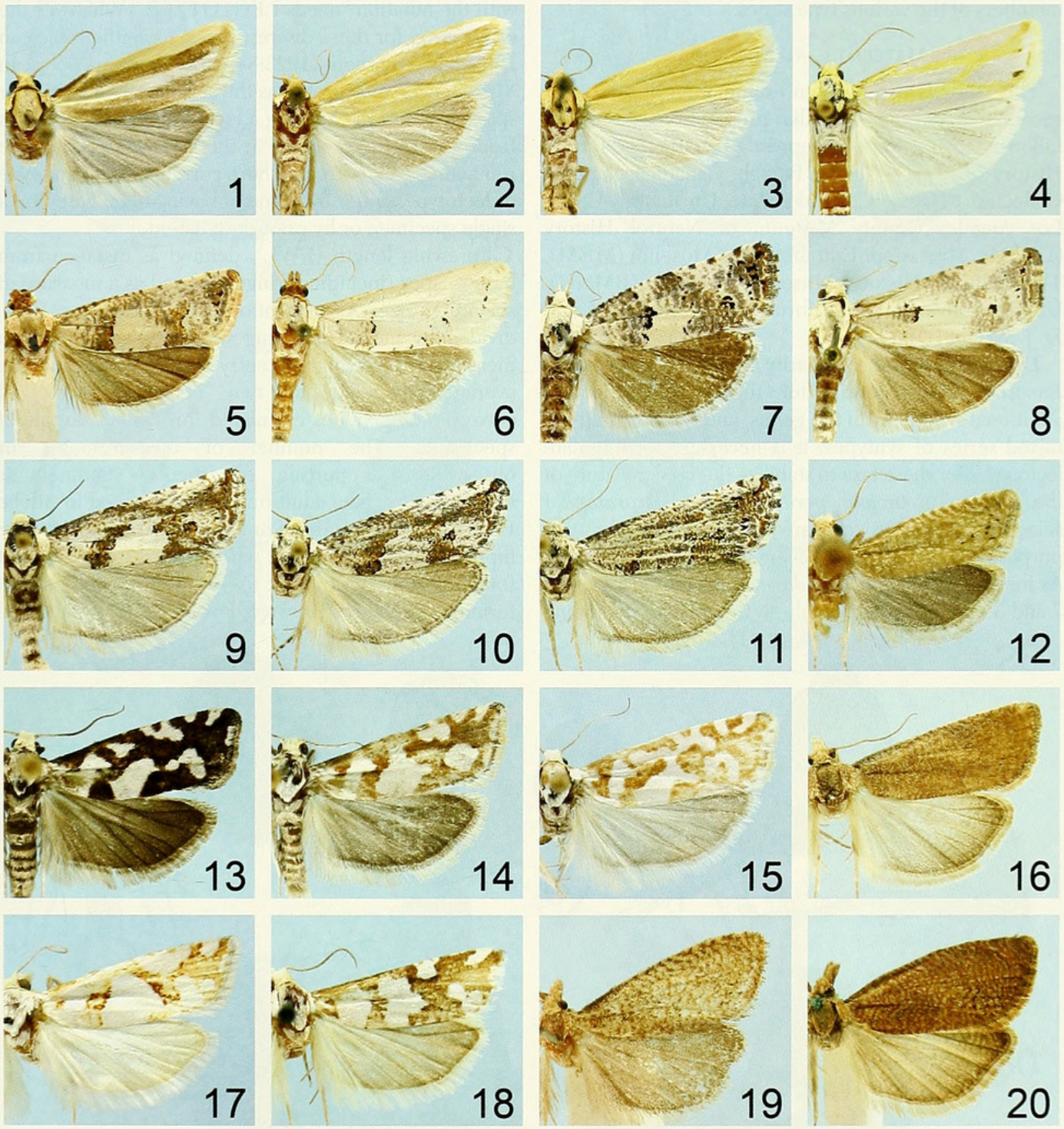
Eucosma fandana Kearfott and *E. gandana* Kearfott are relatively large lemon-yellow species that historically have been separated by the presence in *fandana* (Fig. 2) of longitudinal, white, forewing streaking, a feature lacking in *gandana* (Fig. 3). Each name is based on a single female. The holotypes were the only specimens of these taxa known to Heinrich (1923), and his study did not include an assessment of the female genitalia, so subsequent determinations have been based solely on forewing maculation. Material now available in collections makes it clear that the forewing streaking in *fandana* is variable and grades into the obsolescent form associated with *gandana*. There are no significant genitalia differences in the two forms, so it seems that the two names refer to a single species. There is another western species of similar size with lemon-yellow coloration, *E. canariana* Kearfott, but its forewing features yellow streaking on a silvery-white ground. An illustration of the adult (Fig. 4) is included for comparison.

Each of *E. snyderana* Kearfott and *E. sperryana* McDunnough was described from a single male. In examining a long series of *snyderana* specimens from Albany Co., Wyoming, it became apparent that the *sperryana* forewing pattern (Fig.11) is just one of the variations (Figs. 9–11) found in *snyderana*. The genitalia of the two holotypes are indistinguishable, so *sperryana* should be regarded as a junior synonym of *snyderana*. Two other western species, *E. invicta* (Walsingham) and *E. subinvicta* Kearfott, can easily be confused with *snyderana*. Heinrich (1923) suspected that *subinvicta* is "only a race of *invicta*," but there are consistent differences in both maculation and genitalia that support the case for two species. Diagnostic features of *snyderana*, *invicta*, and *subinvicta* are discussed below.

Walsingham (1879) described *E. irroratana* and *E. perdricana* based on five and two male specimens, respectively, collected during his 1871 expedition to California and Oregon. He noted the similarity of the two species but considered the smaller size and lack of lustrous gray irrorations in the *perdricana* syntypes as grounds for proposing the second name. Kearfott (1907) described *E. kandana* from six specimens collected by Tom Spalding in Stockton, Utah. Heinrich (1923) had access to the *kandana* cotypes and to a specimen of *irroratana* that had been given to Busck by Walsingham for deposit in the United States Museum of Natural History (USNM). He had seen no authoritatively identified specimens of *perdricana* but concluded on the basis of Walsingham's description that *kandana* was a synonym of *perdricana*. The forewing patterns of these species are similar (Figs. 12, 19), and *kandana* is smaller than *irroratana* (a distinguishing character attributed to *perdricana* by Walsingham), but the male genitalia are different (Figs. 29, 30). Consequently, *kandana* must be reinstated as a valid species name. I examined one of the *perdricana* syntypes, two *irroratana* syntypes, and one *irroratana* topotype and found no substantial differences in forewing pattern or male genitalia. The *perdricana* syntype (Fig. 19) is somewhat worn but does show faint traces of the lustrous scaling characteristic of *irroratana* (Fig. 20). The smallest *irroratana* specimen was only slightly larger than the *perdricana* syntype, suggesting that size

is not a diagnostic character. I believe these are sufficient reasons for treating the two names as synonyms. *Eucosma handana* Kearfott, a western species that is similar in maculation and male genitalia to *irroratana*, is also reviewed.

Finally, I propose the name *Eucosma curlewensis* for a new taxon collected recently in Idaho but first noticed during faunal studies in southern California (Brown & Bash, 1997; Powell, 1994). Two western species with potential for being confused with *curlewensis*, *E.*



FIGS. 1-20. **1. *E. fandana***, ♂ Billings Co., North Dakota. **2, 3. *E. fandana***, ♀ ,♀ Alamosa Co., Colorado. **4. *E. canariana***, ♂ Sanpete Co., Utah. **5. *E. invicta***, Lectotype ♂. **6. *E. invicta***, ♂ Natrona Co., Wyoming. **7. *E. subinvicta***, ♀ Coconino Co., Arizona. **8. *E. subinvicta***, ♂ Riverside Co., California. **9, 10, 11. *E. snyderana***, ♂, ♂, ♂ Albany Co., Wyoming. **12. *E. kandana***, ♂ Oneida, Co., Idaho. **13, 14. *E. curlewensis***, ♂, ♂ San Diego Co., California. **15. *E. curlewensis***, ♂ Oneida Co., Idaho. **16. *E. handana***, ♂ Benton Co., Washington. **17. *E. spaldingana***, ♂ Toole Co., Utah. **18. *E. hazelana***, Holotype ♂. **19. *E. perdricana***, Lectotype ♂. **20. *E. irroratana***, Lectotype ♂.

hazelana Klots and *E. spaldingana* Kearfott, are also reviewed.

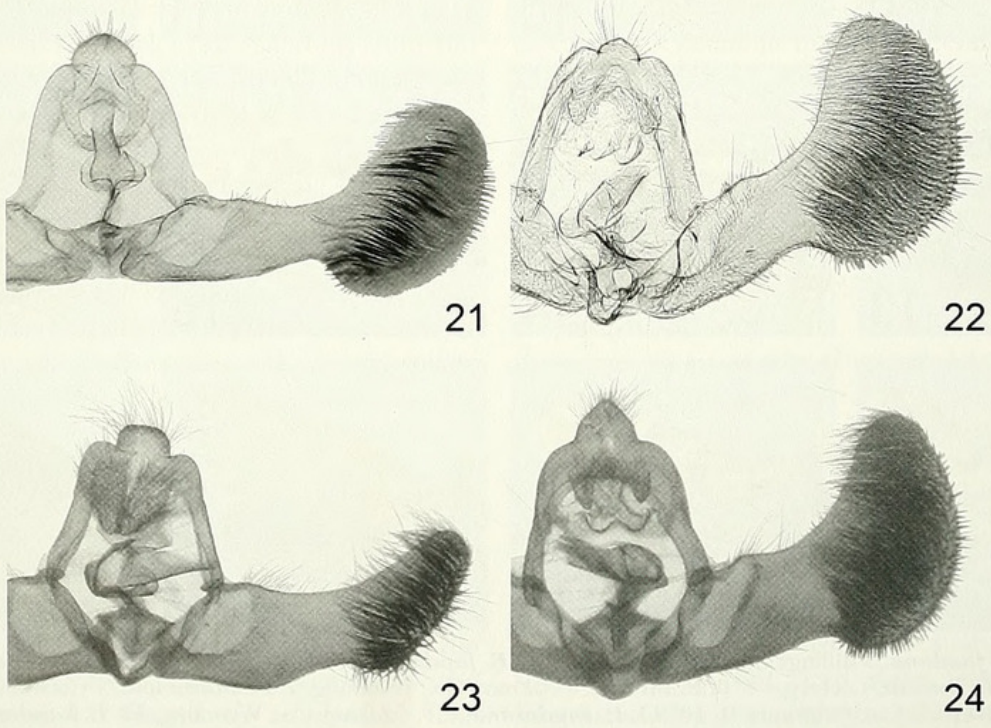
I examined the primary types of all the species mentioned above except *E. canariana*, and I've listed below in the species accounts the data and depositories of all specimens that I could locate and confirm as members of the various type series.

MATERIALS AND METHODS

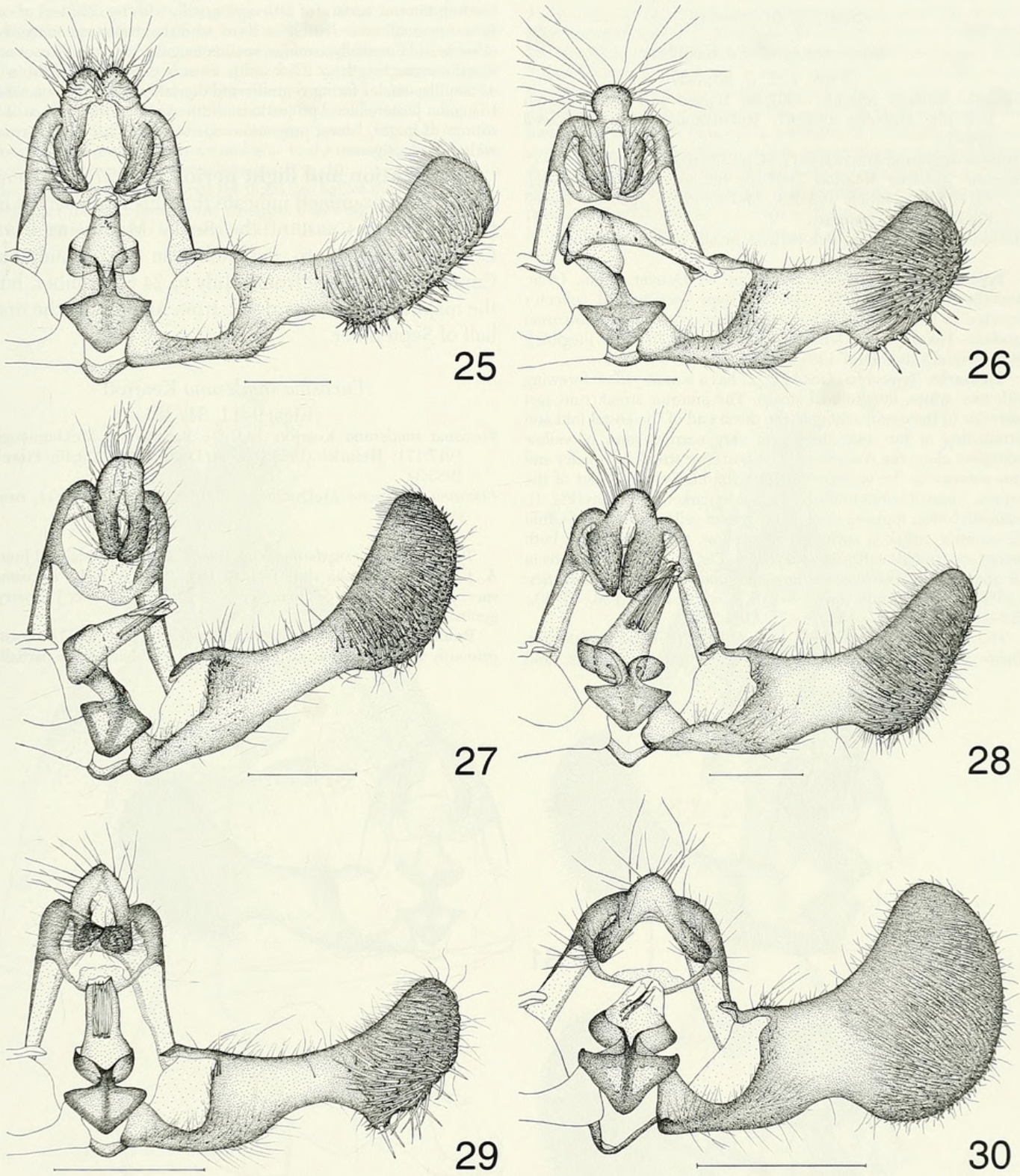
This study is based on an examination of 403 adult specimens and 85 genitalia preparations from the following collections: American Museum of Natural History (AMNH), George Balogh, Canadian National Collection (CNC), Colorado State University (CSU), Los Angeles County Museum of Natural History (LACM), Mississippi Entomological Museum (MEM), The Natural History Museum, London (BMNH), USNM, University of California, Berkeley (UCB), and D. J. Wright (DJW).

Due to the extreme similarity among many species of *Eucosma*, the potential for future recognition of additional synonymy in the genus, and the possibility of mixed series of syntypes, it is necessary to designate lectotypes for these taxa to stabilize the nomenclature of the group. For *invicta*, *perdricana*, and *irroratana* I selected specimens chosen by Obraztsov for this purpose, his designations having never been published. As for *spaldingana* and *handana*, Klots (1942) reported 7 and 3 syntypes, respectively, in the AMNH, including lectotypes whose designations he attributed to Heinrich (1923). The material I received on loan from AMNH consisted of 6 specimens of *spaldingana* and 3 of *handana*, of which none bears the green LECTOTYPE label typically affixed to such specimens by Klots. Pinned on the floor of each unit tray was a green label with the notation "needs LECTOTYPE." Whatever the explanation for these discrepancies, in neither case can Heinrich's comment (1923:84, 102) "Type in American Museum" be interpreted as the selection of a particular specimen, so I'm choosing a lectotype for each species from among the syntypes in the AMNH. Each of the remaining species treated here currently has a holotype or lectotype, either by virtue of having been based on a single specimen or by prior designation.

Forewing length (FWL), defined as distance from base to apex (including fringe), is used as a measure of specimen size. Aspect ratio (AR), defined as FWL divided by medial forewing width, provides a rough measure of forewing geometry and is reported as the average, rounded to two decimal places, of corresponding values calculated for a small sample of specimens. The number of measurements or observations supporting a particular statement is indicated by n. The adult images were edited in Adobe Photoshop CS, and those in Figures 8, 17, and 18 were flipped horizontally so that what appears to be the right forewing is in fact the left forewing. Forewing pattern terminology follows Brown & Powell (1991) as modified



FIGS. 21-24. Genitalia of lectotypes. **21. *E. invicta***, slide BMNH 11574. **22. *E. irroratana***, slide BMNH 11512. **23. *E. spaldingana***, slide DJW 1548. **24. *E. handana***, slide DJW 1505



FIGS. 25-30. Male genitalia. **25**. ***E. fandana***, slide DJW1490. **26**. ***E. curlewensis***, slide DJW 1501. **27**. ***E. hazelana***, slide DJW 1067. **28**. ***E. spaldingana***, slide DJW 1503, **29**. ***E. kandana*** slide DJW 766. **30**. ***E. perdricana***, Lectotype, slide BMNH 11509. Scale bars = 0.5 mm.

by Baixeras (2002).

SPECIES ACCOUNTS

Eucosma fandana Kearfott
(Figs. 1, 2, 3, 25, 35)

Eucosma fandana Kearfott 1907:19; Barnes and McDunnough 1917:169; Heinrich 1923:81; McDunnough 1939:45; Powell 1983:34.

Eucosma argyraula Meyrick 1912:34, invalid replacement name.

Eucosma gandana Kearfott 1907:20; Barnes and McDunnough 1917:169; Heinrich 1923:83; McDunnough 1939:45; Powell 1983:34, **new synonymy**.

Eucosma chloroleuca Meyrick 1912:34, invalid replacement name.

Types. *Eucosma fandana*. Holotype: ♀, Denver, Colo., Oslar, genitalia slide DJW 1488, AMNH [type locality and collector reported by Kearfott (1907) but not present on pin labels]. *Eucosma gandana*. Holotype: ♀, Denver, Colo., 10 Sept. 0? [year illegible], Oslar, genitalia slide DJW 1489, AMNH.

Remarks. Typical *fandana* (Fig. 2) has a lemon-yellow forewing with two, white, longitudinal steaks. The anterior streak runs just posterior to the costa, arising at the distal end of the costal fold and terminating at the apex, leaving a very narrow band of yellow coloration along the costa itself. The posterior streak is broader and runs anterior to the cubital vein from the base to just short of the termen, where it bends toward the apex. In darker specimens (Fig. 1), yellowish brown replaces some of the lemon-yellow coloration. Often the anterior streak is suffused with yellow, and occasionally both streaks are strongly suffused with yellow (Fig. 3). The latter results in the phenotype associated with the name *gandana*. Forewing statistics: ♂ FWL: 10.7–15.7 mm (mean = 13.5, n = 13), AR = 3.36, ♀ FWL: 12.4–15.2 mm (mean = 13.9, n = 7), AR = 3.28.

The male genitalia (Fig. 25) (n = 4) has the following features: Uncus well developed, medially divided into two lobes, and moderately wrinkled (an unusual feature in *Eucosma*); anellus well developed, not closely surrounding aedeagus; vesica lacking deciduous cornuti; interior surface of aedeagus usually with two clusters of *ca.* four very small setae (visible at 100×), one at anterior extremity, the other located medially; cucullus semirectangular with mildly concave costal margin, length *ca.* 2.5 × width. Female genitalia (Fig. 35) (n = 4): Papillae anales facing ventrally and densely setose; sterigma with triangular posterolateral projections, width of posterior margin *ca.* 4 × ostium diameter, lateral projections sparsely scaled; corpus bursae with only one signum.

Distribution and flight period. The 27 specimens (19 ♂, 8 ♀) I examined indicate that this moth occurs in the high plains east of the Rocky Mountains from Colorado north into Saskatchewan and Manitoba. Capture dates range from 7 July to 24 September, but the majority of the records are from August and the first half of September.

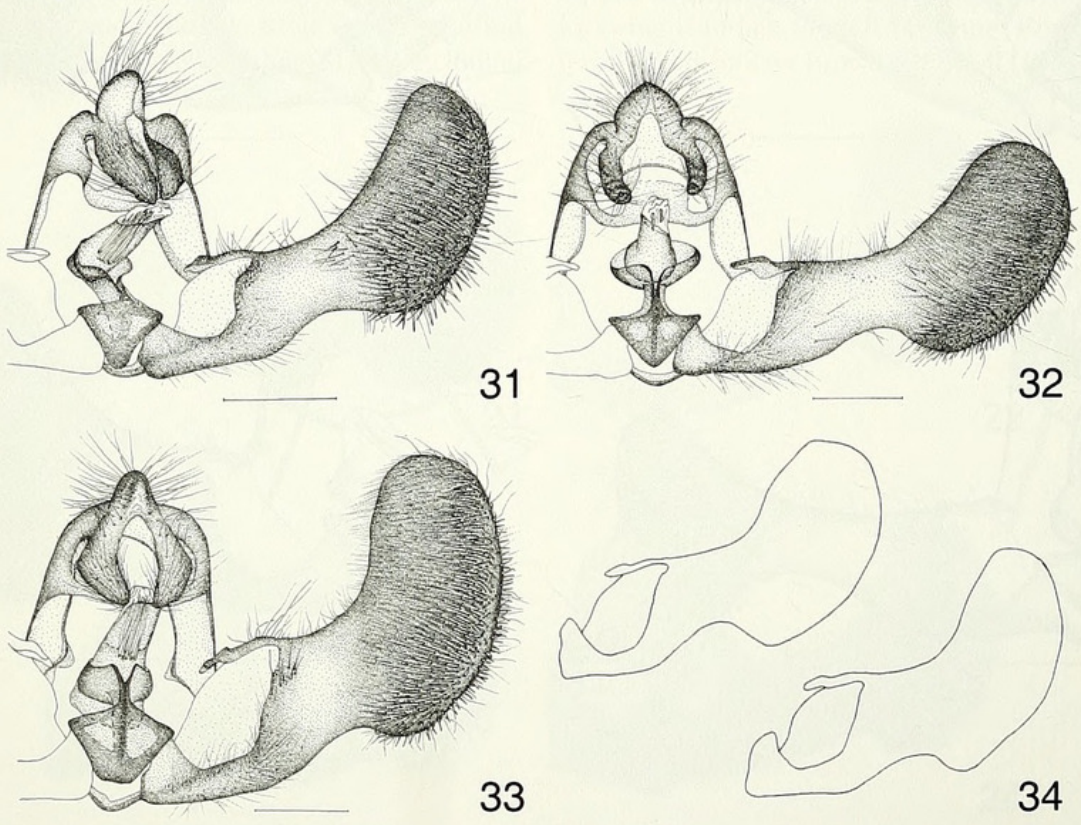
Eucosma snyderana Kearfott
(Figs. 9–11, 31, 38)

Eucosma snyderana Kearfott 1907:89; Barnes and McDunnough 1917:171; Heinrich 1923:107; McDunnough 1939:46; Powell 1983:34.

Eucosma sperryana McDunnough 1942:69; Powell 1983:34, **new synonymy.**

Types. *Eucosma snyderana*. Holotype: ♂, Blackfoot, Idaho, 3 June, A. J. Snyder, genitalia slide CH 16 Dec 1919, AMNH. *Eucosma sperryana*. Holotype: ♂, Opal, Wyo., 24 June 1933, G. & J. Sperry, genitalia slide no. 77, CNC.

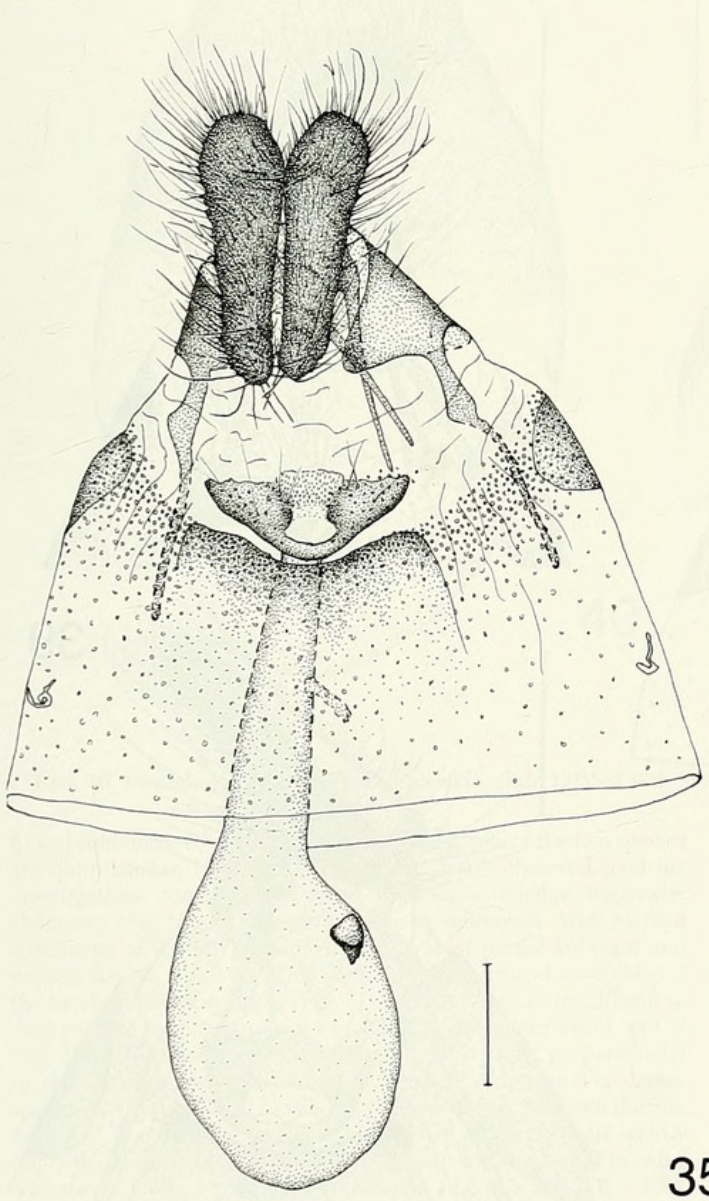
Remarks. Forewing maculation in *snyderana* (Figs. 9–11) consists primarily of three brown and gray markings: a subbasal fascia partially



FIGS. 31-34. Male genitalia. **31**. ***E. snyderana***, slide DJW 267. **32**. ***E. invicta***, slide DJW 160. **33, 34. *E. subinvicta***, slides DJW 1550, 1551, 1552. Scale bars = 0.5 mm.

expressed as an outwardly oblique bar from dorsum to radius; a median fascia composed of a narrow longitudinal streak from mid costa to distal end of cell together with a broader transverse band along the basal margin of the ocellus, the latter terminating on the pretornal portion of the dorsum; and a subtriangular patch anterior to the ocellus that connects to an apical dash. Some specimens (Fig. 9) have a white interfascial spot extending from mid dorsum to radius and a moderate amount of white coloration in the basal area. The phenotype associated with the name *sperryana* (Fig. 11) has the forewing suffused with brown and gray to the extent that the fasciae are largely obscured. Most specimens (Fig. 10) are intermediate in this respect. In all phenotypes the distal one half of the costa is white, with dark marks delimiting the strigulae. Forewing statistics: ♂ FWL: 12.7–16.5 mm (mean = 14.4, n = 24), AR = 3.34, ♀ FWL: 12–14.6 mm (mean = 13.5, n = 13), AR = 3.12.

The male genitalia of *snyderana*, *invicta* and *subinvicta* (Figs. 31–34) are similar but distinguishable. In each case the uncus is semitriangular and well developed. In *invicta* its base is noticeably broader, with basal width *ca.* 2 × height; in the other two species these dimensions are nearly equal. In *snyderana* and *subinvicta* the ventral surface is produced into a wedge-shaped ridge, the ridge line being particularly sharp in *snyderana*. The anellus in *invicta* is cuplike and loosely surrounds the base of the aedeagus, in *subinvicta* it is closely approximate to the aedeagus, and in *snyderana* it is intermediate in this respect. Both *snyderana* and *subinvicta* have deciduous cornuti in the vesica; *invicta* does not but does possess two small sclerotized patches toward the distal end of the aedeagus. In *subinvicta* the valva is somewhat variable in shape (Figs. 33, 34). Compared to the other



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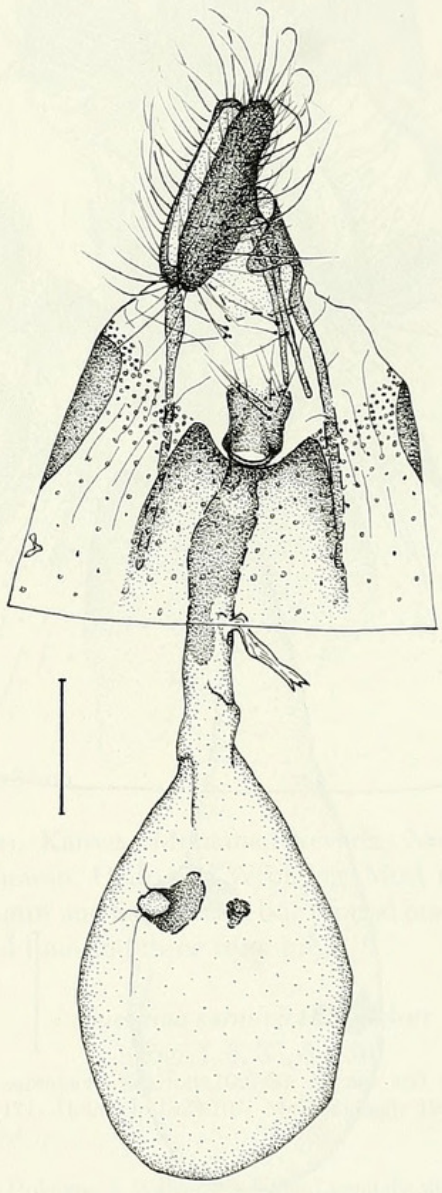

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FIGS. 35-36. Female genitalia. **35. *E. fandana***, slide DJW 1489. **36. *E. kandana***, slide DJW 1549. Scale bars = 0.5 mm.

two species it has a more strongly concave costal margin and is wider basally and at the neck. The apex of the cucullus is angular in *snyderana*, evenly rounded in *invicta*, and intermediate in *subinvicta*. The female genitalia of the three species are quite similar. Subtle differences can be detected in the shape of the sterigma (Figs. 37–39), but this character is sufficiently variable in each species as to render identification on this basis unreliable. In *invicta* there are numerous, long, hairlike setae on the posterolateral corners of the sterigma and on the membrane between the sterigma and the ventral extremities of tergum VIII. Only a few such setae are found in *subinvicta*, and *snyderana* is intermediate in this regard but closer to *invicta*.

Distribution and flight period. I examined 76 specimens (63 ♂, 13 ♀) from California, Idaho, Oregon, Utah, Washington, and Wyoming. The flight period extends from mid May to early July.

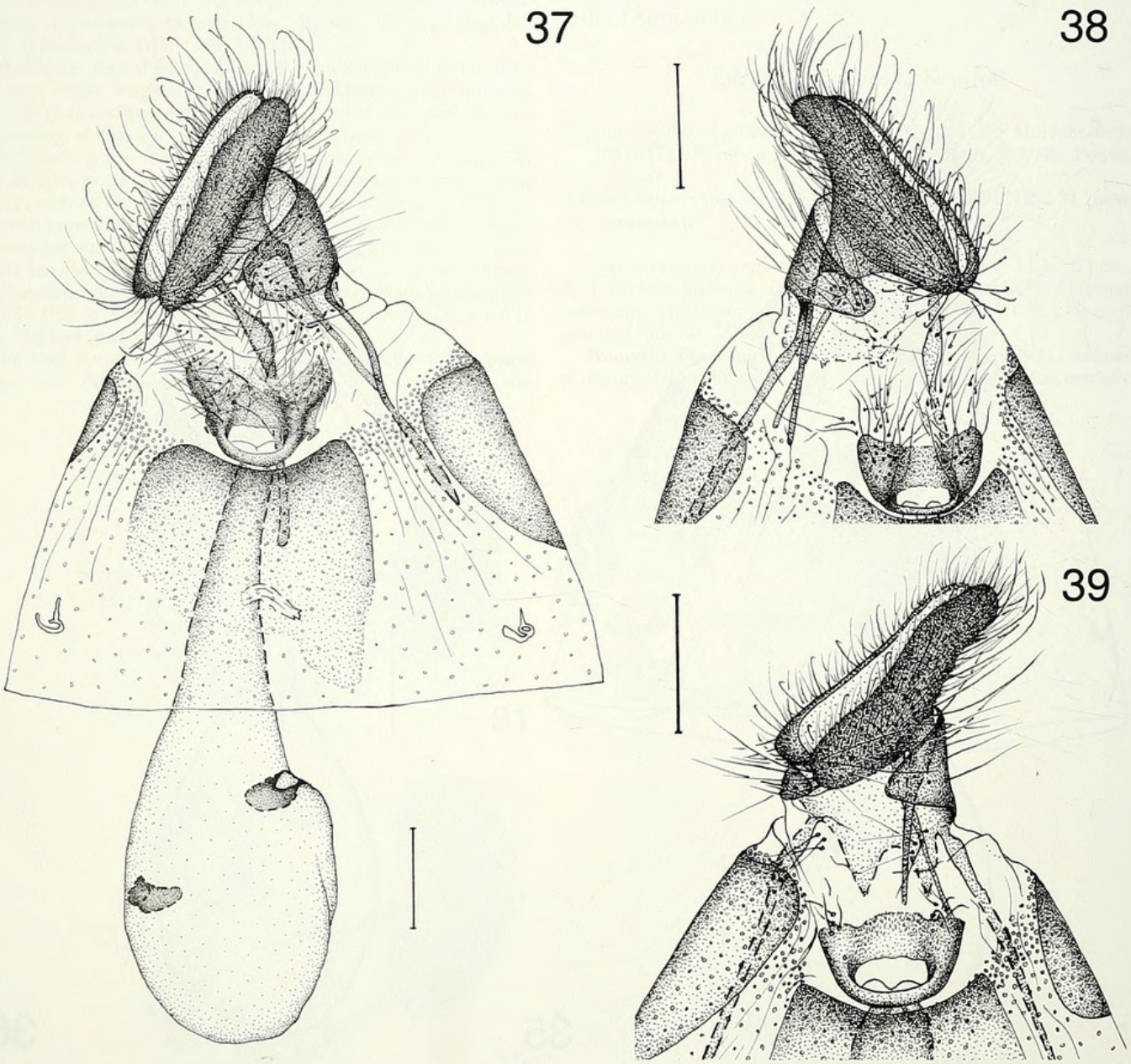
Eucosma invicta (Walsingham)
(Figs. 5, 6, 21, 32, 37)

Paedisca *invicta* Walsingham 1895:509.

Eucosma invicta: Fernald [1903]:460; Barnes and McDunnough 1917:171; Heinrich 1923:107; McDunnough 1939:46; Powell 1983:34.

Types. Lectotype here designated (Figs. 5, 21): ♂, Larimer Co., Colorado, 5000 ft., July 1891, Smith, genitalia slide 11574, BMNH. Paralectotypes: same data as lectotype (8 ♂, genitalia slide 11575), BMNH.

Remarks. Forewing coloration is variable in both *invicta* (Figs. 5,



FIGS. 37-39. Female genitalia. **37**. ***E. invicta***, slide DJW 1555. **38**. ***E. snyderana***, slide DJW 1492. **39**. ***E. subinvicta***, slide DJW 1514. Scale bars = 0.5 mm.

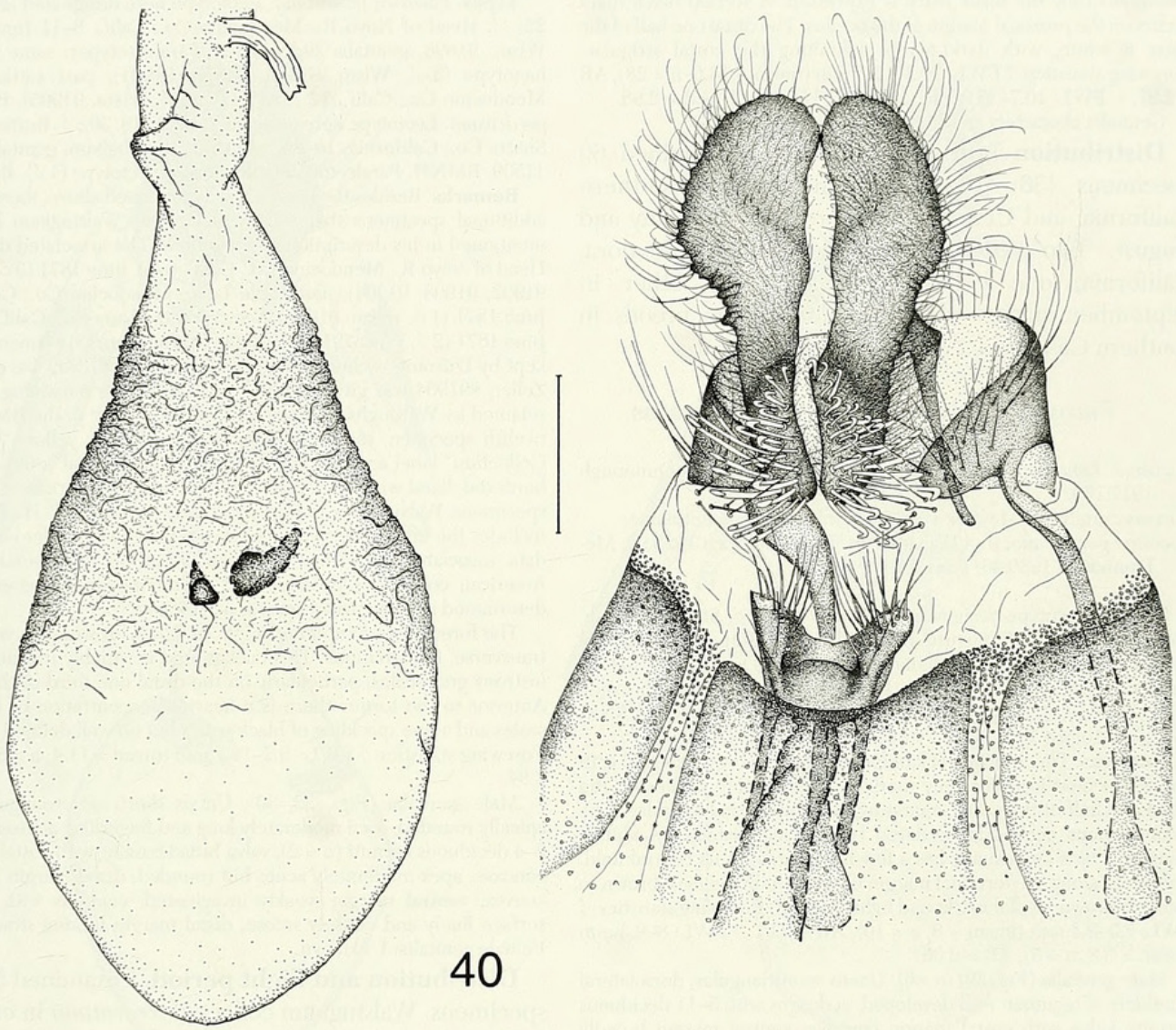


FIG. 40. Female genitalia. ***E. curlewensis***, slide DJW 1499. Scale bars = 0.5 mm.

6) and *subinvicta* (Figs. 7, 8), and pale phenotypes of the two species are quite similar. Nevertheless, Kearfott (1907) observed (and my investigations confirm) that head color is a reliable diagnostic character: rose brown in *invicta*, white in *subinvicta*. Well marked specimens of *invicta* (Fig. 5) display at least partial subbasal and median fasciae, which are often suffused with the rose-brown color of the head. In pale specimens (Fig. 6) these features can be difficult to discern. The maculation always includes a white interfascial spot at mid dorsum. Its proximal margin tends to be straight, perpendicular to the dorsum, and thinly lined with black scales, and in darker specimens it is preceded basally by a brown to gray bar from dorsum to radius. The strigulae on the distal one half of the costa are weakly defined and sometimes coalesce into a white costal streak. Forewing statistics: ♂ FWL: 11.5–17.2 mm (mean = 14.6, n = 28), AR = 3.24, ♀FWL: 13.5–16.6 mm (mean = 14.8, n = 6), AR = 3.05.

Genitalia characters are discussed under *snyderana*.

Distribution and flight period. I examined 50 specimens (40 ♂, 10 ♀) from Alberta, California, Colorado, Kansas, Montana, Nevada, New Mexico, Saskatchewan, Utah, and Wyoming. Most records are from August and September, but I found one each from April and June and three from July.

Eucosma subinvicta Kearfott
(Figs.7, 8, 33, 34, 39)

Eucosma subinvicta Kearfott 1907:33; Barnes and McDunnough 1917:171; Heinrich 1923:107; McDunnough 1939:46; Powell 1983:34.

Types. Holotype: ♀, Williams, Ar[izona], genitalia slide DJW 1547, AMNH. Paratypes: Williams, Ariz., 1 July (1 ♀, genitalia slide 70382), 25 July (1 ♀), USNM.

Remarks. Typical *subinvicta* forewing maculation (Fig. 7) includes a white spot at mid dorsum, a gray basal patch, and a gray median fascia. The forewing in pale phenotypes (Figs. 8) is strongly suffused

with white throughout. The basal patch is bordered distally by a thin line of black scales that widens over the cubitus to form a conspicuous black mark. In most cases the line jogs inwardly on 1A+2A. In pale specimens only the black mark is expressed. A second black mark occurs on the proximal margin of the ocellus. The distal one half of the costa is white, with dark marks delimiting the costal strigulae. Forewing statistics: ♂ FWL: 10.2–15.5 mm (mean = 13.6, n = 28), AR = 2.97, ♀ FWL: 10.7–15.9 mm (mean = 13.5, n = 21), AR = 2.98.

Genitalia characters are discussed under *snyderana*.

Distribution and flight period. I examined 60 specimens (36 ♂, 24 ♀) from Arizona, southern California, and Utah. Most records are from July and August. Two series of specimens from Glendora, California, one collected in May, the other in September, suggest the possibility of two broods in southern California.

Eucosma kandana Kearfott, **revised status**
(Figs. 12, 29, 36)

Eucosma kandana Kearfott 1907:20; Barnes and McDunnough 1917:169.

Eucosma argillacea Meyrick 1912:34, invalid replacement name.

Eucosma perdricana: (not Walsingham, 1895) Heinrich 1923:99; McDunnough 1939:46; Powell 1983:34.

Types. Lectotype designated by Klots (1942): ♂, Stockton, Utah, Tom Spalding, [4–17 August: reported by Kearfott (1907) but not present on pin labels], genitalia slide CH 16 Dec 1919, AMNH. Paralectotypes: Stockton, Utah, Tom Spalding (1 ♀, genitalia slide DJW 1549), AMNH; 4 July 1904 (1 ♂, ♀ , ♂ genitalia slide USNM 70672), 1 August 1904 (1 ♀), 7 August 1904 (1 ♀), USNM.

Remarks. The forewing of *kandana* (Fig. 12) is brownish gold with fine white mottling. The only markings are the thin dashes on the distal one half of the costa separating the white costal strigulae. The inconspicuous ocellus is bordered basally and distally by whitish transverse bars and usually has a few black scales in its central field. The scales along the terminal margin of the membrane have brown to blackish-brown medial marks and lighter apices. Forewing statistics: ♂ FWL: 6.3–9.4 mm (mean = 8, n = 10), AR = 3.01, ♀ FWL: 8–9.3 mm (mean = 8.8, n = 5), AR = 2.96.

Male genitalia (Fig. 29) (n =6): Uncus semitriangular; dorsolateral shoulders of tegumen well developed; aedeagus with 5–11 deciduous cornuti; valva with costal margin concave, ventral margin broadly invaginated, cucullus with apical one third tapering to evenly rounded apex, ventral angle with rounded projection supporting one or two large spiniform setae, distal margin with *ca.* five stout setae and with a mild convex projection above the anal angle, medial surface with numerous stout setae. Female genitalia (Fig. 36) (n = 1): Papillae anales facing laterally and densely setose; sterigma semirectangular, length *ca.* 1.5× width, lateral margins weakly concave; ductus bursae uniform in width, with large sclerotized patch between ostium and juncture of ductus seminalis; corpus bursae with two signa.

Distribution and flight period. I examined 22 specimens (16 ♂, 6 ♀) from California, Colorado, Idaho, Montana, Oregon, Utah and Washington. Capture dates range from 15 June to 10 August.

Eucosma irroratana (Walsingham)
(Figs. 19, 20, 22, 30)

Paedisca irroratana Walsingham 1879:48.

Eucosma irroratana: Fernald [1903]:457; Barnes and McDunnough 1917:170; Heinrich 1923:101; McDunnough 1939:46; Powell 1983:34.

Paedisca perdricana Walsingham 1879:49, **new synonymy.**

Eucosma perdricana: Fernald [1903]:457; Barnes and McDunnough 1917:170.

Types. *Paedisca irroratana*. Lectotype here designated (Figs. 20, 22): ♂, Head of Noyo R., Mendocino Co., Calif., 8–11 June 1871, Wlsm. 91898, genitalia slide 11512. Paralectotypes: same data as lectotype (3 ♂, Wlsm. 91899, 91900, 91901); past Little Lake, Mendocino Co., Calif., 12 June 1871, (1 ♂, Wlsm. 91905). *Paedisca perdricana*. Lectotype here designated (Figs. 19, 30): ♂, Burney Falls, Shasta Co., California, 18–20 July 1871, Walsingham, genitalia slide 11509, BMNH. Paralectotype: same data as lectotype (1 ♂), BMNH.

Remarks. Besides the five syntypes mentioned above, there are six additional specimens that were collected by Walsingham but not mentioned in his description of *irroratana*. The associated data are: Head of Noyo R., Mendocino Co., Calif., 8–11 June 1871 (3 ♂, Wlsm. 91902, 91903, 91904); past Little Lake, Mendocino Co., Calif., 12 June 1871 (1 ♂, Wlsm. 91906); Scott's Valley, Lane Co., Calif., 17–19 June 1871 (2 ♂, Wlsm. 91907, 91908). Walsingham's specimen ledger, kept by Durrant, accounts for their disposition: #91902 was given to Zeller, #91904 was given to the USNM, and the remaining 4 were retained by Walsingham. Today, all but #91904 are in the BMNH. A twelfth specimen, residing in the USNM, bears a yellow "Fernald Collection" label and may well belong to the original series. Its red bordered, hand written, determination label, characteristic of certain specimens Walsingham is known to have given to C. H. Fernald, includes the inscription "Cal. Type," but there is no other collection data associated with this specimen. Inquiries to several North American collections produced no additional specimens correctly determined as either *irroratana* or *perdricana*.

The forewing of *irroratana* (Figs. 19, 20) is brown, with very fine, transverse, tan striations. This background is variably irrorated with lustrous gray scales, particularly on the distal one third of the wing. Anterior to the tornus there is a heavier concentration of lustrous scales and a fine speckling of black scales but no well defined ocellus. Forewing statistics: ♂ FWL: 9.2–13.7 mm (mean = 11.4, n = 5), AR = 2.84.

Male genitalia (Figs. 22, 30): Uncus short, semitriangular and apically rounded; socii moderately long and fingerlike; aedeagus with 2–4 deciduous cornuti (n = 2); valva broad basally, with costal margin concave, apex moderately acute but rounded, distal margin roundly convex, ventral margin weakly invaginated; cucullus with medial surface finely and densely setose, distal margin lacking stout setae. Female genitalia: Unknown.

Distribution and flight period. I examined 5 male specimens. Walsingham collected *irroratana* in early to mid June in Mendocino and Lake Counties in northern California. The two *perdricana* types came from nearby Shasta County, California, on 20 July.

Eucosma handana Kearfott
(Figs. 16, 24, 42)

Eucosma handana Kearfott 1907:20; Barnes and McDunnough 1917:169; Heinrich 1923:102; McDunnough 1939:46; Powell 1983:34.

Eucosma ceramitis Meyrick, 1912:34, invalid replacement name.

Types. Lectotype here designated (Fig. 24): ♂, Stockton, Utah, Tom Spalding, genitalia slide DJW1505, AMNH. Paralectotypes: Stockton, Utah, Tom Spalding (2 ♂, genitalia slide DJW1591, AMNH; 1 ♂, USNM); Stockton, Utah, 20 July 1903, Tom Spalding (1 ♂, genitalia slide DJW1590, USNM).

Remarks. This species may prove to be a variation of *irroratana*, but there are subtle differences in the males, and females of the latter species are not available for comparison. The *handana* types are moderately worn and probably faded. Their forewings show only the faintest indications of transverse tan striations, and they have no discernable lustrous scaling. The costal margin in *irroratana* is

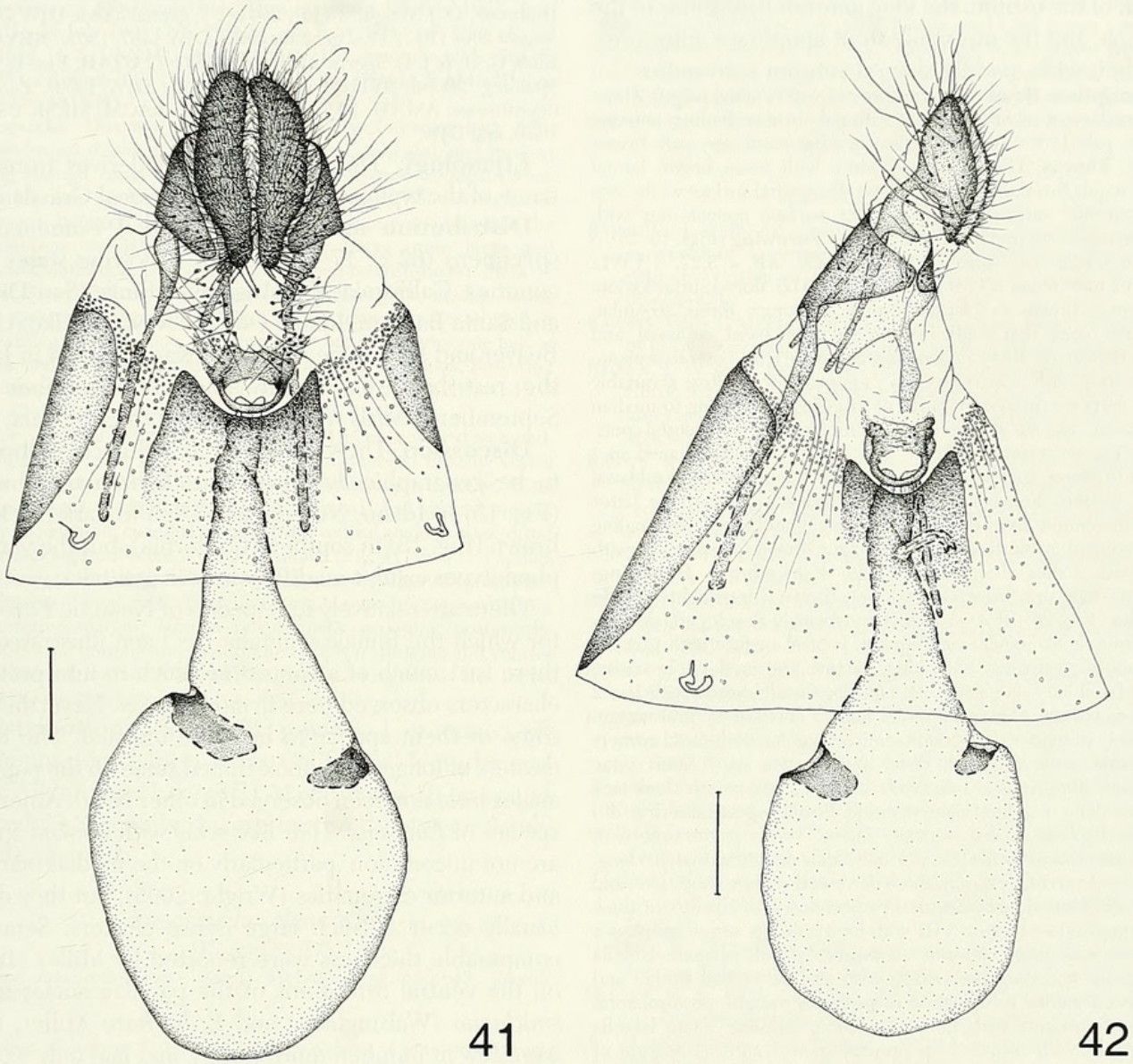


FIG. 41-42. Female genitalia. **41**. ***E. spaldingana***, slide DJW 1504. **42**. ***E. handana***, slide DJW 1506. Scale bars = 0.5 mm.

moderately convex. It is nearly straight in *handana*, producing a slightly more elongate forewing appearance.

The male genitalia (Fig. 24) are similar to those of *irroratana* (Fig. 30), but the cucullus appears to be somewhat narrower, with apex more acutely angled, and the vesica has *ca.* 14 deciduous cornuti (n = 5) vs. 2–4 (n = 2) in *irroratana*. Female genitalia (Fig. 42) (n = 1): Papillae anales facing laterally, with posterior and anterior extremities acutely angled, medial margin convex, and lateral surfaces moderately setose; sterigma semirectangular, anterior margin rounded and ring like, lateral margins with convex medial projections, lamella postvaginalis with shallow medial trough and mildly invaginated posterior margin; corpus bursae with two blunt-tipped signa located near juncture with ductus bursae.

Distribution and flight period. I examined 13 specimens (12 ♂, 1 ♀) from Nevada, Utah, and Washington. Capture dates range from 24 May to 4 August.

Eucosma curlewensis, new species
(Figs. 13–15, 26, 40)

Diagnosis. Forewing color and maculation (Figs. 13–15), though variable, are usually sufficient to identify this moth. Paler phenotypes (Figs. 14, 15) can be confused with *hazelana* or, if worn or greasy, with *spaldingana*, but the three species are clearly separated by male genitalia (Figs. 26–28). Females of *curlewensis* are distinguished by the clusters of thick hook-tipped

setae at the anterior extremities of the papillae anales, the lip on the sterigma projecting over the anterior margin of the ostium, the long anterior extensions of the sterigma, and the unusually stout apophyses anteriores, with their wide, paddle-shaped anterior extremities.

Description. **Head**: Frons and vertex white; labial palpus white, lateral surface of second segment with pale brown shading; antenna white to pale brown, dorsal surface of scape with very pale brown shading. **Thorax**: Dorsal surface white with some brown lateral scaling; tegula brown basally, white apically; ventral surface white; legs with posterior surface white, anterior surface concolorous with forewing markings, particularly on foreleg. **Forewing** (Figs. 13–15): ♂ FWL: 6.6–12.6 mm (mean = 11, n = 43), AR = 3.27, ♀ FWL: 10.5–13.2 mm (mean = 11.9, n = 16), AR = 3.05; dorsal surface white with orange-brown to blackish-brown markings: three, irregular, transverse bands that might be interpreted as basal, subbasal, and median fasciae, the first two generally complete from costa to dorsum, the last frequently interrupted on radius and/or cubitus; a variably shaped mark on distal one fourth of forewing connecting to median fascia, costa, apex and tornus, defining three or four white costal spots, a white bar on terminal margin, and a white variably shaped spot anterior to tornus; a white interfascial spot between basal and subbasal fasciae, another between subbasal and median fasciae, the latter outwardly oblique from dorsal margin to cell and thereafter angling inward toward costa; fringe white to light brown, occasionally with some black scaling along distal margin of membrane. **Hindwing**: Uniformly light gray brown to dark gray brown, fringe lighter. **Male genitalia** (Fig. 26) (n = 11): Uncus a strongly developed, dorsally setose lobe, apex angular or rounded, ventral surface with variably developed medial ridge; socii long, narrow, and moderately setose; gnathos band like; aedeagus long, tapering distally, vesica with 1 or 2 deciduous cornuti; valva with costal margin concave, ventral margin moderately invaginated; cucullus semirectangular, with distal corners and ventral angle rounded, distal margin with *ca.* 5 stout setae distributed along ventral two-thirds, medial surface with short tack like setae along margin of basal opening. **Female genitalia** (Fig. 40) (n = 4): Papillae anales ventrally facing, wider posteriorly, with anterior extremities projecting ventrally, setae on lateral margins long, hairlike, and curving ventrally, those on ventral surface short, fine, and densely distributed, anteroventral projections with clusters of thick hook-tipped setae; tergum VIII with long hair-like setae; apophyses anteriores very stout, anterior extremities paddle shaped; lamella postvaginalis widening posteriorly, with shallow medial trough and pronounced medial invagination of posterior margin, posterolateral corners of sterigma with numerous, long, hair-like setae; lamella antevaginalis with rounded lip projecting over anterior margin of ostium; sterigma with long (*ca.* 2 × ostium diameter), narrow, anterior projections at anteroventral corners; corpus bursae with two signa, membrane finely wrinkled and thickened from signa to juncture with corpus bursae.

Holotype. ♀, Idaho, Oneida Co., Curlew NG [National Grassland], 4 mi. ENE of Holbrook, 25 July 2003, D. J. Wright, deposited in USNM. Type locality at: 42° 10.97' N, 112° 35.12' W.

Paratypes. CALIFORNIA: Los Angeles Co., Santa Catalina Island, Toyon Bay, J. Bennett, 13 August 1983 (1 ♂, genitalia slide JAP 6716); Santa Catalina Island, D. Meadows, 22 September 1932 (1 ♂, genitalia slide JAP 5304); Orange Co., Rcho Miss Viejo, N. Bloomfield, 15–18 September 1999 (1 ♂, genitalia slide DJW 691); San Diego Co., NAS Miramar, N. Bloomfield, 24 July 1997 (2 ♂), 1 August 1997 (2 ♂, 1 ♀), 3 August 1997 (2 ♂); San Diego Co., MCAS Miramar, N. Bloomfield, 3 August 1998 (1 ♂), 16 August 1998 (1 ♂), 6–9 September 1998 (3 ♂); San Diego Co., Torrey Pines St. Res., Sorrento Vy Marsh, N. Bloomfield, 19–26 July 2005 (3 ♂, genitalia slide DJW 1544), 27–30 July 2005 (2 ♂, 1 ♀, ♂ genitalia slide DJW 1543, ♀ genitalia slide DJW 1499), 1–7 August 2005 (4 ♂, 1 ♀), 8–15 August 2005 (2 ♂, 1 ♀); Santa Barbara Co., Santa Rosa Island, Lower Cherry Cyn., J. A. Powell, 21 September 2000 (1 ♂); Santa Barbara Co., 3 mi. N. Refugio Beach, J. S. Buckett, 18 July 1965 (1 ♂, genitalia slide JAP 1930). **IDAHO**: Oneida Co., Curlew NG, 4 mi. ENE of Holbrook, D. J. Wright, 25 July 2003 (1 ♂), 26 July 2003 (3 ♀, genitalia slide DJW 1498); Oneida Co., Curlew NG, T14S R32E S30, D. J. Wright, 28 July 2003 (2 ♀); Oneida Co., Curlew NG, 5 mi. SSE of Holbrook, D. J. Wright, 18 July 2001 (1 ♂, genitalia slide DJW 786), 1 August 2001 (10 ♂, 3 ♀, ♂ genitalia slides DJW 1497, 1501). **NEVADA**: Elko, G. H. & J. L. Sperry, 2 August 1938 (1 ♀). **UTAH**: Eureka, Tom Spalding, 20 July 1911 (1 ♂, genitalia slide DJW 1509). Paratype depositories: AMNH, BMNH, CNC, CSU, LACM, MEM, USNM, UCB, and DJW.

Etymology. The specific epithet derives from the name of the type locality, Curlew National Grassland.

Distribution and flight period. I examined 79 specimens (62 ♂, 17 ♀) from the following states and counties: California: Los Angeles, Orange, San Diego, and Santa Barbara; Idaho: Oneida; Nevada: Elko; Utah: Beaver and Juab. One individual was collected in June, the rest between 18 July and 22 September. All September records were from southern California.

Discussion. The variation in forewing color appears to be geographically dependent (light orange-brown (Fig. 15) in Idaho, Nevada, and Utah to dark blackish-brown (Fig. 13) in southern California), but the various phenotypes exhibit no differences in genitalia

There are relatively few species of Nearctic *Eucosma* for which the female genitalia has been illustrated, so there isn't much of a context in which to interpret the characters observed here in *curlewensis*. Nevertheless, some of them appear to be quite unusual. The large clusters of long, stout, hook-tipped setae on the papillae anales have not been observed in other North American species of *Eucosma*. Hair like setae with hooked apices are not uncommon, particularly on the medial margins and anterior extremities (Wright: 2005), but they don't usually occur in such large dense clusters. Setae of comparable thickness were reported by Miller (1974) on the ventral extensions of the papillae anales in *E. smithiana* (Walsingham) and *E. barbara* Miller; they were few in number, quite stubby, and had only weakly curved apices. Another apparently unique feature of *curlewensis* is the well developed lip on the anterior margin of the ostium. A number of species of *Eucosma* and *Pelochrista* have a medial extension of the posterior margin of sternum VII that partially overlaps the ostium, but to my knowledge this is the first reported case in which the projection is an integral part of the lamella antevaginalis. Finally, I am aware of no other member of the genus with such long, rod like, anterior extensions of the sterigma (presumably for muscle attachment).

Eucosma spaldingana Kearfott
(Figs. 17, 23, 28, 41)

Eucosma spaldingana Kearfott 1907:19; Barnes and McDunnough 1917:169; Heinrich 1923:84; McDunnough 1939:45; Powell 1983:34.

Types. Lectotype here designated (Fig. 23): ♂, Stockton, Utah, Tom Spalding, 28 July 1903, genitalia slide DJW 1548, AMNH. Paralectotypes: Stockton, Utah, Tom Spalding, 20 July 1903 (2 ♂, AMNH), 26 July 1903 (1 ♂, USNM), 28 July 1903 (1 ♂, USNM), 29 July 1904 (1 ♂, USNM), 30 July 1904 (1 ♂, genitalia slide 70195, USNM), 7 August 1904 (1 ♂, AMNH), 11 Aug 1904 (1 ♂, AMNH), [no date] (1 ♂, AMNH).

Remarks. This moth has a silvery-white forewing with light reddish-brown markings (Fig. 17). The basal, subbasal, and median fasciae, though usually well defined as transverse reddish-brown bands, are often weakly expressed toward the costa. White interfascial spots occur between the basal and subbasal fasciae and between the subbasal and median fasciae, the latter being quite large and semitriangular. There is an irregularly shaped reddish-brown mark on the apical one third of the forewing that connects to the median fascia, costa, apex, and termen, forming a white, triangular, costal spot, a small white preapical spot, a narrow white bar on anterior one half of termen, and a medium sized white spot anterior to tornus. Forewing statistics: ♂ FWL: 10.5–13.5 mm (mean = 12.1, n = 34), AR = 3.19, ♀ FWL: 12–14.5 mm (mean = 13.4, n = 6), AR = 3.06.

Male genitalia (Figs. 23, 28) (n = 4): Uncus a well developed, dorsally setose lobe; socii broad basally and tapered distally; vesica with *ca.* 15 deciduous cornuti; valva with costal margin concave, distal margin straight, ventral angle evenly rounded, and ventral margin weakly invaginated; cucullus tapered from ventral angle to apex, distal margin lacking stout setae. Female genitalia (Fig. 41) (n = 1): Papillae anales facing ventrally and densely setose, narrow anterior extremities with clusters of moderately long, hook-tipped setae; sterigma with ring like anterior margin, lamella postvaginalis widening posteriorly, posteroventral corners and membrane between sterigma and ventral extremities of tergum VIII with numerous, long, hair like setae; corpus bursae with two signa.

Distribution and flight period. I examined 66 specimens (58 ♂, 8 ♀) from California, Nevada, and Utah. All but five (1 dated 21 May, 1 dated 19 June, and 3 dated 29 September) were captured between 2 July and 30 August.

Eucosma hazelana Klots
(Figs. 18, 27)

Eucosma hazelana Klots 1936:1; McDunnough 1939:45; Powell 1983:34.

Types. Holotype: ♂, Fountain Valley School, Colorado Springs, Colo., 20–31 Aug. 1932, genitalia slide ABK 18 Dec. 1932, AMNH. Paratype: S. W. Col., July 1899, Dietz, genitalia slide 70718, USNM. [Klots (1936) reported a damaged male paratype in AMNH labeled "Col.", but I did not examine it.]

Remarks. The color and maculation of the forewing of *hazelana* (Fig. 18) is similar to that of *spaldingana*, but the white ground color does not have a silvery hue, the fasciate markings are usually stronger, the interfascial spot at mid dorsum is not triangular, and the white spots on the costa and above the tornus are not as large. Forewing statistics: ♂ FWL: 7.7–11.6 mm (mean = 9.9, n = 5), AR = 3.35.

Male genitalia (Fig. 27) (n = 4): Valva with costal margin concave, apex angular but rounded, distal margin roundly convex, neck long and narrow; cucullus lacking stout setae on distal margin; aedeagus with 2 or 3 deciduous cornuti. Female genitalia: Unknown.

Distribution and flight period. I was able to locate only 5 specimens of this species: 2 from Colorado, 1 from southeastern Montana, and 2 from Coahuila, Mexico. Capture dates range from July [day unknown] in Colorado to 23 September in Mexico.

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