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REVIEW OF THE *EUCOSMA PULVERATANA* (WALSINGHAM) SPECIES GROUP, WITH DESCRIPTIONS OF EIGHT NEW SPECIES (TORTRICIDAE)

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ABSTRACT. *Eucosma pulveratana* (Walsingham) is reviewed along with its closest congeners, *E. suadana* Heinrich, *E. mirosignata* Heinrich, *E. consobrinana* Heinrich and *E. aeana* McDunnough. Eight new species are described that are similar to *E. pulveratana* in forewing pattern and genitalia: *E. coconana*, *E. costastriata*, *E. floridensis*, *E. mojaveana*, *E. navajoensis*, *E. parapulveratana*, *E. seamansi*, and *E. sepiana*. *Eucosma aeana* is recognized as a junior synonym of *E. suadana*. Adults and genitalia of each species are illustrated.

Additional key words: Olethreutinae, Eucosmini, *consobrinana*, *suadana*, *mirosignata*

Walsingham (1879) described *Paedisca pulveratana* from four specimens he collected at San Francisco, California in 1871. The species now resides in *Eucosma* Hübner, having been transferred there by Fernald [1903]. During the past one hundred and thirty years, specimens of similar forewing pattern and genitalia have accumulated in North American collections, and only four additional names have been proposed to accommodate them: *E. consobrinana* (Heinrich 1923), *E. suadana* (Heinrich 1923), *E. mirosignata* (Heinrich 1929), and *E. aeana* (McDunnough 1942). This material includes perhaps a dozen unrecognized species, some represented by only a few specimens. The present paper reviews the current members of the group, interprets *E. aeana* as a synonym of *E. suadana*, and provides descriptions and illustrations for eight new species. Three additional species are illustrated that are probably new but are not described for lack of sufficient material.

MATERIALS AND METHODS

This study is based on the examination of 643 adult specimens (387 ♂, 256 ♀) and 208 genitalia preparations deposited in the following institutional and private collections: American Museum of Natural History, New York (AMNH); The Natural History Museum, London (BMNH); Canadian National Collection, Ottawa, Ontario (CNC); Colorado State University, Fort Collins, Colorado (CSU); Donald J. Wright (DJW); Essig Museum of Entomology, UC Berkeley (EME); George J. Balogh, Portage, Michigan (GJB); John S. Nordin, Laramie, Wyoming (JSN); Mississippi Entomological Museum, Mississippi State University (MEM); Museum of Comparative Zoology, Harvard University (MCZ); Todd M. Gilligan, Loveland, Colorado (TMG); and United States Museum of Natural History, Washington DC (USNM).

Forewing length (FWL), the distance from base to apex including fringe, and aspect ratio (AR), defined as FWL divided by medial forewing width, are used as indications of specimen size and forewing geometry, respectively. The former is reported to the nearest one tenth of a millimeter, the later as the average of several such values rounded to two decimal places. Measurements were made with a Leica M-Z95 stereomicroscope equipped with an ocular micrometer. Saccular angle (SA) refers to the angle formed by linear approximations to the ventral margin of the sacculus and the adjacent margin of the neck (Fig. 1b) and was measured to the nearest degree with a protractor on a projected image of the valva. The SA concept is inherently imprecise, being dependent on the choice of approximating lines, but it has some taxonomic utility in the group of species considered here. The number of observations supporting a particular statistic is indicated by n. Adult images and genitalia drawings were edited in Adobe Photoshop CS. Several were flipped horizontally, so that what appears to be a right wing or valva in the illustration is in fact the left such item on the insect. Morphological terminology follows Gilligan et al. (2008).

For stability of nomenclature, a lectotype is designated for *E. pulveratana* based on an unpublished selection made by Obraztsov approximately fifty years ago. I examined that specimen.

GROUP CHARACTERS

This section defines the *pulveratana* group by discussing characters shared by most, if not all, of its members. It serves as a basis for the descriptions in the subsequent species accounts, thus avoiding an excessive amount of repetition and allowing each account to focus on exceptions and/or variations peculiar to the species at hand.

Forewing (Fig. 1a). The forewing pattern includes two prominent marks on the dorsum, referred to here as the subbasal and pretornal marks, and a less conspicuous postmedian band. The subbasal mark

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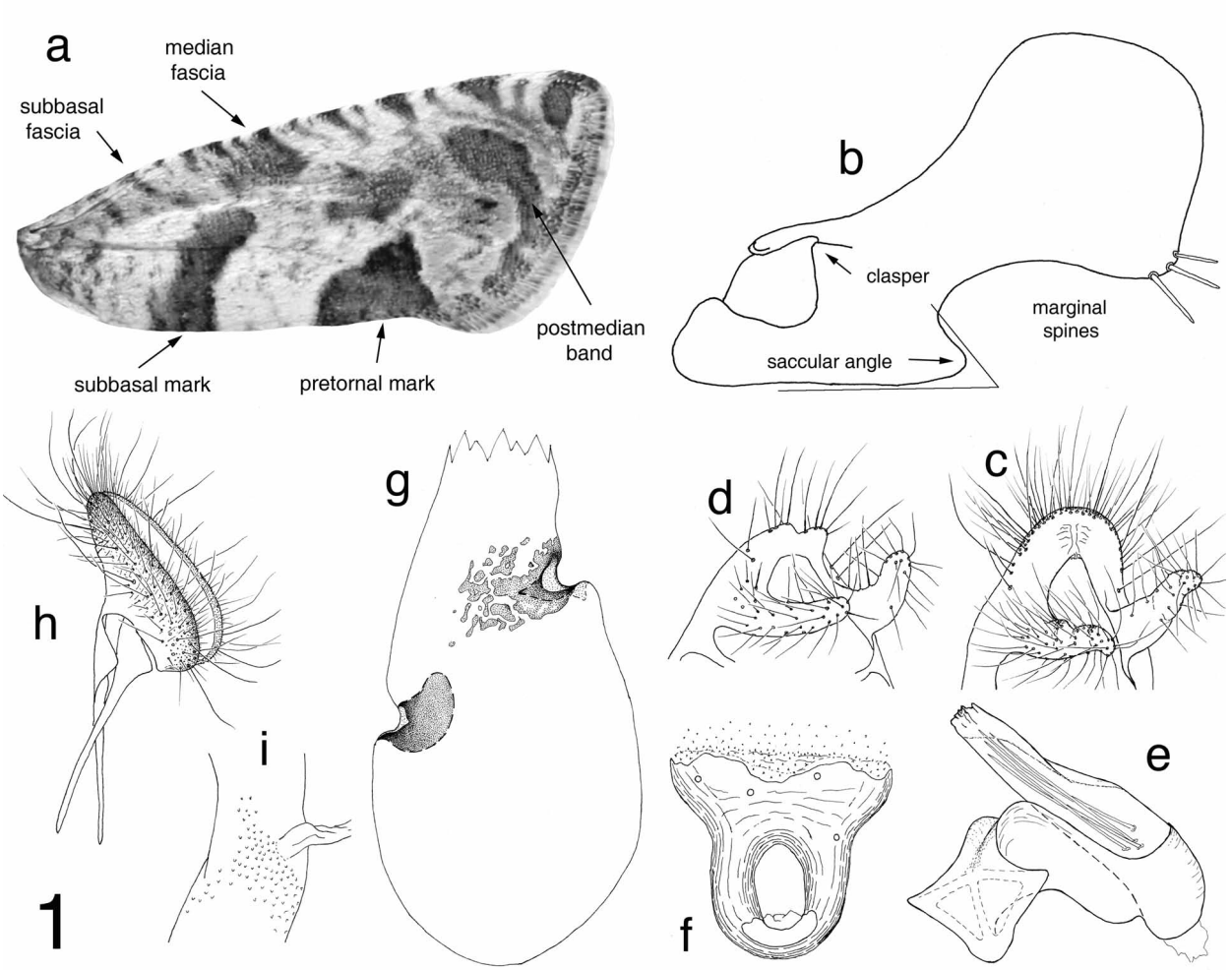


FIG. 1. *Eucosma pulveratana* group characters. a, forewing pattern, *E. suadana*. b, valva, *E.* pulveratana. c, d, uncus and socii, *E. mirosignata*, *E. parapulveratana*. e, phallus, anellus, caulis, and juxta, *E. consobrinana*. f, sterigma, *E. pulveratana*. g, signa and corpus bursae, *E. consobrinana*. h, papillae anales, *E. costastriata*. i, microspinules in ductus bursae, *E. mirosignata*.

tends to be narrow and elongate, extending obliquely from the dorsum nearly to the radius. In some instances there is an associated mark on the costa, which, if connected to the anterior extremity of the subbasal mark, would complete a chevron-shaped subbasal fascia. The pretornal mark is semitriangular, with its distal margin bordering the ocellus. Most variable of the forewing markings is the postmedian band, which frequently is interrupted near the costa and often blends with a patch of dark scales anterior to the ocellus. All the species have conspicuous costal strigulae delimited by dark costal marks of essentially two types, striate and triangulate. In a few species thin striae predominate from base to apex, but usually the proximal one-half of the costa is striate, and the distal one-half has a more or less even mix of striate and semitriangular marks. Often the two patterns are separated at mid-costa by a dark shade interpreted here as a remnant of a median fascia. The ocellus is inconspicuous and bordered basally and distally by lustrous transverse bars. Its central field is concolorous with the interfascial areas and is often marked by blackish longitudinal dashes.

Hindwing. In all members of the group the hindwing is uniformly grayish brown, often with a little darker edging along the margins of the membrane and somewhat lighter fringe.

Male genitalia (Fig. 1b–e). The uncus is dorsally setose and poorly differentiated from the dorsolateral shoulders of the tegumen. Usually it is weakly developed and divided into two convex lobes by a shallow medial indentation (Fig. 1d), but in two species it is strongly produced and semicircular (Fig. 1c). The fingerlike socii are broad basally and taper distally, with the apex narrowly rounded. All species in the group have an elongate phallus (Fig. 1e). Its ventral surface is sclerotized, its anterior extremity is closely surrounded by the anellus, and the vesica contains up to eight deciduous cornuti. The correspondingly elongate caulis has a posterodorsal surface in the form of a trough of V-shaped cross-section. Valval characteristics (Fig. 1b) include: costa concave; distal margin convex except for occasional shallow concave inflection near anal angle; anal angle moderately developed and rounded, measuring ca. 90°; ventral margin of neck broadly emarginated, producing a prominent saccular angle; medial surface with raised setose clasper at basal margin; cucullus with several spines, referred to here as marginal spines, on ventral one-half of distal margin and with medial surface densely setose, the setae arranged in something of a starburst pattern emanating from the midpoint of the distal margin. The marginal spines are positioned on the edge rather than the medial surface of the cucullus. In typical slide-mounted genitalia, their sockets are seen in lateral aspect and appear rectangular, whereas setal sockets on the medial surface have a circular appearance.

Female genitalia (Fig. 1f–i). The papillae anales (Fig. 1h) are laterally facing and moderately setose. The lamella postvaginalis (Fig. 1f) is well developed, with posterolateral corners flared, lateral margins usually concave, and posterior margin variably indented

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medially. The lamella antevaginalis is ring-like, with medial portion partially membranous. Sternum VII has strongly sclerotized lateral margins and a weakly sclerotized medial area (Figs. 51–62). Its posterior edge is concavely emarginated to approximately one-half the length of the sterigma and is separated from the sterigma by a band of membrane. In most members of the group there are two inwardly projecting invaginations of the intersegmental membrane between sterna VI and VII (e.g. Fig. 52), referred to as pockets. In all but two species there is some sclerotization of the ductus bursae between the juncture with the ductus seminalis and the constriction anterior to the ostium (e.g. Fig. 51), and in all cases there is a patch of microspinules near that juncture on the interior surface of the ductus bursae (Fig. 1i). The corpus bursae (Fig. 1g) contains two signa of unequal size, the larger located on the ventral surface at mid-bursa, the smaller on the dorsal surface nearer the juncture with the ductus bursae. Often there is some sclerotization of the membrane adjacent to the smaller signum. In some species it takes the form of a broad plate extending laterally from the signum (Fig. 1g), in others a small patch at the base of the signum (e.g. Fig. 51), and in all cases as microspinules on the interior surface of the membrane and/or sclerotized patch surrounding the signum.

Discussion. Most species in the *pulveratana* group exhibit considerable intraspecific variation. In particular, specimen size (as measured by FWL) frequently varies by up to 2 mm and occasionally by as much as 4 mm. Figure 2 shows the range of values for each species and the amount of interspecific overlap, the taxa being ordered according to increasing average FWL.

In the male genitalia, the number of marginal spines on the cucullus varies not only from specimen to specimen in a given species but from valva to valva in a single specimen. Despite interspecific overlap, most species tend to have many spines (more than 5) versus few (less than 5). Similarly, intraspecific variation in the saccular angle can be considerable from specimen to specimen (as much as 45°) and from one valva to the other. Nevertheless, SA does allow a rough sorting of the species into three categories: acute, obtuse, or approximately 90°.

In females, the form of the sclerotization surrounding the smaller signum appears to be relatively constant within species. Sterigma shape is not (Figs. 63–74). The length of the membranous portion of the lamella antevaginalis as compared to ostium width tends to be stable within species and is useful in segregating taxa according to <, >, and ≈ (nearly equal to). The ostium is generally ovate to elongate. In a few instances the ostium in combination with the unsclerotized portion of the lamella antevaginalis presents a distinctive key-hole shape.

A summary of the data relating to selected genitalic characters is presented in Table 1. It is apparent from Figure 2 and Table 1 that interspecific differences in specimen size and/or genitalia are often subtle and frequently not discrete. Consequently, many of the diagnoses below rely heavily on forewing appearance and geographic distribution.

SPECIES ACCOUNTS

Eucosma pulveratana (Walsingham)
(Figs. 1b, f, 3–7, 39, 51, 63, 75)

Paedisca pulveratana Walsingham 1879:45.

Eucosma pulveratana: Fernald [1903]:457; Barnes and McDunnough 1917:170; Heinrich 1923:128, fig. 238; McDunnough 1939:47; Powell 1983:35; Brown 2005:326.

Types. Lectotype here designated (Fig. 3): ♂, California, San Francisco, Walsingham, 16 May 1871, genitalia slide 11527, BMNH. Paralectotypes: same data as lectotype (3 ♂, BMNH).

Description. *Head*: Frons pale brown to creamy white, vertex pale brown; labial palpus concolorous with vertex, with medial surface shading to creamy white toward base and along dorsal margin, third segment concealed by long scales on second segment; antenna pale brown.

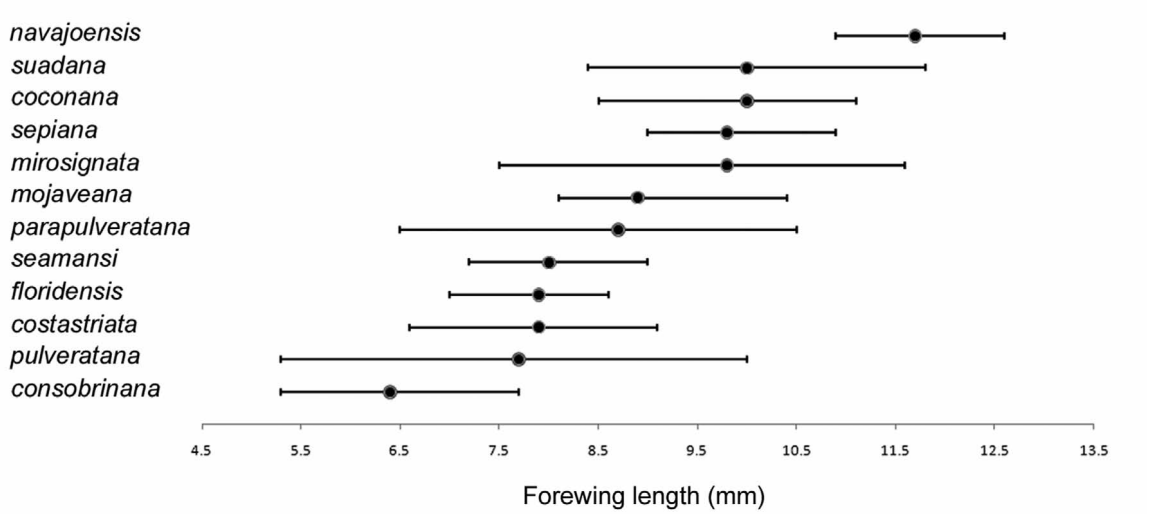


FIG. 2. Comparative FWL data.

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TABLE 1. Comparative data on selected genitalia characters.

Species	♂ genitalia					♀ genitalia		
	uncus	average SA	average # of marginal spines	cornuti	pockets	sclerotization on ductus bursae	sclerotization of membrane near posterior signum	width of membrane of lam. antevag. vs. width of ostium
coconana	divided	79	5.7	2-4	none	yes	small	<
consobrinana	divided	69	3.0	4-6	deep	yes	broad	≈
costastriata	divided	32	4.4	6-8	shallow	yes	spinulate	<
floridensis	divided	46	2.7	4-6	moderate	yes	spinulate	<
mirosignata	semicircular	122	6.3	2-8	deep	no	broad	>
mojaveana	semicircular	136	2.6	2-5	shallow	no	broad	>
navajoensis	divided	66	4.6	6-8	shallow	yes	spinulate	>
parapulveratana	divided	51	6.2	3-7	shallow	yes	spinulate	<
pulveratana	divided	55	3.8	1-7	none	yes	small	≈
seamansi	divided	62	5.8	1-5	moderate	yes	spinulate	<
sepiana	divided	59	4.6	2-6	none	yes	spinulate	≈
suadana	divided	66	5.9	2-5	none	yes	spinulate	≈

Thorax: Dorsal surface concolorous with head; ventral surface creamy white; legs with anterior surfaces pale brown, posterior surfaces creamy white; distal extremities of tarsomeres ringed with pale tan. *Forewing* (Figs. 3–7): ♂ FWL 6.0–10.0 mm (mean = 8.1, n = 88), AR = 3.09; ♀ FWL 5.3–9.0 mm (mean = 7.2, n = 62), AR = 3.03; markings dark brown; interfascial areas creamy white with extensive fine brown reticulations; postmedian band weakly defined, concolorous with apical spot and with scaling anterior to ocellus; fringe scales brown with paler apices; costal markings striate, intermixed with triangulate marks from mid-costa to apex; strigulae obscure on proximal one-half of costa, more clearly defined from mid-costa to apex.

Male genitalia (Fig. 39) (n = 34): Uncus with medial indentation; vesica with 2–7 deciduous cornuti; saccular angle acute (37°–76°, mean = 55°); cucullus usually with 2–5 marginal spines, occasionally with 6 or 7. *Female genitalia* (Fig. 51, 63) (n = 27): Ostium and membranous portion of lamella antevaginalis of nearly equal width; membrane between sterna VI and VII with pockets lacking or barely discernable; sclerotization of ductus bursae extending from ductus seminalis to constriction near ostium; base of posterior signum usually expanded into small sclerotized patch on membrane, infrequently with patch obsolete.

Distribution and biology. I examined 229 specimens (140 ♂, 89 ♀) from 12 counties in California (Yuba to San Diego); from Apache, Cochise and Coconino counties in Arizona; and from Catron, Cibola, Grant, Lincoln, Luna, McKinley and Otero counties in New Mexico (Fig. 75). Capture dates range from early March to November. In southern California the records cluster in April and May and again in September and October, suggesting the occurrence of two primary flights.

Remarks. *Eucosma pulveratana* has been a catch-all taxon, and I believe the treatment presented here still fits that description to some extent. The California specimens, which tend to be homogenous in forewing appearance and genitalia, compare favorably with the lectotype. Arizona and New Mexico populations treated here as *pulveratana* exhibit greater variation in size, coloration, and genitalia (Figs. 5–7). These latter specimens may well represent two or more sibling species, but intergradations with the California material renders diagnosis of additional species problematic based on the methods utilized here.

Eucosma consobrinana Heinrich
(Figs. 1e, g, 8–12, 40, 52, 64, 77)

Eucosma consobrinana Heinrich 1923:128, fig. 242; McDunnough 1939:47; Powell 1983:35; Brown 2005:318.

Types. Holotype: ♂, South Dakota, [Union Co.], Elk Point, C. N. Ainslie, August 1913, genitalia slide 72845, USNM. Paratypes.

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SOUTH DAKOTA: Same data as holotype, (2 ♂, USNM; 2 ♂, AMNH; 2 ♀, USNM, genitalia slides DJW 2273, USNM 70485). IOWA: [Woodbury Co.], Sioux City, C. N. Ainslie, August 1913 (2 ♀, USNM, genitalia slide DJW 2272; 1 ♀, AMNH).

Description. *Head*: Frons pale tan; scales of vertex pale grayish brown basally, with whitish-tan tips; labial palpus with medial surface whitish tan, lateral surface grayish brown, third segment concealed by long scales on second segment; antenna concolorous with vertex.

Thorax: Dorsal surface concolorous with head; ventral surface whitish tan; legs with anterior surfaces brown, posterior surfaces whitish tan; distal extremities of tarsomeres with whitish-tan annulations. *Forewing* (Figs. 8–12): ♂ FWL 5.3–7.7 mm (mean = 6.4, n = 35), AR = 2.98; ♀ FWL 5.5–7.3 mm (mean = 6.4, n = 23), AR = 2.85; markings brown to blackish brown, interfascial areas whitish tan to pale gray, with fine brown to brownish-gray reticulations; median fascia represented by rectangular mark at mid-costa; fringe scales whitish tan with gray-brown to blackish-brown subapical cross-markings; costal strigulae usually well defined from median fascia to apex, obscure from base to mid-costa.

Male genitalia (Fig. 40) (n = 14): Uncus with medial indentation; vesica with 4–6 deciduous cornuti; saccular angle acute (60°–87°, mean = 69°), with vertex rounded; cucullus usually with 2 or 3 marginal spines, occasionally with 4. *Female genitalia* (Figs. 52, 64) (n = 15): Ostium and membranous portion of lamella antevaginalis of approximately equal width; membrane between sterna VI and VII with well developed pockets; sclerotization of ductus bursae not reaching ductus seminalis; posterior signum located medially on broad sclerotized plate, the latter often somewhat fragmented and frequently with ridge emanating laterally from signum.

Distribution and biology. The 64 specimens examined (36 ♂, 28 ♀) document a range extending roughly from the Mississippi River to the eastern slope of the Rocky Mountains and from South Dakota to southern Texas and Mississippi (Fig. 77). In Texas there appear to be two primary flights, March–April and September–November. Most Midwest records are from August.

Remarks. This moth is most similar in forewing appearance and genitalia to *E. pulveratana* but is generally smaller (mean FWL ≈ 6.4 vs. 7.6 mm). The ranges of the two species appear to be disjunct but are nearly contiguous in New Mexico. Females of *consobrinana* are distinguished from those of *pulveratana* by the breadth of the sclerotized patch on the corpus bursae and the presence of well developed pockets in the membrane between sterna VI and VII. The male genitalia of the two species are very similar, and intraspecific variation in both species renders diagnosis on that basis unreliable.

Eucosma suadana Heinrich
(Figs. 1a, 13–14, 41, 53, 65, 75))

Eucosma suadana Heinrich 1923:130, fig. 243; McDunnough 1939:48; Powell 1983:35; Brown 2005:327.

Eucosma aeana McDunnough 1942:68; Powell 1983:35; Brown 2005:314, **new synonymy**.

Discussion. The description of *E. aeana* was based on a single male from Fillmore, Utah. The specimen is somewhat worn, but in forewing pattern and coloration it is an excellent match to the types of *E. suadana*. McDunnough (1942) recognized the similarity of the two species but relied on subtle differences in genitalia (saccular angle less sharp, ventral emargination of the neck more broad, cucullus more circular) to separate *aeana* from *suadana*. My investigations indicate that these are not diagnostic differences but represent intraspecific variation in *suadana*; hence the proposed synonymy.

Types. *Eucosma suadana*. Holotype: ♂, Utah, [Utah Co.], Vineyard, Tom Spalding, 10 July 1912, genitalia slide 72802, USNM. Paratypes: same locality and collector as holotype, 6 July 1912 (1 ♀, AMNH), 8 July 1912 (1 ♂, USNM; 1 ♀, AMNH), 10 July 1912 (2 ♀, genitalia slide 70499, USNM), 14 July 1912 (1 ♂, USNM). *Eucosma aeana*. Holotype: ♂, Utah, [Millard Co.], Fillmore, D. H. Bishoff, 10 August 1940, genitalia slide 90, CNC.

Description. *Head*: Frons and vertex white; labial palpus white, with some grayish-brown shading on lateral surface of second segment; antenna white.

Thorax: Dorsal surface whitish, with some grayish-brown shading; ventral surface white; fore- and mid-legs with brown to blackish-brown anterior surfaces, whitish posterior surfaces, and whitish annulations at mid-tibia, distal end of tibia, and distal extremity of each tarsomere. *Forewing* (Figs. 13–14): ♂ FWL 8.6–11.8 mm (mean = 10.3, n = 21), AR = 3.06; ♀ FWL 8.4–10.2 mm (mean = 9.4, n = 12), AR = 2.91; markings brown to blackish-brown; interfascial areas whitish, variably reticulated with pale brown; subbasal and pretornal marks strongly contrasting with interfascial areas; median fascia represented by dark mark at mid-costa; postmedian band strongly expressed, usually complete but sometimes interrupted by white scaling near costa; lustrous bars bordering ocellus gray to fawn; fringe scales grayish-brown with white apices; striate costal markings interspersed with larger triangulate markings from median fascia to apex.

Male genitalia (Fig. 41) (n = 7): Uncus weakly divided; vesica with 2–5 deciduous cornuti; saccular angle acute (54°–78°, mean = 66°); cucullus with 5–7 marginal spines. *Female genitalia* (Fig. 53, 65) (n = 7): Width of membranous portion of lamella antevaginalis equal to or a little larger than width of ostium; pockets in membrane between sterna VI and VII lacking to barely discernable; sclerotization of ductus bursae extending from juncture with ductus seminalis to constriction near ostium; corpus bursae with membrane near small signum microspinulate.

Distribution and biology. I examined 34 specimens (22 ♂, 12 ♀) collected at elevations between 4500 and 9000 feet in Nevada, Utah and Wyoming (Fig. 75). Capture dates range from 8 June to 10 August, the vast majority of records being from July.

***Eucosma seamansi*, new species**
(Figs. 17–18, 42, 54, 66, 77)

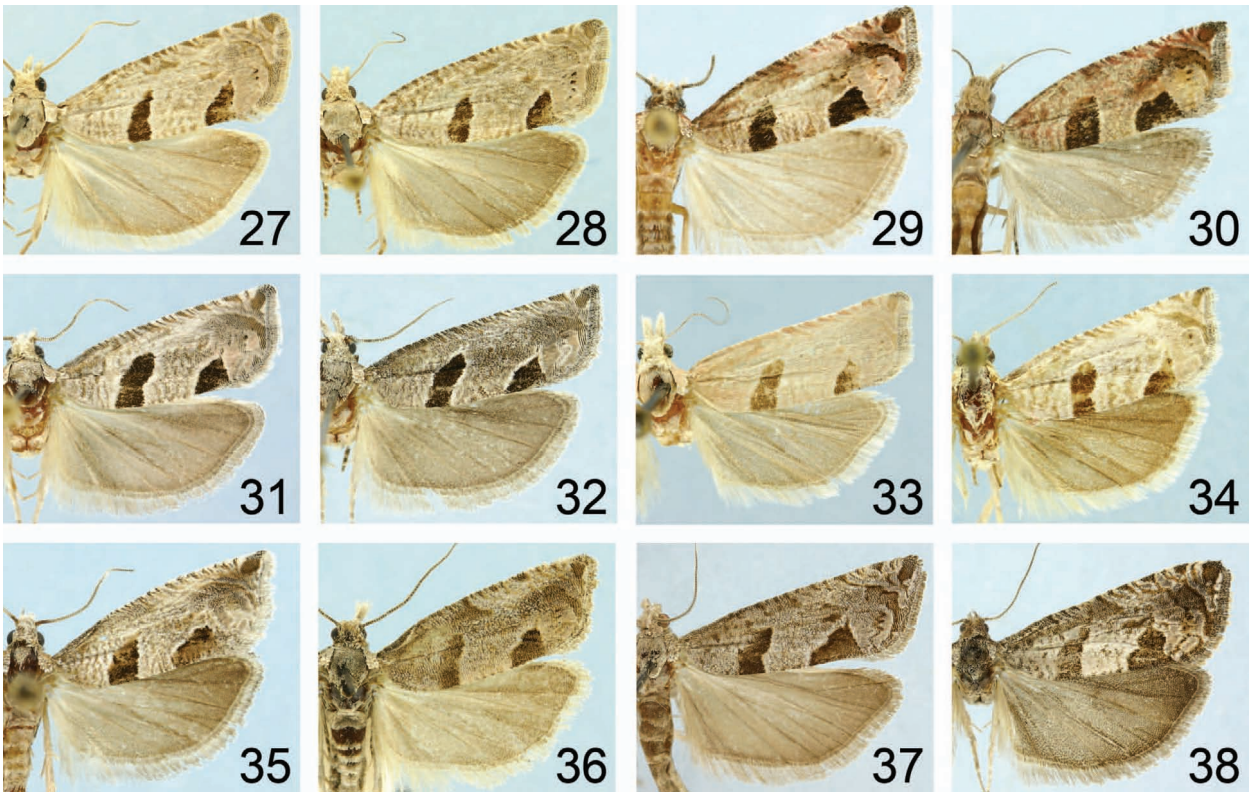
Diagnosis. *Eucosma seamansi* is similar in appearance to *E. suadana* but is smaller (mean FWL ≈ 8.0 vs. 10.0 mm) and darker (head and interfascial areas of forewing more strongly suffused with brownish gray). In *E. seamansi* the median fascia extends from costa to cubitus and is connected to the post median band by a patch of dark scaling anterior to the ocellus. The male genitalia of the two species are essentially indistinguishable. Females of *E. seamansi* have well developed pockets in the membrane between sterna VI

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FIGS. 3-26. **3–7,** *E. pulveratana*. **3,** ♂ lectotype. **4,** ♂ Santa Cruz Island., California. **5,** ♀ White Mountains, Arizona. **6,** ♂ Grant Co., New Mexico. **7,** ♀ Coconino Co., Arizona. **8–12,** *E. consobrinana*. **8,** ♂ Monona Co., Iowa. **9,** ♀ Otero Co., Colorado. **10,** ♀ Cheyenne Co., Colorado. **11,** ♀ Colfax Co., New Mexico. **12,** ♂ Oktibbeha Co., Mississippi. **13–14,** *E. suadana*, ♂,♀ Albany Co., Wyoming. **15–16,** *E. coconana*, ♂,♂ Coconino Co., Arizona. **17–18,** *E. seamansi*. **17,** holotype. **18,** ♂ Pocahontas Co., Iowa. **19–20,** *E. sepiana*. **19,** holotype. **20,** Bear Lake Co., Idaho. **21,** ♂ *E. pulveratana* group nr. *sepiana*, Elko Co., Nevada. **22-26,** *E. parapulveratana*. **22,** ♂ Morton Co., Kansas. **23,** ♂ Albany Co., Wyoming. **24,** ♂ holotype. **25,** ♂ Albany Co., Wyoming. **26,** ♂ Coconino Co., Arizona.

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FIGS. 27–38. **27–28,** *E. navajoensis*. **27,** holotype. **28,** San Juan Co., Utah. **29–30,** *E. floridensis*. **29,** holotype. **30,** ♀ Highlands Co., Florida. **31–32,** *E. mirosignata*. **31,** ♂ Jeff Davis Co., Texas. **32,** ♂ Eddy Co., New Mexico. **33–34,** *E. mojaveana*. **33,** holotype. **34,** ♀ Riverside Co., California. **35,** *E. costastriata*, holotype. **36,** ♂ *E. pulveratana* group, Ventura Co., California. **37,** ♂ *E. pulveratana* group, Teller Co., Colorado. **38,** ♂ *E. pulveratana* group, Albany Co., Wyoming.

and VII, those of *E. suadana* do not. The ranges of the two species are disjunct; *E. seamansi* is a resident of the Great Plains, from southern Canada to Iowa, *E. suadana* of the central Rocky Mountain and Great Basin regions.

Description. *Head*: Frons tan to pale grayish brown; vertex grayish brown; labial palpus with medial surface whitish, lateral surface grayish brown; antenna a shade darker than vertex.

Thorax: Dorsal surface grayish brown; ventral surface pale tan; legs gray brown to tan with paler tarsal annulations. *Forewing* (Figs. 17–18): ♂ FWL 7.5–9.0 mm (mean = 8.0, n = 5), AR = 2.90; ♀ FWL 7.2–9.0 mm (mean = 8.0, n = 9), AR = 2.78; markings brown to blackish brown; interfascial areas white to pale grayish brown, usually with gray-brown reticulations; median fascia represented by oblique rectangular mark extending from mid-costa to cubitus; postmedian band sharply expressed and connected to median fascia by patch of grayish-brown scales anterior to ocellus; lustrous gray bars bordering ocellus thinly edged with white; scales along termen blackish brown with white apices; fringe scales paler with white apices; costal markings alternating striate and triangulate from median fascia to apex.

Male genitalia (Fig. 42) (n = 5): Uncus medially indented; vesica with 1–5 deciduous cornuti; ventral margin of sacculus weakly concave; saccular angle acute (53°–72°, mean = 62°); cucullus with 5–7 marginal spines. *Female genitalia* (Fig. 54, 66) (n = 4): Width of membranous portion of lamella antevaginalis less than width of ostium; membrane between sterna VI and VII with distinct pockets; sclerotization of ductus bursae extending from juncture with ductus seminalis to constriction near ostium; corpus bursae with membrane near posterior signum microspinulate.

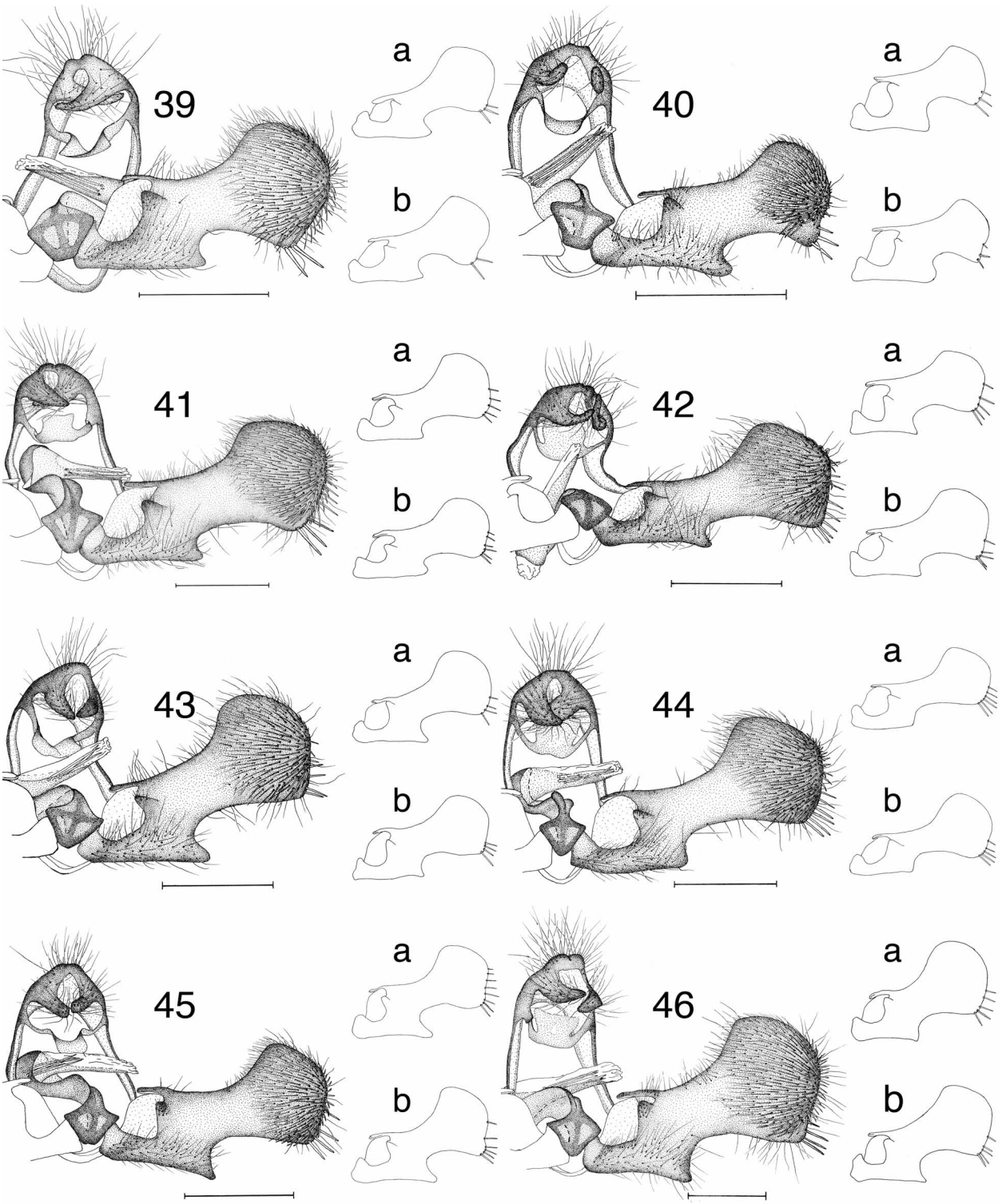
Holotype (Fig. 17). ♂, Canada, Alberta, Lethbridge, H. L. Seamans, 13 July 1928, genitalia slide DJW 2081, CNC.

Paratypes. CANADA. Same location and collector as holotype, 7 June 1920 (1 ♀, genitalia slide DJW 2316), 29 June 1922 (1 ♂, genitalia slide DJW 2315), 4 July 1922 (1 ♂, genitalia slide DJW 2330; 3 ♀, genitalia slide DJW 2313), 12 July 1922 (1 ♂, genitalia slide CNC 136; 2 ♀, genitalia slide DJW 2080), 13 July 1928 (1 ♂, genitalia slide DJW 2081); Manitoba, Aweme, N. Criddle, 16 July 1923 (1 ♀); R. D. Bird, 25 August 1924 (1 ♀). IOWA. Pocahontas Co., Kalsow Prairie, D. J. Wright, 18 June 1992 (1 ♂, genitalia slide DJW 2082); [Johnson Co.], Iowa City, C. N. Ainslie, 23 August (1 ♀). Paratype depositories: CNC, DJW, USNM.

Etymology. This species is named after Howard L. Seamans, the head of the Dominion Entomological Laboratory at Lethbridge, Alberta from 1921 to 1938 and the collector of most of the specimens in the type series.

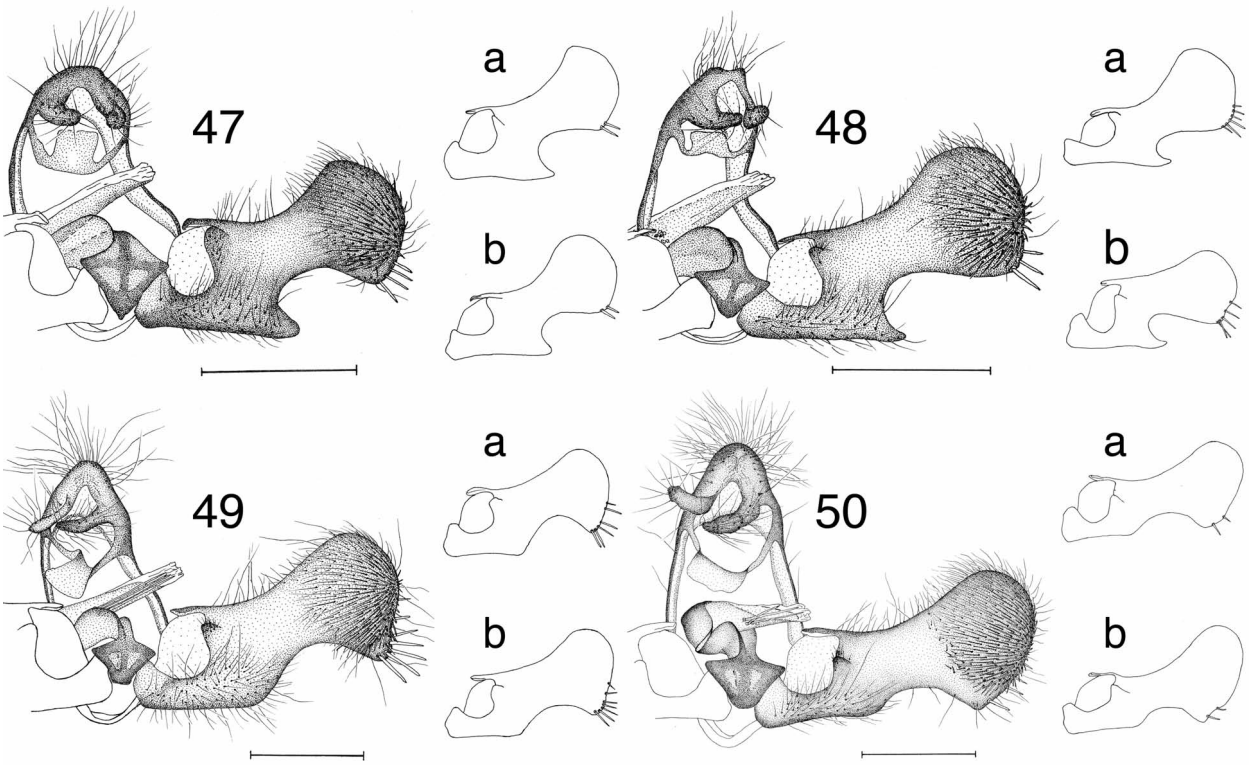
Distribution and biology. I examined 14 specimens (5 ♂, 9 ♀), documenting a range from southeastern Alberta to southeastern Manitoba and south to Iowa (Fig. 77). Adult capture dates range from 6 June to 25 August.

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FIGS. 39–46. Male genitalia. **39,** *E. pulveratana*, slides DJW 1256, USNM 70490, JAP 4224. **40,** *E. consobrinana*, slides DJW 133, 314, USNM 90211. **41,** *E. suadana*, slides DJW 2069, 2079, 2070. **42,** *E. seamansi*, slides DJW 2081, 2330, 2082. **43,** *E. sepiana*, slides DJW 2306, 2307, 764. **44,** *E. coconana*, slides DJW 2325, 2325, 2322. **45,** *E. parapulveratana*, slides DJW 1040, 829, 1190. **46,** *E. navajoensis*, slides DJW 2296, 1075, 2298. Scale bar = 0.5 mm.

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FIGS. 47–50. Male genitalia. **47,** *E. floridensis*, slides DJW 2310, 2309, 1161. **48,** *E. costastriata*, slides DJW 2294, 253, 350. **49,** *E. mirosignata*, slides DJW 2222, 2223, 1258. **50,** *E. mojaveana*, slides DJW 1131, 1851, 2285. Scale bar = 0.5 mm.

Eucosma sepiana, new species

(Figs. 19–20, 43, 55, 67, 75)

Diagnosis. *Eucosma sepiana* is similar in size and genitalia to the sympatric *E. suadana* but is distinguished from that species and from other members of the *pulveratana* group by color (Figs. 19–20): interfascial areas pale yellow brown, markings a darker shade of the same color. *Eucosma mojaveana* (described below) is somewhat similar in appearance (Fig. 33) but is easily separated from *E. sepiana* by genitalia (Figs. 43 vs. 50 & 55 vs. 62).

Description. *Head*: Frons and vertex creamy white, the latter often with pale yellowish-brown tints; labial palpus with medial surface creamy white, lateral surface pale yellowish brown; antenna a shade browner than vertex.

Thorax: Dorsal surface yellowish brown; ventral surface creamy white; legs gray brown with paler tarsal annulations. *Forewing* (Figs. 19–20): ♂ FWL 9.0–10.9 mm (mean = 9.8, n = 22), AR = 3.02; ♀ FWL 9.2–10.6 mm (mean = 9.8, n = 4), AR = 2.83; interfascial areas creamy white to pale yellowish brown, sometimes with fine brown reticulations; subbasal and pretornal marks yellowish brown, often thinly edged with blackish brown; postmedian band yellowish brown and variable in expression; lustrous bars bordering ocellus pale gray; fringe scales pale yellowish brown with creamy white apices; costal markings striate, with interspersed triangular marks from mid-costa to apex.

Male genitalia (Fig. 43) (n = 8): Uncus with dorsal margin straight to weakly indented; vesica with 2–6 deciduous cornuti; saccular angle acute (45°–70°, mean = 59°), with vertex rounded; cucullus with 3–8 marginal spines. *Female genitalia* (Figs. 55, 67) (n = 4): Width of membranous portion of lamella antevaginalis approximately equal to ostium width; membrane between sterna VI and VII lacking pockets; sclerotization of ductus bursae extending from ductus seminalis to constriction anterior to ostium; surface of corpus bursae near smaller signum microspinulate.

Holotype (Fig. 19). ♂, Utah, [Juab Co.], Eureka, Tom Spalding, 16 August 1911, genitalia slide USNM 95243, USNM.

Paratypes. IDAHO: Bear Lake Co., along FS 405, 2 mi. E. Danish Flat, 3 mi. W. Lanark Rd., 7150 ft., 42°17.730' N, 111°30.144' W, T. M. & J. M. Gilligan, 17 August 2004 (2 ♂, genitalia slide DJW 2307); Oneida Co., Curlew NG, 4 mi. ENE of Holbrook, 1 August 2001, D. J. Wright, (1 ♂, genitalia slide DJW 764). UTAH: [Juab Co.], Eureka, Tom Spalding, 30 August 1911 (1 ♂, genitalia slide DJW 2306). WASHINGTON: [Walla Walla Co.], Walla Walla, H. R. Lanchester, 27 August 1953 (1 ♂; 1 ♀, genitalia slide DJW 2302); [Whitman Co.,], Pullman, C. V. Piper, 11 July 1898 (1 ♀, genitalia slide USNM 95244), 10 August 1898 (1 ♀, genitalia slide USNM 70650), 18 September 1898 (1 ♂); [Whitman Co.], Pullman, T. C. Clarke, 27 July 1930 (1 ♂, genitalia slide USNM 70500, wing slide USNM 70501); [Whitman Co.], Kamiack Butte, J. F. Clarke, 4 August 1930 (1 ♂). WYOMING: [Teton Co.], Moran [Junction?], G. H. & J. L. Sperry, 19 July 1938 (3 ♂, genitalia slide DJW 2304), 24 July 1938 (3 ♂, genitalia slide DJW 2308), 25 July 1938 (2 ♂), 29 July 1938 (1 ♂), 30 July 1938 (3 ♂), 11 August 1939 (1 ♂). Paratype depositories: CNC, DJW, TMG, USNM.

Etymology. The specific epithet refers to the distinctive forewing color.

Distribution and biology. The type series consists of 26 specimens (22 ♂, 4 ♀) from Idaho, Utah, Washington, and Wyoming (Fig. 75). Adults fly from mid-July to early September, and capture sites vary in

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elevation from approximately 950 feet at Walla Walla, Washington to 7150 feet in Bear Lake Co., Idaho.

Remarks. Two paratypes from Pullman, Washington collected by C. V. Piper were treated by Kearfott (1907) as cotypes of *Eucosma palousana*, a name interpreted by Wright (2008) as a synonym of *Eucosma biquadrana* (Walsingham).

I examined ten male specimens from the AMNH, CNC, and USNM that have darker brown forewing coloration (Fig. 21) but otherwise seem indistinguishable from *E. sepiana*. They were collected in Colorado, Montana, Nevada and New Mexico at elevations of 7500 to 10,000 feet and are a little larger than the *sepiana* paratypes (mean FWL = 10.6 vs. 9.8 mm).

Eucosma coconana, new species

(Figs. 15–16, 44, 56, 68, 75)

Diagnosis. *Eucosma coconana* is similar in size to *E. suadana*, *E. sepiana*, and *E. mirosignata* (treated below). It lacks the whitish interfascial areas of *E. suadana* and the yellow-brown coloration of *E. sepiana*. It is distinguished from *E. mirosignata* by both forewing appearance (Figs. 15–16 vs. 31–32) and genitalia (Figs. 44 vs. 49 & 56 vs. 61). The SA is usually close to 90°, a feature that distinguishes *E. coconana* from all other members of the group except two possibly unnamed species discussed but not described in the remarks at the end of the paper. *Eucosma coconana* seems to be restricted to the vicinity of Flagstaff, Arizona.

Description. *Head*: Frons pale tan; vertex scales pale tan basally, grayish brown distally; labial palpus with medial surface and dorsal edge pale tan, lateral surface grayish brown; antenna concolorous with vertex.

Thorax: Dorsal surface grayish brown; ventral surface pale tan; fore- and mid-leg with brown anterior surfaces, tan posterior surfaces, and tan annulations at mid-tibia, distal end of tibia, and distal extremity of each tarsomere; hind-leg mostly tan, with tarsomeres somewhat darker and distally ringed with tan. *Forewing* (Figs. 15–16): ♂ FWL 8.5–11.1 mm (mean = 10.1, n = 41), AR = 3.02; ♀ FWL 9.0–10.4 mm (mean = 9.8, n = 6), AR = 2.85; subbasal and pretornal marks blackish-brown; interfascial areas white to tan, heavily reticulated with brown and/or gray, producing a rather dark forewing appearance; median fascia represented by rectangular mark at mid-costa; postmedian band brown to gray, edged with black; lustrous bars bordering ocellus gray; central field of ocellus crossed by three black dashes; scales along termen blackish brown with white apices; fringe scales paler with tan apices; costal markings blackish brown, with striate and triangulate marks interspersed from median fascia to apex, the striae often thinly edged with orange brown.

Male genitalia (Fig. 44) (n = 6): Uncus with dorsal margin straight to weakly indented; vesica with 2–4 deciduous cornuti; saccular angle acute to slightly obtuse (68°–94°, mean = 79°), with broadly rounded vertex; cucullus with 4–7 marginal spines. *Female genitalia* (Figs. 56, 68) (n = 5): width of membranous portion of lamella antevaginalis less than width of ostium; membrane between sterna VI and VII lacking pockets; sclerotization of ductus bursae extending from juncture with ductus seminalis to constriction near ostium; posterior signum with flared base, often extending into narrow sclerotized ring/patch on membrane, with surrounding area microspinulate.

Holotype. ♂, Arizona, Coconino Co., Fort Valley, 7.5 mi. NW Flagstaff, 7350 ft., J. G. Franclemont, 22 July 1964, USNM.

Paratypes. ARIZONA: same location as holotype, R. W. Hodges, 20 June 1961 (1 ♂), 21 June 1961 (1 ♂), 25 June 1961 (1 ♂), 26 June 1961 (1 ♂), 28 June 1961 (1 ♂, genitalia slide DJW 2322; 1 ♀, genitalia side DJW 2323), 3 July 1961 (1 ♂), 6 July 1961 (1 ♀, genitalia side DJW 2367), 7 July 1961 (1 ♂; genitalia slide USNM 70510), 10 July 1961 (1 ♂), 17 July 1961 (1 ♂), 21 July 1961 (1 ♂), 29 July 1961 (1 ♂; 2 ♀, genitalia slide USNM 70512), 30 July 1961 (1 ♂), 7 August 1961 (1 ♂), 9 August 1961 (1 ♂), 11 August 1961 (1 ♂), 22 August 1961 (1 ♀, genitalia slide DJW 2321), 26 August 1961 (1 ♂), 9 September 1961 (1 ♂); J. G. Franclemont, 16 June 1964 (1 ♂), 19 June 1964 (1 ♀, genitalia slide DJW 2324), 26 June 1964 (1 ♂), 28 June 1964 (2 ♂), 29 June 1964 (1 ♂), 1 July 1964 (1 ♂, genitalia slide DJW 2364), 2 July 1964 (1 ♂), 4 July 1964 (1 ♂), 7 July 1964 (4 ♂), 10 July 1964 (3 ♂, genitalia slides DJW 2365, 2366), 13 July 1964 (3 ♂), 14 July 1964 (2 ♂, genitalia slide DJW 2325), 22 July 1964 (1 ♂); Coconino Co., 7 mi. NW Flagstaff, Ft. Valley Exp. For., 7000 ft., H. F. Hsu, J. Powell and M. Prentice, 22–24 July 1989 (4 ♂); Coconino Co., W. Fork Oak Creek, 19 rd. miles SW Flagstaff, 6500 ft., J. A. Powell and F. A. Sperling, 16 July 1995 (1 ♂). Paratype depositories: EME, USNM.

Etymology. The specific epithet derives from the word Coconino, the name of both the County and the National Forest in which the type series was collected.

Distribution and biology. I examined 55 specimens (49 ♂, 6 ♀), all from the vicinity of Flagstaff, Arizona (Fig. 75). Adults have been captured from mid-June to early September, but two-thirds of the records are from July.

Eucosma parapulveratana, new species

(Figs. 1d, 22–26, 45, 57, 69, 76)

Diagnosis. *Eucosma parapulveratana* is recognized by the following combination of characters: forewing elongate (AR = 3.17); interfascial areas uniformly pale and weakly reticulated; cucullus with numerous marginal spines (usually 5 or more); saccular angle acute and strongly produced, with narrowly rounded vertex; width of membranous portion of lamella antevaginalis distinctly smaller than width of ostium; membrane between sterna VI and VII with shallow pockets; surface of corpus bursae near posterior signum microspinulate.

Description. *Head*: Frons creamy white; vertex creamy white to tan; labial palpus with medial surface creamy white, lateral surface pale gray brown; antenna gray brown.

Thorax: Dorsal surface pale tan to gray brown; ventral surface creamy white, sometimes shaded with gray; legs with gray-brown anterior surfaces, creamy white posterior surfaces, and whitish annular markings at mid tibia, distal end of tibia, and distal end of each tarsomere. *Forewing* (Figs. 22–26): ♂ FWL 7.8–9.9 mm (mean = 8.7, n = 27), AR = 3.24; ♀ FWL 6.5–10.5 mm (mean = 8.7, n = 41), AR = 3.13; interfascial areas pale gray to tan, variably suffused with white, and weakly reticulated with brown; subbasal and pretornal marks brown to blackish brown, often edged with black; postmedian band blackish brown, thin, and frequently interrupted near costa; lustrous bars bordering ocellus gray; fringe concolorous with interfascial areas, often darker at apex and at terminal end of postmedian band; costa with striate and triangulate marks from mid-costa to apex.

Male genitalia (Fig. 45) (n = 12): Uncus with dorsal margin straight to weakly indented; vesica with 3–7 deciduous cornuti; saccular angle acute (36°-64°, mean = 51°), with vertex narrowly rounded; cucullus usually with 5–8 marginal spines, occasionally with 4 or 9. *Female genitalia* (Figs. 57, 69) (n = 10): Width of membranous portion of

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lamella antevaginalis approximately one-half width of ostium; membrane between sterna VI and VII with shallow pockets; sclerotization of ductus bursae extending from ductus seminalis nearly to constriction anterior to ostium; corpus bursae with membrane near smaller signum microspinulate.

Holotype (Fig. 24). ♂, Kansas, Morton Co., Cimarron R. & Hwy 51, G. J. Balogh, 25 September 1999, USNM.

Paratypes. COLORADO: Cheyenne Co., Wild Horse Post Office, Hwy 287, 4453 ft., 38°49.60' N, 103°00.60' W, T. M. Gilligan & C. E. Harp, 15 September 2007 (1 ♂; 4 ♀); El Paso Co., Fountain Valley School, 5800 ft., F. M. Brown, 20 June 1958 (1 ♀); Larimer Co., 2 mi. W of Mishawaka on St. Rt. 14, 6300 ft., D. J. Wright, 12 July 1993 (1 ♂, genitalia slide DJW 92); vic. Fort Collins, A. B. Klots, 17 August 1935 (1 ♂); Morgan Co., 3.5 mi. W. of Co. Rd. 19 on Co. Rd. I, 4610 ft., D. J. Wright, 28 July 1995 (1 ♂, genitalia slide DJW 1040); Otero Co., Vogel Canyon Picnic Area, 15 mi. S of La Junta, 4340 ft., 37°46'13" N, 103°30'46" W, D. J. Wright, 18 August 1997 (1 ♂; 2 ♀, genitalia slide DJW 2289); Washington Co., Eastern Colo. Res. Ctr., 16 mi. N Akron, E. Buckner & P. Opler, 19 June 1994 (1 ♂, genitalia slide DJW 270); Weld Co., Pawnee NG, T8N R64W S3, D. J. Wright, 8 August 2004 (1 ♂; 1 ♀); 9 mi. S & 3 mi. W of Fort Morgan by S26 & S27, T2N R58W, T. S. Dickel, 15 August 1992 (1 ♀); 2.5 mi. NE of Roggen on Co. Rd. 386, 4664 ft., 40°11.75' N, 104°20.36' W, C. Harp, 25–26 August 2007 (1 ♂; 2 ♀); Pawnee Nat'l Grassland, Jct. CR-96 & CR-61, 4969 ft., 40°41'00.2" N, 104°24'38.7" W, T. M. Gilligan & P. A. Opler, 31 August 2007 (1 ♂; 2 ♀); Pawnee Nat'l Grassland, Jct. CR-96 & CR-61, 5030 ft., 40°40'58.2" N, 104°24'25.1" W, T. M. Gilligan & P. A. Opler, 31 August 2007 (8 ♀). KANSAS: Morton Co., Cimarron NG, 7.5 mi. N Elkhart, 3414 ft., 37°07.2' N, 101°53.7' W, D. J. Wright, 2 August 1999 (2 ♀, genitalia slide DJW 2290), 25 August 2000 (2 ♀), 26 August 2000 (1 ♂, genitalia slide DJW 2300); Cimarron R. & Hwy 51, G. J. Balogh, 25 September 1999 (2 ♂; 2 ♀, genitalia slide DJW 1261). TEXAS: Cottle Co., Matador WMA, E. C. Knudson, 17 May 1985 (1 ♂, genitalia slide DJW 1263); Hemphill Co., Canadian, A. & M. E. Blanchard, 29 May 1970 (1 ♀, genitalia slide USNM 90403), 2 June 1970 (2 ♂, genitalia slides USNM 90384, 90404); Potter Co., Lake Meredith NRA, Plum Creek, E. C. Knudson, 23 June 1985 (1 ♀, genitalia slide DJW 1265). WYOMING: Albany Co., T15N R73W S1, 2217 Sky View Lane, 7468 ft., J. S. Nordin, 1 July 2002 (1 ♀), 2 July 2005 (1 ♀), 21 July 2004 (1 ♂), 30 July 2001 (1 ♂, genitalia slide DJW 829), 30 July 2006 (1 ♀, genitalia slide DJW 2288); T15N R73W S1, C. D. Ferris, 18 July 2002 (1 ♀, genitalia slide DJW 1038); T15N R75W S29, W side Gelatt Lake, 7250 ft., J. S. Nordin, 9 July 2007 (1 ♀, genitalia slide DJW 1875), 12 July 2004 (1 ♂), 18 July 2005 (1 ♂), 21 July 2004 (2 ♂, genitalia slide DJW 1190; 1 ♀, genitalia slide DJW 1191). Paratype depositories: AMNH, BMNH, CNC, CSU, DJW, EME, GJB, TMG, MEM, USNM.

Etymology. The prefix para, Greek for near, reflects the long history of confusion regarding this species and *E. pulveratana*.

Distribution and biology. I examined 78 specimens (37 ♂, 41 ♀), mostly from the high plains of eastern Colorado, eastern Wyoming, far western Kansas, and the panhandle of Texas (Fig. 76). This count includes some mottled looking specimens (Fig. 26) from Coconino County, Arizona that agree in other respects with typical *E. parapulveratana* but are not designated as paratypes. Adult capture dates range from 20 June to 25 September.

Eucosma navajoensis new species

(Figs. 27–28, 46, 58, 70, 76)

Diagnosis. This is the largest of the species treated here. It is distinguished by size (mean FWL ≈ 11.7 mm) and by the uniformly pale grayish-fawn color of the forewing (Figs. 27–28). In females, the membranous portion of the lamella antevaginalis is distinctly wider than the ostium (Fig. 70). All known specimens are from the southeastern corner of Utah.

Description. *Head*: Frons creamy white; vertex beige; labial palpus with medial surface creamy white, lateral surface beige; antenna concolorous with apex.

Thorax: Dorsal surface beige; ventral surface creamy white; legs with anterior surfaces beige, posterior surfaces creamy white, with ring of creamy-white scales at distal end of tibia, distal end of each tarsomere, and at middle of fore- and mid-tibia. *Forewing* (Figs. 27–28): ♂ FWL 10.9-12.4 mm (mean = 11.6, n = 7), AR = 3.02; ♀ FWL 11.0-12.6 mm (mean = 11.8, n = 4), AR = 2.84; interfascial areas creamy white, heavily reticulated with beige; subbasal and pretornal marks blackish brown; postmedian band narrow, inconspicuous, and largely concolorous with scales anterior to ocellus; lustrous bars bordering ocellus pale fawn; fringe scales beige with creamy-white tips; costal markings alternating striate and triangulate from mid-costa to apex.

Male genitalia (Fig. 46) (n = 4): Uncus weakly divided medially; vesica with 6–8 deciduous cornuti; saccular angle acute (43°–84°, mean = 66°); cucullus with 3–6 marginal spines. *Female genitalia* (Figs. 58, 70) (n = 4): Membranous portion of lamella antevaginalis broader than ostium; membrane between sterna VI and VII with shallow pockets; ductus bursae with sclerotization extending from ductus seminalis nearly to constriction anterior to ostium; membrane of corpus bursae microspinulate near smaller signum.

Holotype (Fig. 27). ♂, Utah, San Juan Co., Comb Ridge west of Bluff, G. J. Balogh, 26 September 2003, genitalia slide DJW 1075, USNM.

Paratypes. UTAH. San Juan Co., Valley of the Gods Rd., 0.5 mi. N. of Hwy 163, G. J. Balogh, 19 September 2000 (1 ♂; 3 ♀, genitalia slides DJW 2297, 2299, 2301), 21 September 2000 (1 ♂, genitalia slide DJW 2298); Comb Ridge west of Bluff, G. J. Balogh, 26 September 2003 (3 ♂, genitalia slides DJW 2077, 2296), 27 September 2003 (1 ♀, genitalia slide DJW 1163). Paratype depositories: DJW, EME, GJB, USNM.

Etymology. The specific epithet refers to the Navajo Indians, whose tribal lands are located just south of the type locality.

Distribution and biology. This species is known from 11 specimens (7 ♂, 4 ♀) collected in September in San Juan County, Utah (Fig. 76) at an elevation of approximately 4500 feet.

Eucosma floridensis, new species

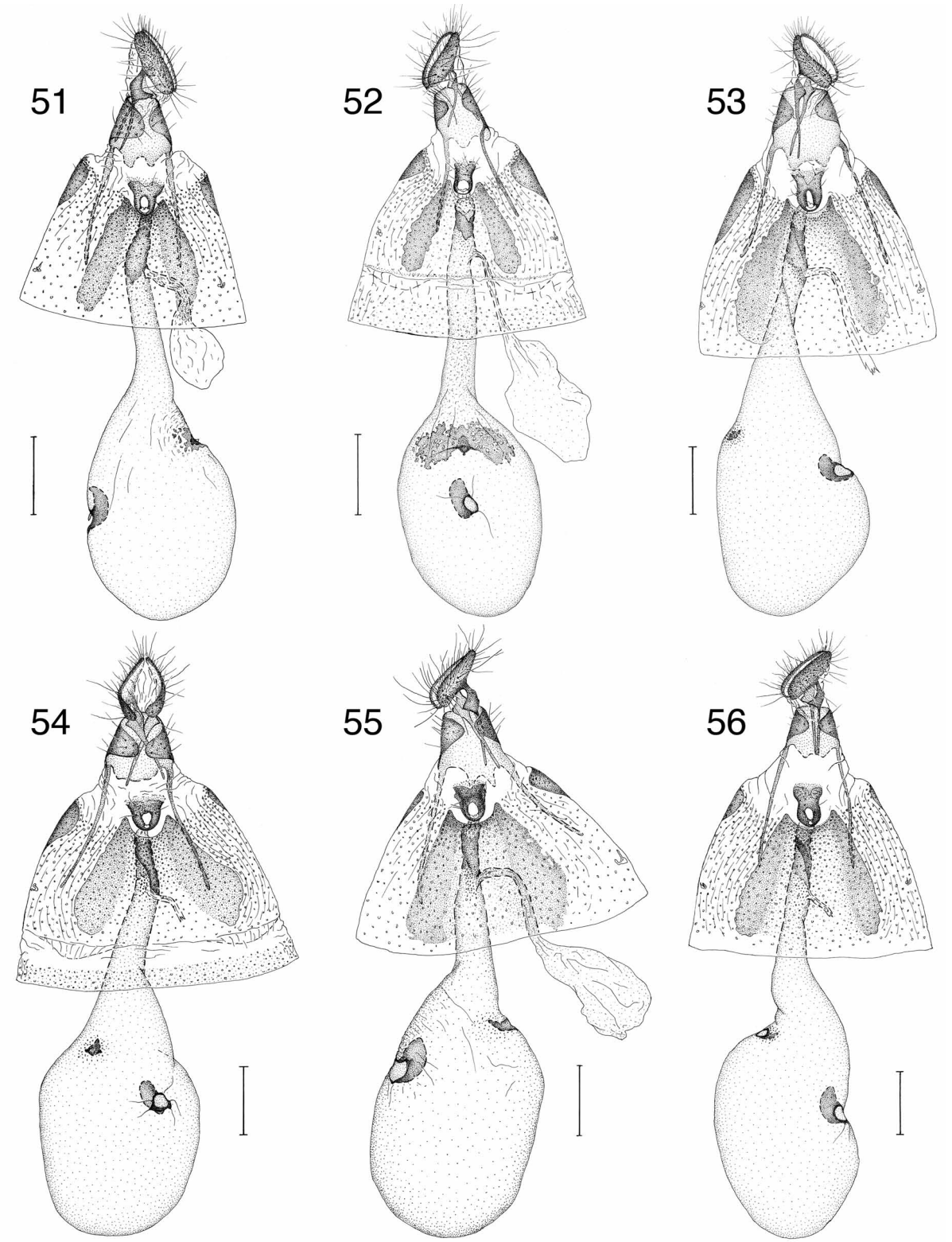
(Figs. 29–30, 47, 59, 71)

Diagnosis. *Eucosma floridensis* appears to be the only member of the *E. pulveratana* group that has been recorded from Florida. It is distinguished by the wine-red color of the postmedian band and the pinkish tint to the distal one-half of the forewing.

Description. *Head*: Frons white; vertex brownish gray to creamy white, sometimes with pale reddish-brown tints; labial palpus with medial surface white, lateral surface brownish gray, shading to white basally; antenna gray to brownish gray.

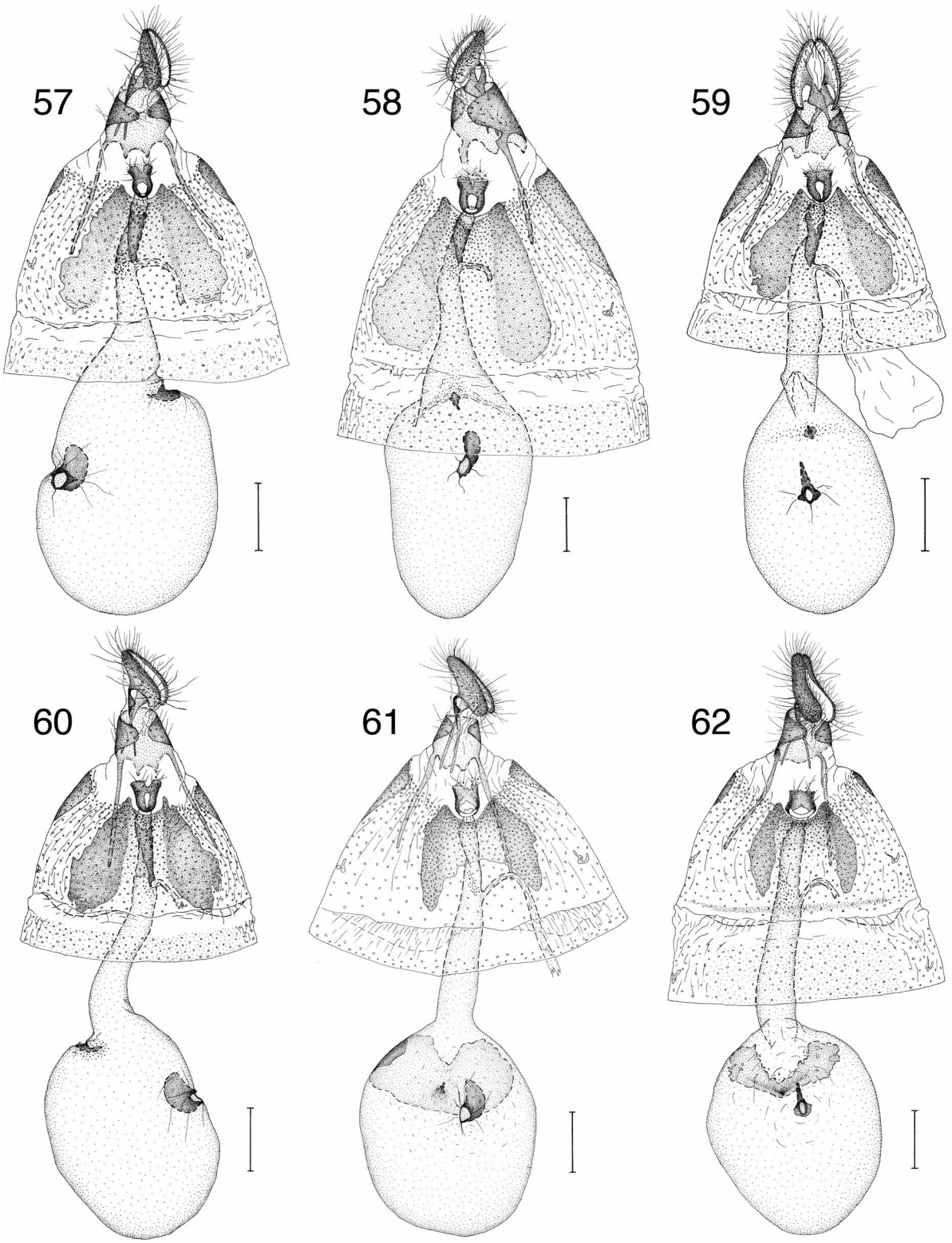
Thorax: Dorsal surface brownish gray tinted with reddish brown; ventral surface whitish; fore- and mid-legs with gray-brown anterior surfaces, whitish posterior surfaces, and whitish markings at mid-tibia, distal end of tibia, and distal ends of tarsomeres; hind-legs whitish, with proximal ends of tarsomeres darker. *Forewing* (Figs. 29–30): ♂ FWL 7.0–8.6 mm (mean = 7.9, n = 5), AR = 2.99; ♀ FWL 7.6 mm (n = 1), AR = 3.17; interfascial areas pale gray brown, variably suffused

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FIGS. 51–56. Female genitalia. **51,** *E. pulveratana*, slide DJW 1257. **52,** *E. consobrinana*, slide DJW 2275. **53,** *E. suadana*, slide DJW 2072. **54,** *E. seamansi*, slide DJW 2313. **55,** *E. sepiana*, USNM 95244. **56,** *E. coconana*, slide DJW 2321. Scale bar = 0.5 mm.

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FIGS. 57–62. Female genitalia. **57,** *E. parapulveratana*, slide DJW 2288. **58,** *E. navajoensis*, slide DJW 2299. **59,** *E. floridensis*, slide DJW 2311. **60,** *E. costastriata*, slide DJW 2293. **61,** *E. mirosignata*, slide DJW 1264. **62,** *E. mojaveana*, slide DJW 2287. Scale bar = 0.5 mm.

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with white and pale reddish brown; subbasal and pretornal marks blackish brown with white edging; postmedian band reddish brown, with some black and gray scaling; lustrous bars bordering ocellus gray; fringe scales blackish gray to reddish gray, with white apices; costal markings mostly striate.

Male genitalia (Fig. 47) (n = 3): Uncus with dorsal margin straight to medially indented; vesica with 4–6 deciduous cornuti; saccular angle acute (38°–56°, mean = 46°), with rounded vertex; cucullus with 2–4 marginal spines. *Female genitalia* (Fig. 59, 71) (n = 1): Width of membranous portion of lamella antevaginalis less than width of ostium; membrane between sterna VI and VII with pockets; sclerotization of ductus bursae extending from ductus seminalis nearly to constriction anterior to ostium; corpus bursae microspinulate near smaller signum.

Holotype. ♂, Florida, Highlands Co., Archbold Biol[ogical] Sta[tion], Lake Placid, D. C. Ferguson, 17 February 1985, USNM.

Paratypes. FLORIDA: same data as holotype (1 ♂, genitalia slide DJW 2309); Highlands Co., Archbold Biol. Sta., S. W. Frost, 22 January 1967 (1 ♂, genitalia slide DJW 1161), 30 January 1964 (1 ♂); Highlands Hammock St. Pk. Cpgd., George J. Balogh, 1 October 1985 (1 ♂, genitalia slide DJW 2310), 15 November 1987 (1 ♀, genitalia slide DJW 2311). Paratype depositories: DJW, MCZ, USNM.

Etymology. The name refers to the state of Florida.

Distribution and biology. The six specimens (5 ♂, 1 ♀) in the type series are from Highlands Co., Florida and were captured between 1 October and 17 February.

Eucosma costastriata new species

(Figs. 1h, 35, 48, 60, 72, 77)

Diagnosis. This species is similar in forewing appearance to *E. mirosignata* (discussed below) but is smaller (mean FWL ≈ 7.9 vs. 9.8 mm) and has distinctly different genitalia (Figs. 48 vs. 49 & 60 vs. 61). The SA is sharply acute (mean ≈ 32°) and the dorsal margin of the uncus is medially indented vs. obtuse (mean ≈ 122°) and semicircular, respectively, in *E. mirosignata*. Females of the two species differ in the sclerotization of both the ductus bursae (present in *E. costastriata*, absent in *E. mirosignata*) and the membrane surrounding the smaller signum (microspinules in *E. costastriata*, a broad plate in *E. mirosignata*). Present data suggest that the ranges of the two species are disjunct (Figs. 77 & 76), but both occur in Texas.

Description. *Head*: Frons pale tan to creamy white; vertex grayish brown; labial palpus with medial surface creamy white, lateral surface grayish brown; antenna concolorous with vertex.

Thorax: Scales on dorsal surface gray brown with white apices; ventral surface tan to creamy white; fore- and mid-legs with anterior surfaces gray-brown, posterior surfaces whitish, and with white annular markings at mid-tibia, distal end of tibia, and distal end of each tarsomere; hind-leg pale tan with lighter tarsal annulations. *Forewing* (Fig. 35): ♂ FWL 6.6–9.1 mm (mean = 7.7, n = 13), AR = 3.02; ♀ FWL 6.8–8.8 mm (mean = 8.0, n = 15), AR = 3.03; interfascial areas pale tan to creamy white, extensively reticulated with gray brown; subbasal and pretornal marks dark brown; postmedian band thin and inconspicuous, often interrupted by whitish subcostal streak; ocellus with lustrous bars gray to fawn and with central field often lacking dark dashes; fringe scales with white tips and pale-brown to blackish-brown medial cross-markings; costal markings striate from base to apex.

Male genitalia (Fig. 48) (n = 8): Uncus weakly divided medially; vesica with 6–8 deciduous cornuti; saccular angle acute (21°–45°, mean = 32°), often weakly falcate; cucullus usually with 4–5 marginal spines, occasionally with 3 or 6. *Female genitalia* (Figs. 60, 72) (n = 5): Membranous portion of lamella antevaginalis shorter than ostium width; membrane between sterna VI and VII with shallow pockets; sclerotization of ductus bursae extending from ductus seminalis nearly to constriction anterior to ostium; corpus bursae microspinulate near small signum.

Holotype (Fig. 35). ♂, Nebraska, Cherry Co., Valentine NWR, Hackberry Lake, R. W. Hodges, 30 June 1983, USNM.

Paratypes. COLORADO: Cheyenne Co., Wild Horse Post Office, 38° 49.60' N, 103°00.60' W, 4453 ft., T. M Gilligan, 11 August 2009 (1 ♂); [El Paso Co.], Colorado Springs, Fountain Valley School, 12–19 July 1932 (1 ♂, genitalia slide ABK 21-XII-32); vic. Colorado Springs, 17 August 1937 (1 ♀); Lincoln Co., Hugo, hospital on Shell St., 5040 ft., T. M. Gilligan, 11 August 2009 (1 ♂; 2 ♀, genitalia slide DJW 2393); Morgan Co., Muir Springs Pk. & Rec. Area, 3 mi. W. Fort Morgan, 4320 ft., T. S. Dickel, 1 August 1992 (1 ♂; 5 ♀, genitalia slide DJW 2293); Morgan Co., 9 mi. S. Ft. Morgan, 3 mi. W. Co. Rd. 19, D. J. Wright, 6 September 2000 (2 ♀); Weld Co., Rd. 386, 1 mi. W Deerfield, Buckner & Opler, 2 September 1994 (1 ♀); Yuma Co., Bonny Reservoir SRA, 0.7 mi. E. of US 385 on Co. Rd. 3, 3720 ft., D. J. Wright, 5 August 1996 (1 ♂, genitalia slide DJW 253). ILLINOIS: Cook Co., Bartel wetland, R. Panzer, 5 September 2002 (1 ♂, genitalia slide DJW 2294). INDIANA: Lake Co., Du Pont Savanna, R. Panzer, 3 August 1999 (1 ♀, genitalia DJW 2295). IOWA: Muscatine Co., Big Sand Mound S. of Muscatine, G. J. Balogh, 11 September 1993 (2 ♂, genitalia slide DJW 350). KANSAS: Morton Co., Cimarron NG, D. J. Wright, 26 August 2000 (1 ♀). MICHIGAN: Allegan Co., T2N R15W S1, G. J. Balogh, 25 July 1992 (1 ♂, genitalia slide DJW 2292), T3N R14 W S31, G. J. Balogh, 25 July 1992 (1 ♂). MONTANA: Carter Co., Medicine Rocks St. Pk., G. J. Balogh, 4 September 2002 (2 ♂; 2 ♀, genitalia slides DJW 1037, 2392), 5 September 2002 (1 ♂, genitalia slide DJW 2076). WISCONSIN: Oneida Co., Lake Katherine, H. M. Bower, 9 August 1961 (1 ♀), 13 August 1961 (1 ♂). Paratype depositories: AMNH, CNC, CSU, DJW, EME, MEM, TMG, USNM.

Etymology. The specific epithet refers to the fine striate markings along the costal margin of the forewing.

Distribution and biology. This moth appears to be restricted to the Great Plains. The 36 specimens (18 ♂, 18 ♀) that I examined document a range extending from southwestern Michigan to eastern Montana, south to Texas and northern Indiana (Fig. 77). Adult flight occurs from early July to mid-September, but most records are from August and September.

Remark. Miller (1987) illustrated as *E. pulveratana* a specimen from Wisconsin that I have included above among the paratypes of *E. costastriata*.

Eucosma mirosignata Heinrich

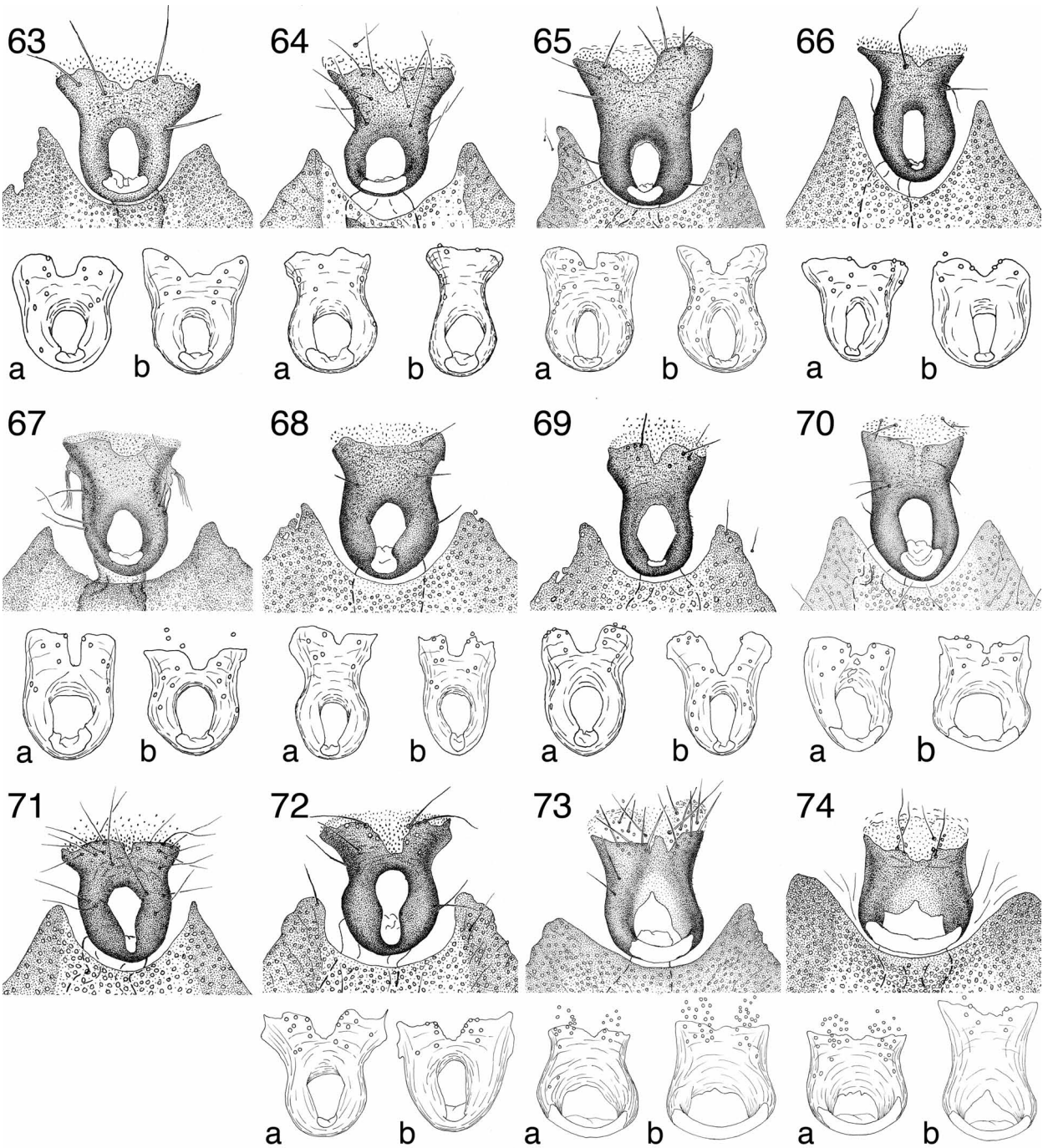
(Figs. 1c, i, 31–32, 49, 61, 73, 76)

Eucosma mirosignata Heinrich 1929:11, fig. 10; McDunnough 1939:47; Powell 1983:35.

Eucosma microsignata: Brown 2005:324, misspelling.

Types. Holotype: ♂, Arizona, Pima Co., Baboquivari Mts., O. C. Poling, 15–30 Oct 1924, genitalia slide 70483, USNM. Paratypes. ARIZONA: Same locality and collector as holotype, 15–30 April 1924 (1 ♀, AMNH), 1–15 May 1924 (2 ♀, USNM, genitalia slide DJW 1259), 15–30 May 1924 (1 ♀, USNM, genitalia slide DJW 1260), 15–30 July 1924 (1 ♀), 27–31 July 1923 (1 ♀, AMNH), 15–30 August 1923 (1 ♀, USNM; 2 ♀, CNC), 1–15 September 1923 (3 ♀, USNM, genitalia slide 70484), 15–30 November 1924 (1 ♀, USNM). CALIFORNIA: (1 ♀, AMNH); San Bernardino Co., Loma Linda, 24–31 August (1 ♀), 16–23 October (1 ♀); San Diego, [San Diego Co.], K. R. Coolidge, 4 August 1920 (1 ♀). [This accounts for 18 of the 20 paratypes mentioned by Heinrich (1929)].

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FIGS. 63–74. Sterigmata. **63,** *E. pulveratana*, slides DJW 1257, USNM 70491, DJW 2073. **64,** *E. consobrinana*, slides USNM 70485, DJW 2272, USNM 90477. **65,** *E. suadana*, slides DJW 1188, 1212, 2278. **66,** *E. seamansi*, slides DJW 2080, 2314, 2316. **67,** *E. sepiana*, slides USNM 95244, DJW 2302, USNM 70650. **68,** *E. coconana*, slides DJW 2323. USNM 70512, DJW 2324. **69,** *E. parapulveratana*, slides DJW 1875, 1191, 2289. **70,** *E. navajoensis*, slides DJW 1163, 2297, 2301. **71,** *E. floridensis*, slide DJW 2311. **72,** *E. costastriata*, slides DJW 1037, 2392, 2393. **73,** *E. mirosignata*, slides DJW 1850, 1260, 1854. **74,** *E. mojaveana*, slides DJW 2286, 2382, 1160.

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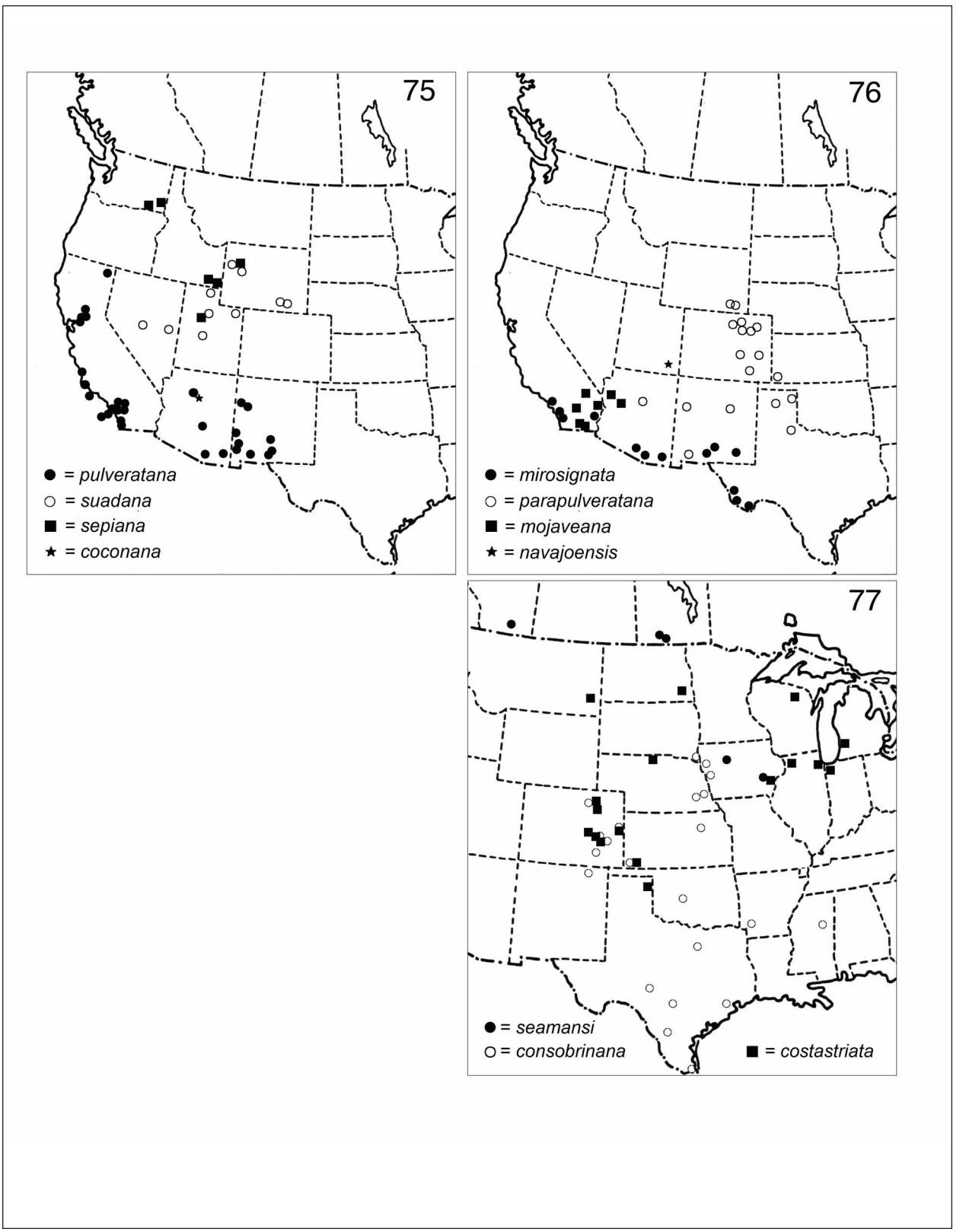


FIG. 75–77. Geographic distribution of species.

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Description. *Head*: Frons white; vertex scales predominantly white, shading to gray brown basally; labial palpus with medial surface white, scales of lateral surface pale brown with white tips; antenna concolorous with vertex.

Thorax: Scales on dorsal surface gray brown with white apices; ventral surface whitish; legs gray brown with white annular markings at mid tibia, distal end of tibia, and distal end of each tarsomere. *Forewing* (Figs. 31–32): ♂ FWL 7.5–11.6 mm (mean = 9.6, n = 27), AR = 3.14; ♀ FWL 8.9–11.2 mm (mean = 10.0, n = 23), AR = 2.95; interfascial areas pale brownish gray, variably reticulated with white; subbasal and pretornal marks blackish brown and prominently edged with white; postmedian band pale brown and inconspicuous, often interrupted by white subcostal streak; lustrous bars bordering ocellus pale fawn to gray; fringe scales with brown to blackish-brown medial cross-markings and white apices; costal markings striate from base to apex.

Male genitalia (Fig. 49) (n = 7): Uncus well developed, with apex rounded; vesica with 2–8 deciduous cornuti; saccular angle obtuse (112°–134°, mean = 122°), with vertex broadly rounded; anal angle acute; cucullus with 5–8 marginal spines. *Female genitalia* (Figs. 61, 73) (n = 9): Lamella postvaginalis with shallow medial trough and with lateral margins weakly concave; membranous portion of lamella antevaginalis broader than ostium; membrane between sterna VI and VII with well developed pockets; ductus bursae lacking sclerotization; sclerotized patch on membrane of corpus bursae moderate to large, constricted medially; smaller signum variable in size, sometimes nearly obsolete.

Distribution and biology. This species seems to be restricted to the desert region of southwestern United States bordering Mexico. I examined 71 specimens (34 ♂, 37 ♀) from southern Arizona, southern California, southern New Mexico, and west Texas (Fig. 76). Adults fly from 24 March to 15 November, but the largest concentrations of records are in April and September.

Remarks. This moth might be confused with *E. costastriata* based on forewing appearance, but the two species are easily separated by genitalia. Differences are discussed in the diagnosis section for *E. costastriata*.

Eucosma mojaveana new species

(Figs. 33–34, 50, 62, 74, 76)

Diagnosis. This species is closest to *mirosignata*, the only other member of the *pulveratana* group with a large apically rounded uncus and an obtuse saccular angle. The two differ in forewing color, *mirosignata* being gray to brownish gray with blackish-brown markings, *mojaveana* creamy white to salmon with orange-brown markings. In *E. mojaveana*, the cucullus has 2–4 marginal spines, and the width of the valva narrows gradually from base to saccular angle; in *E. mirosignata* there are 4–8 marginal spines, and the costal and ventral margins of the basal portion of the valva are parallel.

Description. *Head*: Frons creamy white; vertex and labial palpi creamy white with some pale fawn shading; antenna concolorous with vertex.

Thorax: Dorsal surface pale fawn; ventral surface creamy white; legs creamy white to pale fawn, with white ring at distal extremity of each tarsomere. *Forewing* (Figs. 33–34): ♂ FWL 8.1–8.9 mm (mean = 8.5, n = 11), AR = 2.88; ♀ FWL 8.3–10.4 mm (mean = 9.6, n = 6), AR = 2.89; interfascial areas creamy white, with pale fawn reticulations; subbasal and pretornal marks orange brown; postmedian band pale orange brown, inconspicuous, and usually interrupted by white scaling near costa; lustrous bars bordering ocellus fawn to pearly gray; fringe scales white with brown medial cross-markings; costal markings mostly striate from base to apex.

Male genitalia (Fig. 50) (n = 4): Uncus well developed, with apex rounded; vesica with 2–5 deciduous cornuti; valva narrowing from base to distal end of sacculus; saccular angle obtuse (127°–146°, mean = 136°), with broadly rounded vertex; cucullus with 2–4 marginal spines and with apex semicircular. *Female genitalia* (Figs. 62, 74) (n = 4): Lamella postvaginalis with shallow central trough and with lateral margins straight to weakly concave; lamella antevaginalis almost entirely membranous; membrane between sterna VI and VII with pockets; ductus bursae lacking sclerotization; sclerotized plate on surface of corpus bursae broad, often disintegrating toward lateral extremities, sometimes with thickened ridge emanating laterally from signum.

Holotype (Fig. 33). ♀, California, San Bernardino Co., Afton Road, 23 mi SW Baker, Kitayama, Cave & Chemsak, 23 April 1977, genitalia slide DJW 2287, EME.

Paratypes. ARIZONA: En route Dewey to Salome, 1–7 May (1 ♂); Mohave Co., 8–15 June (1 ♀, genitalia slide DJW 2286); Beaver Dam Canyon, G. J. Balogh, 28 September 2000 (1 ♂, genitalia slide DJW 1131). CALIFORNIA: Imperial Co., Ocotillo, P. A. Opler, 5 October 1967 (1 ♂, genitalia slide DJW 2285); Painted Gorge, E. C. Johnson, 18 April 1950 (1 ♀); [Riverside Co.], Palm Springs, Chino Canyon, E. C. Johnson, 19 April 1950 (1 ♂, genitalia slide DJW 1851); San Bernardino Co., 10 mi. NE Earp, D. D. Linsdale, 17 April 1964 (1 ♂); 10 mi. N Earp, J. R. Powers, 22 April 1960 (6 ♂, genitalia slide DJW 2284), 23 April 1960 (1 ♂; 1 ♀); J. F. Lawrence, 22 April 1960 (1 ♀, genitalia slide DJW 1160). Paratype depositories: CNC, DJW, EME, USNM.

Etymology. The specific epithet refers to the Mojave Desert.

Distribution and biology. The type series consists of 18 specimens (12 ♂, 6 ♀) from southern California and northwestern Arizona (Fig. 76). Most were collected in April, but there is one record each from late September and early October.

REMARKS

Figures 36–38 illustrate moths in the *pulveratana* group which very likely represent three additional unnamed species but which are not described here for lack of sufficient material. The first (Fig. 36) is known from three male specimens collected by A. J. Slater and J. A. Powell on 24 April 1966 at the mouth of the Ventura River in Ventura Co., California. It is a medium sized member of the group (mean FWL = 8.3 mm) with a distinctive olive-brown forewing color. The male genitalia are similar to those of *E. coconana*, with SA ≈ 90°. Figure 37 depicts one of several male specimens acquired by various collectors in July at ca. 8500 ft. in Teller Co., Colorado. These moths are nearly as large as *E. navajoensis* but have a darker and narrower forewing. In male genitalia they resemble *E. suadana*. Finally, Figure 38 is representative of a population of rather melanic-looking members of the *pulveratana* group collected by J. S. Nordin in late June and throughout July at Gelatt Lake in Albany Co., Wyoming. In size they are similar to *E. suadana*, but the male genitalia are closer to those of *E. coconana*, with SA ≈ 90°. A few

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females have been collected at this location, but they are smaller than the males (mean FWL = 9.2 vs. 10.6 mm) and may not be conspecific with the males.

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