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LARVAL HOST PLANT RECORDS OF ASTERACEAE ROOT-FEEDING EUCOSMINI IN CALIFORNIA AND ADJACENT STATES (TORTRICIDAE)

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ABSTRACT. We surveyed woody Asteraceae for root-boring lepidopteran larvae in California, Nevada, and Arizona. Data are reported for 21 species of the genera *Phaneta, Eucosma, Pelochrista, Epiblema,* and *Sonia* (Tortricidae: Eucosmini) reared from 23 species (14 genera) of Asteraceae. Among 80 rearing records, about half of the tortricids were recorded at multiple localities. One widespread species, *Eucosma ridingsana,* fed on several genera of Asteraceae at different localities, and *Sonia vovana* fed on species of two plant genera, whereas other species that we reared more than once were host specific to one or two plants of one genus. Larvae of seven other moth species were associated in these collections, probably as scavengers (Acrolophidae, Oecophoridae, Gelechiidae, macrothecine and phycitine Pyralidae, and Noctuidae). Literature reports of larval hosts for the tortricids are summarized

Additional key words: Lepidoptera, *Phaneta, Eucosma, Pelochrista, Epiblema, Sonia,* Arizona, Nevada, root-borer specificity, Acrolophidae, Oecophoridae, Gelechiidae, Pyralidae, Noctuidae.

INTRODUCTION

The Holarctic genera *Phaneta* and *Eucosma*, *Pelochrista*, and *Epiblema*, along with *Sonia* in the Nearctic, comprise an extremely species-rich group for which no phylogenetic classification has been proposed. Heinrich (1923) based the current classification of Nearctic species on presence/absence of a costal fold in the male, wing venation, and male genitalia. The Eucosmini, including this group of genera, warrants comprehensive study, including assessment of the female genital characters, which Heinrich omitted. There are more than 300 species of these five genera regarded as valid in America north of Mexico, about 60% of them in the western states, and many other species in collections remain unnamed.

Almost all species of the above named genera are endophagous, borers in stems, roots, or conifer cones, and those treated here comprise a guild feeding in roots of Asteraceae. Probably nearly all are specialists in larval host selection, but we lack host plant data for most and have only one record for many of those that have been reared. In 1966–68, as part of broader investigations on microlepidoptera biologies funded by the National Science Foundation, we conducted an extensive survey of tortricid borers in woody Asteraceae. Our study is the primary source of host data for western members of this guild. We present the data here, along with a few records from earlier and later years, in order to make them available for citing host plants in a book in progress on western moths and perhaps to lure researchers into further effort to rearing root-feeding caterpillars.

METHODS

We selected potential field sites for investigation based on past collections of adults, some of which were netted in association with particular composite shrubs, providing clues to their larval hosts. We visited identified localities about four weeks prior to recorded flight dates and searched for likely habitats, especially those dominated by *Chrysothamnus*, *Gutierrezia*, or "*Haplopappus*" (species of the last are now in *Ericameria*, *Hazardia*, *Isocoma*). Armed with narrow blade trenching spades, we dug up suspect shrubs and split open the root crowns to expose evidence of larval borers, exudations of sawdust-like frass. If a healthy colony of Eucosmini was present, we usually detected evidence within the first few plants; if not we spent an hour or more digging to locate a few potential larval galleries or become convinced none was present. When frass was detected, we clipped off lower roots and the above ground stems of the plant and placed the root crowns in plastic bags (45 × 20 cm) for transport in camp coolers. In the insectary, collections were housed in plastic bags lined with paper toweling, and each was reversed and aired out frequently in order to discourage fungal growth yet maintain sufficient moisture to avoid desiccation of larvae or pupae. Larvae were left in situ, and those that successfully transformed constructed emergence trackways leading to frass-encrusted silken turrets where the active pupae wedged enabling eclosion of the adults. When emergences began, the collections were checked daily to harvest newly emerged adult specimens. When moths failed to emerge from the pupal shell following metamorphosis,

identifications were made by genitalia dissections.

All collections were made by one or both of us, often accompanied by one or more student assistants (see acknowledgments). The rearing lot numbers were date-based, e.g. 68G23 = 1968, July, 23rd collection (except "I" was not used, so J-M = September to December). The number for each lot was assigned to notes on larval habits, moths and parasitoid specimens reared, and larvae preserved.

This information is summarized in an Access database. Voucher specimens are deposited in the Essig Museum of Entomology, University of California, Berkeley.

Plant nomenclature and authorship has been updated from that used on our specimen labels and follows The Jepson Manual (Hickman 1993).

Abbreviations: **II** to **XII** = February to December; **emgd.** = dates adults emerged; **n** = number of individuals reared; **AZ** = Arizona. **CA** = California, **NV** = Nevada; **Co.** = County; **Mts.** = Mountains; **Cr.** = Creek; **Vy.** = Valley; **campgr.** = campground; **mi.** = miles; **N, E, S, W, NE** etc. = compass directions

RESULTS

Our efforts produced about 80 rearing records of root-boring Eucosmini from approximately 135 Asteraceae collections processed, including one or more species from 66 collections, 2 or more from 11 collections. In total, we reared 21 species of *Phaneta*, *Eucosma*, *Pelochrista*, *Epiblema*, and *Sonia* from 23 species (14 genera) of Asteraceae, about half of the tortricids from multiple localities. We found one widespread species, *Eucosma ridingsana*, feeding on several genera of Asteraceae at different localities, and *Sonia vovana* fed on both *Gutierrezia* and *Isocoma*; whereas other species for which we had multiple records were host specific to one or two congeneric plants. A species of *Eucosma* and a *Phaneta* or *Sonia* sometimes occupied the same roots, but two congeneric species did so only once, when a single *E. canariana* was reared along with several *E. crambitana*.

Confined females of *Eucosma sandiego* laid large numbers of eggs in crevices and irregularities on the surface of bark and dirt clods, as well as on container sides. Evidently oviposition normally occurs on bark near the base of the plant, and young larvae burrow downward in above ground stems and into the root crowns in later instars. Larvae usually do not penetrate the deeper roots of smaller diameter, but in smaller plants such as *Gutierrezia*, larvae feed on slender roots by scoring a groove and covering the open side with silk and debris. Late instar larvae were found oriented either head upward or downward but eventually form a pupal cell head upward. Emergence is via a track leading to a frass-covered turret at or above ground level. We did not detect a diapause in any of the species we reared.

The roots often are shared by larvae of beetles, especially Cerambycidae and Curculionidae, and by various other insects that invade secondarily. Along with the Eucosmini, we list associated species of Lepidoptera of several families that were reared, all of which probably are detritivores.

Species accounts

Phaneta offectalis (Hulst, 1886)

Senecio spartioides.—68G14: CA: Mono Co., Crooked Creek, White Mts., 10,000', VII.10.1968 (n = 3, emgd. VIII.21/30).

Heinrich (1923) recorded "*Artemisia*" as a food plant of *offectalis*, whereas Sites and Phillip (1989) reared it from *Senecio riddelli*. MacKay (1959) described the larva based on specimens labeled "loco-weed" [*Astragalus* or *Oxytropis*?, Fabaceae], a 1947 collection of larvae from College Station, Texas. This may have been a misidentification of the plant.

Phaneta bucephaloides (Walsingham, 1891)

Chrysothamnus nauseosus. — 68G23: CA, Mono Co., 3 mi. S Lee Vining, VII.11.1968 (n = 3 emgd. VII.29). 68G28: CA, same locality, VII.19.1968 (n = 2, emgd. VIII.5). 68G66: CA, Lassen Co., 3 mi. S Litchfield, VII.24.1968 (n = 19, emgd. VIII.23 to IX.9).

Chrysothamnus viscidifolius.— 68G37: NV, Nye Co., Currant Creek campgr. VII.21.1968 (n= 1, emgd. VIII.21). 68G51: CA, Modoc Co., 8 mi. S Eagleville, VII.23.1968 (n = 1, dead ex pupal shell).

Associated species: 68G23, 68G37 *Eucosma crambitana*; 68G37 *E. canariana*; 68G66 *Alpheias* sp. (Pyralidae).

Engelhardt reared *bucephaloides* from *Chrysothamnus linifolius* in western Colorado (Heinrich 1929) and MacKay (1959) described the larva from the same collection.

Phaneta sp. near ***bucephaloides***

Chrysothamnus viscidifolius: 68G8: CA, Mono Co., Mono Lake, VII.9.1968 (n =1, emgd. IX.9). 68G13: CA, Inyo Co., Westgard Pass, VII.10.1968 (n =1, emgd. VIII.8). 68G35: NV, Nye Co., Currant Cr. campgr. VII.20.1968 (n =1, emgd. IX.9). 68G39: NV, Eureka Co., 3 mi. SE Eureka, VII.21.1968 (n = 1, dead in pupal shell).

Associate species: 68G35 *Alpheias* sp. (Pyralidae),

Eucosma crambitana (Walsingham, 1879)

Chrysothamnus nauseosus.— 68G15: CA, Inyo Co., 5 mi. N Big Pine, VII.10.1968 (n = 1, emgd. IX.5). 68G23: CA, Mono Co., 3 mi. S Lee Vining, VII.11.1968 (n = 13, emgd. VIII.16 to IX.11). 68G28: same locality, VII.19.1968 (n = 3, emgd. VIII.23 to IX.16). 68G48: NV, Washoe Co., 26 mi. N Gerlach, VII.23.1968 (n = 1, dead in pupal shell). 68G66: CA, Lassen Co., 3 mi. S Litchfield, VII.24.1968 (n = 19, emgd. VIII.23 to IX.9).

Chrysothamnus viscidiflorus.—68G3, G4: CA, Mono Co., Topaz Lake, VII.8.1968 (n = 3; emgd. VIII.23/26). 68G37: NV, Nye Co., Currant Creek campgr. VII.21.1968 (n = 4, emgd. VIII.26).

Associated species: 68G23, 68G37 *Phaneta bucephaloides*; 68G37 *E. canariana*; 68G66 *Alpheias* sp. (Pyralidae).

Eucosma sp. near ***crambitana***

Ericameria ericoides. - 66J34: CA, Monterey Co., Seaside, IX.27.1966 (n = 1, emgd. X.3).

Ericameria linearifolia. - 67K93: CA, San Luis Obispo Co., Upper Cuyama Vy., X.6.1967 (n = 5, emgd. X.9/23). 68J20: CA, Ventura Co., Cuyama Vy., 2.8 mi. N Ozena jct., IX-11-1968 (n = 1, emgd. IX.19).

Eucosma canariana Kearfott, 1907

Chrysothamnus viscidiflorus. —68G37: NV, Nye Co., Currant Creek campgr. VII.21.1968 (n =1 emgd. VIII.5).

Associated species: *E. crambitana*, *Phaneta bucephaloides*; *Alpheias* sp. (Pyralidae).

Eucosma aurilineana Ferris, 2005

Chrysothamnus viscidiflorus. —68G11: CA, Mono Co., Toms Place, VII.9.1968 (n = 1, emgd. VIII.28).

Eucosma ridingsana (Robinson, 1869)

Grindelia hirsutula. —66J25: CA, Contra Costa Co., Pt. Molate beach, IX.21.1966 (n = 4, emgd. IX.22 to X.3).

Lessingia filaginifolia.—67D39: CA, San Luis Obispo Co., Oso Flaco dunes, IV.12.1967 (n = 1, emgd. by X.12). 68D194: same locality, IV.27.1968 (n = 2, emgd. VII.22,24).

Gutierrezia microcephala.—64H2: CA, San Diego Co., Boulevard, VIII.9.1964 (n = 1, emgd. IX.24). 68F60: CA, San Diego Co., 1 mi E. Jacumba, VI.7.1968 (n = 1, emgd. dead by IX).

Gutierrezia sp.—68F18: AZ, Mohave Co., NE of Kingman, VI.3.1968 (n = 2, emgd. VIII.19). 68F33: AZ, Yavapai Co., 7 mi. NE Bridgeport, VI.4.1968 (n = 4, emgd. VIII.12/26). 68F34: AZ, Yavapai Co., 15 mi. NE Prescott, VI.4.1968 (n = 1, emgd, VIII.19). 68F41: AZ, Gila Co., 1 mi. S Rye, VI.5.1968 (n = 3, emgd. VIII.22 to IX.5).

Isocoma menziesii.—68H28: CA, San Diego Co., Mission Dam, VIII.26.1968 (n = 1, emgd. X.1).

E. ridingsana was reared by Clarke from *Heterotheca villosa* in southeastern Washington (Brown *et al*.1983) and from *Gutierrezia* by Hetz and Werner (1969) in Arizona. Heinrich (1923) gave a questioned record, root-borer in "greasewood ?(*Sarcobatus vermiculatus*?)" (Chenopodiaceae), which was repeated by MacKay (1959), based on a 1915 collection of larvae from El Paso Co, Colorado. The records by Prentice (1965) as a shoot borer in *Pinus ponderosa* and *P. contorta* in British Columbia are erroneous, and possibly refer to *E. sonomana* Kearfott.

Associated species: 68H28 *Battaristis pasadenae* (Keifer) (Gelechiidae); 68F11 *Tathorhynchus exsiccatus* (Lederer) (Noctuidae).

Eucosma caniceps (Walsingham, 1884)

Artemisia tridentata.—68G1: CA, Mono Co., Leavitt Meadows, VII.8.1968 (n = 2, emgd. VII.22,25).

Artemisia (shrub, not *tridentata* ?).—68G19: CA, Inyo Co., 6 mi. S Bishop, VII.11.1968 (n = 5; emgd. VIII.26 to IX.24).

Eucosma avalona McDunnough, 1938

Artemisia californica.—67D42: CA, Santa Barbara Co., Cuyama River, 11 mi. ENE Santa Maria, IV.27.1967 (n = 2, emgd. by X).

Eucosma sandiego Kearfott, 1908

Isocoma acradenia.—67K1: CA, Kern Co., W of Caliente, X.1.1967 (n = 1, dead in pupal shell).

Isocoma menziesii.—all CA, San Diego Co.: 66J10: 4 mi SE El Cajon, IX.2.1966 (n = 1, emgd. X.28). 66J13: (pale desert race) Scissors Crossing, IX.2.1966 (n = 26, emgd. IX.6/29). 67K59: 4 mi SE El Cajon, X.4.1967 (n = 25, emgd. X.8/17). 67K79: Cardiff-by-the-Sea, X.6.1967; n = 4, emgd. X.11).

Associated species: 66J13, 67K79 *Amydria obliquella* Dietz (Acrolophidae); 66J10, 67K59 *Battaristis pasadenae* Keifer (Gelechiidae); 66J10 *Isophrictis* sp. (Gelechiidae); 66J10, 67K59, K79 *Sonia filiana*.

Eucosma optimana Dyar, 1893

Artemisia tridentata.—all CA Mono Co.: 68G2: Topaz Lake, VII .8.1968 (n = 1, emgd. dead IX). 68G5:1 mi. NE Walker, VII .8.1968 (n = 2; emgd. IX.9/20). 68G7: Mono Lake, VII.9.68 (n = 1, emgd. VIII.26).

Eucosma laticurva Heinrich, 1929

Erigeron inornatus.—68G69: CA, Plumas Co., SW edge Plumas-Eureka State Park, VII.27.1968 (n = 2,

emgd. VIII.5, IX.25).

Eucosma maculatana (Walsingham, 1879)

Eriophyllum lanatum.—67D143: CA, Marin Co., 6 mi. SE Nicasio, IV.30.1967 (n = 2, emgd. VI.2). 68D177: CA, San Benito Co., Limekiln Canyon, IV.24.1968 (n = 2, emgd. V.30).

Eucosma williamsi Powell, 1963

Baccharis pilularis.—67D34.1: CA, San Luis Obispo Co., 5 mi. N Creston, IV.11.1967 (n = 1, emgd. VI.3). 67D43: CA, Santa Barbara Co., Cuyama River,11 mi. ENE Santa Maria, IV.12.1967 (n = 30, emgd, V.27 to VI.29).

The original series of this species was reared by F. X. Williams from larvae boring in roots of *B. pilularis* in February in the Oakland Hills, Alameda Co., CA, adults emerging in July (Powell 1963). De Benedictis *et al*. (1990) also reared this species at San Bruno Mt., San Mateo Co., from the same plant.

Pelochrista metariana (Heinrich, 1923), species complex

Heliomeris multiflora.—68G32: NV, Esmeralda Co., Lida Summit, VII.20.1968 (n = 14, emgd. VIII.5/19).

Pelochrista passerana (Walsingham, 1879)

Achillea millefolium.—04B38: CA, Santa Barbara Co., Santa Barbara Island, II.23. 2004 (n = 3, emgd. VI.1,2).

Epiblema strenuana (Walker, 1863) (beach form, differs phenotypically from typical *strenuana*)

Ambrosia chamissonis.—78J3: CA: Santa Barbara Co., Prisoners Harbor, Santa Cruz Id., IX.25.1978 (n = 1 emgd. X.29). 88M3: CA: Contra Costa Co., Point Molate beach, XII.12.1988 (n = 8, emgd. I.10 to II.19.1989). 92F15: CA: Contra Costa Co., Richmond Field Station, VI.24.1992 (n = 6, emgd. VII.5/19). 95D100: CA: Santa Barbara Co., Cluster Point, Santa Rosa Id., IV.29.1995 (n = 2, emgd. VI.12).

The larvae bore in the woody stems, which act as rhizomes for the spreading plant, at or just beneath the sand surface. Presence of larvae is evidenced by accumulations of frass at nodes or breaks in the brittle stems. On *A. psilostachya* at Antioch dunes Natl. Wildlife Refuge, Contra Costa Co., growing on riverine sand dunes, larvae of *strenuana* burrowed into vegetative terminals and downward in the above ground stems.(82E92, 82F13, 91H23). Typical populations of *E. strenuana* have been reared from Asteraceae in the subtribe Ambrosiinae, including other *Ambrosia* species, *Parthenium*, and *Xanthium*, in widespread parts of North America, recorded by Heinrich (1923), MacKay (1959), Miller and Pogue (1984) and others.

Sonia vovana (Kearfott, 1907)

Gutierrezia californica.—64H2: CA, San Diego Co., Boulevard, VIII.9.1964 (n = 1, emgd. by IX.25). 66H13: CA, Kern Co., McKittrick, VIII.30.1966 (n = 3, emgd. IX.12/ 22). 68H24: CA, Riverside Co., La Sierra College, VIII.22.1968 (n = 5, emgd. IX.13 to X.1).

Gutierrezia microcephala [= *lucida* ?]. - 66H20: CA, Los Angeles Co., 2 mi. S Lancaster, VIII.31.1966 (n =1, emgd. IX.5). 66J2: CA: San Bernardino Co., 2 mi. SE Desert Springs [now Pinon Hills], IX.1.1966 (n = 1, emgd. IX.7). 66J16: CA, Los Angeles Co., 2 mi. N. Lancaster, IX.3.1966 (n = 5, emgd. IX.12 /26). 68F60: CA, San Diego Co., 1 mi. E Jacumba, VI.7.1968 (n = 6, emgd. VIII.5/28). 91F17: CA, Contra Costa Co., Antioch Natl. Wildlife Refuge (LC), VI.11.1991 (n = 1, emgd. IX.9). 91F17.1: same data except (SP, west parcel) (n = 1, emgd. IX.11).

Gutierrezia sarothrae.— all CA, San Diego Co.: 66J11: Buckman Spr., IX.2.1966 (n = 1, emgd. IX.21). 66J12: 1 mi E Boulevard, IX.2.1966 (n = 4, emgd. IX.7 to IX.26). 67K61: Lyons Vy., X.4.1967 (n = 1, dead in pupal shell). 67K71: Scissors Crossing, X.5.1967 (n = 1, emgd. X.8).

Gutierrezia sp. (sterile). - 67K30: CA, Los Angeles Co., 2 mi. N Lancaster, X.2.1967 (n = 1, dead in pupal shell). 67K60: CA, San Diego Co., Lee Vy., X.4.1967 (n = 1, emgd.). 67K65: CA, S.D. Co., Buckman Springs, X.5.1967 (n = 3, emgd. X.10/18). 67K92: CA, San Luis Obispo Co., Upper Cuyama Valley, X.6.1967 (n = 3, emgd. X.11). 68F33: AZ, Yavapai Co., 7 mi NE Bridgeport, VI.4.1968 (n = 2, emgd. VIII.16 to X). 68F36: AZ, Gila Co., Pine campgr., VI.5.1968 (n = 1, emgd. VII.17).

Isocoma tenuisecta.—68F58: AZ, Pima Co., VI.6.1968 (n = 2, emgd. IX.16,18).

Isocoma menziesii.—68H28: CA, San Diego Co., Mission Dam, VIII.26.1968 (n = 1, emgd. X.1).

Associated species: 68F58 *Inga concolorella* (Oecophorinae); 67K92 unidentified sp. (Blastobasinae); 66H13 *Isophrictis* sp. (Gelechiidae); 67K65 *Battaristis pasadenae* Keifer (Gelechiidae); 68F33, 68F60, 68H28 *Eucosma ridingsana*.

Sonia comstocki Clarke, 1952

Isocoma acradenia.—66H19: CA, Los Angeles Co., 6 mi. W Lancaster, VIII.31.1966 (n = 2, emgd. X.3/9). 67K29: CA, L. A. Co., 2 mi. N Lancaster, X.2.1967 (n = 1, emgd . X.7). 67K33: same data except 6 mi. W Lancaster (n = 16, emgd. X.6/17).

Associated species: 67K33 *Ephestiodes gilvescentella*

Ragonot (Pyralidae).

Sonia filiana (Busck, 1907)

Isocoma acradenia.—all CA, San Diego Co.: 66J10: 4 mi. SE El Cajon, IX.2.1966 (n = 12, emgd. IX.13 to X.1). 67K59: same locality, X.4.1967 (n = 83, emgd. IX.18 to XII.16).67K79

Associated species: 67K79 *Amydria obliquella* Dietz (Acrolophidae); 66J10 *Isophrictis* sp. (Gelechiidae); 66J10, 67K59 *Battaristis pasadenae* Keifer (Gelechiidae); 66J10, 67K59 *Eucosma sandiego*.

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LITERATURE CITED

BROWN, R. L., J. F. G. CLARKE, & D. H. HABECK 1983. New host records for Olethreutinae (Tortricidae). J. Lepid. Soc. 37: 224–227.

DE BENEDICTIS, J. A., D. L. WAGNER, & J. B. WHITFIELD 1990. Larval hosts of Microlepidoptera of the San Bruno Mountains, California. Atala 16: 14–35.

HEINRICH, C. 1923. Revision of the North American moths of the subfamily Eucosminae of the family Olethreutidae. U.S. Natl. Mus., Bull. 123; iv + 298 pp.

HEINRICH, C. 1929. Notes on some North American moths of the subfamily Eucosminae. U.S. Natl. Mus., Proc. 75: 1–23.

HETZ, M. W. & F. G. WERNER 1969. Insects associated with some rangeland Compositae in southern Arizona. Southwestern Entomol. 4: 285–288.

HICKMAN, J. C. (ed.) 1993. The Jepson Manual, Higher Plants of California. U. California Press, Berkeley, Los Angeles, London; xvii + 1,400 pp.

MACKAY, M. R. 1959. Larvae of the North American Olethreutidae (Lepidoptera). Canad. Entomol., Suppl. 10; 338 pp.

MILLER, W. E. & M G. POGUE 1984. Ragweed borer (Lepidoptera: Tortricidae: Eucosmini): taxonomic implications of an allometric analysis of adult characters. Ann. Entomol. Soc. Amer. 77: 227–231.

POWELL, J. A. 1963. Records and descriptions of some interesting species of *Eucosma* in California (Lepidoptera: Tortricidae). Proc. Biol. Soc. Washington 76: 235–246.

PRENTICE, R. M. (compiler) 1965. Forest Lepidoptera of Canada, Recorded by the Forest Insect Survey. Vol. 4 Microlepidoptera, pp. 545–840.

SITES, R. W. & S. A. PHILLIPS 1989. Root-feeding insects of *Senecio riddellii* in eastern New Mexico and northwestern Texas. J. Range Mgmt. 42: 404–406.