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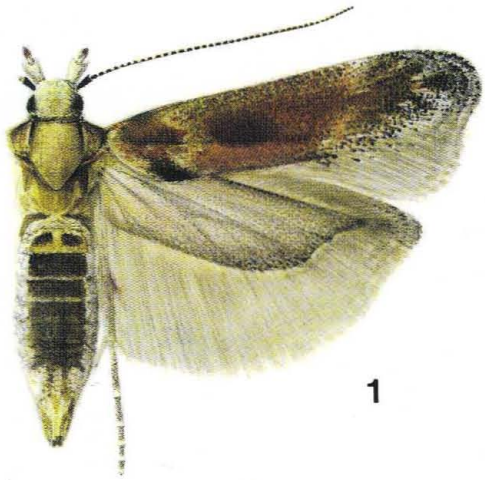
HOLARCTIC LEPIDOPTERA

GNORIMOSCHEMINE MOTHS OF COASTAL DUNE AND SCRUB HABITATS IN CALIFORNIA
(LEPIDOPTERA: GELECHIIDAE)

JERRY A. POWELL
DALIBOR POVOLNÝ



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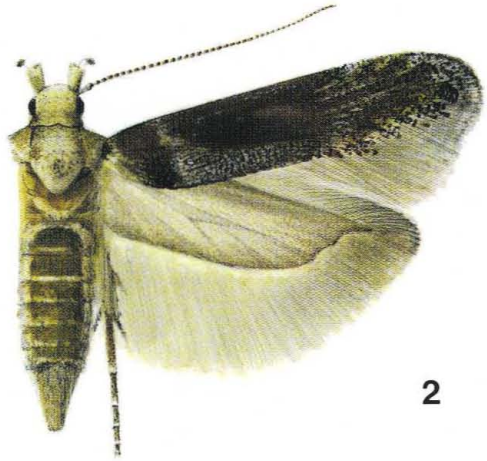

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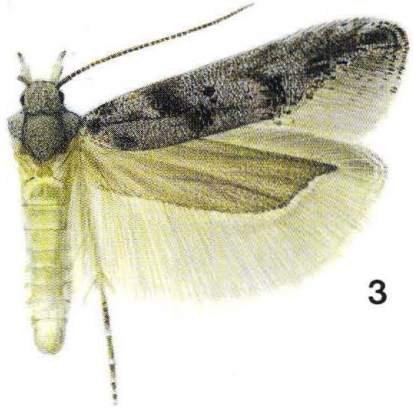

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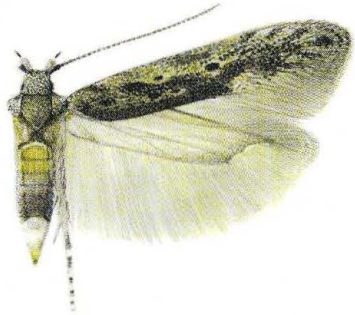

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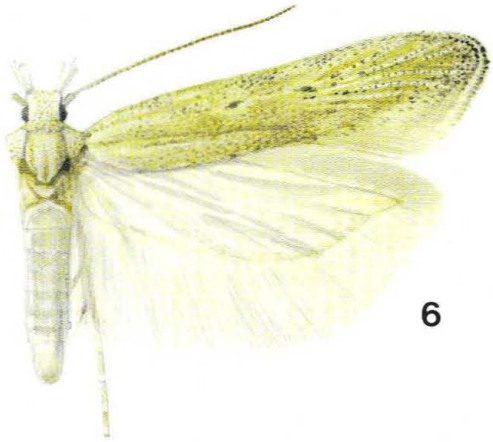

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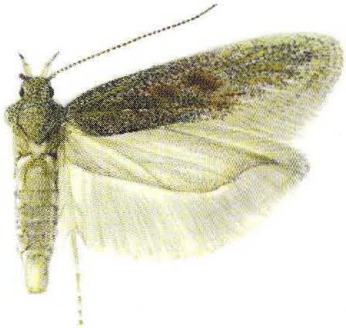

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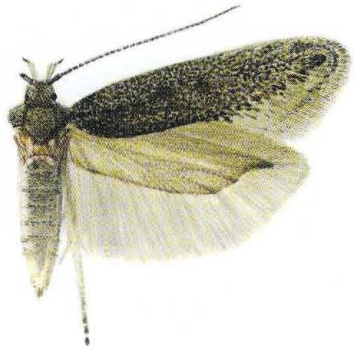

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HOLARCTIC LEPIDOPTERA

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GNORIMOSCHEMINE MOTHS OF COASTAL DUNE AND SCRUB HABITATS IN CALIFORNIA (Lepidoptera: Gelechiidae)

by
JERRY A. POWELL AND DALIBOR POVOLNÝ

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FRONTISPIECE.– Habitus sketches of California Gnorimoschemini: **1-2,** *Gnorimoschema grindeliae* Povolný & Powell, **n. sp.**, females; **3,** *G. debenedictisi* Povolný & Powell, **n. sp.**, male; **4,** *Scrobipalpula gutierreziae* Povolný & Powell, **n. sp.**, female; **5,** *Tuta chiquitella* (Busck), male; **6,** *Exceptia sisterina* Povolný & Powell, **n. sp.**, male; **7-8,** *Euscrobipalpa arenacearielle* Povolný & Powell, **n. sp.**, male, female dark form. Dr. F. Gregor, painter.

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GNORIMOSCHEMINE MOTHS OF COASTAL DUNE AND SCRUB HABITATS IN CALIFORNIA (LEPIDOPTERA: GELECHIIDAE)

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ABSTRACT.– We detail the taxonomy and biology of moths of the tribe Gnorimoschemini that occur on the immediate coast of the Pacific Ocean, San Francisco Bay, and San Joaquin-Sacramento River delta in California. The data are based on our collections at ca. 65 localities, on the mainland and on 6 of the Channel Islands, spanning 40+ years, and examination of other specimens in museum collections. We treat 35 species (ca. 26% of the described Nearctic fauna), of which 17 are newly described; and 3 are Palaearctic names newly applied to the North American fauna, one of them probably introduced, two Holarctic. One species name, *Keiferia elmorei* (Keifer), is raised from subjective synonymy. We apply 3 generic names newly employed in North America: *Euscrobipalpa* Povolný, *Scrobipalpulopsis* Povolný, *Tuta* Strand. New species (type locality) are as follows: *Gnorimoschema aterrimum* Povolný & Powell (San Bruno Mt., San Mateo Co.), *G. baccharisellloides* P. & P. (Oso Flaco Lake, S. L. O. Co.), *G. crypticum* P. & P. (Big Creek, Monterey Co.), *G. debenedictisi* P. & P. (San Bruno Mt.), *G. ericoidesi* P. & P. (Dune Lakes, S. L. O. Co.), *G. grindeliae* P. & P. (Pt. Richmond, Contra Costa Co.), *G. stigmaticum* P. & P. (Santa Catalina Id., L. A. Co.), *G. tenerum* P. & P. (San Bruno Mt.); *Scrobipalpulopsis lycii* Povolný (San Clemente Id., L. A. Co.); *Scrobipalpula antiochia* Povolný & Powell (Antioch, Contra Costa Co.), *S. gutierreziae* P. & P. (Antioch); *Tuta chiquitelloides* Povolný (San Clemente Id.), *T. insularis* Povolný (Santa Catalina Id.); *Euscrobipalpa arenacearíella* Povolný & Powell (Big Creek); *Scrobipalpopsis interposita* P. & P. (Briones Reservoir, Contra Costa Co.), *S. madiae* P. & P. (Big Creek); *Exceptia sisterina* P. & P. (Big Creek). Hostplants are recorded for 25 species, based on rearing adults from ca. 170 larval collections, and are known elsewhere for 3 others, so hostplants for 80% of the species are recorded. We summarize biogeographic relationships of the Nearctic and Californian Gnorimoschemini. Appendices list the described Gnorimoschemini species in California and the larval hostplants used by them.

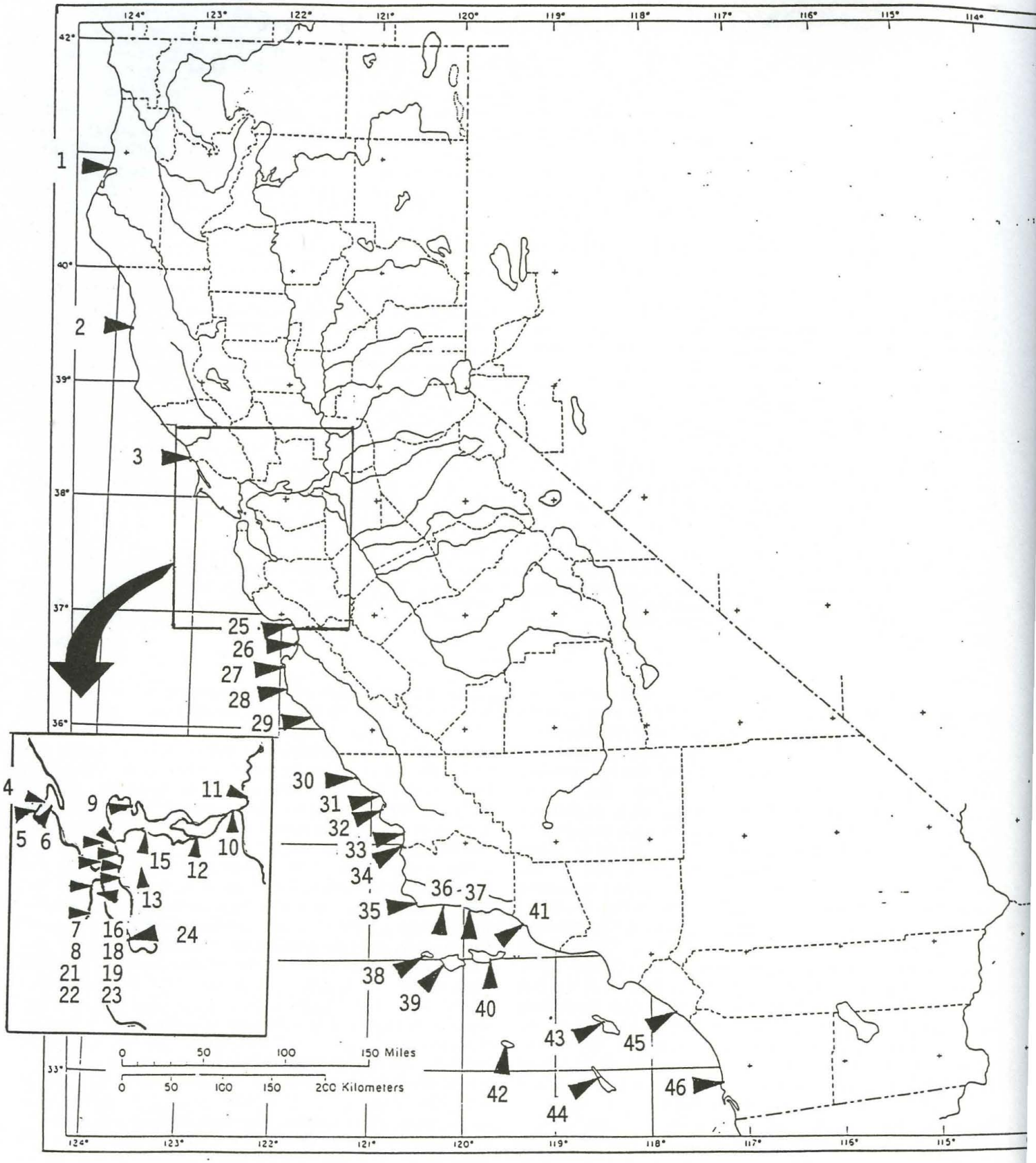
KEY WORDS [new sp. all by Povolný & Powell except as noted]: Asteraceae, biology, Chenopodiaceae, distribution, ***Exceptia sisterina*** n. sp., galls, Gnorimoschemini, ***Gnorimoschema aterrimum*** n. sp., ***Gnorimoschema baccharisellloides*** n. sp., ***Gnorimoschema crypticum*** n. sp., ***Gnorimoschema debenedictisi*** n. sp., ***Gnorimoschema ericoidesi*** n. sp., ***Gnorimoschema grindeliae*** n. sp., ***Gnorimoschema stigmaticum*** n. sp., ***Gnorimoschema tenerum*** n. sp., Holarctic, hostplants, leafmining, Nearctic, North America, Palaearctic, Salicaceae, ***Scrobipalpulopsis lycii*** Povolný n. sp., ***Scrobipalpula antiochia*** n. sp., ***Scrobipalpula gutierreziae*** n. sp., ***Tuta chiquitelloides*** Povolný n. sp., ***Tuta insularis*** Povolný n. sp., ***Euscrobipalpa arenacearíella*** n. sp., ***Scrobipalpopsis interposita*** n. sp., ***Scrobipalpopsis madiae*** n. sp., Scrophulariaceae, Solanaceae, taxonomy.

This study began with sporadic, informal surveys of microlepidoptera associated with coastal sand dunes in California by Powell in the 1960's. Efforts were focused into a more systematic inventory in the early 1970's, when it had become obvious that destruction of the remaining dune systems had accelerated. Coastal scrub and sand dune habitats support unique plant and insect associations that occur in limited geographic areas such that destruction of whole communities by human impact is likely. Habitat perturbation originates primarily from three sources: planting or invasion of non-native plants, urban and industrial development including sand mining, and off-road vehicle (ORV) use, which began to have consummate destructive effects on coastal dunes in California around 1970 (Fig. 112-115).

During the ensuing decade, we attempted inventories at 18 of the 32 dune systems identified by Cooper (1967) and at 3 riverine dune systems in the Sacramento-San Joaquin River delta (Powell, 1981). All of the other coastal dunes defined by Cooper are small, less than 10 sq km, except one, Purisma Point, which is within Vandenburg Air Force Base (Santa Barbara Co.). Ultimately, however, we abandoned the notion of comprehensive inventory of the dune systems owing to problems in defining them and their coastal strand plant communities and in equating sampling effort among systems of vastly different sizes and perturbation histories. Nonetheless, it became evident that larger dune systems are more complex topographically and in vegetational diversity, therefore harboring more species of moths, and endemic species of Lepidoptera in these habitats are confined to the largest systems (Powell, 1976, 1981, 1991).

Coastal strand habitats are rich in gnorimoschemine Gelechiidae. We began a study of the species encountered in the dunes inventories and later enlarged it to encompass Gnorimoschemini feeding on plants in other coastal habitats, especially coastal scrub. The species treated here occur within the ocean coastal strand or along San Francisco Bay and/or the delta area of the Sacramento and San Joaquin Rivers. We include records of previously undescribed species from inland localities, but species known only from inland sites are mentioned only for comparative purposes.

The tribe Gnorimoschemini (Povolný, 1964) is represented worldwide. Its evolutionary center appears to be in xeric habitats of South America (Patagonian cold steppes and xeromontane Andes), and the tribe is diverse in the southwestern Nearctic. A generic framework for the North American fauna has been developed (Busck, 1939; Povolný, 1967a; Hodges, 1983). The previously described fauna includes 117 species in 18 genera (#1968-2053 in the 1983 MONA Check List, Hodges, 1983; Huemer, 1988; Povolný, 1985, 1998a,b,c,d, 1999a,b, 2000). We treat 35 species and add 21 to the Nearctic fauna (17 new, plus 3 European that may be introduced or Holarctic; one species is raised from synonymy), and we apply 3 generic names that have been applied elsewhere previously. One of these, *Euscrobipalpa* Povolný (1967b), replaces *Scrobipalpa* Janse, for our fauna. We do not propose new genera nor generic synonymies. Species level taxonomic study is needed throughout North America, but a comprehensive study of western or California species is not feasible at this time.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Characteristics of coastal dune and strand communities

The coastal dune community develops where there is accumulated sand above high tide level. Along the Pacific Coast of North America, this typically occurs any place where the coastline presents a barrier to prevailing winds from the northwest. The resulting habitats occur like a chain of islands along the coast. They extend inland in a southeasterly direction for varying distances, becoming gradually more stabilized by vegetation, or terminating abruptly with a change in geologic or physiographic formation, such as coastal prairie or rocky bluffs.

The floral diversity is low in species richness and architecture, with only a few dominant plant species at any given locality and little horizontal zonation; yet there is considerable shift in species composition latitudinally (Powell, 1981). Fog and wind are prevalent, particularly during the summer, which is the dry season for other low elevation communities in the region. As a result, many plants remain green and in flower, and insect species often have protracted flight periods (Langston, 1974). The climate is moderate, with minimal seasonal and diel fluctuations in temperature. The maritime influence and summer fogs result in similar mean temperatures in January and July.

Smaller dune sites feature a foredune community of quite low plant diversity, while larger dune systems develop three primary zones or land forms: 1) foredunes, the line of dunes that parallels the beach behind high tide level, which are characterized by unstabilized sand, sparsely covered with a simple plant community of 3-6 low-growing invader species; 2) a deflation plain immediately back of the fore-dunes, at or near the water table and characterized by a mixture of water tolerant plants and invader dune species; 3) an interior zone consisting of stabilized dunes, adjacent to the deflation plain and farther inland, behind high dunes of active sand.

METHODS

Field survey.– Localities sampled for this report include coastal strand and scrub vegetation types, parts of four plant communities as defined by Munz and Keck (1959): Coastal Strand, Coastal Salt Marsh, Northern Coastal Scrub, and Coastal Sage Scrub. Typical Coastal Strand plants include *Ambrosia* (*Franseria*) *chamissonis*, *Artemisia pycnocephala*, *Ericameria ericoides* (Asteraceae), *Atriplex leucophylla* (Chenopodiaceae), and several Nyctaginaceae, Onagraceae, Fabaceae, etc. not used by gnorimoschemines. Relevant Coastal Salt Marsh plants include *Salicornia* species and *Suaeda californica* (Chenopodiaceae). Northern Coastal Scrub plants recorded as larval food plants of Gnorimoschemini include *Baccharis pilularis*, *Gnaphalium* species, *Anaphalis margaritacea* (Asteraceae), and *Castilleja* species (Scrophulariaceae). Coastal Sage Scrub is dominated by *Artemisia californica* (Asteraceae).

We sampled at about 65 coastal sites on the mainland and on six of the eight California Channel Islands (Fig. 9) during the past 40 years. Three approaches were employed: diurnal collections by netting adults in association with their larval hostplants; searches for larvae and subsequent lab rearing to obtain adult specimens; and by attraction of adults to ultraviolet lights ('blacklight'). At most of the sites, especially the smaller dune systems, sampling was limited to diurnal collections. Blacklight collections were made at about 10 localities on the mainland coast and 12 on the Channel Islands, but at most of them on fewer than 6 or 8 dates. Comprehensive seasonal sampling was conducted only at Antioch (Contra Costa Co.), on the San Joaquin River, Pt. Molate-Richmond-Brooks Island on the east shore of the San Francisco Bay, and in coastal scrub at two localities that lack appreciable sand dune habitats: San Bruno Mountain, San Mateo Co. (De Benedictis *et al.*, 1990) and Big Creek, Monterey Co.

Fig. 9. Coastal localities in California cited in the text. Approximate number of collecting dates during 1956-1998 indicated in parentheses, followed by number of Gnorimoschemini species recorded, **in boldface** (see Fig. 104-115).

CALIFORNIA
Humboldt Co.:
1. Samoa dunes (3;**1**)
Mendocino Co.:
2. Inglenook Dunes [near Mackerricker St. Park] (3;**1**)
Sonoma Co.:
3. Bodega Head (2;**1**)
Marin Co.:
4. Drakes Estero (1;**1**)
5. Pt. Reyes Natl. Seashore, North Beach (10+;**3**)
6. Inverness Ridge (80;**2**)
7. Marin Island (2;**1**)
8. Ring Mt., Tiburon Peninsula (30;**2**)
Solano Co.:
9. Grizzly Island (3;**1**)
10. Rio Vista (2;**2**)
Sacramento Co.:
11. Grand Island (1;**1**)
Contra Costa Co.:
12. Antioch Natl. Wildlife Refuge (70+;**7**)
13. Briones Reservoir (10;**1**)
14. Berkeley Hills (10+;**4**) [map=13]
15. Martinez Regional Shoreline (1;**1**)
16. Pt. Molate, Pt. San Pablo (50+;**6**)
17. Pt. Richmond, Richmond Field Station (10+;**5**) [map=18]
18. Brooks Island (19;**4**)
Alameda Co.:
19. Albany Hill (10+;**3**)
20. Berkeley shoreline [West Berkeley] (1;**1**) [map=19]
San Francisco Co:
21. Baker Beach (10;**1**)
San Mateo Co.:
22. Pacifica Manor (1;**1**)
23. San Bruno Mt. (40+;**11**)
Santa Clara Co.:
24. Palo Alto Baylands Nature Reserve (1;**1**)
Santa Cruz Co.:
25. Sunset St. Beach (1;**1**)
Monterey Co.:
26. dunes at Salinas River mouth, Seaside (3;**3**)
27. Carmel St. Beach & Highlands (2;**1**)
28. beach at Little Sur River (1;**1**)
29. Big Creek Reserve (180+;**11**)
San Luis Obispo Co.:
30. San Simeon Beach (1;**1**)
31. Morro Strand St. Beach (2;**1**)
32. Montana del Oro St. Park [So. Morro Bay dunes] (5;**2**)
33. Dune Lakes (10;**4**)
34. Oso Flaco Lake (10+;**5**)
Santa Barbara Co.:
35. Jalama Beach (6;**1**)
36. Gaviota (1;**1**)
37. Coal Oil Pt., U. California campus at Goleta (20+;**4**)
38. San Miguel I.: Cuyler Harbor, E. dunes, Nidever Canyon, North Green Mt. Canyon, Willows Canyon (10;**5**)
39. Sta. Rosa I.: Beechers Bay, Cluster Pt. (10;**4**)
40. Santa Cruz I.: Canada Cervada [Canada Cuesta], Canada del Medio [Central Valley], Cristi Beach, Eagle Canyon, Prisoners Harbor (24;**7**)
Ventura Co.:
41. beach at Ventura River mouth (1;**1**)
42. San Nicolas I., beach at NAS HQ, Dutch Harbor (3;**2**)
Los Angeles Co.:
44. San Clemente I.: Eel Pt., Gord 330m, Horse Beach Canyon, north end airfield, Rockwall Cyn. at Seal Cove, West Cove, Wilson Cove (15;**6**)
43. Sta. Catalina I.: Ben Weston Beach, Little Harbor (8;**3**)
Orange Co.:
45. Aliso Creek at Highway 1 (1;**1**)
San Diego Co.:
46. La Jolla (20+;**1**)

Larval rearing.– In the lab, larvae were confined with clippings of the hostplants in 7 x 5" (ca. 17.5 x 12.5cm) plastic boxes or 12 x 18" (30 x 45cm) polyethylene bags, lined with paper toweling. Each collection (single date, site, and plant species) was given a date-based lot number (e.g., 77F2 was the 2nd collection in June 1977). In total, we report larval food records for Gnorimoschemini from about 170 collections representing 25 of the 35 species discussed here. About 35 of these collections were made by J. A. De Benedictis and others at San Bruno Mountain, and were previously reported (De Benedictis *et al.*, 1990), some with only generic or tentative species identifications, which are clarified in our synonymies.

Specimens, morphological terms, and measurements.– All identifications are vouchered by genital preparations. Genitalia slides were prepared for males and females of each population sample so far as possible, mostly by DP in Brno, along with several made by Sally Adams at the USNM, and later these were integrated into the Essig Museum of Entomology (EME) at Berkeley. Others were prepared by JAP, using standard techniques (e.g., Brown and Powell, 1991). The corresponding slide numbers are given in brackets (e.g., [EME 2210, JAP 5927]) in the data for each species. We examined types and other specimens in the U. S. National Museum of Natural History (USNM), Smithsonian Institution, Washington, DC, in 1963 (DP) and 1986 (JAP), and we searched for coastal California records of these moths in 1996-97 in the following other collections: California Academy of Sciences (CAS), San Francisco; Los Angeles County Museum of Natural History (LACM), Los Angeles; and University of California, Davis (UCD). Where not otherwise indicated in the data, all specimens, including holotypes, are deposited in the Essig Museum of Entomology, University of California, Berkeley. The study is based on about 1,100 specimens from coastal sites (ca. 90% EME). Unless otherwise acknowledged, all collections were made by JAP.

Modifications of the male genitalia in gnorimoschemine moths from a general gelechioid ground plan are complex, and homologies of some structures are difficult to interpret. The morphology has been discussed in detail elsewhere (Povolný, 1991), and the terminology used here follows the nomenclature established in that work (e.g., Fig. 32, 72). The 'saccular fold' and 'parabasal processes' of the sacculus (Fig. 32) have been interpreted as processes of the posterior edge of a greatly expanded vinculum that forms a shield over the anteroventral portion of the genitalia by Huemer (1988) and accepted by Jansen (1998). The 'parabasal processes' of the valvae (Fig. 32) are interpreted by Huemer and Jansen as processes of saccular origin, or the structures are remnants of the sacculi (i.e., perhaps homologous with the divisions of the valva seen in other gelechioids such as Momphidae, Blastobasinae and Ethmiinae). These interpretations are more easily visualized if the ventral portion of the genitalia is detached from the tegumen (e.g., Huemer, 1988). The gnathos 'hook' is the modified terminal part of the joined lateral portions of the gnathos, when narrowly attenuated,

The designation "n = " indicates numbers of dissections or specimens measured. Measurements were made using a Leitz stereomicroscope at 6.3x magnification, employing an ocular micrometer. At least 5 males and 5 females representing each species were measured unless fewer in adequately spread condition were available.

GNORIMOSCHEMA Busck, 1900

The genus *Gnorimoschema* comprises a large array of Nearctic species, with more than 60 described, including 8 newly described here, and no doubt many remain to be discovered in the field and in collections. By contrast, only a dozen species are known in the Palaearctic Region. Several are Holarctic (e.g., *G. nordlandicolella* (Strand), *G. valesiella* (Staudinger), *G. herbichii* (Nowicki)), showing primarily boreal-alpine, disjunct distribution patterns (Rocky Mountains, Alps, Caucasus, high mountains of Central Asia). The adults of most North American species are larger and more robust with broader wings than other Nearctic Gnorimoschemini and the Palaearctic species of *Gnorimoschema*. The genital capsule of males is correspondingly broader and stout relative to the other genera. The fused sacculus, forming a broad ventral plate, appears to be a synapomorphy for members of the genus.

Biology

Nearctic species exhibit a remarkable diversity of larval habits, including life styles that can be classified into five types among Californian coastal species:

1) free living in sand, forming silken tubes attached to leaves buried by the active sand;

2) leaf mining; most of the Palaearctic species and one newly described Californian species are leafminers; another is a leafminer in early instars, then a stem borer;

3) borers in, or creating gall-like deformities in new growing tips of foliage;

4) causing growth of 'soft' or non-persistent stem galls in which the larvae feed;

5) causing 'hard', persistent stem galls: larvae either leave the gall at maturity to pupate on the ground (e.g., *G. baccharisella*) or remain in the gall to overwinter and pupate there (e.g., *G. subterraneum*).

Type 3-5 species feed almost exclusively in woody Asteraceae. By contrast, the Palaearctic species so far as known are miners in herbaceous plants, including *Thymus* (Lamiaceae), *Calluna* and other Ericaceae, *Aster* and *Solidago* (Asteraceae), and there is a Type 1 sand dweller feeding on *Salix* (Povolný, 1990).

Gnorimoschema saphirinella (Chambers)

(Fig. 10, 28, 69, 70)

Gelechia saphirinella Chambers, 1875: 250.
Gnorimoschema saphirinella; Busck, 1903: 832.

A narrow-winged *Gnorimoschema* with prevailing bronze-reddish brown to cinnamon-brown forewings, varying to grayish and tan in some populations.

MALE: FW 4.5-6.0mm, avg. 5.4mm (n = 7); FW length 6.0-6.55 x width. *Head*: Crown brownish to gray with white scale tips; frons paler, nearly unicolorous cream whitish. Labial palpi brownish to cream colored, with two variable dark ringlets on segments II and III, subbasal and subterminal, the distal-most broader and often blackish. *Thorax*: dorsum and tegula concolorous with head. Forewing brown, bronze with reddish hues, to cinnamon brown, with dark flecks, not forming a distinct pattern. Apex and terminal margin blackish, sometimes extending along costa and other veins distally. Ground color in some populations varying to gray or tan, especially costally; in the extreme form completely dark gray to blackish, defining subterminal darker band. Cilia grayish, the scales with black tips. Hindwing usually dark gray, paler in gray individuals. Cilia gray to brownish. Genitalia as in Fig. 28 (drawn from EME 1097; n = 14); tegumen relatively narrow, sacculus rounded; uncus broad, extending to a narrow tip; gnathos tip narrow, short; valvae slender with rounded tips, slightly sigmoid; medial excision of saccular fold shallow and broad, its paired process very short, moderately acute-tipped, with a serrate marginal ledge; paired parabasal processes narrow, curved terminally; saccus prominent with broadly rounded tip, paired, with suprasaccal ledge; lateral margins of tegumen shorter than saccus. Aedeagus ca. 2/3 the length of tegumen, slender with phallobase prominent; tip protruding into an acute edge forming a well- developed curved thorn laterally.

FEMALE: FW length 4.2-5.9mm, avg. 5.0mm; FW length 5.4-6.3 x width. Essentially as described for male, similarly variable in coloration, wings

reduced relative to body size, averaging shorter and slightly broader than in male. Genitalia as in Fig. 69-70 (drawn from EME 1096, 1092; n = 7); no VIII-IX intersegmental pockets; posterior apophyses short, 1.1 X VIII + anterior apophyses length; subgenital plate quadrate with a deep, membranous medial excision extending to periostial area; caudal margin slightly protruding toward ostium bursae; ostial ring short, broad, moderately heavily sclerotized,with a paired semicrescent ledge laterally from medial excision, its margin extending to base of the moderately long anterior apophyses; signum a strong, moderately curved hook.

California Coastal Records.– Contra Costa Co.: Antioch Natl. Wildlife Ref., 2m X-10-91, blacklight, 1m IV-22-92, r.f. *Artemisia douglasiana*, emgd. V-14-92, JAP 92D77 [JAP 7474]; Brooks Id., 1f X-24/25-95, blacklight trap ; Pt. Molate, 5m, 2f VI-12-64, 1f VI-19-64, 1m V-18/19-88 [JAP 7416], 1f X-10-88, 1m XI-27-96 [JAP 7485] . **Los Angeles Co.**: Ben Weston Beach, Sta. Catalina Id., 1m V-2-78 [EME 1094]. West Cove, San Clemente I., 1m, 2f IV-15-80, assoc. *Ambrosia chamissonis* (D. Faulkner & Powell) [EME 1103f, 1104m]. **Marin Co.**: Pt. Reyes Natl. Seashore, N Beach, 1f V-13-72 + 2m, 1f r.f. pupae in silk tubes in sand, emgd. V-16-72, JAP 72E14, 2m VI-4-77 [EME 2225] + 10m, 4f r.f. *A. chamissonis*, emgd. VI-5 to VII-5-77, JAP 77F2, 3m, 6f VI-3-78, r.f. *A. chamissonis*, JAP 78F6. **Mendocino Co.**: Inglenook Fen, N of Cleone, 6m, r.f. sand under *Abronia* and *Ambrosia*, emgd. by II-1-75 (M. Buegler) [EME 1091m], 1m, 1f VII-24-75 + 1m, 3f, r.f. *Franseria* [= *Ambrosia chamissonis*] sand tubes, emgd. VIII-2/10-75, JAP 75G4 [EME 1100f]. **Monterey Co.**: Big Creek Reserve, 0-10 meters, 2m, 1f X-3/4-85, blacklight (J. Brown & Powell), 1m IV-23/24-87, blacklight trap, 3m, 1f VI-5/7-89, blacklight traps (Y.-F. Hsu & Powell), 3m IV-12/13-90 (Hsu & Powell), 1m VIII-2/3-92, blacklight trap, 190-200 meters, 1f II-21/22-88, 190 meters, 1f IX-18-89 (F. Arias); Beach at Little Sur Riv., 7 mi. NW Big Sur, 3m, 1f III-21-74 (Doyen & Powell) [EME 1093m, 1096f, 1097m, 1099f, 1107m]; Dunes at Salinas Riv. mouth, 4m, 1f VII-15-76 [EME 1095m, 1105m]. **San Luis Obispo Co.**: Dune Lakes, 3 mi. S Oceano, 1m VII-11-73 blacklight trap [EME 422]. **San Mateo Co.**: Pacifica Manor, 2m VII-12-75, J.Powell 75G--, r.f. sand tubes, emgd. VII-15-75 (Doyen & Opler) [EME 1098, 1101]. **Santa Barbara Co.**: Coal Oil Pt., 1f X-7-77, r.f. *Ambrosia chamissonis*, emgd. XII-77, 77K1 [EME 1092]; Goleta, U.C. campus, 1f VI-27-65 ; San Miguel Id., Cuyler Harbor, 2m X-14-95, E. dunes 300', 3m, 1f X-15-95 (I. Williams & Powell), same locality 1m V-10-97, r.f. sand tubes under *A. chamissonis*, emgd. date unknown JAP 97E29; Santa Cruz Id., Central Vy., 1f IX-25-78, at light, 1m V-22/24-84, blacklight (D. Wagner); Santa Rosa Id., Cluster Pt., 5m IV-29-95 (D. Kushner & Powell). **Santa Cruz Co.**: 5 mi. N Swanton, 1m, 1f V-28-66 (A. J. Slater). **Ventura Co.**: San Nicolas I., NAS HQ 1m V-5-78, blacklight trap (J. Chemsak); beach area NAS HQ, 2m V-7-78, assoc. *A. chamissonis*, 2m, 1f , r.f. *A. chamissonis*, emgd. VI-5-78, JAP 78E30 [EME 1102m, 1106m].

Taxonomic relationship.– The identity of this species with respect to Chambers' original description is uncertain. A specimen that is designated as the holotype lacks its abdomen and has a label "Kentucky./Chambers" (Miller and Hodges, 1990). Although Miller and Hodges state that the original description implies Texas as the type locality, Chambers gave no locality or person as a source. His description immediately follows a series of 14 species of *Gelechia* and *Tinea* from California received from Behrens in San Francisco and precedes three species for which no locality is stated, then one, *Aroga latifasciella*, received from Missouri (Murtfeldt) and Texas (Belfrage). Although we cannot be certain that the coastal species we treat here is the same as the supposed type, in the interest of nomenclatural stability we follow previous taxonomists in application of this name to a widespread species (AZ, CA, CO, FL, IA, MA, TX in USNM).

Several characters (saccus, sacculus, female subgenital plate) seem to indicate distinctive relationship to certain Palaearctic species, e.g., the *Gnorimoschema herbichii-antiquum* group, which represent the more primitive species of *Gnorimoschema*. The curved thorn in the tip of the aedeagus is derived and appears to be characteristic of this species.

Biology.– In coastal California, adults of *Gnorimoschema saphirinella* appear to be primarily diurnal. In beach dune habitats of California south to Santa Barbara and on the Channel Islands they are most often flushed from patches of *Ambrosia chamissonis* (Asteraceae), which is a primary foredune colonizer. Elsewhere in southern California, *G. saphirinella* has been recorded as a rare leaf-miner on *A. confertiflora* and *A. psilostachya* by Goeden & Ricker (1975, 1976). Their collections were made in coastal and inland sites, but they did not report specific sites and dates for *saphirinella*. Although the larvae may not be specific to *Ambrosia*, in California we have found them associated almost exclusively with this plant. One *G. saphirinella* was reared from a facultative leaf mining larva on a plant believed to be *Artemisia douglasiana* at Antioch, a perturbed former riverine dune site, but the plant may have been misidentified *Ambrosia psilostachya* that grows in the same habitat.

On unstabilized coastal dunes the larvae live in silken tubes in the sand, from which they mine leaves of *Ambrosia* that have been buried by the active sand. The larval habits thus are similar to those of other sand dune gelechioids, including *Areniscythris brachypteris* Powell (Scythrididae), which is polyphagous (Powell, 1976), the European gelechiid, *Gnorimoschema bodillum* (Karsholt and Nielsen, 1974), and *G. vastificum* in California.

The life cycle of *G. saphirinella* is not well defined by available evidence. Adults have been found in the field from March to July, and larvae have produced lab emergence from May to August and in December. Overwintering probably takes place as late instar larvae or pupae in cocoons in the sand.

Gnorimoschema vastificum Braun

(Fig. 11, 29, 71)

Gnorimoschema vastificum Braun, 1929: 47.

A medium sized *Gnorimoschema* with a sandy coloration, ochreous and pale brownish rust mottling.

MALE: FW length 5.7-6.5mm, avg. 6.0mm (n = 5); length 5.7-6.4 x width. *Head:* Crown pale brownish, frons paler. II segment of labial palpus brownish with several darker brownish scales indicating ringlet, especially the subterminal; III segment slender, acute, with indications of two darker ringlets, the terminal one often well developed and broad. *Thorax*: Dorsal scaling and tegula brown. Forewing ochreous tan with numerous spots of chocolate to rust brown; costal margin usually pale cinereous; darker and blackish scaling extending in darker individuals in central axis, expanding to other parts of the wing; indications of blackish stigmata in cell surrounded by pale scales. Cilia pale ochreous. Hindwing whitish with darker dusted veins and margin; cilia whitish to gray. Legs whitish spotted by black to gray. *Abdomen*: Pale grayish, shining, basal two terga yellowish to brownish. *Genitalia:* as in Fig. 29 (drawn from EME 2193; n = 2); uncus obtuse, its caudal margin protruding into a slightly elevated tip; hook of gnathos moderately acute; valvae straight with dilated, obtuse tips, finely hirsute; medial excision of saccular fold very deep, its paired process wide and obtuse with indentations; paired parabasal process concealed beneath the saccular process, slightly longer and curved; saccus very broad with an obtuse tip, horseshoe-shaped. Aedeagus strongly sclerotized, phallobase large, broad, subovoid; apex obtuse with a minor subterminal plate.

FEMALE: FW length 6.4-7.4mm, avg. 7.1mm (n = 5); length 5.3-6.3 X width. General habitus essentially as described for male, no consistent dichroism; forewing larger and averages slightly broader than in male. Genitalia as in Fig. 71 (drawn from EME 1122; n = 4); no VIII-IX intersegmental pockets; posterior apophyses short, 1.67 X VIII sclerite + anterior apophyses; subgenital plate moderately longer than broad, with numerous transverse, sclerotized folds, its periostial edge deeply excised, ostial ringlet well sclerotized, slightly wider than long; ductus bursae very long, slender, longer than corpus bursae after mating; signum a moderately curved, strong, obtuse hook.

California Coastal Records.– Sacramento Co.: Grand Id., W end, 2m, 8f VII-13-75 (Opler & Powell) [EME 1150f, 1151m, 2211f]. **San Francisco Co.**: "S. Francisco", 1f "Oct." [K.2059, CAS]. **Solano Co.**: 0.3 mi. W Rio Vista, 1f IV-21-76 (G. Ulrich); Rio Vista, 5 m, 3f VIII-1985, pitfall traps under *Salix* (K. Hagen) [JAP 7407m].

Taxonomic relationships.– This species was described from Aweme, Manitoba, on the basis of one female. Our identification of the California population as conspecific is equivocal because the type specimen lacks its abdomen (examined by JAP in 1986 at the CNC, Ottawa). However, J.-F. Landry collected specimens, including males, in southern Alberta that compare well with California material, suggesting that we are dealing with a single widespread species. There are specimens identified as *vastificum* from the margins of the Great Basin, in Saskatchewan (Saskatoon, May 1925, USNM), Utah (Vineyard, Aug. 1917, USNM), and eastern California (Olancha, ID "nr. or = *vastifica*" by Braun, ANSP) that lend credence to this assumption. *G. vastificum* may have occurred on coastal dunes a century ago, based on one faded female specimen labelled "S. Francisco, CAL," that appears to be conspecific.

Superficially, the type is quite similar to specimens from Grand Island, CA: white ventrally with predominately rust-colored, mottled forewings. The California specimens have a more variegated, sandy appearance because there is a mixture of cream, yellowish, rust, and dark gray scaling, whereas the pattern of the type specimen is dull grayish rust with scattered cream colored scaling, mostly on the costal half. The type specimen might be somewhat worn and/or faded after collection, having lost some of its dark gray.

The species appears to be closely related to *Gnorimoschema bodillum* Karsholt and Nielsen (1974), from the coasts of Denmark and northern Germany. The European counterpart is paler in general color, has broader wings and a stronger tendency to brachyptery in females (Povolný, 1992). The genitalia indicate a close relationship, *G. bodillum* having a narrower saccus and a broader subgenital plate. We speculate that the two species represent vicariant sister species that survive as relicts in specialized niches of post-glacial sand dunes of Holarctic distribution. These taxa are related to the *Gnorimoschema herbichi-antiquum* group of the Palaearctic, suggesting that they represent ancestral structural types within *Gnorimoschema* and within the Gnorimoschemini.

Biology.– So far as is known, the adults are diurnal; we found them running about riverine sand in mid-afternoon. Karsholt and Nielsen (1974) observed adults of the clearly related species, *G. bodillum*, on active dunes in northern Jutland, Denmark. They were diurnal and were never seen to fly in the field or lab; they ran short distances (30-50cm) and often took short leaps (10-25 cm), exhibiting behavior analogous to the brachypterous, dune-inhabiting scythrid, *Areniscythris brachypteris* (Powell, 1976). The two sites along the Sacramento River are disturbed habitats, dredged sand at Rio Vista, and excavated sand associated with a dump site at Grand Island; prevailing upriver winds aid in keeping the sand active. Adults of *G. vastificum* have been collected in April, July, and August along the Sacramento River, so we assume there is more than one generation per season, as is true of *G. bodillum* (Karsholt and Nielsen, 1974).

We found pale green, slender larvae in frail silken tubes attached to buried leaves of willow (*Salix)* at the Grand Island locality that we assumed were those of *G. vastificum*, but we were unable to rear adults. Larvae of *G. bodillum* occurred in the same niche, skeletonizing leaves of *Salix* and were described as grayish white by Karsholt and Nielsen (1974). Thus the larval habits parallel those of the sand dune scythrid, *Areniscythris brachypteris* (Powell, 1976).

Gnorimoschema tenerum Povolný & Powell, **new sp.**
(Fig. 12, 30)

A slender moth having cinereous whitish ground color with a longitudinal median, blackish forewing stripe.

MALE: FW length 6.0-6.7mm, avg. 6.2mm (n = 5); FW length 4.9-5.4 x width. *Head*: Crown cinereous whitish, frons not paler. Labial palpus slender, III segment elongate with acute tip, concolorous with head, individual scales of II with dark tips. *Thorax:* Dorsum, tegulae, and forewing ground color nearly uniform cinereous whitish, some FW scales with darker gray tips; pattern poorly defined, more or less distinct triad of blackish stigmata in cell, with indication of 5 blackish submarginal strigulae in apical area; elongate blackish strigulae tending to form a poorly defined, median, longitudinal shade extending from base to apical area; traces to variable amount of ochreous accentuating the stigmata in axillary blackish shade. Cilia whitish, sometimes with mixture of blackish basally. Hindwing whitish, often tinged with gray; cilia whitish. Legs nearly unicolorous whitish gray. *Abdomen*: basal tergum ochreous tinged, dorsal scaling otherwise dark gray with a silvery whitish band caudally on each segment; genital scaling and underside sordid whitish. Genitalia as in Fig. 30 (drawn from EME 2684; n = 1); slender with broad uncus having a weakly raised tip; gnathos slender, ligulate, parallel-sided with obtuse tip; valvae slender, not exceeding tip of uncus, terminally moderately dilated and curved; parabasal process elongate, slender, obtuse with a short, subterminal hooklet; paired process of sacculus fold narrow, ear-shaped, medial excision deep, narrow distally; sacculus wall with a paired, narrow, crescentic ledge; paired, strong, crescentic ledge of sacculus wall very thin; saccus triangulate with moderately acute tip, reaching or moderately exceeding vinculum. Aedeagus slightly longer than genital capsule, phallobase slightly inflated, aedeagus trunk slender, moderately curved, its tip truncate with a short subterminal spine.

FEMALE: FW length 6.3-7.3mm; avg. 6.8mm (n = 8); FW length 4.7-5.5 x width. No sexual dimorphism in color pattern. Genitalia as in Fig. 99 (drawn from JAP 7802; n = 2); no VIII-IX pockets; anterior apophyses short, 1.15 X longer than VIII + anterior apophyses; subgenital plate expanded toward base of anterior apophyses; caudal margin strengthened by paired crescentic sclerite forming a longitudinal ledge bordering sterigma; strongly sclerotized, attenuate ridges flanking ostium; antrum distinctly enlarged, membranous; signum small, a subquatrate plate with curved spine.

Holotype male: CALIFORNIA: San Mateo Co., Radio Road, San Bruno Mountain, July 16, 1988, blacklight (J. A. De Benedictis).

Paratypes (29): same data as holotype, 2m, 12f; same data except 3f IV-16-88, 2f V-19-88 [EME 2685], 3f VI-18-88 [EME 2665]; San Bruno Mtn. Park, 2m, 5f VI-1-87, UV light (De Benedictis) [EME 2684m]; same locality, 3m, 2f IV-2-98, r.f. *Anaphalis margaritacea*, emgd. V-15/25-98, JAP 98D1.

Taxonomic relationships.– *Gnorimoschema tenerum* differs phenotypically from other slender-winged species in California by having the FW ground color pale, whitish gray with dark gray or blackish markings restricted to a linear pattern longitudinally through the middle of the wing: ochreous streaks accompany the dark markings and are scattered through the pale costal and dorsal areas. The saccus is broad basally, strongly attenuated distally, with a slightly bulbous tip, unlike any other western Nearctic *Gnorimoschema*; the lateral extensions of the tegumen are curved inward, and the aedeagus is short, less than 1/2 the length of the tegumen + saccus, with a small phallobase. The strongly sclerotized, protruding lateral margins of the ostium are distinctive.

Biology.– Adults were reared from larvae feeding in terminal shelters in new spring growth of *Anaphalis margaritacea* (Asteraceae), along with larvae of *Oidaematophorus phoebus* Barnes & Lindsey (Pterophoridae). Larvae of *G. tenerum* were not observed; they evidently tunneled in the unopened terminal buds but not appreciably into the subtending stems. At maturity they moved to the exterior to form cocoons enmeshed in the dense underside hairs of leaves. No gall formation nor leaf mines were observed. Collections of adults at blacklight span mid-April to mid-July in the same season, so two generations are possible.

Gnorimoschema aterrimum Povolný & Powell, **new sp.**
(Fig. 13, 31)

Scrobipalpa sp. B, De Benedictis *et al.*, 1990: 25.

A small *Gnorimoschema* with deep brown to blackish forewing having cinereous tornal area, nearly patternless.

MALE: FW length 5.1mm (n = 1); length 5.5 x width. *Head*: Covered by

blackish, partly erect scaling; frons with lustrous, bright ochreous scales. Labial palpus slender with acutely pointed III segment, blackish with slight cinereous mixture internally and with erect scales on II externally. *Thorax:* Dorsum and tegula covered by black, partly erect scales. Forewing uniformly covered by blackish scales with paler bases, patternless; tornal margin with mixture of dense cinereous scales tinged with faint ochreous extending towards apex; some of the scales have blackish tips. Fringe cinereous. Hindwing nearly translucent, thinly blackish dusted, paler and partly lustrous basally. Fringe gray to blackish. Legs blackish with narrow, not well defined pale ringlets. *Abdomen*: scale color and pattern not recorded. Genitalia as in Fig. 31 (drawn from holotype; n = 1); uncus concave with a distinct, narrow tip; gnathos elongate ligulate with rounded tip; parabasal process of valva short, cone-shaped, moderately curved, with a short curved tip; sacculus wall broadly excised, flat V-shaped, ending with a short, ear-shaped, distinct hirsute tip, with a paired narrow, elongate sclerite extending from base of sacculus to base of parabasal process; saccus long, nearly parallel-sided, with an obtuse tip not exceeding tips of vinculum edges. Aedeagus delicate compared to the relatively robust genital capsule, with subovate inflated base, trunk very narrow, parallel-sided with short, weakly acute tip, with a delicate serrate subterminal ledge.

FEMALE: unknown.

Holotype male: CALIFORNIA: San Mateo Co.: San Bruno Mountain, March 25, 1987, r.f. *Solidago*, emgd. VII-19-87, JAP 87C53 (J. A. De Benedictis) [JAP 7487].

Taxonomic relationships.– This species shows relationship to *Gnorimoschema stigmaticum*, reflected in similarity of genitalia. *G. aterrimum* shows clear specific characters: the broadly excised sacculus wall, extremely short cone-shaped parabasal process, shape of saccus, the delicate aedeagus, and other details.

Biology.– The larvae of *G. aterrimum* feed in full-depth, blotch mines in leaves of *Solidago canadensis* (Asteraceae) in early spring (De Benedictis et al. 1990). In the lab larvae evacuated the mines at maturity, within six days following collection, but most were parasitized. Emergence occurred about 15 weeks following cocoon construction, presumably following a short-term diapause.

Gnorimoschema debenedictisi Povolný & Powell, **new sp.**

(Fig. 3, 35, 77)

Gnorimoschema sp. A, De Benedictis *et al.*, 1990: 24.

A relatively broad-winged species having gray ground color with moderately distinctive blackish spotted forewing pattern that is usually more distinctive in females.

MALE: FW length 5.6-8.5mm, avg. 7.4mm (n = 7); length 4.8-5.7 x width. *Head*: Crown dark to pale unicolorous gray, lustrous in fresh specimens. Labial palpus gray, II segment paler interiorly; III segment with two dark ringlets. *Thorax*: Dorsum and tegula concolorous with head. Forewing: Ground color gray, irregularly black spotted; triad of blackish stigmata in disc partly fusing to form a dark spot; a group of submarginal blackish stigmata more distinct in paler individuals. Cilia dark to pale gray. Hindwing: unicolorous dark to pale gray, cilia concolorous. Legs blackish or dark gray, tarsi with pale ringlets. *Abdomen*: Dorsum lustrous gray; venter whitish gray. Genitalia as in Fig. 35 (drawn from EME 2682; n = 4); robust, distinctly longer than broad; tegumen narrower than width of vinculum; uncus truncate, with a moderate raised tip medially; saccus slender, ligulate with obtuse tip; valvae relatively short, slender, with obtuse tips, not exceeding uncus tip; sacculus fold with a very deep, broad excision with sparsely hirsute edges; parabasal process short, ear-shaped; saccus broad, more or less parallel-sided, with truncate tip, nearly as long as vinculum extension. Aedeagus about half genital capsule length; phallobase moderately inflated, tip moderately acute with serrate subterminal ledge.

FEMALE: FW length 5.7-7.0mm; avg. 6.0mm (n = 6); length 4.7-5.3 x width. Essentially as described for male, coloration usually paler. Genitalia as in Fig. 77, 77a (drawn from EME 2674, JAP 7682; n = 6); VIII-IX intersegmental pockets widely spaced, small; posterior apophyses 1.85-1.9 x longer than VIII+ anterior apophyses, which are slightly shorter than subgenital plate; latter subquadrate, laterally with distinct longitudinal folds; proximal margin moderately deeply excised, ostium bursae slightly protruding; sclerotization of colliculum distinct, rugose, longer than broad; signum a robust, short, curved spine with very short external projection.

Holotype male: CALIFORNIA: San Mateo Co., San Bruno Mountain, March 26, 1988, r.f. *Solidago spathulata*, emgd. V-30-88, JAP 88C19 (J. A. De Benedictis). Paratypes (19): **San Mateo Co.:** same data as holotype, 3m, 1f, emgd. V-23 to VI-10-88 [EME 2671m, 2672f, 2682m]; same data except 1m, 5f III-19-86, emgd. V-18 to VI-7-86, 86C33.1 [EME 2674f, 2675m]; same locality, 1f III-9-80, [r. f.] prostrate composite, spec. L7.III.80 (D. L. Wagner) [EME 2118]; same locality, 1m, 1f V-4-87, UV light (De Benedictis & S. Stockwell) [EME 2676f], 1f VI-1-87, UV light (De Benedictis) [EME 2676], 1m, 4f VII-16-88, blacklight (De Benedictis) [EME 2677f, 2678m]; San Bruno Mt., E slope below summit, 1m, 1f IV-7-98, r.f *Erigeron glaucus*, emgd. by VI-1-98, JAP 98D4.

Taxonomic relationships.– *Gnorimoschema debenedictisi* differs from other slender-winged species in California by the 3 conspicuous upraised scale tufts on the FW, even in flown specimens. In genitalia males differ from related species (*gallaesolidaginis-baccharisella* groups) by the broadly parallel-sided excision of the saccular fold, having the saccular margin conspicuously setate, the distinctive broad, parallel-sided saccus and comparatively delicate aedeagus. The small, widely spaced VIII-IX intersegmental pockets of the female are diagnostic.

Biology.– This species is univoltine, feeding in new spring growth of *Erigeron glaucus* (Asteraceae), and on *Solidago spathulata* (Asteraceae), according to observations by De Benedictis, although his notes expressed some doubt about the identification of the plant. At the 1998 collection site, these two plants grew intermingled, and their foliage is similar in appearance prior to lengthening of the inflorescences.

Larvae excavate a full-depth blotch mine in early instars. On *Erigeron*, larvae partially mined terminal leaves, usually the apical half, then descended to create silken shelters in subtending leaves, from which they burrowed downward into the stem. The feeding does not seem to cause any gall formation. In the lab, larvae left the shelters in *Solidago* to form cocoons between folds of paper toweling and beneath leaves plastered to the paper, while in *Erigeron*, they pupated in tightly sealed, rolled leaves. Emergence of adults occurred 7-11 weeks following collection of larvae that likely were nearing maturity. Hence, a short term diapause may be normal. The flight period in the field was documented between early June and mid July.

Gnorimoschema stigmaticum Povolný & Powell, **new sp.**

(Fig. 17, 36)

A relatively broad-winged *Gnorimoschema* having a blackish forewing with two more or less distinct, transverse, elongate, black stigmata highlighted by paler scaling.

MALE: FW length 6.6-7.3mm, avg. 7.0mm (n = 5); length 5.0-5.5 x width. *Head:* Crown covered by dense, dark gray-brown scales; frons paler, whitish. Labial palpus thickly scaled; segment II dark gray, pale apically; III with indications of blackish basal and subterminal ringlets. *Thorax*: Dorsal scaling concolorous with head. Forewing covered by dark gray-brown scales with blackish tips, paler toward apex; holotype has black upraised scale tufts near base in dorsal area and two along Cu crease, along with blackish suffusion through middle of wing that evidently are lost with age; worn specimens lack the tufts and blackish suffusion, revealing two more or less distinct black stigmata situated axially, 1st in center, 2nd beyond center in cell, surrounded by paler gray scales; inner stigma elongate-transverse, distal one distinctly crescent- or kidney bean-shaped; another group of black scales indicating an indistinct stigma at 1/3 of costa. Fringe dark cinereous. Hindwing gray-brown with darker suffusion along veins; fringe dark gray. Legs blackish, distinctly spotted with white. *Abdomen:* Basal three abdominal terga honey colored; remainder of dorsum pale gray, genital scaling and underside whitish or silvery lustrous; underside paler. Genitalia as in Fig. 36 (drawn from holotype; n = 2):uncus broad, moderately convex, with a short tip; gnathos

comparatively short, characteristic by its broadly spatulate shape with rounded tip; medial excision of sacculus wall shallow V-shaped; paired saccular process, short, ear-shaped with obtuse tip and finely hirsute; paired parabasal process of valva distinctly curved to sigmoid with a short, obtuse apical hooklet; sacculus wall strengthened by a paired elongate crescentic, moderately rugulose sclerite extending from near base of saccus to base of parabasal process; saccus long, slender, parallel sided, with tip truncate reaching or slightly exceeding lobes of vinculum. Aedeagus delicate relative to the robust genital capsule, somewhat longer than 1/2 the genitalia length, caecum subovate, inflated, trunk slender, parallel-sided, tip with a subterminal serrate ledge.

FEMALE: unknown.

Holotype male: CALIFORNIA: Los Angeles Co.: Avalon, Santa Catalina Island, September 20, 1931 (D. Meadows) [JAP 7507] in LACM. Paratypes (4m): same data as holotype (2), same data except X-13, 20-1931 (2); deposited in LACM and EME.

Taxonomic relationships.– This species shows relations to an undescribed *Gnorimoschema* from Baja California Norte (Povolný ms., in prep.), which was reared from *Haplopappus*. The two share similar paired saccular processes, elongate, parallel sided sacculus, and particularly the aedeagus. *G. stigmaticum* is distinguished by the form of the parabasal processes of the valva, which are distinctly slender and sigmoid, in the shape of the short, rounded gnathos, and in the much more slender crescentic sclerite strengthening the sacculus wall, and other details. The forewing of the Baja California species is dark rust-blackish, with the stigmata scarcely indicated. These two species show relationships to the *G. coquillettella* complex.

Biology.– Unknown.

Gnorimoschema coquillettella Complex
(Fig. 14, 15, 32, 33, 72-75, 100)

Gnorimoschema coquillettella Busck (1902) was originally described from specimens reared by Coquillett in Los Angeles County from *Ericameria* [*Applopappus*] *pinifolia* (Asteraceae). It is widespread in desert margin, inland foothill, and montane habitats, but is not known in coastal habitats, where it is replaced by a sister species, *G. ericameriae* Keifer. Therefore, *G. coquilletella*, which is characterized by a yellow basal patch on the forewing, is illustrated here for comparative purposes (Fig. 14, 32, 75) but not treated in detail. A label accompanying a specimen of the Coquillett material specifies additional data as Lancaster, May 19, 1887, emerged June 16, 1887 from "gall *Acanthopappus sphaerocephalus* lvs." Another specimen was reared from "*Bigelovia veneta*", presumably *Haplopappus* (*Isocoma*) *menziesii* [= *veneta*] of present nomenclature. Povolný (1967a) reported it from Phoenix Lake, Marin Co., reared from *Ericameria arborescens* by H. H. Keifer [V-22-1928, K2020m, 2021f, CAS]; and we have found the onion dome-shaped larval 'galls' on this plant at Big Creek Reserve, Monterey Co. (JAP 89H12, 90D69, 90D97) and have reared adults from *Ericameria linearifolia* at Big Panoche Creek, Fresno Co. (JAP 67D100) and Del Puerto Canyon, Stanislaus Co. (JAP 92D11). One specimen was reared from an unidentified "*Haplopappus*" [= *Ericameria* or *Isocoma*] near Kelsey, El Dorado Co. (JAP 67F6).

Gnorimoschema ericameriae Keifer
(Fig. 15, 33, 72, 73, 74)

Gnorimoschema ericameriae Keifer, 1933: 361.

This is a strictly coastal species that is evidently specific in larval feeding to *Ericameria ericoides*. The adults are relatively narrow winged, dark steel gray to the unaided eye, with darker markings and some honey-brown scaling that defines a narrow transverse band at the basal 1/3, the outer margin of the corresponding yellow patch in *G. coquillettella*.

Forewing length: males, 5.0-7.3mm, avg. 6.1mm (n = 5, reared specimens); FW length 4.9-5.8 x width; females, 5.3-7.5mm, avg. 6.1mm (n = 5, reared specimens); FW length 4.75-5.3 x width. Male genitalia as in Fig. 33 (drawn from EME 450; n = 4); uncus broad with an acute, produced median tip, "shoulders" pronounced; gnathos broad, spatulate with a rounded tip; median excision of saccular wall broadly V-shaped; paired saccular process short, not exceeding sacculus; valva stout, strongly curved, enlarged distally into paddle-shaped club, not exceeding uncus; saccus elongate, broad, expanded distally, exceeding lobes of vinculum. Aedeagus large, nearly as long as tegumen, rather thick, with a double spur subapically and hooked process apically.

Female genitalia as in Fig. 72-74 (drawn from slides JAP 7417, EME 1115, 1111 respectively; n = 4); a pair of small, round, closely adjacent, invaginated pockets in VIII-IX intersegmental membrane; posterior apophyses ca. 1.6X longer than subgenital plate + anterior apophyses; subgenital plate bordered anteriorly by thick ridge, angling posteriorly from ostium; anterior apophyses longer than subgenital plate; colliculum 2x longer than wide; signum a strong scythe-shaped hook from a curved base.

California Coastal Records (in addition to the type series).– **Los Angeles Co.**: El Segundo, 6m, 6f Larva on *Ericameria ericoides*, emgd. V-9/18-39, VIII-1/6-39 (W. D. Pierce, LACM). **San Francisco Co.**: San Francisco, 4m, 4f [emerged] VI-22 to VII-9-37, "gall on Ericameria ericoides" (H. H. Keifer) [EME 1115m, JAP 7417f, 7432m; K.2014f, 2015f, CAS]. **San Luis Obispo Co.**: Dune Lakes, 3 mi. S Oceano, 1m IV-26-73, r.f. *Haplopappus ericoides*, emgd. VII-2-73, JAP 73D32, 1m VII-11-73, blacklight trap [EME 450], 1m VIII-24-73 [EME 1109], 6m, 5f V-2-74, r.f. *H. ericoides*, emgd. VI-28 to VII-8-74, JAP 74E10 [EME 1187m, 1111f, JAP 7679f], 1f VIII-24-74 [EME 1112]; Montana de Oro St. Park, 3m IV-25-96, r.f. *Ericameria ericoides*, emgd. VII-1/14-96, JAP 96D17.

In addition, two atypical specimens were collected at Seaside, Monterey Co.: 1m VI-1-36, "*Ericameria ericoides*" (Keifer, CAS), 1m IX-27-66 (Powell) [EME 2208]. The forewings have more extensive ochreous-rust scaling, and the male genitalia differ slightly, with a shorter gnathos and more elongate, narrower vinculum.

Taxonomic relationships.– *Gnorimoschema ericameriae* was described by Keifer from specimens he reared at San Francisco from *Ericameria ericoides*. Adults are darker and lack the yellow basal patch of *coquillettella* and appear superficially quite different, but the genital characters link the two closely as sister species, which was noted by Keifer (1933), as do the larval habits and food plants. The average forewing length and breadth are greater in *G. coquillettella*, and the moth appears stouter. Its forewing pattern is more distinctly marked, having in addition to the yellow basal patch, a paler gray ground and blotches of rust scaling highlighting the dark stigmata. In genitalia, the males are very similar (cf *coquillettella* Fig. 32, drawn from JAP 7429), while the female subgenital plate is somewhat broader in *ericameriae* and usually more elongate in *coquillettella* (Fig. 75, drawn from JAP 7459).

Biology.– The larvae of both *Gnorimoschema coquillettella* and *G. ericameriae* cause gall-like deformities of terminal foliage tips. These are small, ca. 1cm, onion dome-shaped, hollow 'galls' that appear to consist of leaflets sealed together like the staves of a barrel, rather than typical growth of gall tissue (Fig. 100). The larva skeletonizes within this shelter, and drops to the ground for pupation, leaving thin, partially eaten leaflets, which wither and dry by midsummer. Adults emerge in July and August, and probably both species are univoltine. The inland hostplants of *coquillettella* dry by mid summer, and although *Ericameria ericoides* is evergreen, we have seen no evidence of larval activity later in the season.

Gnorimoschema ericoidesi Povolný & Powell, **new sp.**
(Fig. 16, 34, 76)

This species has narrow, ash-gray forewings marked by blackish and faint ochreous lines in the discal area.

MALE: FW length 8.5-10.0mm, avg. 9.2mm (n = 8); length 5.6-6.0 x

width. *Head*: Crown covered by gray scales having pale tips. Frons covered by appressed, pale cream-colored scales. Labial palpus, II segment not much thicker than III, gray with erect scales, III with concentrations of blackish, especially under tip. *Thorax:* Dorsum and tegula concolorous with head. Forewing ground the same, scales blackish with whitish tips, forming irregular shades between the more prominent spots: three stigmata in discal area, others at one-fifth along costa, axially near wing base. Ochreous shades limited to thin longitudinal, subcostal, and axial lines and faint spots surrounding the black dots of discal area. Apex acute with a longitudinal blackish shade, subtended by submarginal spotting. Cilia gray. Hindwing gray with pale gray cilia. Legs gray with pale fringes and ringlets. *Abdomen*: pale gray, basal 2 terga with short ochreous scaling. Genitalia as in Fig. 34 (drawn from EME 418; n = 4); uncus very long with moderately produced tip; gnathos elongate, strongly sclerotized, subtrapezoidal; valvae short, laterally flattened, proximally with short, slender parabasal process; upper ledge of saccular fold short, flat, medial excision and paired process poorly developed similarly to the very narrow sclerotized saccular ledges; saccus prominent, long, broad, wider distally, tip obtuse, flat; lateral edges of vinculum and its dorsum visible from venter due to a deep, paired excision of lower edge of sacculus. Aedeagus comparatively short, phallobase swollen, shaft slender, tapered apically with a subterminal, short thornlike hooklet and a group of cornuti.

FEMALE: FW length 8.5-9.2mm, avg. 8.8mm; FW length 5.0 x width. Essentially as described for male, no dichromatism in wing pattern. Genitalia as in Fig. 76 (drawn from EME 2192; n = 2); VIII-IX intersegmental membrane with a pair of large, round, invaginated pockets; posterior apophyses 1.5X longer than subgenital plate + anterior apophyses; sterigma with small, cup-like invaginations flanking ostium; colliculum a short, sclerotized sleeve; signum proximal on corpus bursae, a small, curved blade.

Holotype male: CALIFORNIA: San Luis Obispo Co.: Oso Flaco Lk., 5 mi S Oceano, June 7, 1973, [assoc]. *Haplopappus* [= *Ericameria*] *ericoides* (J. Powell). Paratypes (11) same locality: same data as holotype, 7m, 1f [EME 417m, 418m, 2191m, 2192f, DW 80-35]; 1m V-11-65, 1m VII-14-65, 1f VI-1-72 [EME 441].

Taxonomic relationships.– This species is structurally related to *Gnorimoschema albimarginellum* (Chambers) (genitalia figured by Povolný, 1967a), having a similar uncus. Otherwise, however, *G. ericoidesi* differs in details of genitalia and habitus. The FW pattern is similar to that of *G. ericameriae*, but *ericoidesi* almost entirely lacks the rust and ochreous pattern of that species, having dull ochreous restricted to narrow highlighting of the black dots, seen in fresh specimens. The FW is much darker than that of *G. tenerum*, with the dark pattern distributed over the whole wing, and it lacks the upraised scale tufts of *G. debenedictisi*. The saccus is very broad, slightly broadened distally; the aedeagus is short, slightly longer than the tegumen + uncus, and the paired saccular processes are rudimentary. It appears to be a derived species of the *Gnorimoschema baccharisella* group of Nearctic species.

Biology.– Adults were taken flying diurnally in association with *Ericameria ericoides* on coastal sand dunes in May, June, and July. This species was not discovered at Dune Lakes, a few km to the north, where *G. ericameriae* occurs on the same hostplant. The coastal chaparral habitat at Oso Flaco Lake was gradually destroyed by Off Road Vehicle activity during 1966-1977 (Fig. 112-115; Powell, 1981). Although vehicles have been excluded since 1982 and habitat restoration enacted (Powell, 1991), *G. ericoidesi* has not been observed since 1973.

Gnorimoschema grindeliae Povolný & Powell, **new sp.**

(Fig. 1, 2, 37, 38, 78, 101)

A moderately large species with dark to bright rust-brown forewings, nearly unicolorous to variably patterned with poorly defined whitish mottling and subterminal band.

MALE: FW length 8.0-10.5mm, avg. 10.1mm (n = 10); FW length 5.3-5.4 x width. *Head:* Crown rust brownish with silver luster, paler than thorax and FW; frons whitish. Labial palpus stout, covered by long, erect brownish cinereous scales, forming on segment II a distinct double comb, paler interiorly; III darker apically as it protrudes from scaling of II. *Thorax:* Dorsum, tegula, and patagia pale rust brown tinged with cream-colored scales. Forewing ground color varies from deep chocolate-rust to bright rust-brown and from having no pattern to having poorly to moderately well-developed pattern of cream-whitish scaling forming indications of two narrow, transverse bands subapically and subbasally; concentrations of slightly erect, blackish scales near wing base on dorsal margin and at apex. Cilia cinereous. Hindwing dark gray, slightly shining; cilia cinereous gray tinged with brownish. Legs dark brown tinged with black, with narrow, pale ringlets on tarsal segments. *Abdomen*: Velvet blackish dorsally, tinged with brownish, pale ventrally. Genitalia as in Fig. 37-38 (drawn from EME 2174, 1162; n = 5); tegumen large, broad; uncus convex with a moderately produced tip; hooklet of gnathos strongly sclerotized, parallel sided with a rounded tip, short compared to the long tegumen; sacculus broad with a shallow, narrow incision; unpaired saccular process forming a sclerotized fold that protrudes laterally as a triangular process with curved tip; paired semicrescentic ledge in ventral wall of sacculus long; valva stout, slender relative to size of genitalia, with a curved tip reaching to about tip of uncus; parabasal process prominent, situated ventrally to base of valva, with a curved, digitate tip; saccus long, nearly parallel sided, its broadened obtuse tip shorter than the prominent, stout lateral lobes of vinculum; the strong tegumen wall visible ventrally due to deep excision of saccular wall laterally of saccus. Aedeagus slender with swollen phallobase; numerous cornuti and a serrate ledge preceding apex.

FEMALE: FW length 9.0-11.2mm, avg. 10.2mm (n = 9); FW length 4.7-5.2 x width. Slightly larger and more broad-winged than male, but no consistent difference in color or FW pattern. Genitalia as in Fig. 78 (drawn from EME 2188; n = 2); VIII-IX intersegmental membrane with a pair of invaginated pockets similar to *G. ericoidesi*, widely separated, relatively smaller; VIII tergite with lateral pockets at origin of dorsal ridges; posterior apophyses very slender, 1.6x longer than subgenital plate + anterior apophyses; colliculum with narrow sclerotized collar; signum proximal on ductus bursae, with strong free horn.

Holotype male: CALIFORNIA: Pt. Richmond, Contra Costa Co., April 10, 1996, r.f. *Grindelia hirsutula*; emgd. IX-2-96, JAP 96D4 (J. Powell). Paratypes (17): **Contra Costa Co.**: same data as holotype, 3m, 4f, emgd. VIII-7 to IX-16-96 [JAP 7389m, 7413f]; Pt. Molate, 1m III-17-64, r.f. *G. hirsutula*, emgd. VI-VII, JAP 64C5; 1m same data except III-27-64, JAP 64C10 [EME 1162m]; 2f V-6-87, r.f. *G. hirsutula*; emgd. VII-26, IX-8-87, JAP 87E2; 1m IX-15-87 [JAP 5894m]; 1m VI-28-88 [EME 2658m]; 1f VIII-25-88 [JAP 5928f]; 1m, 3f IV-6-89, r.f. *G. hirsutula*, emgd. VIII-6 to IX-10-89, JAP 89D2; 2m, 4f IV-19-91, r.f. *G. hirsutula*, emgd. by VIII-26-91, JAP 91D21.

Taxonomic relationships.– This is a species of the *Gnorimoschema coquillettella* group, having many structures similar with *G. coquillettella*, of specific form in *G. grindeliae*, which are summarized under *G. crypticum*, below.

Biology.– Although adults have been taken in the field from late June to mid-September, there appears to be a single annual generation. The species evidently is host specific, the larvae feeding within soft stem galls of *Grindelia hirsutula*, and the life cycle is adapted to that plant. *G. hirsutula* is perennial but dies back during late summer, and new foliage grows from the root crown each spring, with flowering in May-June. Numerous searches of the beach-inhabiting *Grindelia humilis* that grows within a few meters of the Pt. Molate collection site and remains green through fall and winter failed to detect any gall formation.

Larvae cause the growth of soft, variably shaped galls in newly developing stems in early spring; their growth causes compression of the stem nodes and a clumping of foliage just above them, often including leaves that form a sheath around the gall (Fig. 101). Later the stem extends beyond this rosette prior to flowering. By mid- to late March many galls have reached full size (12-20mm long x 10-12mm diameter), are whitish or pale green with fleshy walls 2-5mm thick, and the larvae are tiny, 2nd or 3rd instar. Growth occurs rapidly, and larvae reach maturity in April, when each cuts a hole in

the gall and drops to the ground; rarely a few larvae persist into early May. By the time galls are beginning to be vacated, in early to mid April, they are white tinged with purplish brown exteriorly. Later, the remaining gall tissue deteriorates, and by late summer they are evidenced only by the clustering of nodes and twigs that they cause in spring.

In the lab, larvae formed dense silken cocoons in loose sand, sometimes affixed to paper toweling on the sand surface. Cocoons are quite large relative to the pupal size, ca. 1.5-3cm in length and 4-5mm thick, with a greater lumen diameter than the non-motile pupa would seem to require. The plants typically grow on sandstone bluffs just above the bay shore, and larvae probably pupate in loose sand and leaf litter on the ground surface.

We assume eggs are deposited at the base of the plants in summer; by fall the upper portions of the plants have completely dried. Presumably overwintering takes place by eggs or early instar larvae in the root crowns. The sympatric *Grindelia humilis*, by contrast, remains green all winter, and flowering occurs in fall and winter, yet *Gnorimoschema grindeliae* rarely, if ever feeds on it.

Gnorimoschema crypticum Povolný & Powell, **new sp.**

(Fig. 18, 39, 40, 79)

A moderately large, relatively broad-winged species having variable rust-brown colors with variable, transverse patterns of whitish to ochreous, flecked with blackish.

MALE: FW length 6.2-7.75mm; avg. 7.4mm (n = 10, flown specimens); FW length 4.5-5.1 x width. *Head:* Crown rust brown with admixture of whitish or cream whitish. Frons usually paler. Labial palpus robust with erect scaling, color varying with that of crown. *Thorax*: Dorsum and tegulae concolorous with head. Forewing ground color varies from chocolate- to pale rust-brown, nearly unicolorous or dorsal margin pale brownish to cream colored; distal and tornal areas often with admixture of cinerous scales with black tips. Pale pattern variable, possibly with age, usually as poorly defined, transverse markings and subterminal band, superimposed on diffuse, dark brown areas and blackish strigulae. Cilia cinereous to brown. Hindwing dark gray with blackish veins, paler basally. Cilia gray, sometimes tinged with brownish. Legs dark gray to blackish with pale ringlets indicated to distinct. *Abdomen*: Basal 2 visible terga with short ochreous scaling, becoming larger, successively darker gray distally; genital, lateral, and ventral scaling shining whitish. Genitalia as in Fig. 39-40 (drawn EME 2659, JAP 7197; n = 8); tegumen stout; uncus broad, moderately convex with an obtuse tip; gnathos broad, short, ligulate, with rounded tip to broadly subtrapezoidal; valvae slightly curved with distinctly inflated, truncate or rounded tip; parabasal process a short, stout hook; paired sacculus process slightly rounded, forming a short, straight ledge; medial sacculus excision short, acute; a paired, concave crescentic sclerite enforces sacculus wall; saccus form varies, usually parallel-sided with truncate tip, occasionally narrowed toward obtuse tip, slightly shorter than the slender, lateral arms of the vinculum. Aedeagus longer than genital capsule; phallobase broadly subovate, contrasting with slender aedeagus trunk, which has an obtuse tip and a narrow, serrate, subterminal ridge.

FEMALE: FW length 5.4-7.75mm; avg. 7.0mm (n = 8, flown specimens); length 4.75-5.5 x width. Essentially as described for male, similarly variable; abdomen with basal terga only faintly ochreous tinged. Genitalia as in Fig. 79 (drawn from EME 2660; n = 4); VIII-IX intersegmental pockets moderately large, widely separated; posterior apophyses 1.8x longer than VIII + anterior apophyses; subgenital plate broader than long, with a striking protrusion of the periaxial margin, forming a funnel strengthened by broad, crescentic ledges, strengthened laterocaudally by a short, crescentic sclerite; posterior apophyses slightly longer than subgenital plate; colliculum a short, sclerotized, irregular ringlet; signum relatively short, curved spine.

Holotype male: CALIFORNIA: Monterey Co., Big Creek Reserve [28 airline km SE Big Sur], March 1, 1989, r.f. *Haplopappus* (= *Hazardia*) *squarrosa*, emgd. VII-16-89, JAP 89C3. Paratypes (50): **Los Angeles Co.:** Avalon, Sta. Catalina Id., 1m X-13-1931 (D. Meadows, LACM). **Monterey Co.**: same data as holotype, 2m, 8f emgd. VII-7 to VIII-25-89; same locality, 1m X-3/5-85, assoc. *Haplopappus squarrosus* [EME 2210], 1m, 1f X-3/5-85, blacklight (J. Brown & Powell) [EME 2188f], 1m VII-7/8-86, blacklight trap; 1m, 2f II-21/22-88, r.f. *Haplopappus squarrosus*, emgd. by X-30-88, JAP 88B34 [EME 2659m]; same data 1m, 1f, JAP 88B45 [EME 2660f]; same locality 1m IX-18-89, blacklight (F. Arias). **San Luis Obispo Co.**: Morro Strand St. Beach, 22m, 4f VIII-20/22-90, assoc. *Haplopappus acradenius* [JAP 7414m, 7420f]. San Simeon Beach, 4m VIII-28-61 (R. Langston & Powell) [EME 472, 2173, 2174]. Additional specimens: **Santa Barbara Co.**: all San Miguel Island: Nidever Cyn., 1f X-14-95 [JAP 7181], Cuyler Harbor, 1f X-15-95, 1m V-10-97, r.f. *Isocoma menziesii vernonioides*, emgd. VIII-2-97 JAP 97E44 [JAP 7646], Willows Cyn. 100-300', 1m X-15-95 [JAP 7197], 3f V-10-97, r.f. *I. m. vernonioides*, emgd. IX-15-97 JAP 97E39, cyn. below Knox 200-300', 1m V-11-97, r.f. *I. m. vernonioides*, emgd. by XI-2-97 JAP 97E50.

Taxonomic relationships.– This is a cryptic sister species of *Gnorimoschema grindeliae* that is allopatric and associated with different woody composite hostplants. In contrast to *G. crypticum*, the male genitalia of *G. grindeliae* tend to be more broadly spatulate, have truncated valvae, elongate and narrow, hook-shaped parabasal process, longer paired process of the sacculus fold, stouter sacculus with moderately concave sides and longer ovate phallobase. The subgenital plate of *G. grindeliae* has a distinctly longer funnel-shaped prolongation and stouter, less curved signum spines.

The variation in color and forewing pattern appears to be in part related to aging and may be partly geographical polytypy. Reared specimens from the type locality, the northernmost known population, tend to be more unicolorous and darker rust brown, while flown examples (n = 2 at Big Creek and all San Luis Obispo Co. specimens) are paler rust brown with variable whitish patterning. Three specimens from San Miguel Island and one from Catalina Island, the southernmost sites, collected in October, have much paler color ochreous-rust, with a washed out, paler pattern, but they are worn and too few to characterize with confidence. Specimens reared from galls at the same sites on San Miguel Island are darker with typical forewing pattern and have more gray, less rust than mainland examples.

Biology.– The life cycle and larval habits are similar to those of *Gnorimoschema grindeliae*. The hostplant at Big Creek, *Haplopappus (Hazardia) squarrosa*, and *H.* (*Isocoma*) *menziesii* var. *vernonioides* on San Miguel Island, and those presumed by association of adults at San Simeon and Morro Strand, *H.* (*Isocoma*) *acradenia*, are evergreen shrubs with erect, woody stems that do not die back to the ground at the end of the season. The galls caused by *G. crypticum* are soft, variable in form, and ephemeral, similar to those of *grindeliae*. Feeding takes place in February to early April, as late as May on San Miguel Island; mature larvae leave to form cocoons in ground litter or soil, where they must undergo diapause until summer. We have sampled extensively at the type locality and have seen adults from July to October.

Gnorimoschema baccharisella Busck

(Fig. 19, 41, 80, 103)

Gnorimoschema baccharisella Busck, 1903: 825.

This species is widespread in coastal California, where the larvae cause hard stem galls on *Baccharis pilularis* (Asteraceae).

Diagnosis.– The adults are moderately large (FW length: males, 6.2-8.5mm, avg. 7.3mm; females, 6.5-9.0mm, avg. 7.5mm), and the forewing pattern is characterized by a pale peach-colored basal patch (ca. 0.2 of wing length) that is variably tinged with rust, the remainder of the wing pale to dark gray. There is a subtle, longitudinal streak of rust on the fold in the cell, sometimes connected to the basal patch; usually two additional rust spots in middle and end of cell; and the distal half often has longitudinal, whitish streaks. Male genitalia as in Fig. 41 (drawn from EME 442; n = 5); medial sacculus incision V-shaped, parabasal process truncate; saccus subtriangulate with truncate tip, shorter than vinculum arms. Aedeagus ca. 2/3 tegumen +

vinculum length, its phallobase broadly subovate, trunk narrowed with a serrate ledge. Female genitalia as in Fig. 80 (drawn from K 2012, CAS; n = 3); pockets of VIII-IX membrane moderately large but shallow, widely separated; posterior apophyses 1.35-1.4x longer than VIII + anterior apophyses; latter ca. 2x longer than subgenital plate, which is broader than long with strong crescentic paired sclerite delimiting sterigma on both sides; signum strong, moderately curved spine with a prominent, capitate external protrusion.

California Coastal Records.– Alameda Co.: Albany Hill, 1m VI-7-98, r.f. gall on *Baccharis pilularis*, emgd. by X, 98F20, same locality 2m, 1f VII-11-98, galls on *B. pilularis*, emgd. IX-6 to X-98, 98G8; no locality stated, 2m, 1f "Sept." [1885-1888, Koebele] [slides K.2012f, K.5640m, CAS, USNM]. **Contra Costa Co.**: Antioch Natl. Wildlife Refuge, 2f VIII-15-91, r.f. *B. pilularis*, emgd. X-13-91, 91H27; Brooks I., 1m, 1f X-24/25-95, bl. trap; Pt. Molate, 2f IX-15/16-88, blacklight . **Marin Co.**: 3 mi. W Inverness, 1m VIII-15-65 (J. S. Buckett, UCD); Inverness Ridge, Post Fire Survey (Drakes View trail), gall on *B. pilularis*, III-14-96, 96C5, same data 1m V-14-98, r.f. *B. pilularis*, emgd. VII-22-98, 98E22, same data (Bay View trail head), IV-15-97, 97D23. **Monterey Co.**: Big Creek Reserve, 1f VI-7-93, r.f. *B. pilularis*, emgd. VIII-16-93, 93F12; same locality, 5m, 5f at blacklight on 8 dates VIII-5 to XI-30, 1987-93 (F. Arias, Powell, *et al.*); Big Sur, 1m X-5-86, bl. trap. **San Francisco Co.**: Baker Beach, 1m VIII-29-77 [EME 1130m]; Lone Mt., 1f IX-18-1908, (F. X. Williams) [K.2013, CAS]. **San Luis Obispo Co.**: Oso Flaco Lk., 5 mi. S Oceano, 1m X-3-72, black & white lights [EME 442m]; same locality 2m, 1f VIII-23-73, at light [EME 1131f]. **San Mateo Co.**: San Bruno Mt., 4m,2f VII-5-84, r.f. *B. pilularis*, emgd. VIII-25 to IX-7-84, JAP 84F46 (J. De Benedictis). **Santa Barbara Co.**: Goleta, U. C. Campus, 1m VII-17-65, assoc. *Baccharis* [EME 2686m]; San Miguel Id., Nidever Cyn., Willows Cyn., 2m X-13/14-95, blacklight (I. Williams & Powell); Santa Cruz Id., Prisoners Harbor, 1m IX-28-78, bl.trap [EME 1129m]; Santa Rosa Id., Cherry Cyn., Windmill Cyn, Torrey Pines area, galls, young larvae IV-28/28-95, 95D57, D81, D95.

Biology.– *Gnorimoschema baccharisella* is not limited to the immediate coast where the typical, prostrate form of the hostplant occurs. The moth occurs inland, probably throughout the range of the plant, which is widespread in coastal foothill areas, often as an invader in disturbed fields. The original description was based on specimens reared by Koebele probably from Berkeley and Alameda (type locality erroneously cited by Busck as Berkeley County), who found the galls abundant in June. The moth's biology and the parasitoid complex have been studied in detail by Tilden (1951). We have reared the species and/or its parasitoids at several sites and have observed the galls at many others.

There is a single annual generation. Tilden (1951) reported that eggs are deposited on peripheral branches of the perennial shrubs, and overwintering takes place as eggs. He observed that the newly hatched larva burrows into the tip of the growing terminal. The gall begins to develop at the point of the larval entry, and the hollow gall develops around the larva. Galls develop in the newly elongating stems and are evident by February. They are green, spindle-shaped and reach full size (ca. 18-36mm in length, Fig. 103) by late February or March, but larvae are still quite small and do not survive if galls are removed from the plant before June or July. By this time often are most of them are parasitized.

At maturity, the larva cuts a hole to the exterior and drops to the ground for pupation, which evidently occurs without diapause. Emergence takes place primarily in August and September. We have collection records of the nocturnal adults from mid-July (Goleta, Sta. Barbara Co.) to late November (Big Creek, Monterey Co.).

Gnorimoschema baccharisellloides Povolný & Powell, **new sp.**

(Fig. 42)

A moderate sized species that is similar to *G. baccharisella* but has the forewing basal patch defined by white that extends outward forming a crescent below the cell.

MALE: FW length 7.0-8.2mm (n = 2); FW length 4.8-5.3 x width. *Head:* Crown unicolorous ash gray to whitish, individual scales having white tips. Labial palpus thickly scaled, whitish, darker exteriorly, with numerous scales having dark tips; slight indication of broad dark ringlets, especially on III segment. *Thorax:* Dorsum and tegula concolorous with head. Forewing ground color a mixture of grayish and rust scales, appearing unicolorous to unaided eye, basal patch (0.2 wing length) pale rust, defined outwardly by a whitish transverse band extending obliquely from costa to dorsal margin that extends outward in dorsal area, curving upward as a crescentic streak; transverse portion edged outwardly by dark gray; two brownish stigmata indicated at about middle and about 2/3 FW length axially. Some scales with blackish tips indicating submarginal spotting in apical area. Cilia gray. Hindwing gray; cilia paler. Legs exteriorly covered with cinereous scales with darker tips; whitish interiorly. *Abdomen*: Scaling not recorded. Genitalia as in Fig. 42 (drawn from holotype; n = 2); stout, uncus broad, with a moderately produced tip; gnathos broader at base, moderately acute-tipped, subtrapezoidal. Valva curved, tips moderately widened and rounded; parabasal process stout with a broad membranous base extending behind paired saccular process; medial fold of sacculus distinct with a narrow excision, laterally with an inconspicuous process; semicrescentic ledge on wall of sacculus broad, extending from base of saccus to base of parabasal process; saccus elongate with concave lateral margins and a broadly dilated tip; lateral corners of vinculum prominent, reaching beyond length of saccus. Aedeagus pear-shaped, phallobase very large, shaft slender; a subterminal hooklet under the obtuse tip and a dorsal ledge with numerous indentations.

FEMALE: unknown.

Holotype male: CALIF.: Oso Flaco Lake, 5 mi. S Oceano, San Luis Obispo Co., October 3, 1972, at black & white lights (J. Powell) [EME 449]. One paratype male, same locality, 1m IX-8-69, (Opler & Powell) [EME 1110]. One additional male, same data as holotype, is smaller with a more suffused FW pattern but appears to be conspecific [EME 421].

Taxonomic relationships.– This is a sister species of *Gnorimoschema baccharisella* Busck. The wing pattern is similar but less distinct in *G. baccharisellloides*, and features a whitish transverse band and outward crescent that are not developed in *G. baccharisella*. The male genitalia are similar, but the gnathos of the new species is subtrapezoidal, not parallel-sided; its medial fold of the sacculus is shorter, with a correspondingly shorter incision, while the paired parabasal process of *G. baccharisellloides* is stronger and stouter; the semicrescentic ledge of the sacculus is broader. The saccus is more elongate and its lateral margins are more concave and the tip wider. The aedeagus is relatively larger, with a much broader phallobase, whether viewed in lateral or dorsal aspect. The subtrapezoidal gnathos suggests the new species is also related to *G. coquillettella*, but it seems obvious that *G. baccharisellloides* is a cryptic sibling with *G. baccharisella*.

Biology.– Adults were collected in September and October in coastal dune habitat that was severely perturbed by Off Road Vehicle activity by 1972 (see comments under *G. ericoidesi*).

Gnorimoschema subterraneum Busck

(Fig. 20, 43, 81, 102)

Gnorimoschema subterraneum Busck, 1911: 5.
Gnorimoschema sp. B, De Benedictis *et al.* 1990: 24.

This species was described from Massachusetts, reared from stem galls on *Aster multiflorus* at or beneath ground level. Although the species has not been recorded any place between the east and west coasts, we could not detect any morphological differences between specimens we reared from stem galls on *Aster* in the San Francisco Bay area and paratypes of *G. subterraneum*, except in size.

California reared specimens: Forewing length, males 8.1-10.5mm, avg. 9.3mm (n = 10), FW length 4.3-4.9 x width; females 7.3-10.1mm, avg. 8.3mm (n = 10); length 4.5-5.0 x width. Broad-winged, stout, and almost uniformly colored; forewings rust- to deep ebony-brown in three populations (Ring Mountain, Pt. Richmond, San Bruno Mountain) and bright brick red

in one (Richmond Field Station). The last more resemble the color of the smaller adults from Massachusetts. Indications of obsolete blackish stigmata are visible on individuals of paler coloration. Male genitalia as in Fig. 43 (drawn from EME 2656; n = 4); characterized by a sclerite with paired, rounded lobes arising from the sacculus fold just ventral to the generically typical "ear-shaped" paired process. This lobate process is present, less well developed in *G. gallaesolidaginis* (Riley) of the eastern U. S. Aedeagus of *G. subterraneum* slender, enforced by a serrate ledge. Female genitalia as in Fig. 81 (drawn from EME 2171; n = 5); no invaginated pockets of VIII-IX membrane; antrum elongate, funnel-shaped; signum with a stout, curved spine. Genitalia of typical specimens from Massachusetts were illustrated by Povolný (1967a).

California Coastal Records.– Contra Costa Co.: Pt. Molate, 1m, 2f IV-26-88, r.f. stem gall *Aster chilensis*, emgd. IX-16,27-88, JAP 88D41; same data except 3m V-18-88, emgd. IX-8/27-88, 88E8 [JAP 5940]; 3m, 11f VI-28-88, emgd. IX-18/30-88, 88F102, F103; 6m, 5f VIII-25-88, emgd. IX-11/24-88, 88H12, H13 [JAP 5933m, 5934f]; Richmond Field Sta., 2m, 3f V-20-92, r.f. *A. chilensis*, emgd. IX-20 to X-11-92, JAP 92E236. **Marin Co.**: Ring Mt., 1 mi. SE Corte Madera, 3f IV-30-86, r.f. *A. chilensis*, emgd. IX-9-86, JAP 86D134 [EME 2171]; same data except 4m, 7f V-6-87, emgd. IX-6/30-87 (+ 1m, 3f DOA ex galls), 87E3 [EME 2655m, 2656f]. **San Mateo Co.**: San Bruno Mt., Radio Rd. 3m, 3f III-26-88, r.f. "*?Solidago canadensis*", emgd. VIII-16 to IX-14-88, JAP 88C17 (J. De Benedictis) [JAP 7465m]; same data except 2m, 1f V-2-88, emgd. VIII-28 to IX-2-88, 88E1 [JAP 7466f], 1m, 1f VII-13-88, emgd. VIII-19, IX-20-88, 88G23; same locality 2m, 1f VII-13-88, r.f. galls *Aster*, emgd. VIII-18/29-88, 88G21 (all J. De Benedictis) [EME 2654f], same locality, 2m, 7f VIII-18-98, r.f. *A. chilense*, emgd. VIII-31 to X-2-98, 98H34.

Biology.– In California, *Gnorimoshema subterraneum* is univoltine, with lab emergence records in mid August to early October. In collections from Pt. Molate in 1988, males emerged Sep 1-26, with 50% by Sep 16, while females emerged Sep 11-30, 50% by Sep 24, from galls collected in April, May, June, and August. We have not seen adults in the field; they are presumed to be nocturnal, but none came to blacklights in several samples at Pt. Molate and San Bruno Mountain.

The larvae cause large, nearly spherical to watermelon-shaped galls (17-27mm long, 12-16mm diameter, Fig. 102) on stems of *Aster chilensis* (Asteraceae). At San Bruno Mountain this plant grew intermixed with *Solidago canadensis*, and collections were thought to have originated from both plants (De Benedictis *et al.*, 1990). We were unable to confirm the use of *Solidago* in 1998. Galls are full sized by March or April, but those taken from the plant prior to late April contain immature larvae. Larvae probably complete feeding by May, judging from success in rearing; prepupal larvae remain in the galls until pupation in late summer.

Typically, galls occurred 12-15cm or more above ground level. However, at one site at Pt. Molate, on a sandstone bluff just above the bay shore, many galls occurred at ground level, mostly 2-5cm above the roots, and often hidden in the leaf litter (JAP 88D41, E9, F103, H12). Others in this colony ranged up to comparable heights to those of other sites. These occurred on shorter, more spindly-stemmed *Aster chilensis* that bloomed earlier, and the galls tended to be smaller than average and mature earlier in summer. Similar variation in stem gall height has been noted in *G. gibsoniella* Busck (Busck, 1915). In a collection at San Bruno Mountain (98H34), gall height had a strongly bimodal distribution, with most low on the plant, 0.5-9.5cm above the rootstock (avg. 8.3cm, n = 14), while others were high, 22.5-35cm from the base (avg. 26.7, n = 3). Because the plants grew densely interspersed with *Rubus* and other chaparral stems, it is likely the sample was not a random representation, with those low on the plants more difficult to detect, but none was discovered at heights of 10-22cm.

In one instance two galls of *G. subterraneum* were produced on one stem, with a gap of 12mm separating them, and both produced moths (88H12). When the stems dry in fall, the galls become woody and persist, sometimes for two or more seasons. Larvae of a parasitoid wasp, *Microdontomerus* sp. (Torymidae), were prevalent at Ring Mountain (87E3) but were not observed at the other localities. The fully grown, gregarious larvae (9-12 per gall) waited in diapause in the galls over winter until the following July to emerge when the next season larvae of *G. subterraneum* were fully developed.

SYMMETRISCHEMA Povolný, 1967

Type species: *Phthorimaea plaesiosema* Turner, 1919 (= *Trichotaphe tangolias* Gyen, 1915).

Species of *Symmetrischema* are unambiguously characterized by: an unpaired, typically digitate sclerite centrally from the sacculus fold; the gnathos usually is subangulate, occasionally serrate; the aedeagus tends to bifurcation apically; the female subgenital plate often has sculpture of longitudinal folds; the spine of the signum is short, relatively delicate, serration usually lacking, poorly indicated in a few species. In more derived forms there is a paired lobate sclerite on both sides of the ostium bursae. Numerous South American species lack the unpaired saccular process but show obvious characters of the genus (aedeagus bifurcation, serrate gnathos, shape of subgenital plate) (see Povolný, 1989b).

The larval food plants are Solanaceae, so far as confirmed, both cultivated and in natural communities. The species richness of *Symmetrischema* is focused in the Neotropical Region, particularly the South American Andes, from which pest species have been introduced, and the few Nearctic species have radiated.

Symmetrischema tangolias (Gyen)

Trichotaphe tangolias Gyen, 1913: 338.
Symmetrischema tangolias; Hodges & Becker, 1990: 84 (synonymy).
Phthorimaea plaesiosema Turner, 1919: 126.
Symmetrischema plaesiosema; Povolný, 1967a: 55.
Phthorimaea melanoplintha Meyrick, 1926: 279.
Gnorimoschema tuberosella Busck, 1931: 59.

A relatively broad-winged species with gray to brownish FW having a variable pattern, pale basally with a blackish band at basal 0.2 of costa, angled outward to Cu fold, thence shaded toward apex (figured in color by Povolný, 1994).

MALE: FW length 5.9-8.1mm, avg. 7.35mm, length 4.75-5.4 x width (n = 8); female FW 6.05-7.75mm, avg. 6.9mm. Male genitalia with a pair of broadly foliate sacculus processes and a clavate or digitate unpaired process from the saccular fold ventrally. Female genitalia with short subgenital plate with a paired, lobate sterigmal sclerite and a parallel-sided funnel protruding from center of subgenital plate (see figures, Povolný, 1989b).

California Coastal Records.– Alameda Co.: Albany Hill, 1m V-8-98, DOA in pupa beaten from *Solanum americanum*, 98E16 [JAP 7781]; Berkeley, adults II-3-84, IV-3-84, IV-20-91, VI-3-90, XI-6-95, XI-18-92, blacklight. **Los Angeles Co.**: El Segundo, 2f, larvae on *Solanum nigrum*, emgd. VII-11/15-38 (W. D. Pierce, LACM); San Clemente Id.: N end airfield, 2m, 2f II-20-87, r.f. *S. douglasii*, emgd. IV-4/28-87, 87B154 (J. De Benedictis), 3m, 1f Horse Beach Cyn., II-22-87, r.f. *S. douglasii*, emgd. III-17/ IV-9-87, 87B178 (De Benedictis), Wilson Cove, 1f XII-4-81, at light; Santa Catalina Id., Avalon, 2m, 1f X-14/19-1931, 3m, 1f IV-25 to V-27-1932 (D. Meadows, LACM). **Marin Co.**: Pt. Reyes, 1m III-31-59. **Monterey Co.**: Big Creek Reserve, adults, 14 dates, May 22 to January 24, 1985-1992, 0-500 m, blacklights in coastal sage scrub, riparian and mixed conifer-hardwoods. **San Diego Co.**: Del Mar, 1f VIII-15-43 (J. Comstock, LACM); San Diego, 1f 9-26-24 [26 Sept. 1924], 1m 11-16-24 [16 Nov. 1924] (E. Piazza, LACM). **San Francisco Co.**: San Francisco, 1m VIII-27-36, r.f. *S. nigrum*, emgd. IX-14-36 (H. H. Keifer). **Santa Barbara Co.**: Goleta, U. C. Campus, 1m VI-28-65, 1f VII-4-65 (J. S. Buckett, UCD); 3 mi. N Refugio Beach, 1m VI-28-65 (Buckett, UCD); Santa Rosa Id., 1f XI-16-41 (J. A. Comstock, LACM).

Taxonomic relationships.– This species was introduced into Australia as a pest of potato, where it was redescribed by Turner as *S. plaesiosema*, the name used for many years after its discovery in California. It was first reported in California (as *G. tuberosella*) in 1932, at Saticoy, Ventura Co. (Barrett 1932), but *S. tangolias* was already widespread here by that time. There are specimens dating from 1924 at San Diego, 1931-32 at Catalina Island (LACM), and from 1925 in Marin Co. (Keifer, 1937).

Biology.– The larvae bore into stems of *Solanum*, and early records in California were in association with *Solanum nigrum*, an introduced plant not used by native species of gnorimoschemines, according to Keifer (1937). Although *Symmetrischema tangolias* evidently has not adapted to tomatoes or potatoes in our climate, it has been called the "potato stem borer" elsewhere. In California it does not depend solely upon introduced plants. Adults have been collected on and at light near, but not reared from *Solanum douglasii* in native communities at Big Creek, Monterey Co., and larvae were collected on this plant on San Clemente Island. The species is multivoltine and may be homodynamic; the nocturnal adults have been recorded in every month from May to January at Big Creek and in February and April in Berkeley.

Symmetrischema striatellum (Murtfeldt)

Eucatoptus striatella Murtfeldt, 1900: 163.
Symmetrischema striatellum; Povolný, 1967a: 58.

The distinctive, striate forewing in various shades of brown distinguish this species from all other western Nearctic members of the tribe (figured in color by Povolný, 1994).

MALE: FW length 5.3-7.0mm, avg. 6.1mm, length 4.9-5.3 x width (n = 7); female FW 5.3-6.4mm, avg. 5.8mm (n= 5). The male genitalia have a truncate, unpaired process arising from the center of the sacculus fold, aedeagus with lateral bifurcation distally. The female genitalia feature a paired, snare-shaped ledge and short, subtriangulate funnel reinforcing the periostial margin of the subgenital plate; signum absent (see figures Keifer, 1937; Povolný, 1967a, 1994).

California Coastal Records.– **Alameda Co.**: "Alameda Co.", 1m "May" [1885-1888, Koebele] [K.2032, CAS]; Albany Hill, 1m III-24-95, r.f. *Solanum americanum*, emgd. IV-15-95, JAP 95C40; Berkeley, 1f VII-20-95, 1f VIII-6-95, 1f IX-19-92, 1m X-11-95, blacklight. **Contra Costa Co.**: Antioch Natl. Wildlife Ref., 1m IX-20-90, blacklight; Brooks Id., 1f III-31-94, r.f. *S. furcatum*, emgd. IV-22-94, JAP 94C93; same data 1m, 1f VI-21-95, emgd. VII-11, 20-95, 95F16, same data 2m, 1f XI-13-95, emgd. XII-25/28-95, 95L8, same data 1f III-21-96, emgd. by VII-96, 96C32. **Los Angeles Co.**: [No locality], 1m "Apr" (Koebele Collection, CAS); San Clemente Id., Stone Biol Lab, 1m XII-4-81, at light (S. Miller & Powell); Santa Catalina Id., 1m "larva on Quercus dumosa, emgd. III-24-41" [evidently a labelling or rearing lot contaminant error] (C. Henne, LACM). **Marin Co.**: Inverness Ridge, Post Fire Survey (Muddy Hollow), 3m, 3f IX-19-97, r.f. *S. xantii*, emgd. X-10/12-97, 97J8, same data, 3m, 7f X-9-98, emgd. X-29 to XI-11-98, 98K13. **Monterey Co.**: Big Creek Reserve, 1m, 2f X-3/4-85, 0-10m blacklight (J. Brown & Powell), same data, 1m VII-7-86 [EME 2868], 1f r.f. *S. douglasii*, emgd. VIII-10-86, 86G16, same data, 2m III-26/28-87, emgd. IV-21,25-87, 87C64 & 1m r.f. pupa in dry *Brassica* stem, 1f XI-6/7-89, 220m blacklight, 1m IX-3/4-91, 725m blacklight, 1m, 1f X-29/30-89, r.f. *S. douglasii*, emgd. XII-4,10-89, 89K2, 3m, 2f VIII-7-93, r.f. *S. douglasii*, emgd. VIII-29 to IX-12-93, 93H20. **Orange Co.**: Aliso Cr., 0.5 mi E Highway 1, 1f X-7/8-87. **San Diego Co.**: Del Mar, 1m VIII-8-43 (J. Comstock, LACM); San Diego, 1m 11-19-24 [19 Nov. 1924] (E. Piazza, LACM). **San Francisco Co.**: San Francisco, 2m, 1f IX-1/12-1926, 1f VI-20-1927, r.f. *Solanum nigrum* (H. H. Keifer)[K.2033f, CAS]. **San Mateo Co.**: San Bruno Mt., 5m, 2f I-24-86, r.f. *S. furcatum*, emgd. III-1/11-86, 86A7 [EME 1729f, JAD 634m], same data except 2m, 3f I-24-88, emgd. II-27 to III-12-88, 88A36, 1f VI-11-86, emgd. VII-7-86, 86F131, 3m, 2f XI-12-86, emgd. I-20 to II-13-87, 86L76 (all J. De Benedictis), same locality, 3m, 6f VIII-18-98, r.f. *Solanum*, emgd. VIII-31 to X-2-98, 98H34. **Santa Barbara Co.**: Goleta, U. C. Campus, 1m VI-27-65 (J. S. Buckett, UCD); Jalama Beach, 2m, 1f II-3-87, r.f. *S. xantii*, emgd. II-27 to III-12-87, JAP 87B27; Lompoc, 1m XII-18-33 (Jones, CAS); 3 mi. N Refugio Beach, 1f VII-4-65 (J. Buckett, UCD); San Miguel Id., N Green Mt. Cyn., 8m, 6f X-16-95, r.f. *S. douglasii*, emgd. XI-10/20-95, JAP 95K24; Santa Cruz Id., 1f VIII-13-39 (L. Martin, LACM); Santa Cruz Id., Central Vy., 1f IX-25-78, blacklight, Canada Cervada, 5m, 1f V-22-84, r.f. *S. wallacei*, emgd. VI-20 to VII-11-84, JAP 84E58, Eagle Cyn., 1f V-25-84, r.f. *S. ?wallacei*, emgd. VII-1-84, 84E90. **Sonoma Co.**: Bodega Head, 1m III-6-77.

Taxonomic relationships.– *S. striatellum* was originally described from Missouri, and it was presumed to be of secondary occurrence in California by Keifer (1936a, 1937). He found the species associated only with *Solanum nigrum*, an introduced plant, and concluded *S. striatellum* was an immigrant. If true, the introduction was an early one because there are specimens from Alameda Co. and Los Angeles Co. from the Koebele Collection (CAS), which must have originated during field work in the 1880s or 1890s. There are specimens from San Diego collected in 1924 (LACM) and San Francisco in 1926 (CAS); *S. striatellum* was recorded on Santa Cruz Island in 1939, at the beginning of moth survey there. The species is now widely distributed in foothill situations in California, often associated with native species of *Solanum*. The data suggest that it is a native insect in California.

Biology.– In California, *S. striatellum* is multivoltine and probably homodynamic; we have collected larvae in every month from March to November. At least six species of native and introduced *Solanum* have been recorded as hostplants in coastal habitats. Although larvae were recorded feeding in nightshade berries by Murtfeldt (1900), our observations concur with those of Keifer (1937): larvae live in terminal leaf shelters, folding each leaf neatly and sealing the opposing edges, and the larva skeletonizes the upper surface within the shelter, packing the frass at one end, in the manner of gall formers. They leave the shelters at maturity to form cocoons, probably in debris on the ground. We have not observed diapause in any stage.

KEIFERIA Busck, 1939

Tildenia Povolný, 1967a: 101.

This genus comprises mainly Neotropical species that are larval miners of Solanaceae so far as known. Only three species occur in California, one presumably introduced from the Neotropics.

Keiferia altisolani (Keifer)

(Fig. 44)

Gnorimoschema altisolani Keifer, 1937: 179.
Keiferia altisulani; Povolný, 1967a:100.

This species was described from Ebbetts Pass, at 2750m in the Sierra Nevada, California, feeding on *Solanum xanti*. Subsequently, it has been found at lower elevations, including coastal sites, feeding on the same plant. The adults are somewhat larger and darker gray than *Keiferia lycopersicella* and *K. elmorei*.

Diagnosis.– Male FW length 5.4-6.2mm, avg. 5.7mm, length 4.1-4.5 x width (n = 4); female FW length 5.0-5.9mm, avg. 5.35mm (n = 4). Male genitalia as in Fig. 44 (drawn from EME 2205; n = 2), distinguished by more deeply bifurcate valvae apically, a much broader, fingernail-shaped saccus with rounded tip, and by having the aedeagus more strongly bent, contrasted to longer and more slender in *K. lycopersicella* and *K. elmorei*. The female subgenital plate of *K. altisolani* has only a short prolongation of the antrum, while it is very long, exceeding the anterior apophyses in *K. elmorei*, nearly equal to them in *K. lycopersicella* (see figures, Keifer, 1937; Povolný, 1967a). In addition, *K. altisolani* differs in larval body color and sclerotization (Keifer, 1937).

California Coastal Records.– San Luis Obispo Co.: Montana de Oro St. Park (Los Osos dunes), 2m, 1f IV-25-96, r.f. *Solanum xanti* (thick-leafed, viscid var.), emgd. V-19/21-96, 96D19 [JAP 7486f], same data 2m, 1f V-23-98, emgd. VI-20/29-98, 98E29. **Santa Barbara Co.:** Gaviota, 1f II-3-87, r.f. *S. xanti* var. *hoffmanni*, emgd. II-26-87, JAP 87B61 (D. Wagner & Powell); 3 mi. E Los Prietos Rgr. Sta., 1m II-12-68, r.f. *Solanum*, emgd. II-27-68 , JAP 68B85 (P. Opler) [EME 2205].

Biology.– Larvae of *Keiferia altisolani* are primarily leaf miners and may spend their entire life mining without folding leaves. Some leaf tying occurs, but the leaves usually have a baggy appearance (Keifer 1937). At high elevations the species likely is univoltine, but it may be facultative, bi- or multivoltine near the coast. Larval records are February to April but too few to define a life cycle.

Keiferia lycopersicella (Walsingham)

Eucatoptus lycopersicella Walsingham, 1897: 69.
Phthorimaea lycopersicella Busck, 1928: 171.
Keiferia lycopersicella (Busck); Busck, 1939: 571.
Keiferia lycopersicella (Walsingham); Hodges, 1965: ; Povolný, 1967: 100, synonymy.

This species was originally described from the West Indies, quite likely an introduced species there, but Walsingham's name was unrecognized when the insect began to be noticed in other tomato growing regions. It was then redescribed from Hawaii with the same species name, as a synonym and homonym, by Busck (1928).

Biology.– This is the notorious 'Tomato Pinworm', and there is an extensive literature on its biology in connection with agricultural practices in California and elsewhere (e.g., Oatman *et al.*, 1979). The Tomato Pinworm was recorded in California in 1923 (Campbell and Elmore, 1931; Keifer, 1937) and was widespread in southern California by the mid 1930s (Keifer, 1936a), but it was not known to be established in central California and northward at that time. We do not have records of *K. lycopersicella* in native coastal communities.

Keiferia elmorei (Keifer), revised stat.

Gnorimoschema elmorei Keifer, 1936b: 349.
Keiferia lycopersicella; Povolný, 1967a: 100, not Busck, 1939 (in part); De Benedictis *et al.*, 1990: 25.

This species is closely related to *K. lycopersicella* but is a miner in native, non-commercial *Solanum* species.

Male FW length 4.0-5.9mm, avg. 5.1mm, length 4.3-4.8 x width (n = 7); female FW length 3.4-5.3mm (n = 3). Flown specimens from Santa Cruz Island average smaller than those available from the mainland, although there are too few for statistical comparison. In genitalia, *elmorei* males have more strongly curved valvae and relatively small anellus than *lycopersicella*, and in the female the antrum is appreciably longer.

California Coastal Records (in addition to localities cited by Keifer (1936b).– **San Mateo Co.:** San Bruno Mt., 2m, 1f II-14-85, r.f. *Solanum umbelliferum*, emgd. III-16/31-85, JAP 85B5 (J. De Benedictis) [JAD 606]. **Santa Barbara Co.:** Santa Cruz Id., Canada Cuesta, 1m III-15-69 (Opler & Powell) [EME 2200m], UC Field Sta., 6m, 6f V-22/24-84, r.f. *S. clokeyi*, emgd. VI-12/20-84, JAP 84E84 (De Benedictis, Powell, Wagner) [EME 2194m, 2195m, 2196f, 2202f, 2212m, 2213f], same data except 1m, blacklight (D. Wagner) [EME 2215].

Taxonomic relationships.– Keifer presented convincing evidence, based on morphology of adults and larvae and cage mating trials, that *K. elmorei* is a native sibling species distinct from *K. lycopersicella*. He had first discovered the new species in native habitat Marin County in 1927, prior to any known establishment of *K. lycopersicella* in the Central Valley or coastal central California (Keifer, 1936b, 1937). By 1936, *K. elmorei* was found to be sympatric with *K. lycopersicella* at some localities (Mt. Hermon, Santa Cruz Co.; Corona del Mar and La Habra, Orange Co.) (Keifer, 1936b).

Nonetheless, *Keiferia elmorei* has been treated as a synonym in recent decades, owing to the similarity in male genitalia. *K. elmorei* adults average larger, are dark gray-brown, contrasted with a primarily dull tan general color in *K. lycopersicella*.

Biology.– The larvae feed on foliage of native *Solanum* species as a leafrolling miner and were not observed to bore into the fruits in numerous collections (Keifer, 1936b; present data). The species occurs in foothill and coastal areas of the coastal counties in California, and populations may be limited to mild winter situations where diapause is not required. Larvae have been observed from January to September.

SCROBIPALPULOPSIS Povolný, 1987

This genus comprises essentially Andean and Patagonian taxa (Povolný, 1987). The single previously described Nearctic species feeds on *Castilleja* (Scrophulariaceae). We add a species that was associated with *Lycium* (Solanaceae) on San Clemente Island.

Scrobipalpulopsis lutescella (Clarke)
(Fig. 45, 82)

Gnorimoschema lutescella Clarke, 1934: 172.
Scrobipalpula lutescella; Povolný, 1967a: 88; De Benedictis *et al.*, 1990: 24.
Scrobipalpulopsis lutescella; Povolný, 1987: 45.

This has been the only known Nearctic species referable to the genus *Scrobipalpulopsis*. It was described from eastern Washington and occurs along the coast of central California; and it is more widely distributed than recorded, Povolný (1998c) having identified it from recent collections in Ontario, and the Yukon, Canada.

Diagnosis.– Forewing length: male, 4.8-5.7mm, avg. 5.3mm (n = 8); female, 5.0-6.5mm, avg. 5.8mm (n = 5); length 4.7-5.2 x width. Male genitalia (Fig. 45, drawn from EME 2189; n = 8) show two pairs of saccular fold processes and a minute, cone-shaped parabasal process of the valva, which has a striking hump-shaped dilation. Aedeagus nearly as long as the genital capsule. Female genitalia (Fig. 82, drawn from EME 2186; n = 4) with a short, asymmetrical, funnel-shaped prolongation of the ostial margin and a sclerotized distal section of the ductus bursae; two "peninsular", foam-like sclerites on both sides of the sterigmal funnel.

California material examined.– Los Angeles Co.: Toyon Bay, Catalina Id., 1m XI-16-81 (S. Bennett, LACM) [JAP 7526]. **Marin Co.:** Marin Island, 2m, 2f IV-13-89, r.f. *Castilleja foliolosum* emgd. IV-30, IX-7 to X-12-89, 89D23 [JAP 7213m]; Pt. Reyes Natl. Seashore, N Beach, 2m, 2f VI-3-78 no assoc. + 2m, 2f r.f. *Castilleja* [*wrighti*], emgd. dates unknown, 78F5. **Monterey Co.:** Carmel Highlands, 1m VII-3-86, r.f. *Castilleja* [*affinis*], emgd. by XII, 86G28 (J. Brown); Carmel St. Beach, 1m VIII-12-84, r.f. *Castilleja* [*affinis*], emgd. date unknown, 84H44; Big Creek Reserve, Whale Pt., 1m X-12-89, blacklight (F. Arias) [EME 2869], same locality except 725m, 1m VI-3/4-94, blacklight; Salinas River mouth dunes, 3m V-18-77, r.f. *Castilleja*, emgd. date unknown, JAP 77E113. **San Mateo Co.:** San Bruno Mt., 1f III-21-68, r.f. *Castilleja*, emgd. IV-6-68, 68C44 (P. A. Opler); same locality, series mm, ff IV-16-82, III-8-84, VI-15-85, VII-1-85, r.f. *C. wrightii*, emgd. IV-22 to V-7-82, JAD 82106-B [JAD 214f, 215m], emgd. IV-4/22-84, JAD 84068-B [EME 2189m], emgd. IX-22, X-3-85, 85F17 [EME 2176f, 2190f], emgd. IX-17 to X-5-85, JAP 85G1 (all De Benedictis), same locality, 1m, 2f III-31-81, r.f "*Gnaphalium?*" [presumably misid. plant], emgd. by VI, JAD 81090-A (De Benedictis) [JAP 7480m], same locality 3m IV-27-86, VII-1-87, blacklight (De Benedictis) [EME 2661], same locality, 1f VI-7-83, r.f. inflores. *Castilleja*, emgd. VI-14-83 (J. Whitfield), same locality except Radio Tower Rd., series mm, ff IV-9-82, r. f. *Castilleja* fls., emgd. IV-20 to VI-5-82 (D. Wagner) [EME 2175m, 2186f]. **Santa Barbara Co.:** Santa Rosa Id., 0.5 km W Beechers Bay, 1m IV-27-95, blacklight [JAP 7094].

The single specimen from Santa Rosa Island is darker gray in general and lacks contrastingly paler, peach color of the forewing dorsal area.

Taxonomic relationships.– This species is distinguishable from all

other Gnorimoschemini in California by having the forewing dorsal area contrastingly paler, peach colored. Remainder of forewing gray, variably streaked longitudinally with dark gray and pale, peach-brown; blackish stigmata in cell usually obscured by infuscation, lower stigma on Cu crease usually discernible; a row of subterminal back dots suggested by blackish scales at base of fringe.

Biology.– The larvae of *S. lutescella* live in flowers of Indian Paint Brush, *Castilleja*, (Scrophulariaceae), feeding in the tubular corollas and immature seeds (Clarke, 1934; present data). The species is multivoltine in coastal California, larvae having been observed from early March to mid-August. In Washington, Clarke (1934) reported that larvae collected in May entered the soil for pupation in late May-early June, producing adults August 8 to September 2, indicating estivation in diapause for 8-10 weeks. Some of our larvae collected in March and April proceeded through development without diapause, but a population at Marin Island (89D23) produced adults both in April without diapause (n = 2) and in September-October, after 5 months estivation (n = 4). Those collected in June-August eclosed in the fall, similar to Clarke's observation. The adults are nocturnal and have been taken at blacklights in April, June, and October.

Scrobipalpulopsis lycii Povolný, **new sp.**

(Fig. 21, 46, 47, 83)

Scrobipalpula n. sp. (*Lycium*) Powell, 1994: 458.

A small, uniformly gray species lacking any distinctive forewing pattern.

MALE: FW length 3.6-3.9mm, avg. 3.8mm (n = 5); FW length 5.0-5.4 x width. *Head:* Crown gray, covered by appressed scales, frons paler, whitish. Labial palpus cinereous, II segment exteriorly covered by erect scales with darker tips; III segment with subbasal and subterminal dark ringlets. *Thorax:* Dorsum and tegula nearly unicolorous gray. Forewing covered by mixed pale and darker cinereous scales, the latter concentrated along costa and apical area. A triad of blackish dots, the first and 3rd at 1/2 and 2/3 wing length, at middle and end of cell, the 2nd more elongate, situated below the 1st, closer to dorsal margin. Fringe gray tinged with brownish, paler toward tornus. Hindwing shining whitish with slight mixture of blackish scales basally; fringe pale gray to whitish. *Abdomen*: Scale coloration not recorded. Genitalia as in Fig. 46, 47 (drawn from EME 1152, 1154; n = 6); uncus broad, rounded; gnathos slender with a shovel-shaped tip with a serrate margin. Valva slender, moderately S-curved, with a prominent, rounded tip curved axially; saccular fold narrow with a very deep and broad medial excision; paired saccular process on both sides of the excision prominent, slender, with acute hooklet tapering caudally from its tip; parabasal process of valva slender, elongate, reaching about 1/2 the length of saccular paired process. Saccus very long and slender with an obtuse, rounded tip. Aedeagus distinctly longer than genital capsule, slender with relatively short, suboval phallobase; tip rounded with a minor curved hooklet; shaft with a serrate ledge that is best visible in dorsal or ventral aspect.

FEMALE: FW length 3.9mm (n = 2); FW length 5.5 x width. *Head:* External features essentially as described for male. Genitalia as in Fig. 83 (drawn from EME 1155; n = 2); subgenital plate not well defined, with funnel-shaped, elongate sclerotization of ductus bursae, longer than anterior apophyses, with elongate sclerotization of its distal wall; VIII sternum of subgenital plate membranous with fine dotted structure and longitudinal folds and ledges extending from bases of the anterior apophyses. Signum a fine, well developed, sclerotized hooklet.

Holotype male: CALIF: San Clemente Island, West Cove, Los Angeles Co. March 21, 1972, associated with *Lycium californicum* (J. Powell) [EME 1154]. Paratypes (7): same data as holotype, 2m, 2f [EME 1152m, 1153f, EME 1155f, 1159m]; San Clemente I., Wilson Cove, 1m IV-11-80, at light (Powell & Faulkner) [EME 1156], 1m XII-4-81 [EME 1158]; San Clemente I., Gord 330m, 1m XII-6-81 [EME 1157].

Taxonomic relationships.– The reliable characters that distinguish *Scrobipalpulopsis lycii* are found in the genitalia of both sexes. This is a much smaller moth than *S. lutescella*, lacking its peach colored forewing pattern. It is an isolated taxon with distant relations to other members of the genus, indicated by genitalia. Superficially, the new species can be confused with pale specimens of *Tuta chiquitella* (Busck), most specimens of which are darker with the triad of dark stigmata more prominent and often surrounded by brownish scaling. The genital diagnoses spelled out under each will easily distinguish the two.

Biology.– So far as known, *S. lycii* is an insular endemic, restricted to San Clemente Island. Several other microlepidoptera are known to be endemic on San Clemente and/or also on Santa Cruz Island, or on San Clemente and Baja California and not adjacent mainland California (Powell, 1985, 1994). Adults were flushed diurnally from the xeric shrub, *Lycium californicum* (Solanaceae) in December, March, and April; it seems likely they are nocturnal but have not been detected by blacklight survey.

SCROBIPALPULA Povolný, 1964

Scrobipalpula includes numerous species that show differing genital characters, distributed in the Neotropical Region, especially in the cold steppes of Patagonia and in the high Andes (Povolný, 1987). In the Holarctic, however, the *S. psilella* complex exhibits many populations that share essentially similar structural features, yet differ in phenotypes, hostplant, voltinism and diapause, and hibernation habits: these occur widely in North America and from Europe to Japan.

Scrobipalpula potentella (Keifer)

Gnorimoschema potentella Keifer, 1936a: 238.
Scrobipalpula potentella; Povolný, 1967a: 84; De Benedictis *et al.*, 1990:24.

This species was described from San Francisco, reared from *Potentilla* (Rosaceae), and Keifer (1936a) mentioned two specimens taken at light in Pasadena. Subsequently, the species has been discovered only at San Bruno Mountain on the San Francisco peninsula. The forewing overall is darker than in most *S. psilella*, although females tend to be paler than males.

Diagnosis.– FW length: male, 4.6-5.9mm, avg.5.0mm (n = 5); FW length 5.0-5.6 x width; female, 4.5-5.0mm, avg. 4.8mm (n = 5) [lab-reared specimens]. *Head*: Crown covered by cinereous scales with blackish tips, frons whitish. Labial palpus slender, gray with extensive blackish scaling concentrated in 2 spots on segment II, basally and apically; segment III with 2 blackish ringlets distinct or indicated, basal and subterminal; inner side cinereous. *Thorax:* Dorsum concolorous with head. Forewing covered by dark cinereous scales with blackish tips; two distinct, dark ochreous streaks, in subcostal area to nearly 1/2 FW length, 2nd along Cu crease to stigma at 1/3; some inconspicuous ochreous streaks in terminal 1/3 2 blackish stigmata in cell axially, 1st at 1/2, 2nd 2/3 FW length, a 3rd stigma indicated to variably distinct in Cu crease at ca. 1/3; faint dark ochreous scaling concentrated around stigmata; smaller black spots along apical margin. Fringe cinereous with black scales basally. Hindwing gray to whitish gray, partly lustrous. Fringe dense, pale gray. Legs black with whitish ringlets or white spotted. *Abdomen*: Gray with basal 2 terga variably dull ochreous. Male genitalia (figured by Keifer, 1936a): uncus broad, bluntly pointed; gnathos spoon-shaped; valvae reaching to apex of uncus, stout, incurved at tips; paired processes of sacculus broad, weakly outcurved at apex; saccus broad, truncate. Aedeagus stout, shorter than tegumen. Female genitalia (Keifer, 1936a): posterior apophyses moderately long, ca. 1.6x longer than subgenital plate + anterior apophyses; ostium broad, sterigma unmodified; signum a simple, curved spine.

California Coastal Records (in addition to the type series).– **San Mateo Co.**: San Bruno Mt., series mm, ff II-21-85, III-15-85, III-22-85, r.f. *Horkelia californica*, emgd. III-27 to IV-23-85, JAP 85B14, 85C8, 85C21 (J. De Benedictis & J. Whitfield) [EME 2143m, 2144f]; same data except, 2f II-1-

86, emgd. III-7-86, JAP 86B7 (De Benedictis).

Biology.– The larvae are leaf miners of *Horkelia californica*, which was considered to be a *Potentilla* at the time of Keifer's work (Jepson, 1925). Larvae usually tie and mine a succession of leaflets along the compound leaf. Lab emergences occurred between March 3 (Keifer, 1936a) and April 23. Because larvae have been found only in February and March, we assume the species is univoltine, but the life cycle and diapause stage are not documented.

Scrobipalpula psilella (Herrich-Schäffer) Complex

This complex occupies an enormous geographic range, from the steppes of Patagonia and the Nearctic Region through Europe to Japan. Unlike numerous distinctive species of *Scrobipalpula* in southern South America, which show clear cut differences in genitalia and phenotypes, the *S. psilella* complex consists of often phenotypically differing populations, the genitalia of which are nearly indistinguishable, differing only in size or relative sclerotization. Many of these forms have been described as species, which in part reflects the extraordinary wide range of composite food plants (Povolný, 1987, 1990). In their recent review of European species of *Scrobipalpula*, Huemer and Karsholt (1998) define four species based on minor genital differences. They suggest that Western Hemisphere populations assigned to *S. psilella* may represent discrete but phenotypically similar sibling species. This may be true for populations referred to *S. psilella* here.

It is obvious that some of the populations should be accorded species status, not only due to their phenotypic and larval host differences but because they are sympatric and/or differ in voltinism. It is often impossible, however, to designate such species on morphological grounds when they are allopatric and/or without knowledge of their life histories.

In California, members of the *S. psilella* group feed on Asteraceae, the 'typical' form primarily on *Gnaphalium*, but at the Antioch dunes we find three sympatric populations using *Gnaphalium*, *Senecio*, and *Gutierrezia*, the last exceptional in differing markedly in genital structure as well. On San Bruno Mountain there is a population feeding on *Heterotheca sessifolia* [= *Chrysopsis villosa* of older literature] that is characterized by larger, darker colored moths. However, we have been unable to define distinguishing morphological characters, and cannot differentiate all specimens taken at lights with confidence. Thus we do not propose a formal name.

Scrobipalpula psilella (Herrich-Schäffer), sensu lat.

(Fig. 48-51, 84, 85)

Gelechia psilella Herrich-Schäffer, 1853: 171.
Scrobipalpula psilella; Povolný, 1964: 339.
Scrobipalpula "psilella"-group, sp. A, De Benedictis *et al.*, 1990: 24.

California populations assigned to this name share a generally similar phenotype and use native species of *Gnaphalium* and *Anaphalis* as larval food plants. We have not found them using introduced species such as *G. luteo-album* and thus conclude they are native populations of the *psilella* complex.

Diagnosis.– The forewing is pale to dark cinereous, showing the triad of characteristic stigmata usually well defined, highlighted by varying amounts of ochreous. Male FW length 4.5-6.5mm, avg. 5.95mm, FW length 5.5-6.3 x width (n = 7); female FW length 4.5-5.6mm, avg. 5.9mm (n = 7). Male genitalia as in Fig. 48-51 (drawn from EME 2187, 1140, 1149, 2662, respectively; n = 43). Female genitalia as in Fig. 84-85 (drawn from EME 1143, 2681; n = 10).

California Coastal Records.– **Alameda Co.:** Albany Hill, 1m II-27-98, r.f. *Gnaphalium canescens*, emgd. III-31-98, JAP 98B4. **Contra Costa Co.:** Antioch Natl. Wildlife Ref., 3m, 2f III-15-85, r.f. *Gnaphalium*, emgd. IV-4/22-85, 85C11 [EME 2161m, 2162f, 2170f, 2187m, JAP 5631m]; Brooks Id., 2m X-24/25-95, blacklight trap; Richmond Field Sta., 1f III-3-92, r.f. *Gnaphalium*, emgd. IV-22-92, JAP 92C11; Pt. Molate, 1m XI-7-82, r.f. *Gnaphalium*, emgd. XI-3-82, JAP 82L13 (D. Wagner) [EME 2227]; Pt. Richmond, 1m, 2f III-6-94, r.f. *G. californicum*, emgd. IV-6-94, 94C3 [JAP 7395m]; Pt. San Pablo, 1f II-20-88, r.f. *Gnaphalium*, emgd. III-18-88, 88B1; Tilden Park, E Ridge, 1m XII-14-69, r.f. 'everlasting', emgd. by II-70, JAP 69M4 (P. A. Opler) [EME 1145]. **Los Angeles Co.**: Santa Catalina Id., Avalon, 1m, 1f X-9, 19-1931, 4m V-1,3-1932 (D. Meadows, LACM) [JAP 7503, 7537], Middle Cyn., 2m V-1/2-78, blacklight (J. Chemsak & Powell) [EME 1144, 1146]; San Clemente Id., West Cove, 1m IV-11/14-80, blacklight trap [EME 1141]. **Marin Co.**: Inverness, 1m VII-13/15-94, at light [JAP 7401]. **Monterey Co.**: Big Creek Reserve, 30 records, March through November, 1987-94, blacklights and r.f. *Gnaphalium*, 87E34, 92E28, 94D17, 94D40, and *G. californicum*, 89D6 (F. Arias, Y.-F. Hsu, M. McIntosh, Powell, et al.) [EME 2810m, 2811m, 2817m, 2819m, 2648m, JAP 7404m, 7412m]. **San Diego Co.**: La Jolla, 2m VI-25-63, blacklight [EME 2228]. **San Luis Obispo Co.**: Dune Lakes, 3 mi. S Oceano, 1m IV-26-73, 1f VI-6-73, 1m II-15-74, 1m V-2-74, blacklights [EME 433m, 1132f, 1142m, 1149m]; Oso Flaco Lk., 5 mi S Oceano, 1m X-1-64, 1m X-3-72, at light, 1m III-23-74, blacklight [EME 424, 1148]. **San Mateo Co.**: San Bruno Mt., 9 rearing records, Jan.-June, 1961-86: r.f. *Anaphalis margaritacea*, JAP 61C4, 62C3 (MacNeill), DLW L33VI80 (D. Wagner), JAD 82050-B, 86A8.5 (De Benedictis) [EME 2165f, 2226f, 2232f, JAD 213m], r.f. *Gnaphalium*, JAP 69C97 (Opler & Powell), JAP 85D1, JAD 82036-E, 82106-D, 1f III-13-87, 1f IV-21-87, 1m, 1f V-4-87, 2m VII-30-87, 2m, 1f V-19-88, blacklight (De Benedictis) [EME 2649m, 2652f, 2653m, 2666m, 2668f]. **Santa Barbara Co.**: Anacapa Id., 1m "larva on Castilleja douglasii No. 1941-2865", emgd. III-24-41 (C. Henne, LACM) [probably a hostplant misidentification, error in labelling, or rearing lot contamination] [JAP 7525]; Goleta, U.C. Campus, 3m, 1f VI-27-65 (J. S. Buckett, UCD & Powell); Purisma Hills, 2m, 2f II-3-87, r.f. *Gnaphalium*, emgd. III-4/14-87, JAP 87B15 [JAP 7445m]; 3 mi. N Refugio Beach, 1f VI-28-65 (J. S. Buckett, UCD); San Miguel Id.: Harris Pt. trail, 1m, 1f X-13-95, blacklight [JAP 7422m], Nidever Cyn 400', 1m X-13-95, Willows Cyn., 2m X-14-95, blacklight trap [JAP 7455] (I. Williams & Powell); Santa Cruz Id.: Central Vy., IV-27-66, 1m, 3f r.f. *Gnaphalium beneolens*, emgd. V-21 to VI-6-66, 66E1 [EME 456m, 457m, 1143f], same locality, 1f V-22/24-84, r.f. *Gnaphalium*, emgd. VII-3-84, 84E53, Canada Cervada 330', 6m V-23-84, blacklight trap [EME 2164, 23168, 2199, 2231, 2235], `Cascada' [W end Central Vy.], 4m, 3f V-22/24-84, blacklight trap [EME 2163m, 2234f, JAP 7444m], UC Field Sta., 1m V-22-84, blacklight [JAP 7447]; Santa Rosa Id., 0.5 km W Beechers Bay, 1f IV-27-95, blacklight trap, 1m III-18-97, r.f. *Gnaphalium ?canescens*, emgd. V-6-97, 97C79.1.

"Species B" (De Benedictis *et al.*, 1990: 24) (Fig. 51, 85): **San Mateo Co.**, San Bruno Mt., 3m, 2f IV-1-87, r.f. *Chrysopsis villosa*, emgd. V-3/8-87, JAP 87D3, 13m, 4f IV-15-87, r.f. *C. villosa*, emgd. V-3 to VI-2-87, 87D9 (J. De Benedictis) [EME 2646m, 2647m, 2661m, 2663m, 2664f, 2680m, 2681f, 2683m].

Biology.– California populations that we assign to *Scrobipalpula psilella* (sens. lat.) feed as stem and terminal foliage borers in spring growth of Everlasting and Cudweeds, *Anaphalis* and *Gnaphalium* (Asteraceae), species of which are closely related and difficult to identify. Thus plant identifications for many of our 25 rearing records spanning 35 years mostly are not reliable at the species level. Because there are seemingly distinct sympatric phenotypes, there may be host specificity of sibling species that we have not detected.

In Europe *S. psilella* is recorded feeding on *Artemisia* and *Aster*, as well as *Gnaphalium* (Huemer and Karsholt, 1998), but we have processed a great many larval collections from several species of *Artemisia* in California and have not found *S. psilella* using any *Artemisia*.

The larvae feed in the new season growth that begins following onset of winter rains, from November through March. Those collected later in spring may represent second generation individuals. They bore through the dense pubescence of the basal leaves and later in spring in the terminals to form hollows at the axils where they bore into stem tissue. The mines are kept clean of frass, which is

ejected in small piles on an adjacent leaf or at the axil, which are densely pubescent and viscid. Hence presence of larvae often is easily detected, even though no evidence of damage to the plant is visible. Pupation occurs in a silk-lined hollow at the point of feeding, although lab reared larvae usually form cocoons in debris or folds of paper toweling if the foliage has deteriorated.

Adults have been collected at lights from March to the end of July at San Bruno Mt., March to June and mid-August to November at Big Creek, and February-June and October at the Santa Maria dunes, which suggests there are two or three annual generations, with a summer diapause. However, none of our rearing records documents that pattern. Larvae have been collected from November through May, with adult eclosion 2-6 weeks later.

Scrobipalpula antiochia Povolný & Powell, **new sp.**

(Fig. 22, 53, 86)

A member of the *psilella* complex having more or less bicolored forewings, with ferrugineous costal, gray dorsal half. Reared females tend toward short-winged, but we have no field captured examples to document a possible trend toward brachyptery.

MALE: FW length 4.8-6.0mm, avg. 5.6mm (n = 3); FW length 4.8-5.2 x width. *Head*: Crown covered by rust or ferrugineous scales; frons paler to whitish. Labial palpus relatively thickly scaled; II segment exteriorly and III with blackish ringlets developed or indicated by spots. *Thorax*: Dorsum and tegulae concolorous with head. Forewing distinctly bicolored, costal half nearly unicolorous ferrugineous; dorsal area gray, with admixture of blackish. Termen with a mixture of cinereous and blackish. Delicate blackish stigmata usually evident in discal area just on border of the two colors. Groups of blackish scales indicate submarginal stigmata. Cilia gray. Hindwing gray with variable hues. Cilia gray. Legs outside blackish with distinctly whitish annuli. *Abdomen:* basal 3 terga pale ochreous, banded posteriorly with pale gray, remainder of dorsum pale shining gray; venter white with dark gray lateral bands diminishing posteriorly; genital scaling whitish. Genitalia as in Fig. 53 (drawn from EME 2160; n = 2); structurally conform with those of the psilella-complex; more elongate than average.

FEMALE: FW length 5.0-5.4mm; avg. 5.2mm (n = 3, reared specimens; + one short-winged, possibly deformed, not measured); FW length 4.6-5.4 x width. As described for male; forewings apparently shorter, broader, possibly an effect of rearing conditions. Genitalia as in Fig. 86 (drawn from EME 2159; n = 1), similar to other members of the *psilella* complex.

Holotype male: CALIFORNIA: Contra Costa Co., Antioch Dunes National Wildlife Refuge, February 20, 1982, r.f. *Senecio douglasii*, emgd. III-2-82, JAP 82B17 (J. Powell) [EME slide 1147]. Paratypes (7): **Contra Costa Co.:** same data as holotype, 1m, 2f emgd. III-12/28-82 [EME 2160m], same data except 1m II-20-82, emgd. III-18-82, 82B18, 1f III-13-82, emgd. IV-21-92, 82C16, same except 1m, 1f III-15-85, emgd. IV-17,22-85, 85C12 [EME 2159f].

Taxonomic relationships.– This species is distinguished from other *Scrobipalpula* in California by the rust colored costal half of the forewing and the larval specificity to *Senecio* in sympatry with typical *S. psilella* on *Gnaphalium*.

Biology.– The larvae feed in terminal shelters in new foliage of *Senecio douglasii* (Asteraceae) along with those of an undescribed species of *Agonopterix* near *fusciterminella* Clarke (Oecophoridae). The terminals are stunted by larval activities, but they are difficult to observe because most terminals are misshapen by colonies of an aphid at the type locality. The foliage of this xeric shrub withers and dries in autumn at the end of the flowering season, and foliation begins anew following winter rains. The larvae leave their shelters at maturity and presumably form cocoons on the ground. Emergence takes place without intervention of diapause, and we found no evidence of larvae later in the spring and summer.

Scrobipalpula gutierreziae Povolný & Powell, **new sp.**

(Fig. 4, 52, 87, 88)

A relatively large, dark gray *Scrobipalpula* species with paler gray markings and two of the characteristic triad of black stigmata.

MALE: FW length 4.4-5.7mm, avg. 5.3mm (n = 6, reared specimens); FW length 5.3-6.3 x width. *Head:* Crown dark gray intermixed with ochreous; frons pale gray. Labial palpus cinereous, II segment with erect scaling showing one basal and one subterminal dark spot exteriorly; III with a blackish ringlet medially. *Thorax:* Dorsum and tegula dark gray. Forewing ground blackish gray with variable dark ochreous, longitudinal streaks in costal half and in cell; usually two of the characteristic stigmata triad visible in cell; additional spots near base and at about 1/3 of costa; blackish scaling indicating submarginal spotting. In darker individuals entire distal area, apex to tornus, blackish. Fringe mixed pale and dark gray. Hindwing shining whitish basally, costa and apex blackish. Fringe gray, brownish apically. Legs pale cinereous with whitish ringlets on tarsal segments. *Abdomen:* dorsal scaling dark gray, basal 2 or 3 terga dark ochreous, variably faintly so. Genitalia as in Fig. 52 (drawn from EME 2246; n = 3); uncus moderately arched, rounded caudally, its edge having a minute tip; gnathos short, distinctly spatulate. Valva moderately sigmoid with rounded tip slightly curved and extended over tip of uncus, subterminally with a sclerotized, subcrescentic ledge, moderately inflated; paired process of sacculus long and slender, parallel-sided with rounded tip protruding laterally to a short, acute spine; paired parabasal process short, slender cone-shaped. Saccus moderately elongate, horseshoe-shaped with a rounded tip. Aedeagus slender with moderately inflated phallobase; tip rounded with a weak subterminal spine.

FEMALE: FW length 5.0-5.7mm, avg. 5.3mm (n = 6, reared specimens); FW length 5.1-5.7 x width. No consistent sexual dimorphism in forewing color but basal 2 abdominal terga and genital scaling usually brighter ochreous than in male. Genitalia as in Fig. 87, 88 (drawn from JAP 7506, EME 2165; n = 2); subgenital plate longer than broad due to a strong, funnel-shaped prolongation of its proximal margin that reaches tips of the moderately long, curved anterior apophyses; subgenital plate nearly entirely covered by fine, foam-like sculpture, developed especially on both sides of the prolongation near bases of apophyses. Signum well developed, spine-shaped.

Holotype male: CALIF.: Antioch National Wildlife Refuge, Contra Costa Co., March 15, 1985, r.f. *Gutierrezia californica*; emgd. X-8-85, JAP 85C16 (J. Powell). Paratypes (31): **Contra Costa Co.:** same data as holotype, 8m, 12f, emgd. VIII-14 to X-19-85 [EME 2166m, 2167f]; same locality, 3m, 1f IV-9-82, r.f. *G. californica*, emgd. by IV-1983, 82D27 [EME 2246m, 2327f]; same locality, 1f V-11-83, r.f. *G. californica*, emgd. by X-28-83, 83E35; same locality, 1m, 3f V-2-91, r.f. *G. californica*, emgd. IX-9 to 29-91, 91D12; same locality, 2m X-10-91, blacklight; 7 airline km SW Byron, 1m IV-27-82, r.f. *Gutierrezia ?sarothrae*, emgd. by IV-83, 82D50, [JAP 7506].

Taxonomic relationships.– This species evidently represents a localized, oligophagous adaptation that has resulted in isolation from sympatric members of the *Scrobipalpula psilella* species group. We have conducted sufficiently extensive larval surveys at the type locality to document with confidence the occurrence of three sympatric, oligophagous species of *Scrobipalpula*, as well as *Euscrobipalpa artemisiella*, feeding on four genera of perennial Asteraceae. The genitalia of *S. gutierreziae* differ from nominate *S. psilella* by a narrower and simply arched uncus, by the slender valvae with elongate, rounded tips, and by the prolonged, paired process of the sacculus. The aedeagus is slender with only a subtle subterminal hooklet, in contrast to most members of the group. The female subgenital plate shows a funnel-shaped prolongation that is much stouter, wider and more elongate than typical for members of the *S. psilella* group.

Biology.– The species evidently is univoltine and host specific in larvae feeding. Larvae of *Scrobipalpula gutierreziae* feed during spring on *Gutierrezia californica* and possibly other *Gutierrezia* (Asteraceae) and reach maturity in April or May. They create shelters by webbing together distal ends of new foliage, and as the leaves elongate, the shelters become more evident by the misshapen, bowed lower parts of the foliage. Pupation takes place in tough silken cocoons probably in debris on the ground or in loose sand and appears to involve a short duration diapause. Emergence in the lab occurred in mid to late summer, at the hottest, driest time of year but

when the *Gutierrezia* is still green and in flower.

Adults are nocturnal (one collection at blacklight). Presumably eggs are deposited on the bark of the hostplant, and a second diapause may take place at this stage. The foliage withers by October, and new foliation starts after winter rains begin.

TUTA Strand, 1910

Tuta Strand, 1910, *in*: Kieffer & Jörgensen, 1910: 363.
Tuta Strand, 1911: 165.
Phthorimaea; Hodges & Becker, 1990: 77 (in part).
Scrobipalpuloides Povolný, 1987: 89.

Kieffer and Jörgensen (1910) studied plant galls and the insects that cause them in Argentina. They sent specimens to Strand, who provided manuscript names, which were used by Kieffer and Jörgensen, and they attributed the names to him. Thus the genus name *Tuta* and its type species have been credited to Strand by most authors, even though his formal descriptions were not published until the following year (i.e., as recommended by ICZN Art. 51B). Hodges and Becker (1990), however, disagree and credit the names to Kieffer and Jörgensen. Moreover, they propose subjective synonymy of *Tuta*, believing the type species, *T. atriplicella* Strand (in Kieffer & Jörgensen) to be congeneric (but not conspecific) with the type species of *Phthorimaea*. Povolný (1993) has discussed the status of *Tuta* and rejected its subjective synonymy. It is beyond the scope of the present paper to review the arguments.

Tuta as presently conceived comprises several species of the southern Nearctic and Neotropical Regions. The male genitalia show some apomorphic characters, having the tegumen elongate, slender, reduction of the gnathos, sacculus reduced to a membranous cushion, the valva more cylindrical, bent apically, and the aedeagus extremely long and slender and curved. The female genitalia exhibit similarities to *Scrobipalpula* in the foam-like sculpture of the periostial region and in the form of the signum bursae. The larval food plants so far as known are halophilous Chenopodiaceae, especially those of ocean shores, in contrast to species of *Phthorimaea*, which are Solanaceae-feeders.

Tuta chiquitella (Busck), new comb.
(Fig. 5, 54, 55, 89)

Gnorimoschema chiquitella Busck, 1910: 176.

This species was described from New Mexico; nonetheless it is congeneric with South American members of *Tuta* (Povolný, 1993, 1994).

Diagnosis.– A tiny, pale gray moth, FW showing relatively large and moderately distinct triad of discal stigmata. FW length: male, 4.2-4.9mm, avg. 4.5mm (n = 10), length 4.8-5.6 x width; female, 4.0-5.4 mm, avg. 4.5mm (n = 7), length 4.7-5.1 x width (San Clemente Island specimens average slightly smaller than Contra Costa, Solano Co. specimens but are within this range). Male genitalia as in Fig. 54-55 (drawn from EME 1123, 1120; n = 14). Female genitalia as in Fig. 89 (drawn from EME 1124; n = 5).

California Coastal Records.– **Alameda Co.**: West Berkeley, 2m, 4f VIII-29-92, r.f. *Chenopodium*, emgd. IX-15/25-92, JAP 92H32 (Y.-F. Hsu) [JAP 7470m, 7471f]. **Contra Costa Co.**: Martinez Reg. Shoreline, 1m VIII-30-92, r.f. *Atriplex semibaccata*, emgd. X-8-92, 92H35.1 (Hsu), same data except 4m, 11f r.f. *Chenopodium*, emgd. IX-21 to X-4-92, 92H36 (Hsu) [JAP 7435m, 7436f]; Pt. Molate, 1m IX-15-94, 1m XI-14-96 (Povolný & Powell), 3m, 1f XI-27-96 [EME 7481m, 7482f]. **Los Angeles Co.**: El Segundo dunes, 1m, 1f V-20-39, leaf tier on *Atriplex semibaccata* (W. D. Pierce, 1939-452, LACM) [JAP 7509m]; San Clemente Id., Eel Pt., 1m IV-11-80 [EME 1121], same data except Wilson Cove, 1m blacklight (D. Faulkner & Powell) [EME 1123], same data except Rock Wall Cyn. at Seal Cove, 1m IV-14-80 [EME 1122], Gord, 3m XII-6-81 [EME 1125, 1127, 1128], Wilson Cove, 2m XII-4-81, blacklight [EME 1126], N end Airfield, 1m II-20-87, r.f. *Atriplex*, emgd. III-31-87, JAP 87B155 (J. De Benedictis) [JAP 7441]; Santa Catalina Id., Ben Weston Beach, 1m V-2-78 [EME 1120], Little Harbor, 1f V-3-78, Middle Cyn., 2m, 1f V-1/2-78, blacklight (J. Chemsak & Powell) [EME 1124f]. **Santa Barbara Co.**: Santa Barbara Id., 2m V-19-86, "200.1, 200.2", 1m VIII-25-86 [C. Drost, LACM] [JAP 7513]; Santa Cruz Id., Prisoners Harbor, 1m V-21/25-84, r.f. *Atriplex*, emgd. VI-28-84, JAP 84E93 (D. Wagner) [EME 2201]. **Santa Clara Co.**: Palo Alto Baylands Nat. Reserve, 5m, 3f VIII-29-92, r.f. *Chenopodium*, emgd. IX-14 to X-4-92, JAP 92H31 (Hsu) [JAP 7392m]. **Santa Cruz Co.**: Sunset St. Bch., 1m IV-9/11-89, at light. **Solano Co.**: Grizzly Id., 2m, 6f VII-12-92, r.f. *Atriplex patula hastata*, emgd. VII-27 to VIII-29-92, JAP 92G13, G17 (Hsu) [JAP 7438m, 7439f, 7499m]. **Ventura Co.**: San Nicolas Id., Dutch Harbor, 1m V-6-78 (Doyen & Powell), NAS HQ area, 1m V-7-78, at light [JAP 7643].

Taxonomic relationships.– The species shows clear cut specific differences from its sister species, *T. chiquitelloides*, described under that species.

Biology.– Larvae web and mine in the terminal leaves of halophitic Chenopodiaceae. On semi-succulent *Atriplex* species, two or three to several leaves may be tied into a shelter, and larvae then mine into the basal portions of the included leaves. On broader leaved hosts, such as *Atriplex patula hastata* (e.g. 92G13), larvae form irregular mines, often along the midrib, with digitate extensions, where they reside throughout feeding. Pupation occurs in a thin silken cocoon, probably in debris on the ground. The species is multivoltine and apparently homodynamic; we found larvae in February, May, July, and August, and adults in the field in April, May, September, and active into late November in the San Francisco Bay area and December on San Clemente Island. Adult eclosion occurred 2-5 weeks following larval collections, evidently without diapause.

Tuta chiquitelloides Povolný, new sp.
(Fig. 23, 56, 90)

Scrobipalpula n. sp. nr. *chiquitella*, Powell, 1994: 458.

A small, nondescript, pale gray species with irregular blackish spots and tiny stigmata on the forewings.

MALE: FW length 3.9-4.8mm, avg. 4.2mm (n = 6); FW length 5.4-5.8 x width. *Head:* pale cinereous to whitish; frons shining white. Labial palpus slender with prominent, acutely pointed III segment; whitish with irregular groups of black-tipped scales exteriorly on II and with a dark basal spot or complete ringlet on III. *Thorax:* Dorsum and tegula whitish gray. Forewing covered by whitish scales, many of which have gray or dark gray tips, concentrated in apical area indicating marginal and submarginal spotting. Triad of small black stigmata in cell and indications of additional stigmata on costa near base and axially near base. Cilia gray. Hindwing cinereous with darker gray cilia. Legs cinereous to whitish with darker spots. *Abdomen:* Blackish, genital scaling whitish. Genitalia as in Fig. 56 (drawn from EME 1132; n = 6); uncus with protruding semicircular sclerite; gnathos reduced, paired lateral arms with the characteristic hooklet reduced to a poorly sclerotized base. Valva strongly curved medially toward tip of uncus; saccular fold high with a weakly sclerotized semicircular, medial excision; paired saccular process slender with a concave outer ledge; parabasal process short and obtuse. Saccus very long with lateral edges moderately converging to a slightly acute tip. Aedeagus very long, thin, weakly sclerotized; phallobase elongate, moderately swollen; tip slightly dilated with one poorly developed subterminal hooklet dorsally.

FEMALE: FW length 4.3-4.5mm (n = 2); FW length 5.3-5.6 x width. The two females have slightly broader wings with more extensive darker scaling, otherwise as described for male. Genitalia as in Fig. 90 (drawn from EME 1119; n = 2); subgenital plate slightly longer than broad, smooth, weakly sclerotized; proximal margin with a deep, symmetrical incision with a protruding, short funnel-like sclerotized ostium bursae. Anterior apophyses moderately long with a paired ledge from their bases, delimiting the sclerotized pleural region of VIII from subgenital plate, which is similar to *T. chiquitella* but has extensive foam-like sculpture. Ostial ring well

developed, slightly broader than long; ductus bursae membranous. Signum reduced to an indication.

Holotype male: CALIFORNIA: Los Angeles Co: San Clemente Island, Gord 330m, December 6, 1981 (J. Powell). Paratypes (9): **Los Angeles Co.:** San Clemente I., 1m IV-4-1939, 2m XI-20,29-1939 (LACM Channel Is. Biol. Survey) [JAP 7522, 7655, LACM]; same data as holotype, 3m [EME 1116, 1118]; San Clemente Id., Wilson Cove, 1m IV-11-80, at light (D. Faulkner & Powell) [EME 1117]; San Clemente Id., Stone Biol Lab, 1m, 1f XII-4,6-81, at light (Powell) [EME 1119f]. **Santa Barbara Co.**: Santa Rosa Id., 0.5 km W Beechers Bay, 1m IV-29-95, blacklight trap [JAP 7450], Beechers Bay, 1f V-1-95, bl. trap [JAP 7451] (D. Kushner & Powell).

Taxonomic relationships.– The new species is closely related to *Tuta chiquitella*, which is slightly larger and darker with more distinct forewing markings. In male genitalia, the upper ledge of the uncus is more prominent while the gnathos is less sclerotized in *T. chiquitelloides*, and the valva is strongly curved, thus not reaching over the tip of the uncus as it is in *T. chiquitella*. The saccular process in the new species has a concave, not convex ledge, and the whole aspect of the saccular fold is different in the two species. The aedeagus is longer but weakly sclerotized compared to *T. chiquitella* (n = 14 *T. chiquitella* examined). The association of the female as described is equivocal, as males and females were not taken together in the field except at light, but if correct, the female is distinguished by the subgenital plate, which has extensive foam-like sculpture, whereas in *T. chiquitella* (n = 5 examined) this sculpture is concentrated into a pair of lateral spots. The signum is quite reduced in the new species.

Biology.– The species evidently has more than one annual generation, with records of adults in April and November-December. No potential hostplant association was observed.

Tuta insularis Povolný, new sp.

(Fig. 24, 57)

A small, delicate species having cinereous forewings with tiny blackish stigmata. Superficially very similar to the slightly smaller *T. chiquitella* and *T. chiquitelloides*.

MALE: FW length 5.0-5.4mm; FW length 4.7-5.3 x width (n = 3). *Head:* cinereous to whitish; frons white. Labial palpus slender with acutely pointed III segment; II whitish, groups of blackish tipped scales forming two distinct ringlets externally and a blackish tip on III. *Thorax:* dorsum and tegula cinereous. Forewing cinereous to pale grayish; a triad of more or less distinct stigmata, 1st near Cu crease, 2nd axially in wing center, 3rd at distal end of cell; distinctness of stigmata variable; ground cinereous paler distally; groups of blackish scales poorly indicating marginal dots. Fringe whitish cinereous. Hindwing pale gray with whitish cinereous fringe. *Abdomen:* pale gray, lustrous lead colored. Legs nearly unicolorous whitish gray, with only scattered scales showing darker tips. Genitalia as in Fig. 57 (drawn from JAP slide 7517; n = 1); stout relative to the size of the moth; uncus prominent with broadly rounded or moderately truncate distal edge; gnathos present as strongly sclerotized lateral arms, tip absent or poorly developed; paired saccular process short, hook-shaped, hirsute, exceeding the short, broad, truncate parabasal process of the valva, which has an obtuse spur on its inner side; a short hooklet-shaped sclerite on sacculus wall near base of parabasal processes medially; saccus elongate, broad, distinctly exceeding vinculum lobes, with a broadly rounded, only weakly attenuated tip. Aedeagus as long as genital capsule, thin, with a moderately inflated, elongate caecum, its tip having a delicate subterminal hooklet; entire aedeagus curved like a bow.

FEMALE: unknown.

Holotype male: CALIFORNIA: Los Angeles Co.: Avalon, Santa Catalina Island, February 6, 1932 (D. Meadows) [JAP 7517]; in LACM. Paratypes (2): same data as holotype except V-5-1932, V-15-1932 [LACM].

Taxonomic relationships.– The male genitalia differ from those of *Tuta chiquitella* and *T. chiquitelloides* by the distinctly longer longitudinal axis, by the different shape of the paired processes, and by the curved form of the aedeagus, which is nearly straight or only moderately curved in the two related species. The moths are slightly larger than *T. chiquitella* and *T. chiquitelloides* but vary both in size and distinctness of the forewing stigmata.

Biology.– *Tuta insularis* may be multivoltine, with records of adults in February and May.

EUSCROBIPALPA Povolný, 1967

Scrobipalpa Janse, 1951, was described with its type species *heliopa* Lower, an Australian species, which had been introduced into South Africa and elsewhere. *Euscrobipalpa* Povolný was proposed as a subgenus of *Scrobipalpa* to accommodate the large fauna of Palaearctic species formerly assigned to *Scrobipalpa*, with *S. grossa* Povolný, 1966, as its type species (Povolný, 1967b). *S. grossa* was later revealed to be a synonym of *Bryotropha indignella* Staudinger, 1879 (Povolný, 1988). Povolný (1989a) restricted *Scrobipalpa* to an endemic Australian taxon with two species and formally raised *Euscrobipalpa* to generic rank. Subsequently, the group has been treated at both subgeneric (Karsholt and Razowski, 1996) and generic (Lastůvka 1998) ranks. Interpretation of its derived characters as synapomorphies at the generic level is debatable, but it seems best to treat *Euscrobipalpa* as a genus pending rigorous phylogenetic analysis of genera within the tribe.

As defined, *Euscrobipalpa* includes more than 250 described species. Six of these occur in California, three presumably having been introduced from Europe, one evidently is Holarctic, and we describe an apparently endemic species. Whether the few other North American species assigned to *Scrobipalpa* (i.e., Hodges, 1983) are appropriately placed in *Euscrobipalpa* needs to be ascertained by further study.

Species of *Euscrobipalpa* in California are small, mostly tan to rust or dark gray moths without distinctive forewing patterns. The male genitalia have paired processes of saccular fold and parabasal valva usually of nearly equal length; valva clavate, its tip moderately inflated; uncus relatively narrow, rarely excised, delicately spinose; saccus usually subtriangulate; aedeagus usually shorter than tegumen+saccus length, with subapical spine. The female subgenital plate is oblong or subquadrate, the anterior apophyses usually moderately longer than subgenital plate; base of apophyses and adjacent sclerites often with foam-like sculpture or at least indication of folds or dots; signum a distinct, serrate spine.

Palaearctic species of *Euscrobipalpa* feed as miners or stem borers, specialists on a wide variety of Asteraceae, halophitic or weedy Chenopodiaceae, and less commonly other plants (Povolný, 1990).

Euscrobipalpa artemisiella (Treitschke)

(Fig. 58, 91)

Lita artemisiella Treitschke, 1833, 9: 97.
Scrobipalpa (Euscrobipalpa) artemisiella; Povolný, 1967b: 214.
Ilseopsis (Euscrobipalpa) artemisiella; Povolný, 1996: 31.

This species has not been recognized previously in North America, and in contrast to *E. atriplicella* and *E. obsoletella*, which presumably are introduced, *E. artemisiella* appears to be natively Holarctic in distribution. *E. artemisiella* exhibits a transpalaearctic distribution, including distinctive geographic races in the Near and Middle East, Mediterranean, and Mongolia. In North America, Povolný has examined specimens from Saskatchewan (Povolný, 1998c), northeastern Nevada, and Inyo Co., CA (UCB), in addition to the coastal California records cited here. California populations reared from native *Artemisia* include phenotypically distinctive forms that show minor genital differences, including some that conform to European phenotypes.

Diagnosis.– Male FW length 5.9-6.5mm, avg. 6.1mm, FW length 4.4-5.0 x width (n = 6); female FW length 6.0-7.0mm, avg. 6.3mm. Head, thorax and forewing dark gray; blackish stigmata in disc surrounded by groups of brownish scales, occasionally expanded to form longitudinal striae, in a radiate pattern; rarely the brownish replaces all grayish, ranging to FW nearly uniform rust brownish. Male genitalia as in Fig. 58 (drawn from JAP 7387; n = 4 CA dissections examined), delicate, uncus with rounded tip, its upper edge sometimes moderately concave centrally. Paired processes of saccular fold and valva base nearly equal in size, sacculus processes elongate, cone-shaped, parabasal process short, truncate. Valva clavate with moderately inflated tip. Aedeagus short, stout, with truncate tip. Female genitalia as in Fig. 91 (drawn from EME 2204; n = 2 Calif. dissections examined), posterior apophyses very slender, ca. 2.3x longer than VIII sclerite + anterior apophyses; subgenital plate oblong-rectangular, paired peninsular sclerites on both sides of ostium bursae and base of anterior apophyses with fine, foam-like sculpture. Anterior apophyses as long as subgenital plate. Colliculum a narrow ringlet; signum a short, moderately curved spine.

California Coastal Records.– **Contra Costa Co.**: Antioch Natl. Wildlife Refuge, 20m, 6f IV-3-90, r.f. *Artemisia douglasiana*, emgd. V-1/10, VI-27-90, JAP 90D18 (Y.-F. Hsu & Powell) [JAP 7381m], 1f IX-20-90, blacklight [JAP 7644]; Pt. Richmond, 2m, 2f III-16-95, r.f. *A. douglasiana*, emgd. V-1-95, JAP 95C30 [JAP 7387m]; Tilden Park, Big Spr. Cyn., 1f IV-13-84, r.f. *A. douglasiana*, emgd. V-14-84, JAP 84D43 [EME 2204]. **Humboldt Co.:** Arcata, 1m VII-4/6-69, at light [JAP 7783]. **Monterey Co.:** Big Creek Reserve, 1f V-26-95, r.f. *A. douglasiana*, emgd. by VIII, 95E49 [JAP 7551].

Taxonomic relationships.– Adults from coastal Humboldt Co., Contra Costa Co. adjacent to San Francisco Bay and the San Joaquin River, and one female from Monterey Co. are darker, with the FW pattern variable, from mostly gray to mostly dark brownish rust, while those from Los Angeles Co. (an inland population in the San Gabriel Mts., reared from *Artemisia douglasiana*, JAP 57C23) have paler, primarily rust forewings. Although the larval host in a native Californian plant, it is conceivable that one or more of the Humboldt and Contra Costa sites represent an introduced population from the Old World. It seems much less plausible for the Monterey and Los Angeles populations occurring in less disturbed habitats far from any likely ports of introduction. Thus, the possibility of introduction of this species from Europe as well as occurring here natively cannot be ruled out.

Biology.– There is an unresolved problem with the larval hostplant and the species we and the Europeans are calling *Euscrobipalpa artemisiella*. As indicated by the species name, Treitschke (1833), according to von Tischer's observations, believed this species fed on *Artemisia* (Asteraceae). Later authors have reported *E. artemisiella* to feed on *Thymus* (Lamiaceae). This contradiction originated early (Herrich-Schäffer 1853: 366), and Stainton (1865) speculated ("I fancy that . . .") Treitschke's original record of *Artemisia* as a food plant might have been due to confusion with the not yet described *Scrobipalpula psilella* (Herrich-Schäffer, 1853). That idea was accepted by Meyrick (1895) and has been perpetuated like folklore by subsequent manual writers, who mostly cite Meyrick verbatim (e.g., Ford, 1949; Bradford, 1979), even for populations in Austria (Sattler, 1987).

Continental European authors followed Herrich-Schäffer (1853), listing both food plants for *E. artemisiella*, simply citing both hosts without analysis (e.g., Snellen, 1882; Spuler, 1913; Eckstein, 1933; Povolný, 1967, 1980; Medvedev, 1990). Sattler (1987), however, translated Stainton's speculation into fact and emphasized that *E. artemisiella* is restricted to *Thymus* and occasionally other Lamiceae and specified that Povolný (1980) erred by listing Asteraceae foodplants for *E. artemisiella*. He stated that such errors are due to uncritical acceptance of names in the literature! Povolný (1990a) suggested the possibility of differing hostplant races over the broad distribution of *E. artemisiella* and continued listing both families of foodplants.

The association of *Scrobipalpa artemisiella* with Asteraceae in Europe has been confirmed by Povolný, who has observed numerous adults flying about *Artemisia* in absence of *Thymus*, and recently he has received a series of *E. artemisiella* adults that were reared from *Helichrysum* in Thuringia, Germany. On the other hand, Jansen (1998) reported finding larvae of *artemisiella* on *Thymus pulegioides* on costal dunes in The Netherlands; and Kaitila (1996) recorded *Thymus* as a foodplant in Finland, according to R. W. Hodges (in litt.). Thus there is evidence that *E. artemisiella* uses both Asteraceae and Lamiaceae as larval foodplants in Europe.

There are no appreciable differences in genital characters in California examples from figures illustrated from Palaearctic specimens, including those of Povolný (1967b) from Afghanistan, and Pierce and Metcalfe (1922) from England, whereas Medvedev's (1990) figure, presumably from Russia, which shows a much broader gnathos and apparently more stout aedeagus, looks like another species. There may be sibling species involved, and it seems more likely that the *Thymus*-feeding species in Europe needs careful study and a new name, rather than the unlikely alternative, that all observations of Asteraceae-feeding in Europe are in error and that the California populations represent a new species that coincidentally feeds on *Artemisia*.

We have reared adults from larvae feeding in new terminals of a native Californian *Artemisia*, *A. douglasiana* (Asteraceae), at five widely scattered localities. The caterpillars silk together the unopened leaves and bore into the meristematic tissue. *Thymus* occurs in California only as a cultivated herb, and we have no records of larval feeding by any Gnorimoschemini on it or any other Lamiaceae. Conversely, populations of the *Scrobipalpula psilella* complex here feed on Asteraceae (25+ rearing records on *Gnaphalium*, *Anaphalis*, *Chrysopsis*), but we have not found a colony on *Artemisia*.

There are at least three possible explanations for differences of opinion on the larval hosts in Europe: 1) there are two (or more) sibling species, one of which is restricted to *Thymus*; 2) differing geographical races of a single widespread species use different hostplants; 3) misidentified hostplants and/or adult associations that were assumed to represent larval food associations by Treitschke, Novickij and others were the source of records on *Artemisia*, *Cirsium*, and *Helichrysum*). In the latter case, the Californian populations presumably would represent a new species that by improbable coincidence feeds on *Artemisia*. In view of the prevailing pattern of oligophagy by species of Gnorimoschemini, the first of these alternatives seems plausible. However, for purposes of this study, we assume the Californian populations are related to central European *E. artemisiella* that feed on *Artemisia*, perhaps including introductions.

Bradford (1979), quoting from Meyrick (1895), indicated *E. artemisiella* is univoltine in England, with larvae maturing in May-June and adults active in June-July, while Spuler (1913) recorded larvae throughout Europe from April to June, and adults from May to July. There appears to be a single annual generation in California, with larvae maturing in April and May, and adults emerging in May and June in the lab. However, our only records for field activity of adults are single specimens taken in July and September. We have no information on the mode of estivation and overwintering.

Euscrobipalpa atriplicella (Fischer von Röslerstamm)

(Fig. 59, 92)

Gelechia atriplicella Fischer von Röslerstamm, 1839: 223.
Scrobipalpa (Euscrobipalpa) atriplicella; Povolný, 1967b: 214.
Ilseopsis (Euscrobipalpa) atripliciella; Povolný, 1996: 30.
Gnorimoschema chenopodiella Busck, 1916: 148.

Diagnosis.– Male FW length 5.4-6.5mm, avg. 5.85mm, FW length 4.75-5.0 x width (n = 13); female FW length 5.8-6.4mm, avg. 6.1mm. Head, thorax and forewing ground color gray to dark gray, with blackish, delicate stigmata in disc and subapically; stigmata often surrounded by paler, rust-colored scales and apical area sometimes gray-whitish spotted. Male genitalia as in Fig. 59 (drawn from EME 2223; n = 13); uncus narrow, distal edge truncate or moderately excised medially, not convex; gnathos a delicate hooklet; paired processes of sacculus narrow, foliate, with obtuse tip; parabasal process short, truncate, of nearly equal length to sacculus process; medial excision of sacculus wall of medium depth, relatively narrow; valvae long, parallel-sided, tips reaching distinctly beyond distal margin of uncus; saccus comparatively short, subtriangulate. Aedeagus stout, short, ca. 1/2 the genitalia length, with broadly ovate, inflated caecum. Female genitalia as in Fig. 92 (drawn from EME 2224; n = 4); posterior apophyses very slender, 2.2x longer than VIII plate + anterior apophyses; subgenital plate subquadrate, with distinctive foamy sculpture on apophyses bases and especially on the paired "peninsular" sclerite flanking ostium, slightly shorter than the slender anterior apophyses; colliculum a narrow ringlet showing differentiated sclerotization; signum an oblong, moderately curved spine arising from a short, rounded plate, occasionally with a poorly serrated base.

California Coastal Records.– **Alameda Co.:** Berkeley, 1m V-13-79, at light [JAP 7490]. **Contra Costa Co.:** Walnut Creek, foot of Shell Ridge, 1m IX-24-61, 2m IX-16-62, 1f VII-26-63, black light [EME 2206m, 2214m, 2223m, 2224f]. **Monterey Co.:** Los Osos, Morro Bay, 3m, 5f V-22/24-81 (J. Donahue, LACM) [JAP 7510m]. **San Francisco Co.**: Keifer reared a long series from *Chenopodium* at San Francisco V to VIII, 1926 [K.2030f,2031m, 2038m, 2056m, 2061f, CAS, JAP 7442f]. **Santa Barbara Co.**: Santa Cruz Id., Central Vy., 3m, 1f IV-25, 26-66, at lights [EME 473m, 474m].

Taxonomic relationships.– This species is widespread in the Palaearctic (Povolný, 1967b, 1996). It was introduced into eastern North America long ago, having been described as *Gnorimoschema chenopodiella* by Busck based on specimens collected before 1916, and it had reached the Pacific Coast by 1926. It was reported in California at San Francisco and Sacramento (as *chenopodiella*) by Keifer (1927, 1937).

Biology.– In England, *E. atriplicella* larvae feed in spun leaves, flowers, and seed of *Chenopodium* and *Atriplex* (Chenopodiaceae) (Bradford, 1979); in eastern Europe, Povolný has reared *E. atriplicella* from sugar beet (*Beta maritima*, Chenopodiaceae) in cultivation; and in southern Europe it feeds on a wide spectrum of chenopods. There are two generations, with adults emerging in May and in July-August in England, and overwintering occurs as pupae (Bradford, 1979). The same likely is true in California, as adults have been taken at lights in April-May on Santa Cruz Island and coastal Monterey Co. and in July-September at Walnut Creek, Contra Costa Co. Busck (1916) described *G. chenopodiella* based on specimens reared from "pigweed". Keifer (1937) reported the larvae feed in the flower heads of *Chenopodium murale*, a European plant, destroying the flowers and producing conspicuous damage. We have no record of *E. atriplicella* feeding on native Chenopodiaceae in California.

Euscrobipalpa obsoletella (Fischer von Röslerstamm)

(Fig. 60, 95)

Gelechia obsoletella Fischer von Röslerstamm, 1840: 225.
Scrobipalpa (Euscrobipalpa) obsoletella; Povolný, 1967b: 222; 1967a: 108 (synonymy).
Gnorimoschema miscitatella Clarke, 1932: 64.
Scrobipalpa miscitalella Povolný, 1967a: 108 (missp.).

Diagnosis.– Female FW length 6.0-7.9mm, avg. 6.85mm; FW length 4.6-5.3 x width (n = 5). Relatively broad-winged and stout. Head, thorax, FW pale gray or cinereous, scales prevalently gray, occasionally with darker tips. Blackish stigmata subtle or obsolete, central triad occasionally surrounded by paler scales. Male genitalia as in Fig. 60 (drawn from JAP 5963, Wenatchee, WA, paratype of *miscitatella*; n = 1 CA slide examined); uncus relatively narrow, distal margin distinctly convex; gnathos a long hooklet; medial excision of sacculus, U- or V-shaped; paired process of sacculus short, ear-shaped, moderately curved; parabasal processes of equal length, short with convex lateral margin and obtuse, rounded tip. Valva narrow with clavate, inflated tip; saccus narrow, ligulate, exceeding lobes of vinculum. Aedeagus relatively long, stout, caecum moderately inflated. Female genitalia as in Fig. 95 (drawn from EME 2169; n = 4 Calif. slides examined); posterior apophyses very slender, ca. 2.5x longer than VIII sclerite + anterior apophyses; subgenital plate relatively narrow, longer than broad, only poorly developed, dotted sculpture, mainly on a distinct, paired lobate sclerotization flanking ostium; anterior apophyses ca. 1.5x longer than subgenital plate; colliculum a narrow, delicate ringlet. Signum a robust, moderately curved spine, distinctly serrate basally, arising from a flat, crescentic sclerite.

California Coastal Records.– **Alameda Co.**: Alameda, 1m "20/4 90" [IV-20-1890] (Koebele Collection) [CA 1128, CAS]; Albany, 1m V-15-58, light trap [JAP 7930]. **Contra Costa Co.**: Antioch [dunes area], 1f IV-5-56 (J. Powell) [EME 2197]; Antioch Natl. Wildlife Refuge, 1f IX-20-90, blacklight, 2f VI-11-91, blacklight (Y.-F. Hsu & Powell) [JAP 7408]; Walnut Creek, foot of Shell Ridge, 3f IX-2-63, VI-14-66, IX-11-66 [EME 2207]. **Los Angeles Co.:** Toyon Bay, Sta. Catalina I., 1f V-29/31-81 (Nagano, Mercer, Miller) [JAP 7511, LACM]. **Ventura Co.**: Mouth Ventura River, 1f IV-24-66 (Powell) [EME 2169].

Taxonomic relationships.– *Euscrobipalpa obsoletella* is widespread in the Palaearctic (Povolný, 1967b) and was introduced into North America long ago. It described from Washington State as *G. miscitatella* by Clarke in 1932, and Keifer (1937) reported *E. obsoletella* from California in the Sacramento and San Jose areas. He found it common in the Central Valley but absent at San Francisco, in effect expressing ecological displacement with *E. atriplicella* on the same introduced European plant, *Chenopodium murale* L. Our survey tends to corroborate that occurrence in the San Francisco Bay area, with *E. obsoletella* recorded primarily east of the Berkeley Hills; both occur at Walnut Creek, Contra Costa Co.; while only *E. obsoletella* occurs on coastal dunes in southern California.

Biology.– Bradford (1979) listed both *Atriplex* and *Chenopodium* (Chenopodiaceae) as hostplants in England, where the species presumably is multivoltine, with adults active from May to September and larvae from June to October. Scant records suggest the same life cycle in California. Pupation takes place in the stem, and a small hole indicates the presence of a pupa. Keifer (1937) reported the larva is a stem borer in *Chenopodium murale*, causing die back of the flower heads. We have not seen records of *E. obsoletella* having adapted to native plants in California.

Euscrobipalpa instabilella (Douglas)

(Fig. 25, 61, 93)

Gelechia instabilella Douglas, 1846: 1270.

A small, relatively broad-winged moth having the forewing unicolorous shining dull brown, faintly tinged with rust.

MALE: FW length 5.6-6.0mm; (n = 3); FW length 4.5-4.8 x width. *Head:* Crown covered by brownish scales with whitish tips. Frons concolorous, lustrous. Labial palpus sand colored, II segment with erect scaling, III slender with appressed scaling. *Thorax*: Dorsum, tegulae, and forewing uniformly lustrous, brownish gray, with scattered ochreous scales and weak indication of two linear, rust stigmata in cell. Cilia pale brownish. Hindwing pale gray. Cilia gray. Legs uniformly lustrous, dark brownish gray. Genitalia as in Fig. 61 (drawn from EME 2217; n = 2 Calif.); uncus, tegumen, gnathos similar to those of *E. atriplicella* and *obsoletella*, valva broader and more enlarged apically than that of *E. atriplicella*; saccus broader and slightly shorter, only slightly exceeding lateral extensions of tegumen, and aedeagus stouter than in the preceding 3 species.

FEMALE: Essentially as described for male; California specimen too poor to characterize. Genitalia as in Fig. 93 (drawn from EME 2219; n = 1 Calif.); posterior apophyses very slender, much longer than VIII sclerite + anterior apophyses (n = 1, damaged); subgenital plate as long as broad, only poorly developed, dotted sculpture on inner margins of paired lobate sclerotization

flanking ostium; anterior apophyses ca. 1.5x longer than subgenital plate; colliculum a narrow, delicate ringlet. Signum small, without serration.

California coastal records.– Marin Co.: North end Drakes Estero, 3m, 1f V-23-1970, assoc. *Salicornia* (J. Powell) [EME 2217m, 2219f, JAP 7562m].

Taxonomic relationships.– *E. instabilella* is closely related to *E. salinella* (Zeller), as discussed by Povolný (1964, 1966). Superficially, it is more similar to the native *E. arenacearíella*, described below, than to the other Palaearctic congeners that are established in California.

Biology.– The larvae feed on *Plantago maritima* and halophytic Chenopodiaceae in Europe (Spuler, 1913; Povolný, 1964, 1990). Adults in California were taken in a coastal salt marsh, not sand dunes as cited by Povolný (1998c).

Euscrobipalpa arenacearíella Povolný & Powell, **new sp.**

(Fig. 7, 8, 62, 63, 94)

Scrobipalpa sp. A, De Benedictis *et al.*, 1990: 25.

A small species having nearly unicolorous rose-rust to rust-gray forewings, often with a triad of dark discal stigmata indicated by faintly darker brown scaling, and whitish hindwings.

MALE: FW length 5.9-6.2mm, avg. 6.1mm, FW length 4.5-4.9 x width (n = 5). *Head:* Crown pale rose-rust to rust-gray; frons and dorsal edge of labial palpi paler, cream colored. Labial palpus III segment darker than II, without indication of ringlets. *Thorax:* Dorsum and tegula concolorous with head. Ground color of forewing concolorous, with a more pronounced indication of brownish lines in longitudinal wing folds; sometimes a triad of dark brown stigmata in cell poorly indicated. Cilia gray. Legs gray with pale ringlets, metathoracic legs with paler fringe and interiorly. Hindwing pale cinereous with gray cilia having a slightly brownish hue. *Abdomen*: shining graphite gray with paler pleurae and genital scaling. Genitalia as in Fig. 62-63 (drawn from EME 1133, 2178; n = 5); uncus with distinct medial excision; tegumen elongate, relatively slender; valva moderately curved, with rounded tips reaching beyond posterior edge of uncus; parabasal process of valva slender with rounded tips exceeding the adjacent process of saccular fold, which projects into a paired, prominent process having a convex lateral edge and provided with a distinct tip in inside edge; medial excision of sacculus between its paired process deep and narrow; saccus moderately elongate, its obtuse tip slightly exceeding lateral corners of vinculum. Aedeagus stout, with moderately swollen phallobase and a distinct subterminal hooklet.

FEMALE: FW length 5.1-6.2mm, avg. 5.8mm (lab reared), FW length 4.4-5.0 x width (n = 8). Essentially as described for male. The triad of dark stigmata in cell more distinct in female, especially the 3rd, elongate stigma situated axially at about 2/3 of FW. Genitalia as in Fig. 94 (drawn from EME 1132; n = 6); posterior apophyses very slender, 2.1x longer than VIII sternite + anterior apophyses; subgenital plate longer than broad, without distinctive sculpture; central part of plate membranous, pleural sclerite more sclerotized, with longitudinal folds and a paired, narrow ledge extending from near base of the long anterior apophyses. A paired semicrescent sclerite supporting ostium bursae ventrally. Signum a prominent, strongly sclerotized, curved hooklet serrated on its dilated base.

Holotype male: CALIFORNIA: Monterey Co.: Big Creek Reserve [28 airline km SE Big Sur], May 4, 1991, r.f. *Artemisia douglasiana*, emgd. VI-25-91, JAP 91E7 (J. Powell). Paratypes (44): **Alameda Co.**: Berkeley Hills, 1400', 1f V-12-66, r.f. *A. douglasiana*, emgd. VI-28-66, 66E12 [JAP 7434]. **Contra Costa Co.**: Briones Dam, 1m, 1f V-9-83, r.f. *A. douglasiana*, emgd. by II-1984, 83E31 [JAD 625]; Tilden Park, Berkeley Hills, 1m, 1f IV-14-68, r.f. *A. douglasiana*, JAP 68D135 (P. A. Opler) [EME 2177f, 2178m]; **Monterey Co.**: same data as holotype, 7m, 20f, emgd. VI-26 to VII-29-91 [JAP 7426m, 7427f], same data except 2m IV-12-85, emgd. VII-5-85, JAP 85D22 (J. De Benedictis), 2f III-18-94, emgd. V-17, VI, 94C42 (M. McIntosh & Powell). **San Luis Obispo Co.**: Dune Lakes, 3 mi. S Oceano, 4m, 1f VI-2-74, r.f. *A. douglasiana*, emgd. VI-19 to VII-10-74, 74E6 [EME 1133m, 1134m, 1135f, JAP 7488m]; same locality, 1f VI-6-73, blacklight trap, [EME 1132]; **San Mateo Co.**: San Bruno Mt., 1f V-10-83, r.f. *A. douglasiana*, emgd. VI-29-83, JAD 83130-I (J. De Benedictis) [EME 1730], same data except 1f V-30-85, emgd. VII-7-85, JAP 85E112 (De Benedictis).

Taxonomic relationships.– *Euscrobipalpa arenacearíella* appears to be related to the western Palaearctic group of *S. disjectella* (Staudinger)-*delattini* Povolný, which occupy xeric habitats of the Mediterranean and Near and Middle East, as evidenced by both male and female genitalia. The new species is atypical for the genus in lacking the foam-like sculpture of the female subgenital plate. Inland populations (Berkeley Hills, Briones Dam) of *E. arenacearíella* tend to have more colorful, rose-rust scaling, while coastal populations (Big Creek, Dune Lakes) have uniformly dull gray-rust forewings.

Biology.– Larvae of *E. arenacearíella* mine in the soft leaves of *Artemisia douglasiana* (Asteraceae) during early instars, then create characteristic shelters by forming a single fold of the leaf edge. They skeletonize the upper leaf surface within the tightly closed shelter until maturity. This *Artemisia* deteriorates rapidly after the leaves are removed from the plant, so the larvae are difficult to rear in the lab if immature when collected. A young larva that has abandoned a deteriorating leaf can initiate a new mine and create a new shelter when provided with a fresh leaf. Sometimes larvae left the decaying leaves to form thin cocoons between layers of paper, but the type series all pupated within tightly folded leaf shelters.

The species evidently is univoltine, with larvae maturing in late March to early June, and adults emerge from mid May to late July, following a diapause of several weeks. Adults presumably are nocturnal, but only one was taken at blacklight, in early June, despite extensive diurnal survey and light trapping at the type locality.

SCROBIPALPOPSIS Povolný, 1967

This genus is essentially Nearctic in distribution, with four previously described species in North America and one Holarctic species complex that includes a rare arcto-alpine species in the Alps and Scandinavia, *S. petasitis* (Pfaffenzeller), and a closely related species in the eastern USA (Povolný, 1967a). Hence it was of considerable interest to find two new species in California that share features of the male genitalia which reflect their relationships to other members of *Scrobipalpopsis*: the posterior margin of the uncus convex, arched, with fine microsetae dorsolaterally; paired processes of the saccular wall and parabasal processes fused basally, and the characteristic slender aedeagus with obtuse tip bearing subterminal sclerites. The new species are Asteraceae-feeders associated with the typically Californian Province shrub, *Artemisia californica*, and the coastal woodland endemic, *Madia madioides*.

Hodges (1983) erred in proposing synonymy of this genus with *Ptycerata* Ely (type: *P. busckella* Ely, 1910), which is related to *Monochroa* and *Isophrictis* (Hodges & Becker 1990). *Scrobipalpopsis* was treated as a subjective synonym of the South American genus *Tecia* Kieffer & Joergensen, based on similarity of male genitalia between *S. petasitis* (Pfaffenzeller) and *T. venosa* (Butler) (= *T. mendozella* (Kieffer & Jörgensen) (Hodges and Becker, 1990). The status of *Tecia* and *Scrobipalpopsis* was discussed in detail by Povolný (1993), who considers their synonymy unwarranted in view of differences presumed to be synapomorphic: in *Tecia* the labial palpi are porrect, the uncus is produced medially (a crescent sclerite forming a convex, evenly rounded ledge in *Scrobipalpopsis*), and in female genitalia *Tecia* have the subgenital plate broader than long with the sclerotization produced periostially forming a rudimentary antrum, lacking in *S. petasitis*, which has the subgenital plate longer than broad, with lobes on the posterior apophyses produced inwardly that are not developed in *Tecia* (see Fig. 5-8, Povolný, 1993).

Scrobipalpopsis interposita Povolný & Powell, **new sp.**

(Fig.27, 65, 96)

Ptycerata sp. De Benedictis *et al.*, 1990: 25.

A small, relatively broad-winged moth having dark cinereous forewings shaded with brownish and with distinct, variable black markings.

MALE: FW length 5.0-5.9mm, avg. 5.4mm, length 4.6-5.3 x width (n = 5). *Head*: Crown and frons covered by lead colored, lustrous scales. Labial palpus concolorous, II segment with erect scaling, III very slender smooth scaled, acute. *Thorax*: Dorsum and tegulae lead colored. Forewing ground a dense mixture of dark gray and brownish; groups of partly black scales concentrated irregularly along costal margin and form stigmata along middle of wing; the distal stigma elongate, tending to form a elongate streak toward apex; apical area cinereous with black submarginal spotting. Cilia gray. Hindwing shining whitish cinereous. Cilia long, grayish. Legs pale gray, slightly lustrous, with paler ringlets poorly indicated. *Abdomen*: Dorsum shining pale tan, basal terga ochreous, each segment tinged brownish distally. Venter whitish or silvery tan, tinged dark brown forming poorly defined ventrolateral bands. Genitalia as in Fig. 65 (drawn from holotype; n = 5); delicate, slender, elongate; uncus convex, arched; gnathos a delicate spine; valva slender with moderately inflated, clavate tip; paired sacculus process lanceolate, fusing with digitate parabasal process of valva; saccus subtriangulate with obtuse, rounded tip that exceeds vinculum. Aedeagus moderately distinctly curved with prominent, ovate phallobase; slender, tip obtuse with complex subterminal sclerites.

FEMALE: FW length 5.2-5.6mm, FW length 4.5 x width (n = 2). Essentially as described for male. Genitalia as in Fig. 96 (drawn from JAP 7448; n = 2); subgenital plate concave, excised laterally at level of anterior apophyses bases, apophyses convex, curved; paired periostial sclerotization finely sculptured, protruding to form a short, curved, parallel-sided antrum; signum large, subtriangulate, with rounded margins and a strong spine.

Holotype male: CALIFORNIA: Contra Costa Co., Briones Reservoir, April 1, 1984, r.f. *Artemisia californica*, emgd. VI-30-84, JAP 84D7 (J. Powell) [EME slide 2203]. Paratypes (11): **Monterey Co.**: Big Creek Reserve, 0-10 meters, 1m X-3/4-85, blacklight trap [EME 2198], 1f V-3-91, r.f. *A. californica*, emgd. VI-30-91, 91E14, same locality except 350 meters, 500 meters, 1m, 1f X-2/3-91, blacklight traps [JAP 6662m, 7448f], same locality except S. Access Rd. 240 meters, 3m V-31-97, blacklight trap. **Riverside Co.**: Jurupa Hills, Janzen Quarry, 1m II-2-96, r.f *A. californica* (G. Ballmer & K. Stockwell, UCR) [JAP 7469]. **San Bernardino Co.**: Lytle Creek at Highway I-15, 1f III-24-96, r.f. *A. californica* (Ballmer & Stockwell, UCR). **San Mateo Co.**: San Bruno Mt., 1m V-3-83, r. f. *A. californica*, emgd. VII-8-83, JAD 83123-F [JAD 614], 1f II-14-85, r.f. *A. californica*, emgd. V-25-85, JAP 85B4 (J. De Benedictis).

Taxonomic relationships.– The male genitalia, with characteristic paired processes of the sacculus and aedeagus, indicate relationship to *Scrobipalpopsis tetradymiella* (Busck), although the two are not similar phenotypically. *S. tetradymiella* is a much larger, pale gray moth of desert areas.

Biology.– The larvae form shelters in tightly tied tips of new foliage on the endemic coastal chaparral shrub, *Artemisia californica* (Asteraceae). The shelters are evident in early spring, January and February in inland southern California and February to early May in central coastal areas. As the larvae mature, plant growth causes the terminals to curl, and abandoned shelters are more conspicuous by their drying leaflets and distorted form. Larvae form cocoons in debris beneath the plants, where they evidently undergo diapause for part or most of the dry season. The species appears to be univoltine, with lab emergences from late May to early July. However, field-collected adults were taken in light traps at the end of May and in early October at Big Creek, Monterey Co., suggesting the possibility of two generations or a bimodal diapause similar to that of *Scrobipalpulopsis lutescella* (Clarke).

Scrobipalpopsis madiae Povolný & Powell, **new sp.**

(Fig. 26, 64)

A medium sized *Scrobipalpopsis* having white forewings with two blackish, discal stigmata and a group of submarginal black dots.

MALE: FW length 6.6 mm (n = 1); FW length 4.5 x width. *Head*: Crown shining whitish silvery. Labial palpus slender, III segment moderately tufted, unicolorous whitish, III subequal in length to II, smooth scaled, white. *Thorax*: Dorsum and tegulae whitish silvery. Forewing nearly unicolorous milky white, some scales slightly grayish; two black stigmata, slightly elongated, 1st before, 2nd after middle of cell; poorly defined, ochreous brown shade subtending the stigmata and in subterminal area; a series of 5 poorly defined, black, submarginal dots extending from apex to tornus; apical area with admixture of scales with blackish tips. Fringe whitish peppered with blackish scale tips. Hindwing white including cilia. Legs white, reflecting lustrous silvery. *Abdomen*: Scale coloring not recorded. Genitalia as in Fig. 64 (drawn from holotype; n = 1); delicate, uncus with distal edge broadly rounded, differentiated from broader tegumen by pronounced "shoulders". Gnathos slender, elongate, attenuate with hooked tip. Valva slender, clavate with moderately inflated tip. Parabasal process short, broadly lobate. Paired process of saccular fold broadly foliate, truncate with moderately acute external tip; medial excision of saccular fold broad, deep. Saccus elongate, narrow, attenuated to a pointed tip, exceeding lobes of vinculum. Aedeagus long, slender with globose phallobase; trunk parallel-sided , its tip obtuse with a distinct but weakly sclerotized subterminal hooklet.

FEMALE: unknown; probably similar to *S. arnicella* (Clarke).

Holotype male: CALIFORNIA: Monterey Co., Big Creek Reserve [28 airline km SE Big Sur], May 4, 1991, r.f. *Madia madioides*, emgd. VI-18-91, JAP 91E45.1 (Y.-F. Hsu & Powell) [JAP 6648].

Taxonomic relationships.– This species is similar to *Scrobipalpopsis arnicella* (Clarke, 1942), which was described on the basis of two females from Whitman County in southeastern Washington. Clarke characterized the male based on one specimen from Siskiyou County, California. *S. madiae* differs from the Siskiyou male in details of forewing pattern and genitalia. The forewing of the alleged *S. arnicella* male is darker, more uniformly sprinkled with brownish scales but lacks the ochreous-brown shades subtending the two stigmata and preceding the termen, while the black terminal spotting at the base of the fringe in *S. madiae* is lacking on the Siskiyou male.

Clarke (1942) mounted and illustrated the genitalia of the Siskiyou male in lateral aspect, which was the style used by Busck (1939); we removed the preparation from the slide (JFGC 3703, USNM) and examined it in fluid. The saccus is broader and less attenuated than in *S. madiae*, and the gnathos hook and "shoulders" of the tegumen are more pronounced in *S. madiae*. We also examined one male from Ferry County in northeastern Washington. This specimen lacks the conspicuous black forewing maculation of the Siskiyou male and differs markedly in genital characters (JAP slide 7727, USNM), having a reduced uncus and much broader saccus than does *S. madiae* or the Siskiyou male. Thus, there may be three species involved in this complex.

It is possible that either the Ferry Co. specimen or the Siskiyou male is conspecific with the *Arnica*-feeding females of southeastern Washington. The female is described as having two basal black spots, which are lacking in the Siskiyou male. In any event, the *Madia*-feeding species in coastal redwoods of central California certainly is not the same as the *Arnica* associate in eastern Washington.

Biology.– The single moth emerged from whole plants of *Madia* (Asteraceae) that had been collected to obtain the tortricid, *Epiblema deverrae* R. Brown from pupae in dry stems of the previous season. The larva of *Scrobipalpopsis madiae* could have been a foliage feeder on the current season growth, as was reported for *S. arnicella* (Clarke, 1942). *Madia madioides* grows on rocky talus slopes in redwood canyons, and we have sampled the habitat several times in

May and June with blacklights without finding *S. madiae. Arnica* and *Madia* are now considered to be more closely related Asteraceae than indicated in older literature, members of the Tribe Heliantheae (J. Strother, *in lit.*).

EXCEPTIA Povolný, 1967

This genus was proposed for a Californian species, *E. neopetrella* (Keifer). Although Keifer's work and illustrations were extremely meticulous, Povolný (1967a) assumed that Keifer had overlooked parabasal processes of the valvae, which Povolný found in a male from Mill Valley, Marin Co. The genitalia illustrated by Povolný, however, were drawn from misidentified specimens. Based on additional material, we now realize the male represents an undescribed sister species. The female genitalia illustrated by Povolný (1967a) from a specimen from Los Angeles County, are another species. The female genitalia of *Exceptia* are characterized by extraordinarily long posterior apophyses, extending nearly the length of the abdomen when the ovipositor is retracted, and by a large, broadly sclerotized, scythe-shaped signum, nearly half the length of the enlarged (post-mating) corpus bursae.

Exceptia neopetrella (Keifer)
(Fig. 66, 97)

Gnorimoschema neopetrella Keifer, 1936a: 239
Exceptia neopetrella; Povolný, 1967a: 114.

This species was described from Alma, in the eastern foothills of the Santa Cruz Mountains, Santa Clara Co., California, and it has remained known only from the type series. The moths are smaller (FW length 5.4-6.2mm; n = 8) and usually darker colored than the new species described below, even though most specimens of the type series of *E. neopetrella* are worn appearing, and the color may be faded. The forewing of *E. neopetrella* is suffused with grayish brown, sometimes with the triad of linear, black stigmata well defined by whitish. Male genitalia as in Fig. 66 (drawn from holotype, JAP prep. 7460; n = 2). Female genitalia as in Fig. 97 (drawn from paratype, JAP prep. 7456; n = 2).

Exceptia sisterina Povolný & Powell, **new sp.**
(Fig. 7, 67, 68, 98)

Exceptia neopetrella; Povolný, not Keifer (in part, Fig. 121), 1967a: 114.

A moderately large, relatively broad-winged species having nearly unicolorous, whitish forewings, variably tinged with ochreous and brownish and with weak indications of one or two dark discal stigmata.

MALE: FW length 10.1-10.9mm (n = 6); FW length 4.3-5.2 x width. *Head:* Crown cream-white. Labial palpus concolorous with faint admixture of dark-tipped scales; II segment with erect scaling. *Thorax:* Dorsum and tegula cream-white. Forewing whitish, variably overlaid with brownish to brownish ochreous scaling; 2 slightly elongate, black stigmata, 1st in cell, 2nd at end of cell, either of which may be reduced to a trace or lost. Brownish scaling very faint to nearly uniformly covering ground whitish, with ochreous streaks between the veins in terminal area (n = 2); pale, faintly dusted individuals may represent loss of overscaling with age. Loss of stigmata not correlated with reduced brownish; pale or brownish FW may have stigmata well developed or lost. A row of blackish scales indicating submarginal dots. Fringe white. Hindwing whitish, scaling along veins faintly darker; fringe whitish, tinged with ochreous except in anal area. *Abdomen*: dorsal scaling sordid whitish, basal 3 terga tan; paler ventrally. Genitalia as in Fig. 67-68 (Fig. 67 drawn from K2029, CAS [figd. as *E. neopetrella* by Povolný, 1967a]) and (Fig. 68 drawn from holotype; n = 4); tegumen elongate, uncus strongly convex, finely hirsute; gnathos a short, curved spine; valva slender, parallel-sided; paired process of sacculus fold broadly foliate on both sides of a deep, narrow medial excision, with an acute tip; parabasal process of valva slender, sticklike, adjacent to sacculus process laterally; saccus very long, slender ligulate. Aedeagus slightly shorter than tegumen + saccus with abrupt phallobase inflation.

FEMALE: FW length 9.8-11.6mm (n = 5); FW length 4.5-5.2 x width. Essentially as described for male, FW color similarly variable, ranging to brownish gray with faint whitish streaks. Abdomen cream-white, 1st two terga with modified ochreous scaling. Genitalia as in Fig. 98 (drawn from JAP 7473; n = 4); posterior apophyses extremely long and slender, 3.5-3.6x longer than VIII sternite + anterior apophyses; subgenital plate moderately longer than broad, funnel shaped; anterior apophyses longer than subgenital plate, flattened to beyond half their length; sterigma forming two peninsular sclerites on both sides of ostium, joined by a transparent membrane; colliculum a weakly sclerotized ringlet; signum longer than anterior apophyses, half the post-mating bursa length, scythe-shaped with serrate base and moderately acute tip.

Holotype male: CALIFORNIA: Monterey Co., Big Creek Reserve [28 airline km SE Big Sur], 0-10m, June 5/8, 1989, blacklight (Y.-F. Hsu & J. Powell) [EME 2881]. Paratypes (16): **Humboldt Co.**: Samoa Dunes, 1f VII-17-69 [JAP 7478]. **Marin Co.:** 3 mi. W Inverness, 2f VIII-15-65 (J. S. Buckett, UCD) [JAP 7524]; Mill Valley, 1m VII-3-1926 (H. H. Keifer) [K.2029, CAS]. **Monterey Co.**: same data as holotype, 1f [JAP 7473], same locality except 550m, 2m V-31-97 blacklight trap, same data except 240m, 1f, same locality at Whale Pt. 180m, 1f VI-5-98 BL (F. Sperling & Powell); Bixby Cyn., 1f VIII-1-48 (J. W. Tilden) [K.2052, CAS]; Hastings Reserve, Carmel Vy., 4m, 2f V-30-97, MV, blacklights (J. Kruse & Powell) [JAP 7605m].

Taxonomic relationships.– *Exceptia sisterina* is appreciably larger than *E. neopetrella*, its only congener, and differs by having paler coloration, the FW varying from brownish ochreous-streaked to whitish, rather than typically suffused with grayish brown in *E. nepetrella*. In male genitalia, *E. neopetrella* has a more slender gnathos tip and much broader paired processes of the sacculus than in the new species, and *E. sisterina* has a slender, sticklike parabasal process of the valva, which is rudimentary in *E. neopetrella*. The female genitalia differ by dramatic development of sculpturing and scobination of the subgenital plate and elongate antrum in *E. sisterina*, not developed in *E. neopetrella* (Fig. 98, 97 respectively).

Biology.– *Exceptia neopetrella* was one of the very few species that Keifer described from field collected adults, with no information of the biology, and we have no larval feeding data on it nor *E. sisterina*. The extremely elongate posterior apophyses of these two species indicate some kind of specialized oviposition behavior involving insertion of eggs into a substrate, such as compact inflorescences. The adults are nocturnal and fly in late May to August; at Big Creek and Hastings Reserve adults were taken at the edge of coastal chaparral and Coast Live Oak (*Quercus agrifolia*) woods, while at Inverness the collection site was along the margin of Bishop Pine-Live Oak woods and open grassland. At Samoa, however, *E. sisterina* was taken in coastal sand dune habitat.

DISCUSSION

R. W. Hodges has shown by recent comprehensive studies of gelechiid taxa (Dichomeridinae, *Chionodes*) that fewer than half the North American species of Gelechiidae represented in collections are described (Hodges 1986, 1999). Hence it is not surprising that 17 of 35 species treated in this study were undescribed. We can project from the 86 species recorded by Hodges (1983), at least 170-200 species of Gnorimoschemini already collected in America north of Mexico. In addition, 31 species have been described by Huemer (1988) and Povolný (1985, 1998a,b,c,d, 1999a,b, 2000); and we describe 17 as new, record three Palaearctic species in the United States for the first time, of which one may be introduced, two presumably are Holarctic, and one name is raised from synonymy. These additions bring the Gnorimoschemini recorded in America

north of Mexico to 137 species. The total Nearctic fauna likely is much greater, with many species awaiting discovery by intensive sampling in species-rich, arid regions of western U. S. and Nearctic Mexico.

Based on the species recorded to date, we can offer some generalizations on the Nearctic Gnorimoschemini, elaborating on those provided by Povolny (1967a) and Hodges (1986). The 137 species are assigned to 18 genera, which comprise four primary components: Endemic, essentially Nearctic, essentially Palaearctic with minor development in the Nearctic, and essentially Neotropical. In addition, one genus is of uncertain origin, and one is represented by an introduced species.

1. **Essentially Nearctic genera, less developed in Palaearctic**:
   Gnorimoschema Busck, 1900 (60+ Nearctic, ca. 20 Palaearctic, and 3 Holarctic species). Known Nearctic larvae feed primarily on Asteraceae; many induce stem or tip galls.
   Scrobipalpopsis Povolný, 1967a (6 Nearctic, one Holarctic, and one Central American species). Known Nearctic larvae feed on Asteraceae, on foliage or in stem galls.
2. **Endemic Nearctic genera and subgenera**:
   Eurysaccoides Povolný, 1998b (2 species, California).
   Exceptia Povolný, 1967a (2 species, California).
   Frumenta Busck, 1939 (2 species). Listed as Gnorimoschemini by Povolný (1967a) and appears to be related to *Caryocolum*, but the status of this genus and its relationship to this tribe need review.
   Neopalpa Povolný, 1998b (monobasic, California and Baja California Sur).
   Neoschema Povolný, 1967a (2 species, California, Nevada).
   Nevadopalpa Povolný 1998a (6 species, California).
   The larval biology of none of this group is known.
3. **Essentially Palaearctic genera with lesser development in the Nearctic**:
   Euscrobipalpa Povolný, 1967 (250+ described species). Marginally represented in Afrotropical, Oriental, and Australian Regions. At least two species introduced into North America, possibly two Holarctic, and at least three endemic to Nearctic. The few endemic, Holarctic, and/or introduced species in North America feed on foliage or inflorescences of Chenopodiaceae or Asteraceae.
   Caryocolum Gregor & Povolný, 1954 (120+ species, 2 Holarctic). No strictly Nearctic species documented (Huemer 1988); the status of three species listed by Hodges (1983), but not Huemer (1988), needs review.
   Agonochaetia Povolný, 1965 (4 Palaearctic, 1 Nearctic species).
   Klimeschiopsis Povolný, 1967b (2 Palaearctic, 1 of which occurs in North America, Holarctic; Povolný, unpubl.).

   There is one additional Eastern Hemisphere genus marginally represented in the Nearctic:
   Microcraspedus Janse, 1958 (ca. 60 described species, primarily in the "Steppe corridor" of the Palaearctic, Near and Middle East to South Africa, a few in the Oriental Region, 1 Australian, and 2 Nearctic species in California).
4. **Neotropical genera, less developed in Nearctic**:
   Symmetrischema Povolný, 1967a (s. str.) (ca. 100 species, 10 Nearctic, one introduced in Nearctic and Australia, pest of potatoes). All known larval records are Solanaceae.
   Scrobipalpula Povolný, 1964 (ca. 35 Neotropical, 5 Nearctic species, one Holarctic). The known Nearctic larvae are all tip borers in Asteraceae, often herbaceous species.
   Keiferia Busck, 1939 (ca. 20 Neotropical, 3 Nearctic species). Larvae are Solanaceae feeders.
   Scrobipalpulopsis Povolný, 1987 (7 Neotropical, one Nearctic species). The Nearctic species feeds on Scrophulariaceae, in the inflorescences.

   One genus is of uncertain origin:
   Tuta Strand, 1910 (ca. 20 species, saline and maritime habitats of Atlantic and Pacific Oceans in north and south temperate zones). Larvae are miners of halophytic Chenopodiaceae.

   One genus is represented by an introduced species:
   Phthorimaea Meyrick, 1902 (2-4 Indoaustralian species, one introduced cosmopolitan). Pests of potatoes (Solanaceae).

The center of generic and species diversity in the Nearctic appears to be the arid southwest, and the California fauna consists of all of these components. There are 64 described species recorded in California (Appendix 1), 47% of the known Nearctic fauna, of which 33 (52%) are members of endemic or essentially Nearctic genera. The other major element comprises essentially Neotropical genera, with 10 species. Primarily Palaearctic genera are represented by only 7 species, and at least 3 of those are introduced.

LITERATURE CITED

Barrett, R. E.
1932. Notes on a new potato pest. *J. Econ. Ent.* (Lanham), 25:134.

Bradford, E. S.
1979. Gelechiidae. *In* A. M. Emmet (ed.), *A Field Guide to the Smaller British Lepidoptera*, 115-132. London: Brit Ent. & Nat. Hist Soc.

Braun, A.
1929. New microlepidoptera from Alberta and Manitoba. *Can. Ent.* (Ottawa), 58:46-50.

Brown, J. W., and J. A. Powell
1991. Systematics of the *Chrysoxena* group of genera (Lepidoptera: Tortricidae: Euliini). *Univ. Calif. Publ. Ent.* (Berkeley), 11:1-87.

Busck, A.
1903. A revision of the American moths of the family Gelechiidae, with descriptions of new species. *Proc. U. S. Natl. Mus.* (Washington), 25:767-938.
1910. New microlepidoptera from New Mexico and California and a synoptic table of North American species of *Heliodines* Stainton. *Proc. Ent. Soc. Washington*, 11:175-188.
1911. On the gall-making moths on Solidago and Aster, with description of two new species. *Can. Ent.* (Ottawa), 43:4-6.
1915. Descriptions of new North American microlepidoptera. *Proc. Ent. Soc. Washington*, 17:79-94.
1916. Descriptions of new North American microlepidoptera. *Proc. Ent. Soc. Washington*, 18:147-154.
1928. *Phthorimaea lycopersicella*, new species (Family Gelechiidae), a leaf feeder on tomato (Lep.). *Proc. Hawaiian Ent. Soc.* (Honolulu), 7:171-174.
1931. Two new Peruvian microlepidoptera of economic importance (Gelechiidae and Oecophoridae). *Proc. Ent. Soc. Washington*, 33:59-63.
1939. Restriction of the genus *Gelechia* (Lepidoptera: Gelechiidae), with descriptions of new genera. *Proc. U. S. Natl. Mus.* (Washington), 86: 563-593.

Campbell, R. E., and J. C. Elmore
1931. Damage to tomatoes in southern California by the tomato pin worm and potato tuber moth. *Calif. Dept. Agric., Mon. Bull.* (Sacramento), 20:458-460.

Chambers, V. T.
1875. Tineina of the United States. *Cincinnati Qtr. J. Sci.*, 2:226-259.

Clarke, J. F. G.
1932. New microlepidoptera from the Pacific Coast (Gelechiidae). *Can. Ent.* (Ottawa), 64:63-69.
1934. Notes and new species of microlepidoptera from Washington State. *Can. Ent.* (Ottawa), 66:171-181.
1942. Notes and new species of microlepidoptera from Washington state. *Proc. U. S. Natl. Mus.* (Washington), 92:267-276.

Cooper, W. S.
1967. Coastal dunes of California. *Mem. Geol. Soc. Amer.* (Washington), 104:1-131, 15 pl.

De Benedictis, J. A., D. L. Wagner, and J. B. Whitfield
1990. Larval hosts of microlepidoptera of the San Bruno Mountains, California. *Atala* (Seattle), 16:14-35.

Eckstein, K.
1933. *Die Schmetterlinge Deutschlands. Bd. 5. Die Kleinschmetterlinge Deutschlands*. Stuttgart: Lutz Verlag. 223pp.

Fischer von Rölerstamm, J. E.
1834-41. *Abbildungen zur Berichtigung und Ergänzung der Schmetterlingskunde, besonders der Microlepidopterologie, als Supplement zu Treitschke's und Hübner's europäischen Schmetterlingen, mit erläuterndem Text*. 304pp.

Ford, L. T.
1949. *A Guide to the Smaller British Lepidoptera*. London: So. London Ent. & Nat. Hist. Soc. 230pp.

Gaede, M.
1937. Gelechiidae. *Lepidopterorum Catalogus*, 97. Neubrandenburg: G. Feller Verlag. 630pp.

Goeden, R. D. and D. W. Ricker
1975. The phytophagous insect fauna of the ragweed, *Ambrosia confertiflora*, in southern California. *Environ. Ent.* (Lanham), 4:301-306.
1976. The phytophagous insect fauna of the ragweed, *Ambrosia psilostachya*, in southern California. *Environ. Ent.* (Lanham), 5:1169-1177.

Gyen, W. van
1913. Descriptions of Chili microlepidoptera. *Bol. Mus. Nacional* (Santiago), 5:338-340.

Herrich-Schäffer, G. A. W.
1847-55. Die Schaben und Federmotten. In *Systematische Bearbeitung der Schmetterlinge von Europa*. Bd. 5. Regensburg: G. J. Manz. 394pp.

Hodges, R. W.
1983. Gelechiidae *In* R. W. Hodges *et al.* (eds.), *Check List of the Lepidoptera of America north of Mexico*, 19-25. London: E. W. Classey & Wedge Entomol. Res. Found.
1986. *The Moths of America North of Mexico. Fasc. 7.1. Gelechioidea, Gelechiidae (part)*. Washington: Wedge Ent. Res. Found. 195pp, 42 + 4 pl.
1999. *The Moths of America North of Mexico. Fasc. 7.6. Gelechioidea, Gelechiidae (Part* - Chionodes). Washington: Wedge Ent. Res. Found. 339pp, 5 pl.

Hodges, R. W., and V. O. Becker
1990. Nomenclature of some Neotropical Gelechiidae (Lepidoptera). *Proc. Ent. Soc. Washington*, 92:76-85.

Huemer, P.
1988. A taxonomic revision of *Caryocolum* (Lepidoptera, Gelechiidae). *Bull. British Mus. (Nat. Hist.), Ent.* (London), 57:439-571.

Huemer, P. and O. Karsholt
1998. A review of the Old World *Scrobipalpula* (Gelechiidae), with special reference to central and northern Europe. *Nota Lepid.* (Basel), 21:37-65.

Jansen, M. G. M.
1998. Bemerkungen zur Taxonomie der in den Niederlanden Vorkommenden Arten der Gattung *Scrobipalpa* Janse (Lepidoptera: Gelechiidae). *Verh. Westdeutschland Ent., Tag 1997*, 145-157.

Jepson, W. L.
1925. *A Manual of the Flowering Plants of California*. Berkeley: Univ. Calif. Pr. 1238pp.

Karsholt, O., and E. S. Nielsen
1974. A new species of *Gnorimoschema* from northern Europe (Lepidoptera, Gelechiidae). *Notul. Ent.* (Helsinki), 54:91-96.

Karsholt, O., and J. Razowski (eds.)
1996. *The Lepidoptera of Europe. A Distributional Check List*. Stenstrup: Apollo Books. 380pp.

Kaitila, J.-P.
1996. The biology of the species of Gelechiidae occurring in Finland. *Baptria* (Helsinki), 21:81-105.

Keifer, H. H.
1927. California microlepidoptera. *Pan-Pac. Ent.* (San Francisco), 3:136-138.
1933. California microlepidoptera VI. *Calif. Dept. Agric., Mon. Bull.* (Sacramento), 22:351-365.
1936a. California microlepidoptera IX. *Calif. Dept. Agric., Mon. Bull.* (Sacramento), 25:235-259.
1936b. California microlepidoptera X. *Calif. Dept. Agric., Mon. Bull.* (Sacramento), 25:349-359.
1937. California microlepidoptera XI. *Calif. Dept. Agric., Mon. Bull.* (Sacramento), 26:177-203.

Langston, R. L.
1974. Extended flight periods of coastal and dune butterflies in California. *J. Res. Lepid.* (Beverly Hills), 13:83-98.

Laštůvka, Z. (ed.).
1998. *Checklist of Lepidoptera of the Czech and Slovak Republics*. Brno: Konvoj.

Medvedev, G. S. (ed.).
1990. *Keys to the Insects of the European Part of the USSR. Vol. 4. Lepidoptera, Part 2*. Leiden: E. J. Brill. 1092pp. [Engl. transl.]

Meyrick, E.
1895. *A Handbook of British Lepidoptera*. London: MacMillan. 843pp.
1926. *Exotic Microlepidoptera*, 3:276. Marlborough.

Miller, S. E., and R. W. Hodges
1990. Primary types of microlepidoptera in the Museum of Comparative Zoology (with a discussion on V. T. Chambers' work). *Bull. Mus. Comp. Zool.* (Cambridge, Ma.), 152:45-87.

Munz, P. A., and D. D. Keck
1959. *A California Flora*. Berkeley: Univ. Calif. Pr. 1681pp.
1968. *A California Flora and Supplement*. Berkeley: Univ. Calif. Pr. 224pp.

Murtfeldt, M. E.
1900. New Tineidae with life histories. *Can. Ent.* (Ottawa), 32:161-166.

Oatman, E. R., J. A. Wyman, and G. R. Platner
1979. Seasonal occurrence and parasitization of the tomato pinworm on fresh market tomatoes in southern California. *Environ. Ent.* (Lanham), 8:661-

664.

Povolný, D.

1964. Gnorimoschemini Trib. Nov. — Eine neue Tribus der Familie Gelechiidae nebst Bermerkungen zu ihrer Taxonomie (Lepidoptera). *Acta Soc. Ent. Czechoslov.* (Prague), 61:330-359.

1965. Neue und wenig bekannte palaearktische Arten und Gattungen der Tribus Gnorimoschemini nebst Bermerkungen zu ihrer Taxonomie (Lepidoptera, Gelechiidae). *Acta Ent. Bohemoslov.* (Prague), 62:480-495.

1966. Neubeschreibungen von Palaearktischen *Scrobipalpa*-Arten (Lepidoptera, Gelechiidae). *Acta Ent. Bohemoslov.* (Prague), 63:400-402.

1967a. Genitalia of some nearctic and neotropic members of the tribe Gnorimoschemini (Lepidoptera, Gelechiidae). *Acta Ent. Mus. Nat. Prag.* 37:51-127.

1967b. Ein kritischer Beitrag zur taxonomischen Klaerung einiger palaearktischer Arten der Gattung *Scrobipalpa* (Lepidoptera, Gelechiidae). *Acta Sci. Nat. Brno*, 1:209-250.

1968. Neue und wenig bekannte Taxone aus der Tribus Gnorimoschemini Povolný, 1964 (Lepidoptera, Gelechiidae). *Acta Sci. Nat. Brno*, 2:1-44.

1980. Die bisher bekannten Futterpflanzen der Tribus Gnorimoschemini (Lep., Gel.) und deren Bedeutung fur taxonomische-oekologische Erwägungen. *Acta Univ. Agric. Brno*, 28:179-210.

1982. Zur artspezifischen Indentität mancher westpaläarktischer Gnorimoschemini (Gelechiidae). *Nota Lepid.* (Basel), 5:121-124.

1985. *Gnorimoschema siskiouense* sp. n. — a new gelechiid moth from California (Lepidoptera, Gelechiidae). *Acta Univ. Agric. Brno*, 33:111-114.

1987. Gnorimoschemini of southern South America III: the scrobipalpuloid genera (Insect, Lepidoptera, Gelechiidae). *Steenstrupia* (Copenhagen), 13:1-91.

1988. *Scrobipalpa nitentella* (Fuchs, 1902) species *revocata* und *S. indignella* (Staudinger, 1879) *species bona* sowie sonstige irrtümliche Urteile über die Gattung *Scrobipalpa* (Lepidoptera, Gelechiidae). *Dtsch. Ent. Zeit.* (Frankfurt), (n.s.) 35:369-378.

1989a. Bemerkungen zur generischen und subgenerischen Bewertung einiger Gnorimoschemini (Insecta, Lepidoptera, Gelechiidae). *Reichenbachia* (Dresden), 26:157-167.

1989b. Gnorimoschemini of southern South America IV: the genera *Symmetrischema* and *Phthorimaea* (Lepidoptera, Gelechiidae). *Steenstrupia* (Copenhagen), 15:57-104.

1990a. Zur heutigen Kenntnis von Nahrungspflanzen der Tribus Gnorimoschemini (Lepidoptera, Gelechiidae). *Acta Univ. Agric. Brno*, 38:191-204.

1990b. Gnorimoschemini of Peru and Bolivia (Lepidoptera, Gelechiidae). *Steenstrupia* (Copenhagen), 16:153-223.

1991. Morphologie, Systematik und Phylogenie der Tribus Gnorimoschemini (Lepidoptera, Gelechiidae). *Acta Sci. Nat. Acad. Sci. Bohemoslov.* (Brno), (n.s.) 25:1-103.

1992. A critical review of the Palaearctic taxa of the genus *Gnorimoschema* Busck (Lepidoptera, Gelechiidae). *Acta Ent. Bohemoslov.* (Prague), 89:217-233.

1993. Zur Taxonomie und Nomenklatur der amerikanischen gnorimoschemoiden Gattungen *Tuta* Strand, *Tecia* Strand, *Scrobipalpopsis* Povolný, und *Keiferia* Busck (Lepidoptera, Gelechiidae). *Reichenbachia* (Dresden), 30:85-98.

1994. Gnorimoschemini of southern South America VI: identification keys, checklist of Neotropical taxa and general considerations (Lepidoptera, Gelechiidae). *Steenstrupia* (Copenhagen), 20:1-42.

1996. Gnorimoschemini (Gelechiidae). *In* O. Karsholt and J. Razowski (eds.), *The Lepidoptera of Europe. A Distributional Checklist*, 115-117. Steenstrup: Apollo Bks.

1998a. *Nevadopalpa* gen. nov. and *Neoschema* Povolný, 1967 stat. nov. — two new Nearctic genera of the tribe Gnorimoschemini, with descriptions of three new species. *Ent. Abh.* (Dresden), 58(6):1-12.

1998b. *Neopalpa* gen. n. and *Eurysaccoides* gen. n. — two new genera of the tribe Gnorimoschemini from California, with the description of three new species (Lepidoptera, Gelechiidae). *SHILAP Revta. Lepid.* (Madrid) 26:139-146.

1998c. New taxa and faunistic records of the tribe Gnorimoschemini from the Nearctic Region (Lepidoptera, Gelechiidae). *Stapfia* (Linz), 55:327-347.

1998d. *Nevadopalpa albula* spec. nov. — a third species of the genus *Nevadopalpa* Povolný, 1998, from California (Insecta: Lepidoptera: Gelechiidae). *Reichenbachia* (Dresden), 32:313-315.

1999a. A revision of the genus *Nevadopalpa* Povolný, 1998 with descriptions of four new species (Lepidoptera: Gelechiidae). *SHILAP Revta. Lepid.* (Madrid) 27:379-391.

1999b. Two indigenous Nearctic species of the genus *Microcraspedus* Janse, 1958 (Lepidoptera: Gelechiidae). *SHILAP Revta. Lepid.* (Madrid) 27: 413-417.

2000. Four new Nearctic species of the genus *Tuta* Strand (Lepidoptera: Gelechiidae). *SHILAP Revta. Lepid.* (Madrid), 28:213-225.

Powell, J. A.

1976. A remarkable new genus of brachypterous moth from coastal sand dunes in California (Lepidoptera: Gelechioidea, Scythrididae). *Ann. Ent. Soc. Amer.* (Lanham), 69:325-339.

1981. Endangered habitats for insects: California coastal sand dunes. *Atala*, 6:41-55 (1978).

1985. Faunal affinities of the Channel Islands Lepidoptera: a preliminary overview. In A. Menke and S. Miller (eds.), *Biogeography of the Insects of the California Channel Islands*, 61-94. Santa Barbara Nat. Hist. Mus.

1991. A review of *Lithariapteryx* (Heliodinidae), with description of an elegant new species from coastal sand dunes in California. *J. Lepid. Soc.* (Los Angeles), 45:89-104.

1994. Biogeography of Lepidoptera on the California Channel Islands. *In* W. Halvorson and G. Maender (eds.), *The Fourth California Islands Symposium: Update on the Status of Resources*, 449-464. Santa Barbara: Santa Barbara Mus. Nat. Hist.

Sattler, K.

1987. Die an Compositen gebunderen *Scrobipalpa*-Arten des oestlichen Osterreichs (Lepidoptera, Gelechiidae). *Ann. Naturhist. Mus. Wien*, (B) 88/89: 435-456.

1988. The systematic status of the genera *Ilseopsis* Povolny, 1965 and *Empista* Povolny, 1968 (Lepidoptera, Gelechiidae). *Nota Lepid.* (Basel), 10:224-235.

Snellen, P. C. T.

1882. *De Vlinders van Nederland. Microlepidoptera.* Leiden: E. J. Brill. 1196pp, 14 pl.

Spuler, A.

1913. *Die sogenannten Kleinschmetterlinge Europas.* Stuttgart: E. Schweizerbart'sche Verlag. 523pp, 10 pl.

Stainton, H. T.

1865. *The Natural History of the Tineina. Vol. IX. Gelechia. Part I.* London: J. van Voorst. 276pp, 8 pl.

Tilden, J. W.

1951. Microlepidoptera associated with *Baccharis pilularis*. II. Tortricidae, Phaloniidae, Gelechiidae. *Wasmann J. Biol.* (San Francisco), 9:239-254.

Treitschke, F.

1833. Schaben. *In* F. Ochsenheimer, *Die Schmetterlinge von Europa*. Band 9. Leipzig: E. Fleischer. 262pp.

Turner, A. J.

1919. The Australian Gelechianae. *Proc. Roy. Soc. Queensld.* (Brisbane), 31: 108-172.

Walsingham, T. de G.

1897. Revision of the West Indian Micro-lepidoptera, with descriptions of new species. *Proc. Zool. Soc. London*, 1897:54-182.

APPENDIX 1. List of Described Gnorimoschemini in California

GELECHIID TAXA	TYPE LOCALITY	SOURCE
Gnorimoschema Busck, 1900		
saphirinella (Chambers, 1875)	unstated	Pov. & Powell 2001
vastificum Braun, 1929	Saskatchewan	Pov. & Powell 2001
tenerum Povolný & Powell, 2001	San Bruno Mt., San Mateo Co.	
aterrimum Povolný & Powell, 2001	San Bruno Mt., San Mateo Co.	
debenedictisi Povolný & Powell, 2001	San Bruno Mt., San Mateo Co.	
stigmaticum Povolný & Powell, 2001	Santa Catalina I.	
coquillettella Busck, 1902	Los Angeles	
ericameriae Keifer, 1933	San Francisco	
ericoidesi Povolný & Powell, 2001	Dune Lakes, SLO Co.	
octomaculellum (Chambers, 1875)	CO	Busck 1903
grindeliae Povolný & Powell, 2001	Pt. Richmond, C. Costa Co.	
crypticum Povolný & Powell, 2001	Big Creek, Monterey Co.	
baccharisella Busck, 1903	Berkeley	
baccharisellodes Pov. & Powell, 2001	Oso Flaco Lk., SLO Co.	
siskiouense Povolný, 1985	"Mt. Siskiou Co., Cal" [Mt. Shasta, Siskiyou Co.]	
subterraneum Busck, 1911	MA	Pov. & Powell 2001
powelli Povolný, 1998c	La Mesa, San Diego Co.	
Neoschema Povolný, 1967		
klotsi (Povolný, 1967)	Mono Lake	
Phthorimaea Meyrick, 1902		
operculella (Zeller, 1873)	TX	Essig, 1926 [introduced]
Symmetrischema Povolný, 1967		
striatellum (Murtfeldt, 1900)	MO	Busck 1903 [introduced?]
tangolias (Gyen, 1913)	Chile	Barrett 1932 [introduced]
plaesiosema (Turner, 1919)	Australia	
Keiferia Busck, 1939		
Tildenia Povolný, 1967		
lycopersicella (Walsingham, 1897)	St. Croix	Essig 1926 [introduced]
elmorei (Keifer, 1936)	Phoenix Lk., Marin Co.	
altisolani (Keifer, 1937)	Ebbetts Pass, Alpine Co.	
Scrobipalpulopsis Povolný, 1987		
lutescella (Clarke, 1934)	WA	Pov. & Powell 2001
lycii Povolný, 2001	San Clemente I.	
Scrobipalpula Povolný, 1964		
henshawiella (Busck, 1903)	CO	Busck, 1912
potentella (Keifer, 1936)	San Francisco	
psilella (Herrich-Schaf., 1853)	Europe	Pov. & Powell 2001
gutierreziae Pov. & Powell, 2001	Antioch, C. Costa Co.	
antiochia Povolný & Powell, 2001	Antioch, C. Costa Co.	
n. sp.? [Chrysopsis]	San Bruno Mt., San Mateo Co.	
Tuta Strand, 1910		
chiquitella (Busck, 1910)	NM	Pov. & Powell 2001
chiquitelloides Povolný, 2001	San Clemente I.	
insularis Povolný, 2001	Santa Catalina I.	
isolata Povolný, 2000	Zzyzx Spr., San Berdo. Co.	
spinosa Povolný, 2000	Eureka Dunes, Inyo Co.	
totalis Povolný, 2000	Tuttle Cr., Inyo Co.	
truncata Povolný, 2000	Surprise Can., Inyo Co.	
Euscrobipalpa Povolný, 1967		
artemisiella (Treitschke, 1833)	Europe	Pov. & Powell 2001
atriplicella (F. v. R., 1839)	Europe	
chenopodiella (Busck, 1916)		Keifer 1931 [introduced]
atriplex (Busck, 1910)	San Berdo. Co.	

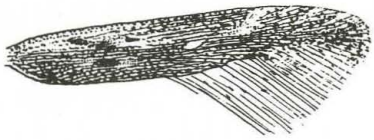
obsoletella (F. v. R., 1840)	Europe	Keifer 1937 [introduced]
miscitatella (Clarke, 1932)	WA	
instabilella (Douglas, 1846)	Europe	Pov. & Powell 2001 [introduced]
arenacearíella Pov. & Powell, 2001	Big Creek, Monterey Co.	
Nevadopalpa Povolný, 1998a		
alboaura Povolný, 1999a	Hungry Vy., L.A. Co.	
albula Povolný, 1998d	Red Rock Cyn., Kern Co.	
deaurata Povolný, 1999a	Tuttle Cr., Inyo Co.	
maculata Povolný, 1999a	Zzyzx Spr., San Berdo. Co.	
minor Povolný, 1998a	Red Rock Cyn., Kern Co.	
striata Povolný, 1998a	Devils Punchbowl, L.A. Co.	
Neopalpa Povolný, 1998		
neonata Povolný 1998b	Santa Catalina I.	
Microcraspedus Janse, 1958		
fontosus Povolný, 1999b	Saratoga Spr., San Berdo. Co.	
powelli Povolný, 1999b	Zzyzx Spr., San Berdo. Co.	
Eurysaccoides Povolný, 1998		
gallaespinosae Povolný, 1998b	Los Angeles Co.	
alternatus Povolný, 1998b	Big Pine, Inyo Co.	
Scrobipalpopsis Povolný, 1967		
arnicella (Clarke, 1942)	WA	Clarke 1942
madiae Povolný & Powell, 2001	Big Creek, Monterey Co.	
interposita Povolný & Powell, 2001	Briones Reservoir, C. Costa Co.	
tetradymiella (Busck, 1903)	Los Angeles	
Exceptia Povolný, 1967		
neopetrella (Keifer, 1936)	Alma, Santa Clara Co.	
sisterina Povolný & Powell, 2001	Big Creek, Monterey Co.	
Caryocolum Gregor & Povolný, 1954		
cassella (Walker, 1864)	"North America"	McCloud, Sisk. Co. [R.W. Hodges]
nearcticum Huemer, 1988	Sheep Rock, Sisk. Co.	
pullatella (Tengstrom, 1848)	Finland	White Mts. [ID Powell]

APPENDIX 2. Larval Hostplants Recorded for Gnorimoschemine Moths in California

PLANT TAXA	MOTH TAXA	SOURCE
ASTERACEAE:		
Acanthopappus sphaerocephalus (A. Gray)	Gnorimoschema coquillettella	present data
"	G. octomaculellum (Busck)	Busck 1903
Ambrosia chamissonis (Less.)	G. saphirinellum	present data
Ambrosia confertifolia DC	"	Goeden & Ricker 1975
Ambrosia psilostachya DC	"	Goeden & Ricker 1976
Anaphalis margaritacea (L.)	Scrobipalpula psilella	De Benedictis et al. 1990
"	Gnorimoschema tenerum	present data
Artemisia californica Less.	Scrobipalpopsis interposita	present data
Artemisia douglasiana Besser	Euscrobipalpa arenaceariella	present data
"	E. artemisiella	present data
Aster chilensis Nees	Gnorimoschema subterraneum	present data
Baccharis pilularis DC	G. baccharisella	Busck 1903; present data
Baccharis sarothroides A. Gray	G. powelli	Povolný 1998c
Chrysothamnus sp.	G. octomaculellum	UCB specimens, JAP 70F44
Ericameria arborescens (A. Gray)	G. coqillettella	Povolný 1967a
Ericameria ericoides (Less.)	G. ericameriae	Keifer 1933; present data
Ericameria linearifolia (DC)	G. coquillettella	present data
Ericameria pinifolia (A. Gray)	"	Busck 1903
Erigeron glaucus Kev-Gawler	G. debenedictisi	present data
Gnaphalium californicum DC	Scrobipalpula psilella	present data
Gnaphalium canescens DC	"	present data
G. canescens ssp. beneolens (Davidson)	"	present data
Gnaphalium stramineum (Kunth)	"	De Benedictis et al. 1990
[=G. chilense Spregel]		
Gnaphalium spp.	"	De Benedictis et al. 1990;present data
Grindelia hirsutula Hook. & Arn.	Gnorimoschema grindeliae	present data
Gutierrezia californica (DC)	Scrobipalpula gutierreziae	present data
Gutierrezia ?sarothrae (Pursh)	"	present data
Haplopappus (Hazardia)		
squarrosa (Hook. & Arn.)	Gnorimoschema crypticum	present data
Haplopappus (Isocoma)		
menziesii (Hook.& Arn.)	G. coquillettella	present data
[=veneta Kunth]		
menziesii var. vernonioides (Nutt.)	G. crypticum	present data
Heterotheca sessilifolia (Nutt.)	Scrobipalpula psilella "sp. B"	De Benedictis et al. 1990
[=Chrysopsis villosa auctt.]		
Madia madioides (Nutt.)	Scrobipalpopsis madiae	present data
Senecio douglasii (DC)	Scrobipalpula antiochia	present data
[S. flaccidus var. douglasii]		
Solidago canadensis L.	Gnorimoschema aterrimum	present data
Solidago spathulata DC	Gnorimoschema debenedictisi	present data
Tetradymia canescens DC	Scrobipalpopsis tetradymiella	Busck 1903
Tetradymia spinosa Hook & Arn.	Eurysaccoides gallaespinosae	Povolný 1998b
Tetradymia stenolepis E. Greene	Scrobipalpopsis tetradymiella	UCB specimens, JAP 77K6
CHENOPODIACEAE:		
Atriplex patula L	Tuta chiquitella	present data
Atriplex semibaccata R. Br.	"	present data
Chenopodium murale L.	Euscrobipalpa atriplicella	Keifer 1937
"	Euscrobipalpa obsoletella	Keifer 1937
Chenopodium sp.	Tuta chiquitella	present data
ROSACEAE:		
Horkelia californica Cham. & Schldl.	Scrobipalpula potentella	Keifer 1936a; present data
SALICACEAE:		
Salix sp.	Gnorimoschema vastificum	present data
SCROPHULARIACEAE:		
Castilleja affinis Hook. & Arn.	Scrobipalpulopsis lutescella	present data
Castilleja foliolosa Hook. & Arn.	"	present data
Castilleja wrighti Elmer	"	De Benedictis et al. 1990

SOLANACEAE:		
Datura stramonium L	Phthorimaea operculella	UCB specimens, JAP 61C14, 93L3
[misid. D. wrightii Regel =D. meteloides auctt.?]		
Lycopersicon esculentum L. (tomato)	Keiferia lycopersicella	Campbell & Elmore 1931, et al.
"	Phthorimaea operculella	Campbell & Elmore 1931
Solanum americanum Miller	Symmetrischema striatellum	present data
"	Symmetrischema tangolias	present data
Solanum douglasii Dunal	"	present data
Solanum furcatum Dunal	Symmetrischema striatellum	present data
Solanum nigrum L.	"	present data
Solanum nigrum L.	Symmetrischema tangolias	Keifer 1937
Solanum tuberosum L. (potato)	Keiferia lycopersicella	Keifer 1936b
Solanum tuberosum L. (potato)	Phthorimaea operculella	many authors
Solanum umbelliferum Eschsch.	Keiferia elmorei	Keifer 1936b; De Benedictis et al.1990
Solanum wallacei A. Gray	Symmetrischema striatellum	present data
Solanum wallacei var. clokeyi Munz	Keiferia elmorei	present data
Solanum xanti A. Gray	"	Keifer 1936a; present data
"	Keiferia altisolani	Keifer 1937; present data
"	Symmetrischema striatellum	present data
Solanum xanti var. hoffmannii Munz	Keiferia altisolani	present data

Fig. 10-27. Habitus sketches of California Gnorimoschemini forewings: **10,** *Gnorimoschema saphirinellum* (Chambers); **11,** *G. vastificum* Braun; **12,** *G. tenerum* Povolný & Powell; **13,** *G. aterrimum* Pov. & Powell; **14,** *G. coquillettella* Busck; **15,** *G. ericameriae* Keifer; **16,** *G. ericoidesi* Pov.& Powell; **17,** *G. stigmaticum* Pov. & Powell; **18,** *G. crypticum* Pov. & Powell; **19,** *G. baccharisella* Busck; **20,** *G. subterraneum* Busck; **21,** *Scrobipalpulopsis lycii* Povolný; **22,** *Scrobipalpula antiochiae* Pov. & Powell; **23,** *Tuta chiquitelloides* Povolný; **24,** *Tuta insularis* Povolný; **25,** *Euscrobipalpa instabilella* (Douglas); **26,** *Scrobipalpopsis madiae* Pov. & Powell; **27,** *S. interposita* Pov. & Powell.



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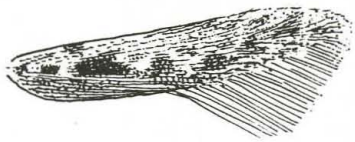

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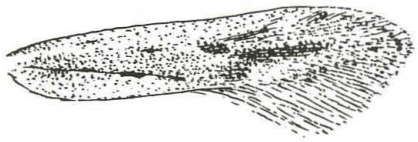

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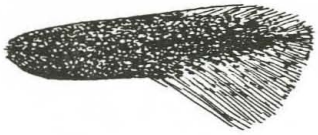

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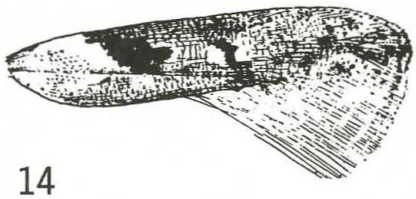

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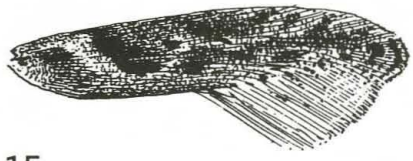

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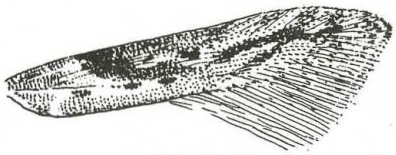

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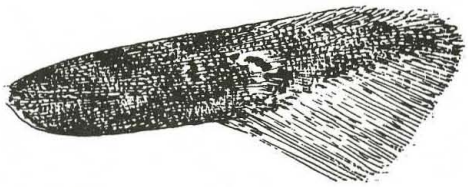

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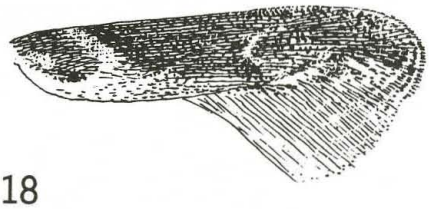

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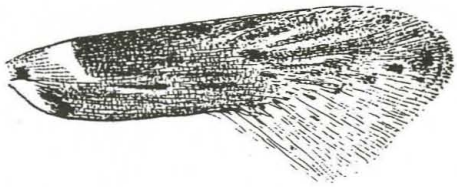

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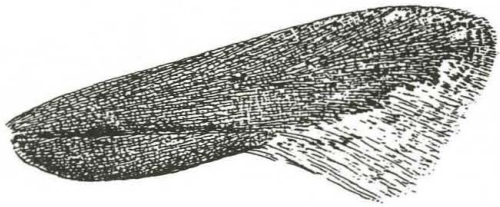

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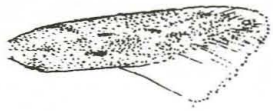

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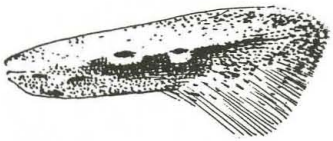

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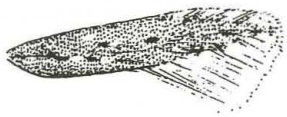

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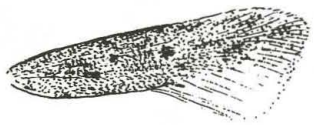

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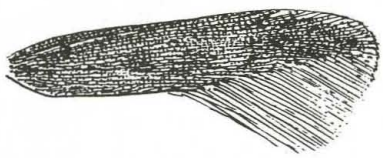

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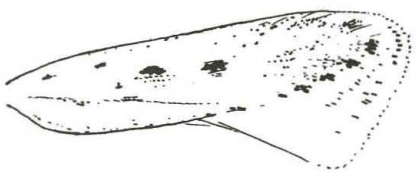

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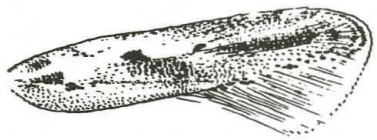

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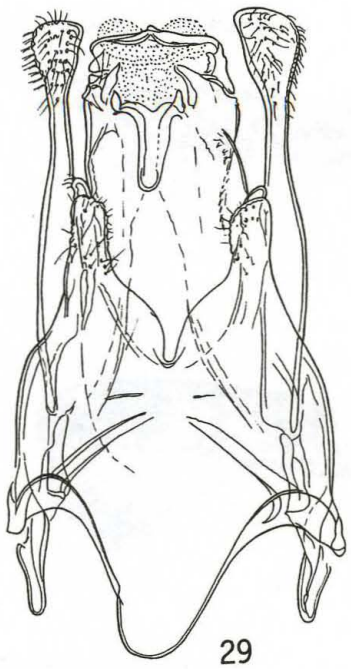

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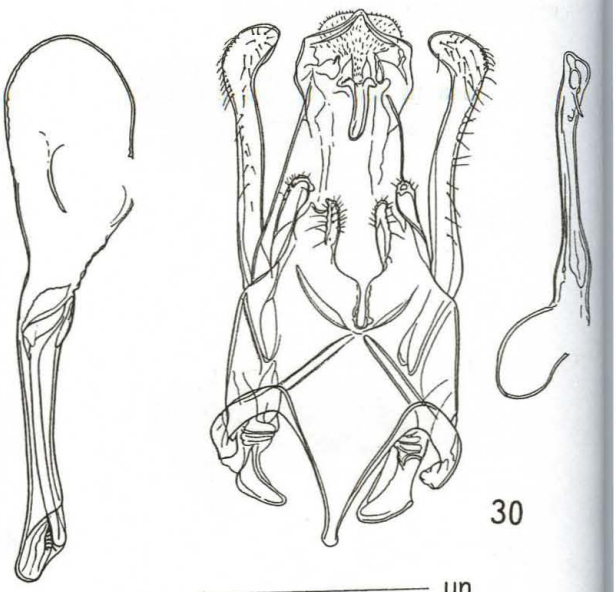

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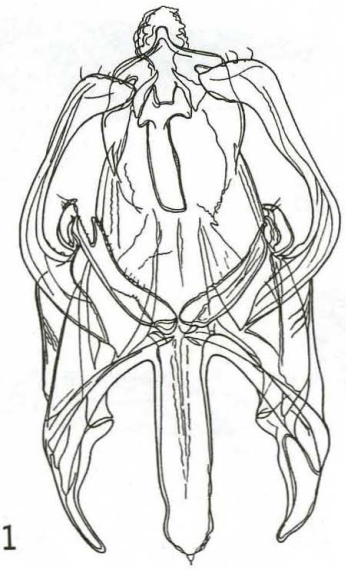

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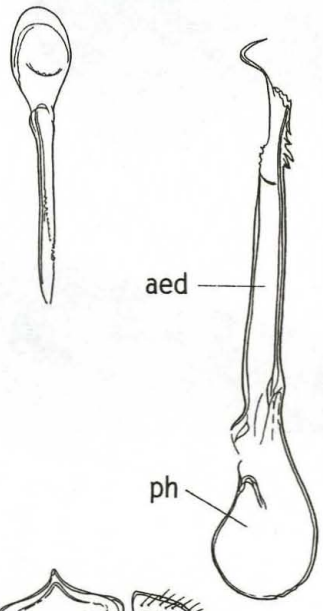

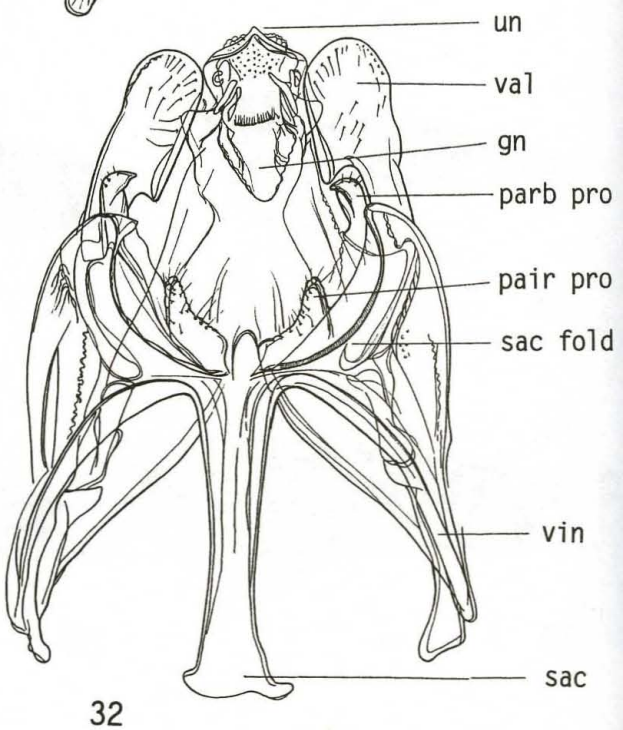

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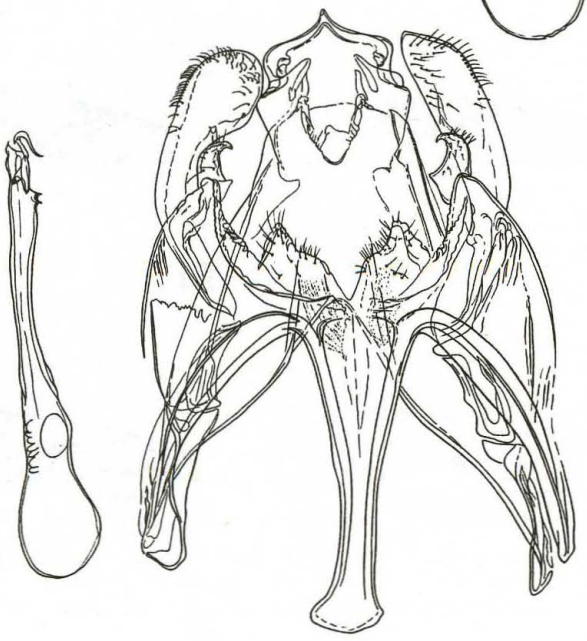

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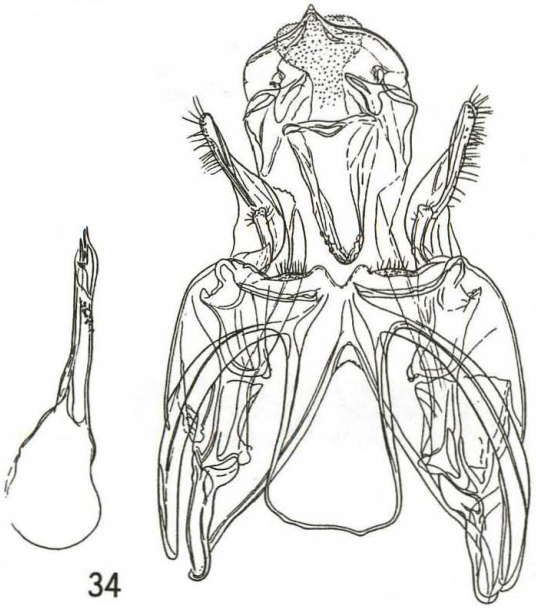

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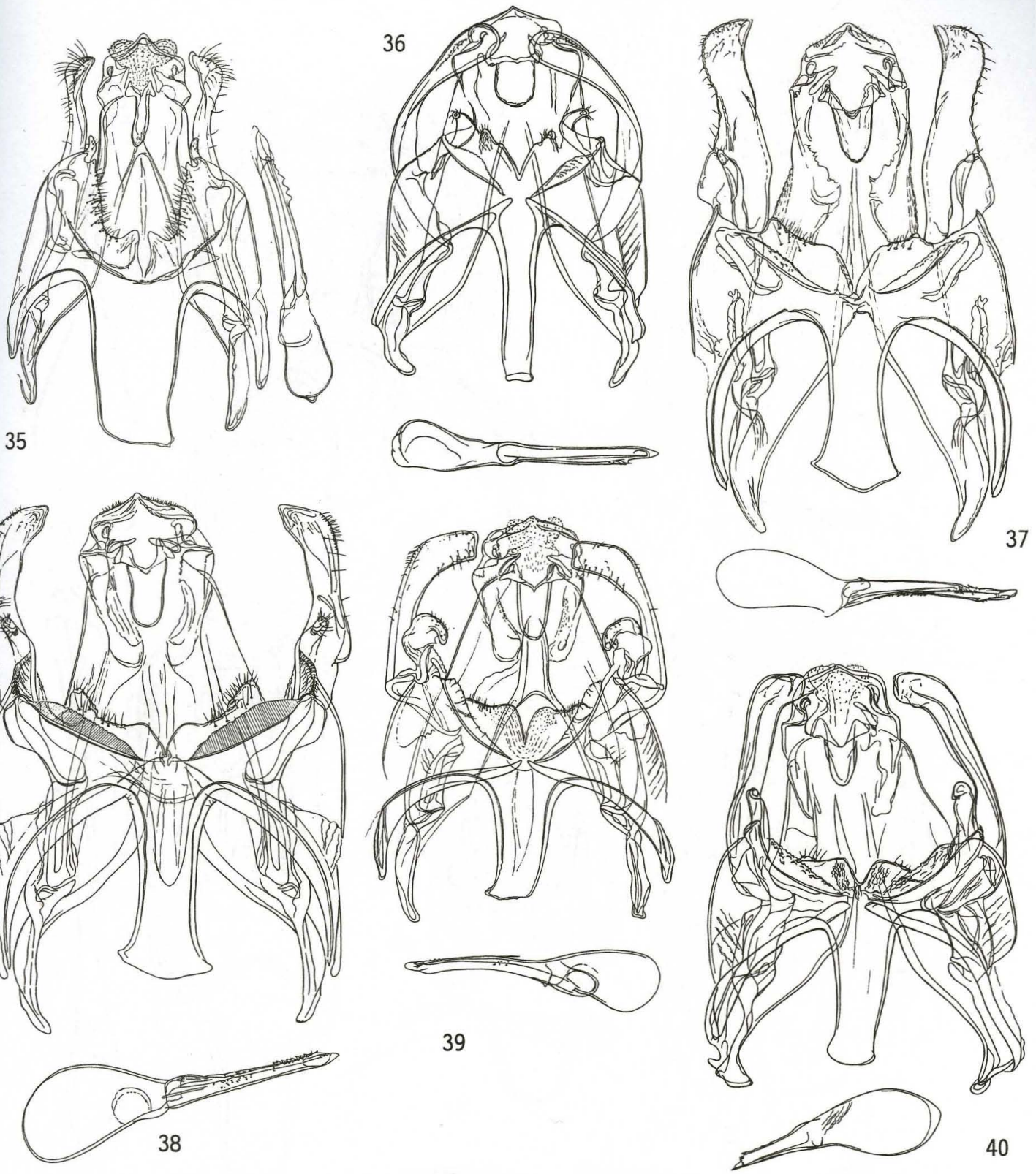

Fig. 35-40. Male genitalia of California *Gnorimoschema*, ventral aspect, aedeagus removed: **35,** *G. debenedictisi* Pov. & Powell; **36,** *G. stigmaticum* Pov.& Powell; **37, 38,** *G. grindeliae* Pov. & Powell; **39, 40,** *G. crypticum* Pov.& Powell.

Fig. 28-34. Male genitalia of California *Gnorimoschema*, ventral aspect, aedeagus removed: **28,** *G. saphirinellum* (Chambers); **29,** *G. vastificum* Braun; **30,** *G. tenerum* Pov. & Powell; **31,** *G. aterrimum* Pov. & Powell; **32,** *G. coquillettella* Busck; **33,** *G. ericameriae* Keifer; **34,** *G. ericoidesi* Pov. & Powell.
Abbreviations: **un=** uncus tip; **val=** valva; **gn=** gnathos; **parb pro=** parabasal process of valva; **pair pro=** paired process of sacculus; **sac fold=** saccular fold; **vin=** vinculum, lateral arm; **sac=** saccus; **aed=** aedeagus; **ph=** phallobase.

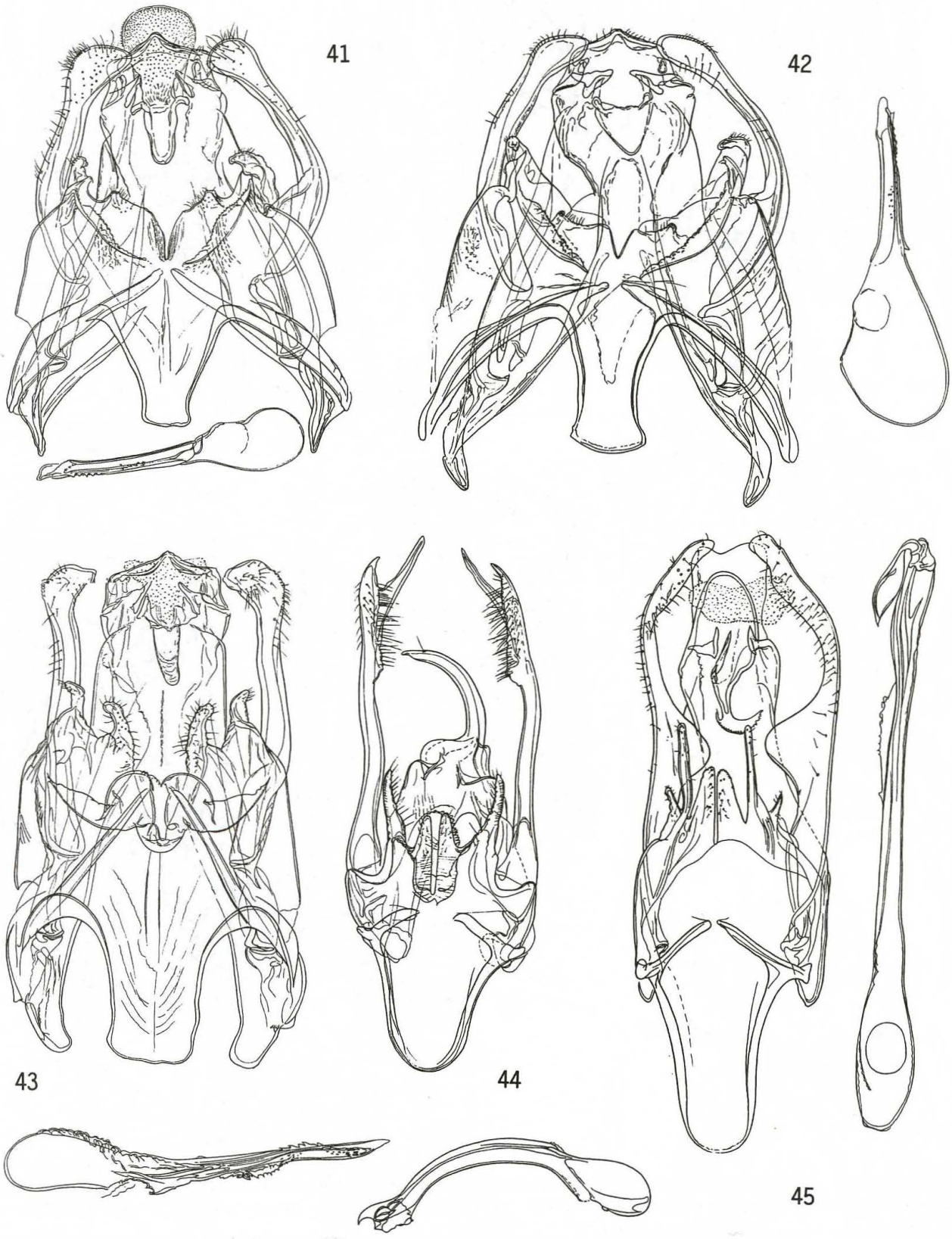

Fig. 41-45. Male genitalia of California Gnorimoschemini, ventral aspect, aedeagus removed: **41,** *Gnorimoschema baccharisella* Busck, aedeagus below; **42,** *G. bacchariselloides* Pov. & Powell; **43,** *G. subterraneum* Busck, aedeagus below; **44,** *Keiferia altisolani* (Keifer), aedeagus below; **45,** *Scrobipalpulopsis lutescella* (Clarke).

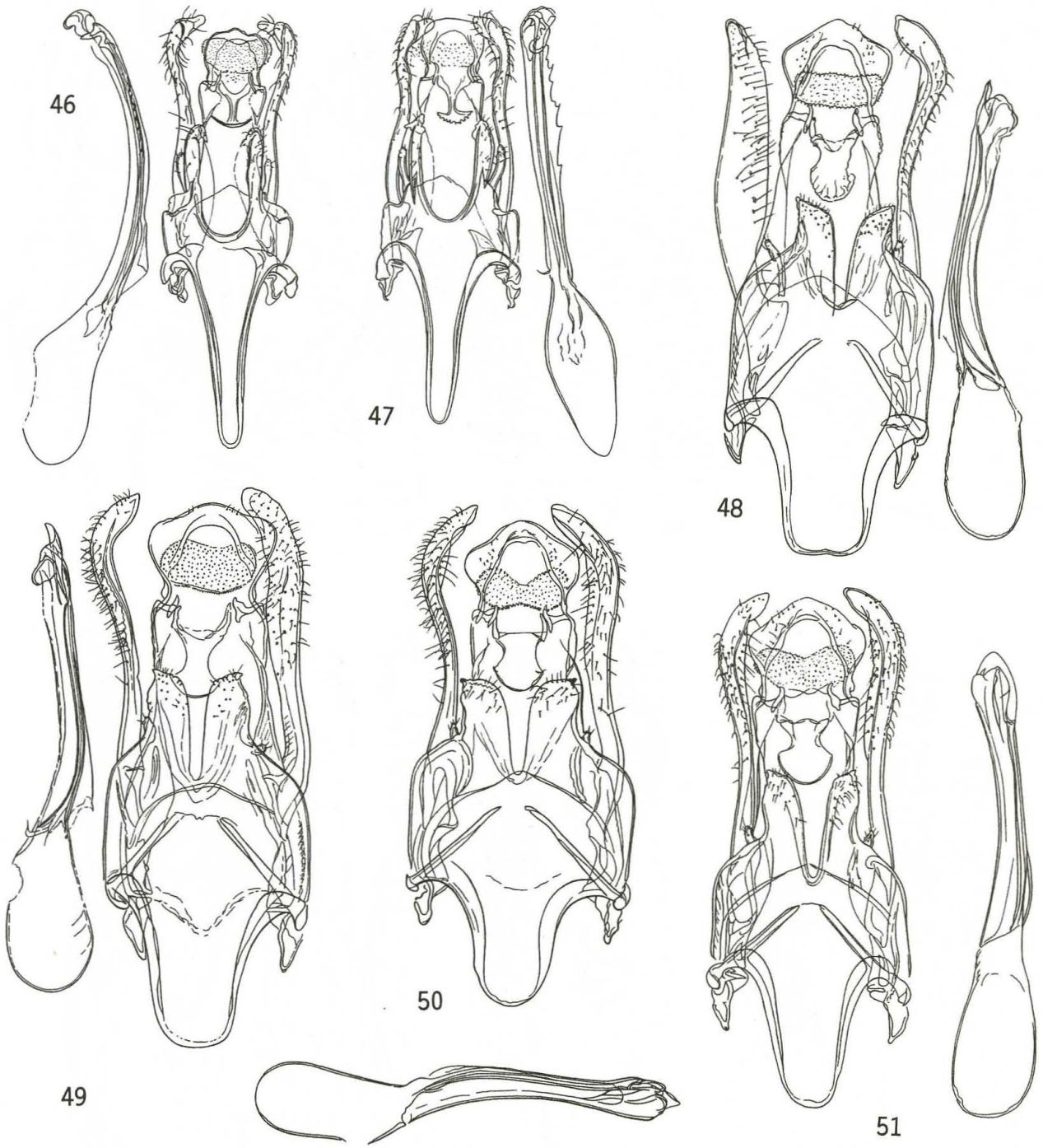

Fig. 46-51. Male genitalia of California Gnorimoschemini, ventral aspect, aedeagus removed: **46, 47,** *Scrobipalpulopsis lycii* Pov. & Powell; **48, 49, 50,** *Scrobipalpula psilella* (H.-S.) sens. lat.; **51,** *S. psilella* sens. lat., var. A, reared from *Heterotheca* (=*Chrysopsis*).

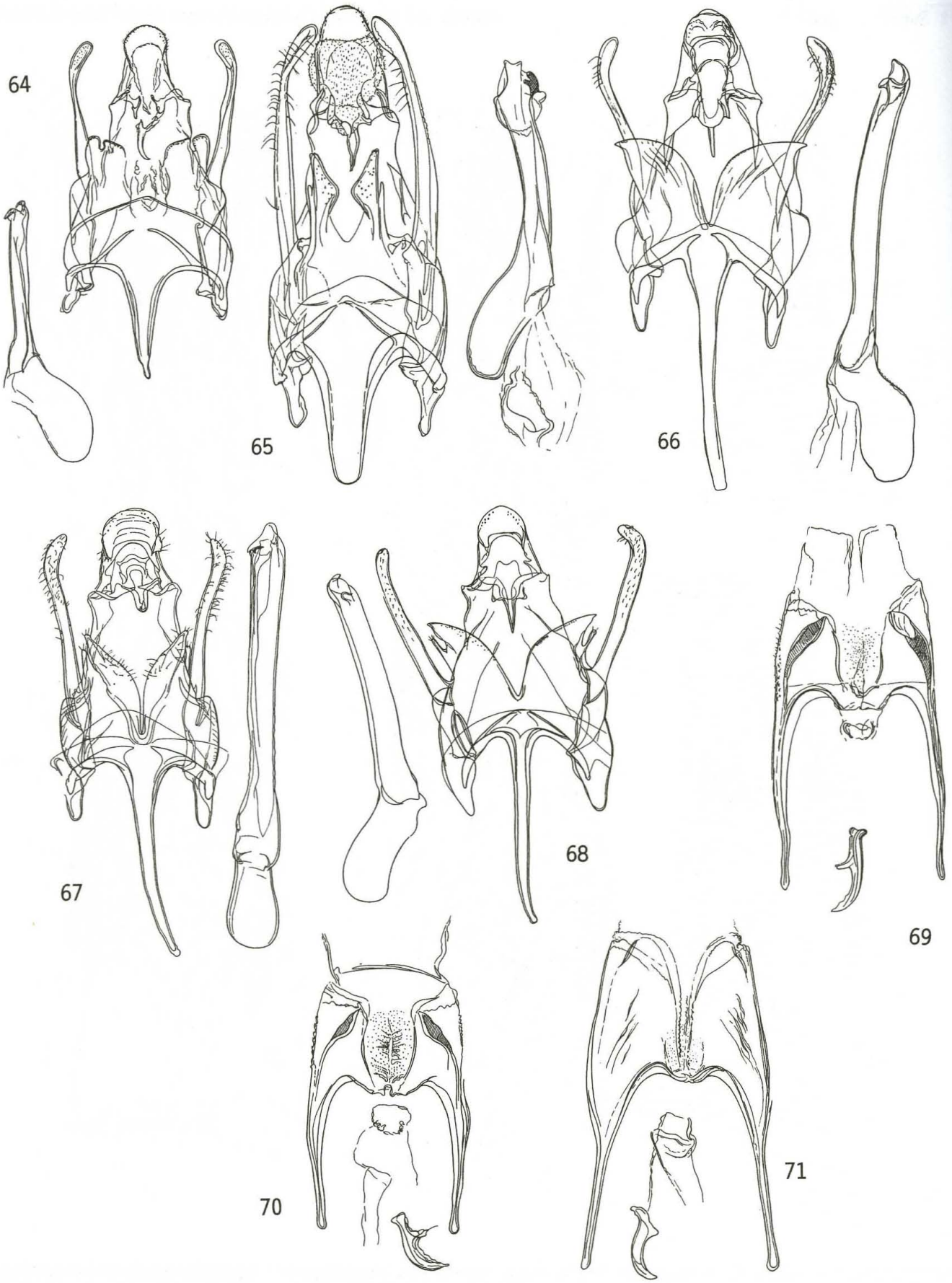

Fig. 64-68. Male genitalia of California Gnorimoschemini, ventral aspect, aedeagus removed: **64,** *Scrobipalpopsis madiae* Pov. & Powell; **65,** *S. interposita* Pov. & Powell; **66,** *Exceptia neopetrella* Keifer; **67, 68,** *E. sisterina* Pov.& Powell.

Fig. 69-71. Female genitalia of California *Gnorimoschema*, VIII abdominal segment + colliculum and signum: **69, 70,** *G. saphirinellum* (Chambers); **71,** *G. vastificum* Braun.

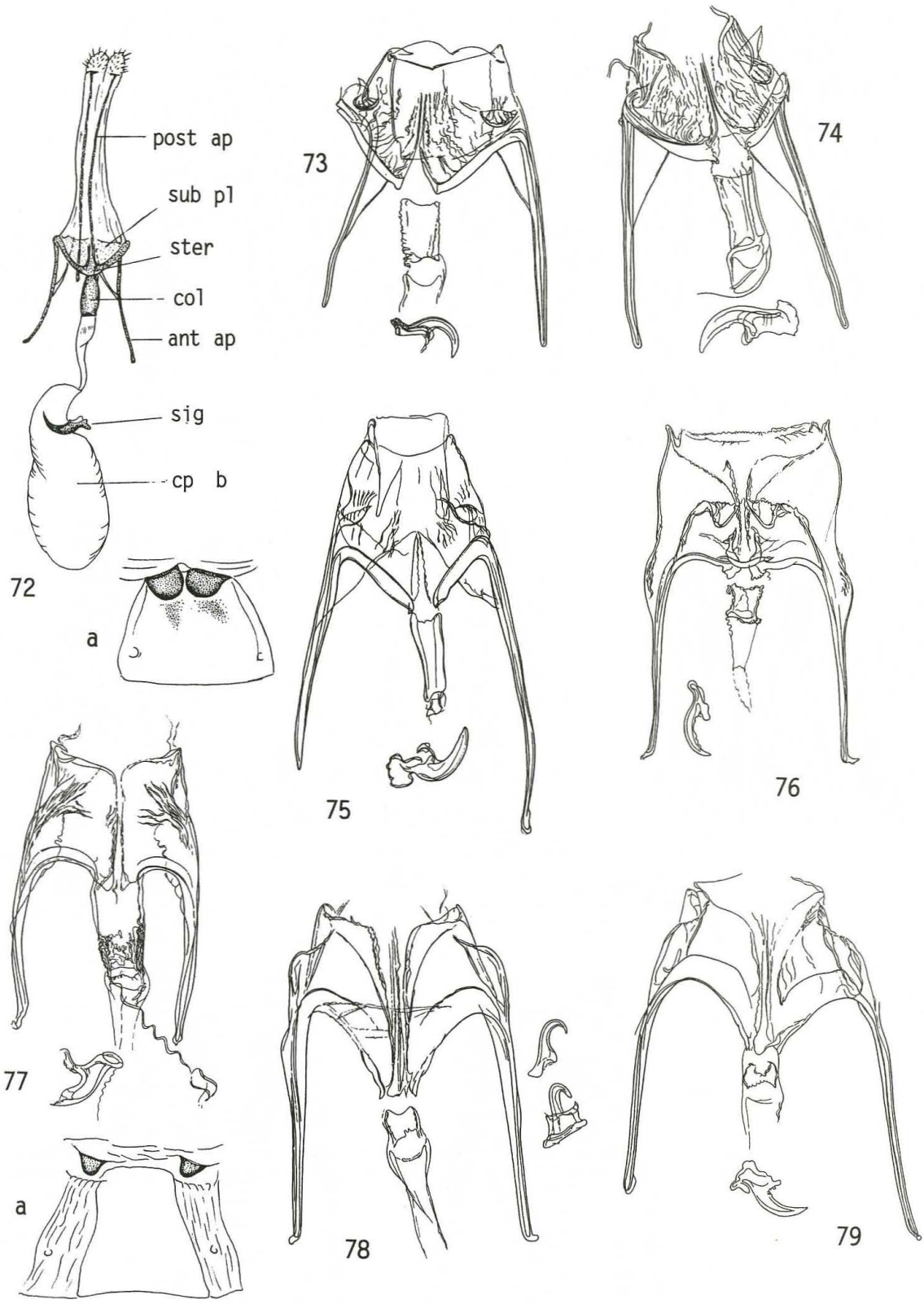

Fig. 72-79. Female genitalia of California *Gnorimoschema*, VIII abdominal segment + colliculum and signum: **72**, female genitalia of *Gnorimoschema ericameriae* Keifer, ventral aspect; and **72a,** VIII abd. tergum with pockets of VIII-IX intersegmental membrane shaded. Abbreviations: **post ap=** posterior apophyses; **sub pl=** subgenital plate; **ster=** sterigma; **col=** colliculum; **ant ap=** anterior apophyses; **sig=** signum; **cp b=** corpus bursae. Figs. 73-79, female genitalia of California *Gnorimoschema*, ventral aspect of VIII abd. segment + colliculum and signum: **73, 74,** *G. ericameriae*; **75,** *G. coquillettella* Busck; **76,** *G. ericoidesi* Pov.& Powell; **77,** *G. debenedictisi* Pov. & Powell, and **77a** VIII abd. tergum with pockets of VIII-IX intersegmental membrane shaded; **78,** *G. grindeliae* Pov. & Powell; **79,** *G. crypticum* Pov. & Powell.

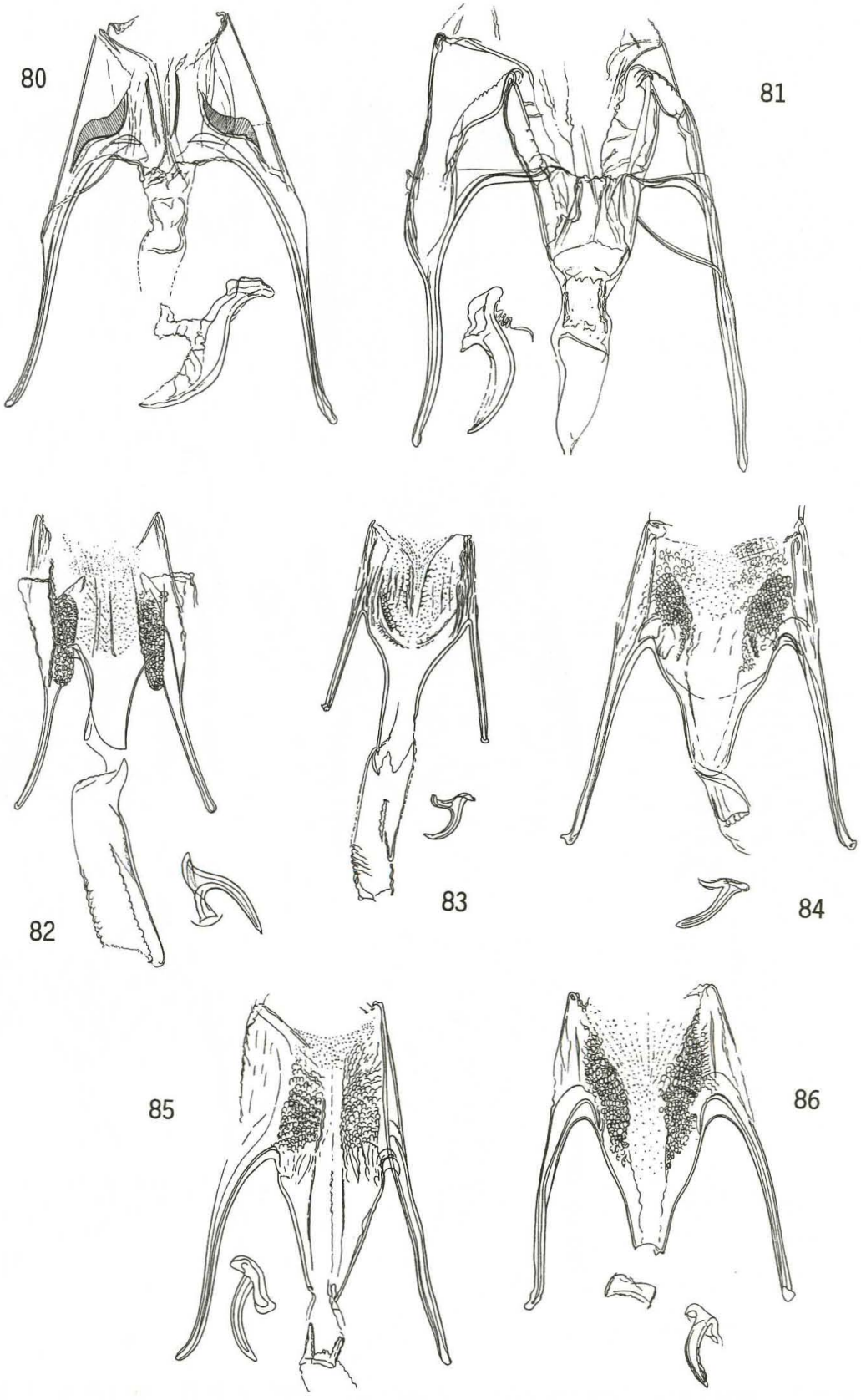

Fig. 80-86. Female genitalia of California Gnorimoschemini, ventral aspect of VIII abd. segment + colliculum and signum: **80,** *Gnorimoschema baccharisella* Busck; **81,** *G. subterraneum* Busck; **82,** *Scrobipalpulopsis lutescella* (Clarke); **83,** *S. lycii* Povolný; **84,** *Scrobipalpula psilella* (H.-S.) sens. lat.; **85,** *S. psilella* var. A from *Heterotheca* (=*Chrysopsis*); **86,** *S. antiochia* Pov.& Powell.

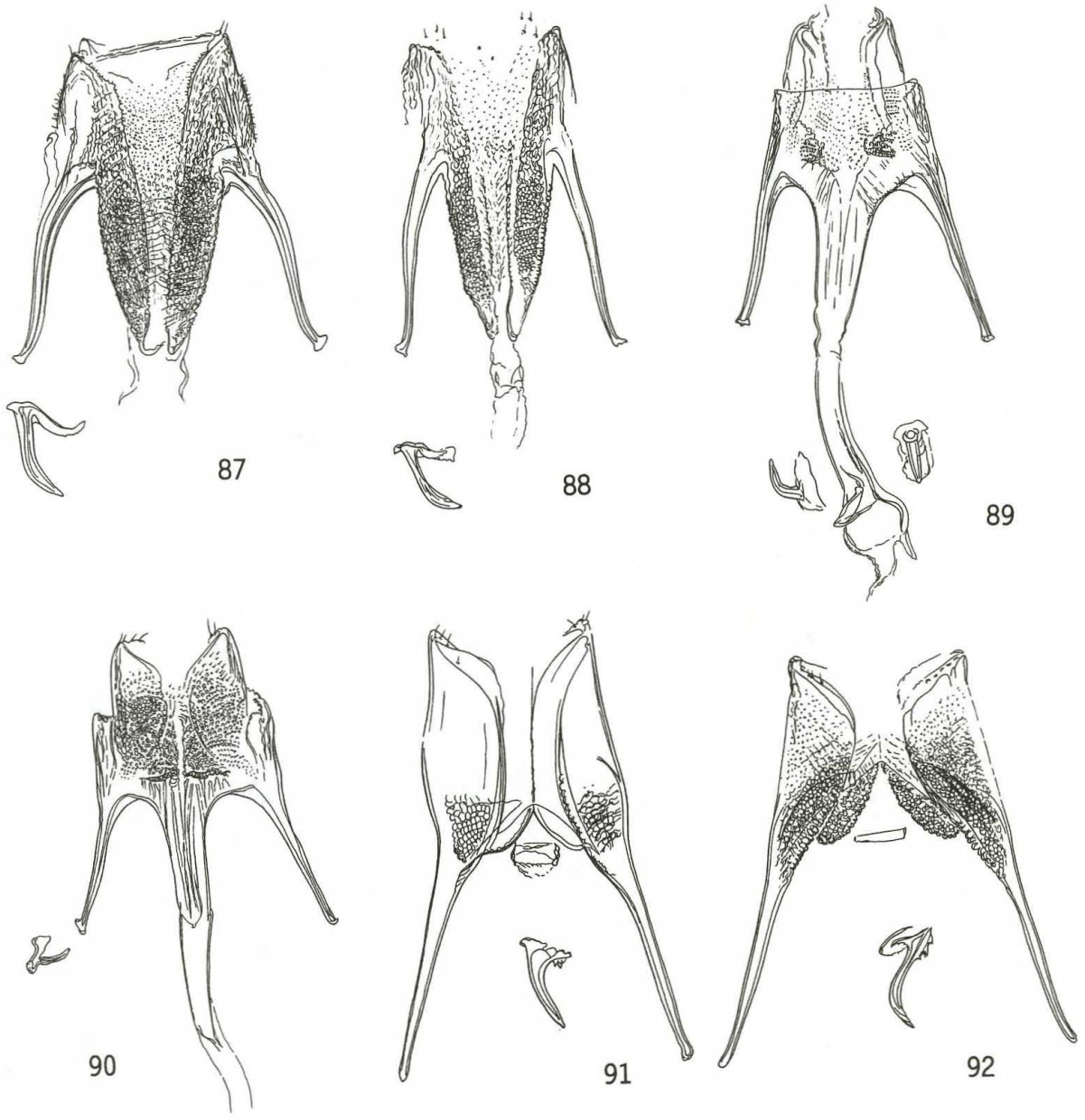

Fig. 87-92. Female genitalia of California Gnorimoschemini, ventral aspect of VIII abd. segment + colliculum and signum: **87, 88,** *Scrobipalpula gutierreziae* Pov. & Powell; **89,** *Tuta chiquitella* (Busck); **90,** *T. chiquitelloides* Povolny; **91,** *Euscrobipalpa artemisiella* (Tr.); **92,** *E. atriplicella* (F. v R.).

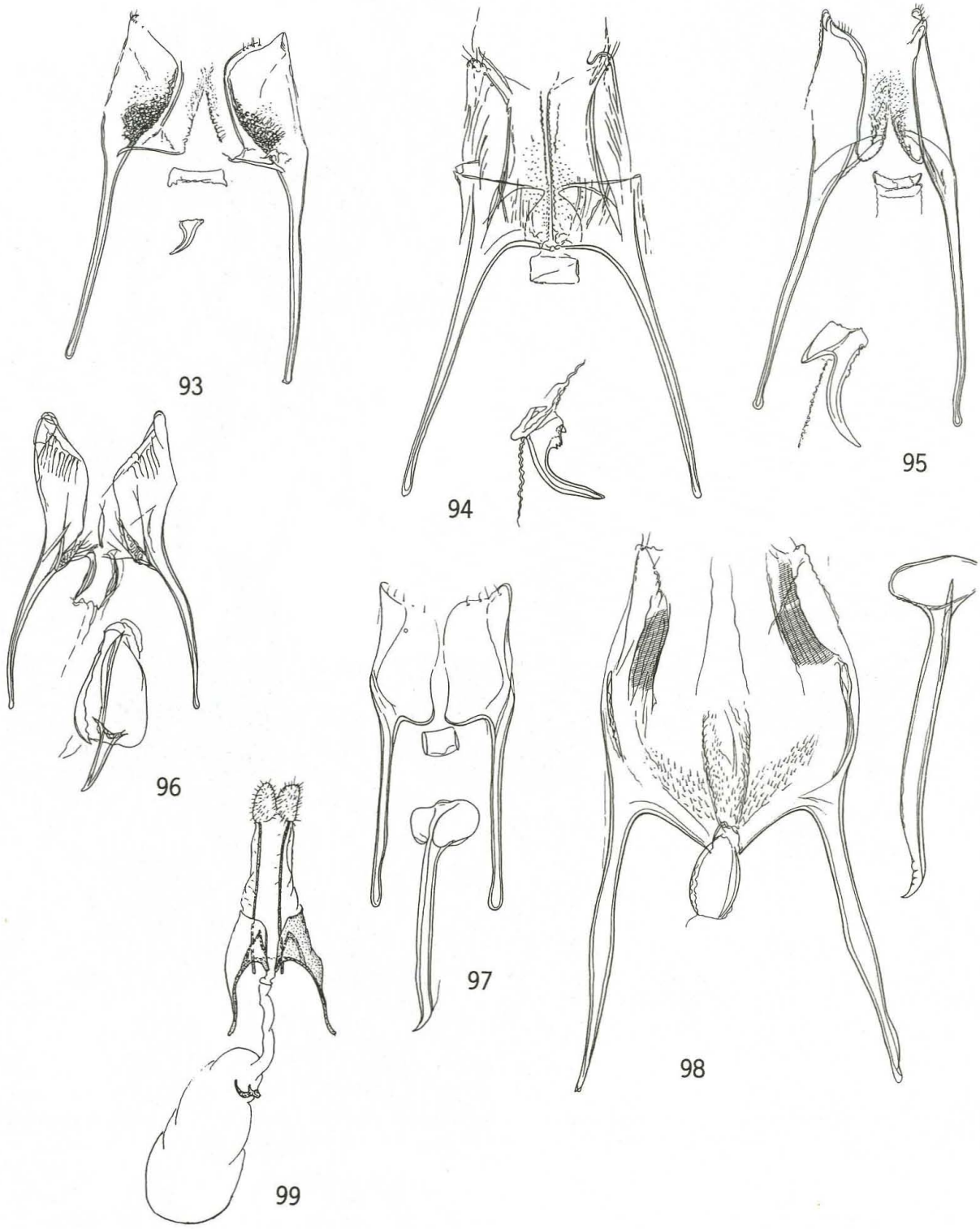

Fig. 93-98. Female genitalia of California Gnorimoschemini, ventral aspect of VIII abd. segment + colliculum and signum: **93,** *E. instabilella* (Douglas); **94,** *E. arenaceariella* Povolny & Powell; **95,** *E. obsoletella* (F. v R.); **96,** *Scrobipalpopsis interposita* Pov. & Powell; **97,** *Exceptia neopetrella* (Keifer); **98,** *E. sisterina* Pov. & Powell; **99**, *Gnorimoschema tenerum* Pov. & Powell.

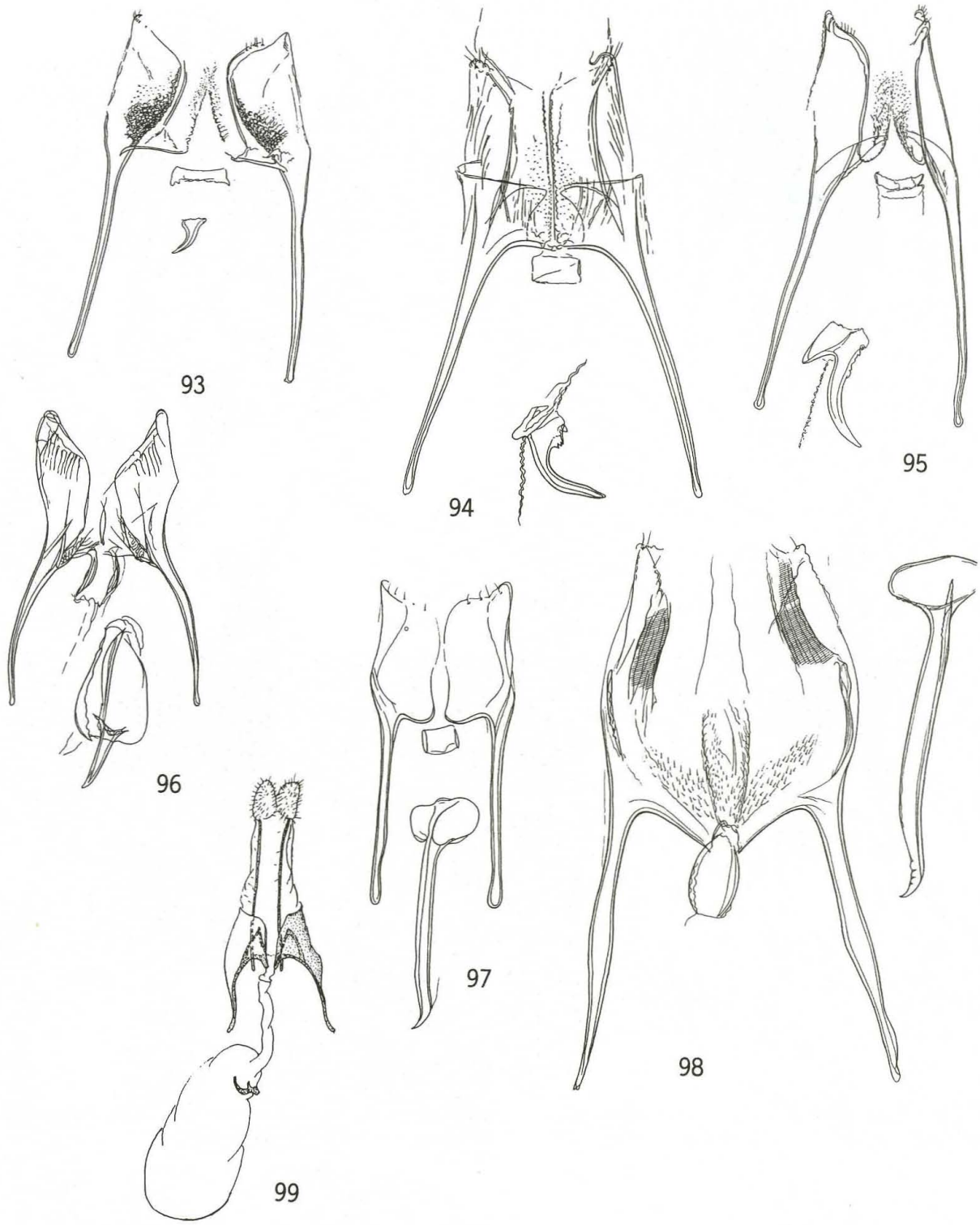

Fig. 93-98. Female genitalia of California Gnorimoschemini, ventral aspect of VIII abd. segment + colliculum and signum: **93,** *E. instabilella* (Douglas); **94,** *E. arenacearielle* Povolny & Powell; **95,** *E. obsoletella* (F. v R.); **96,** *Scrobipalpopsis interposita* Pov. & Powell; **97,** *Exceptia neopetrella* (Keifer); **98,** *E. sisterina* Pov. & Powell; **99**, *Gnorimoschema tenerum* Pov. & Powell.

Fig. 100-103. *Gnorimoschema* larval galls: **100,** *G. coquilletellum* tip gall, on *Ericameria linearifolia* (Asteraceae) (Del Puerto Cyn., Stanislaus Co., May 1975); **101,** *G. grindeliae* stem node gall, on *Grindelia hirsutula* (Asteraceae) (Pt. Molate, Contra Costa Co., April 1999); **102,** *G. subterraneum* stem gall, on *Aster chilensis* (Asteraceae) (Pt. Molate, Contra Costa Co., May 1988); **103,** *G. baccharisella* subterminal stem gall, on *Baccharis pilularis* (Asteraceae) (Albany Hill, Alameda Co., July 1998).

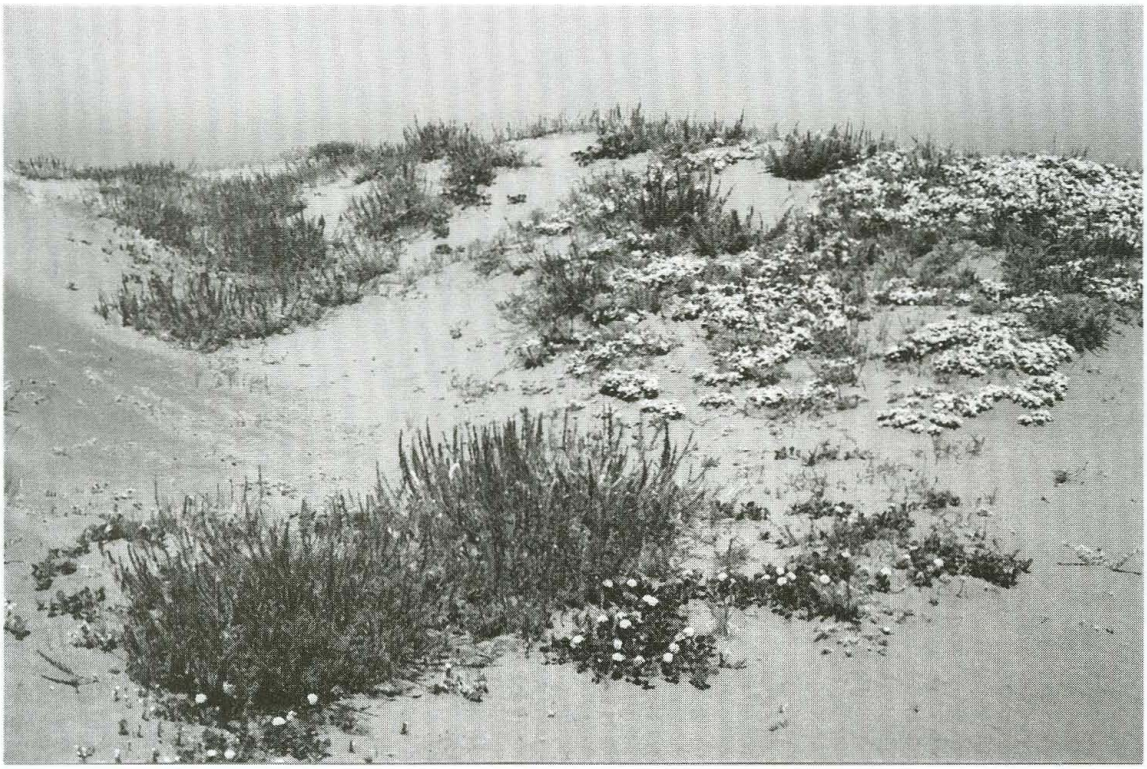

Fig. **104**. Gnorimoschemini habitat: McKerricher Beach, Mendocino Co. – 1976.
Typical foredune vegeation featuring three colonizer plants of open dunes: *Abronia latifolia* (Nyctaginaceae) in foreground with yellow flowers; *Artemisia pycnocephala* (Asteraceae) with erect inflorescences; and *Ambrosia chamissonis* (Asteraceae), with pale foliage, which is the host plant of *Gnorimoschema saphirinella*, larvae of which live in the shifting sand.

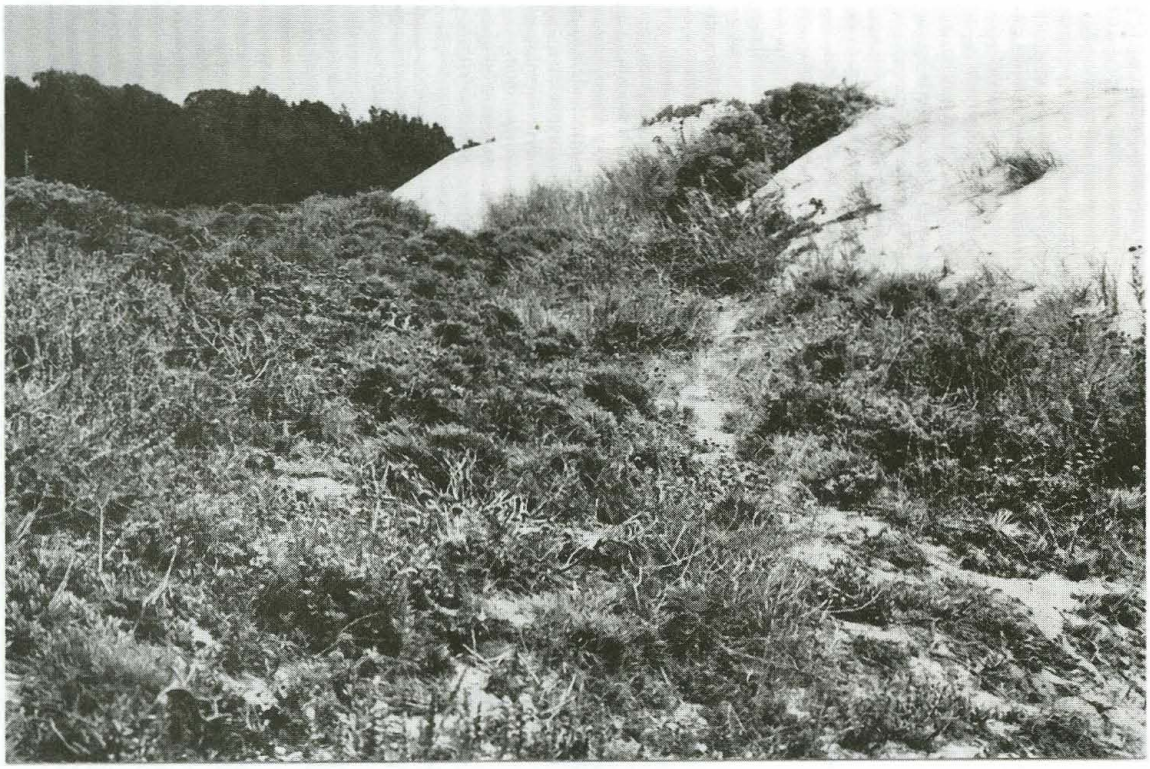

Fig. **105**. Gnorimoschemini habitat: Baker Beach, San Francisco – 1976
Coastal bluff with Coastal Scrub vegetation, stabilizing the dunes well above highest tide levels. Perennial plants include *Phacelia distans* (Hydrophyllaceae), *Dudleya* (Crassulaceae), *Eriogonum latifolium* (Polygonaceae), and *Ericameria ericoides* (Asteraceae), the host plant of *Gnorimoschema ericameriae*, which was described by Keifer in 1933 from San Francisco. Herbaceous vegetation in foreground includes *Castilleja latifolia* (Scrophulariaceae), the larval host of *Scrobipalpulopsis lutescella*. The unstabilized sand was kept active by foot traffic, which subsequently has been diverted to a raised wooden walkway by the National Park Service, and the habitat has stabilized completely, eliminating several plant species that are dependent upon active sand.

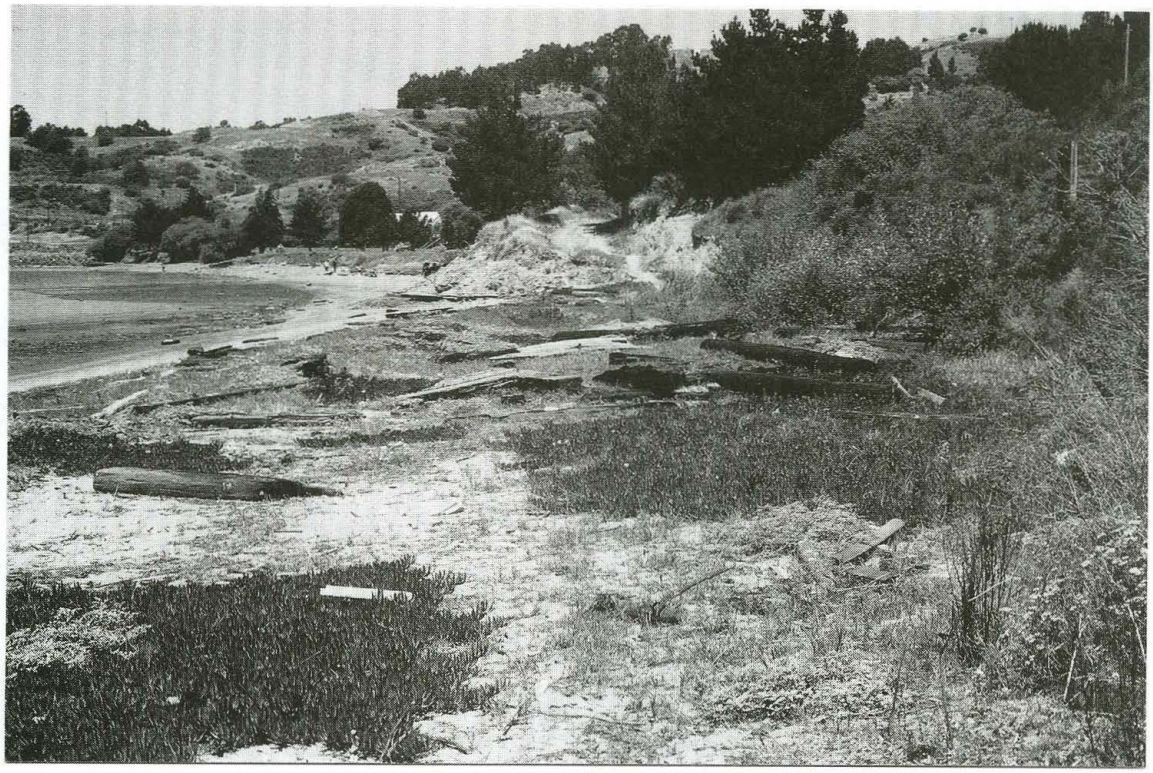

Fig. **106**. Gnorimoschemini habitat: Pt. Molate Beach, Contra Costa Co. – 1968
Weedy beach on the edge of San Francisco Bay, subject to rare tidal inundations and resists consummate spread of iceplant (*Mesembryanthemum*, Aizoaceae) (dark patches), which are no more intrusive 30 years later. Three species of gnorimoschemines live here: *Gnorimoschema saphirinellum*, on *Ambrosia*; *G. grindeliae*, on *Grindelia* (Asteraceae) on the sandstone bluff in background; and *Tuta chiquitella* on *Chenopodium* (Chenopodiaceae).

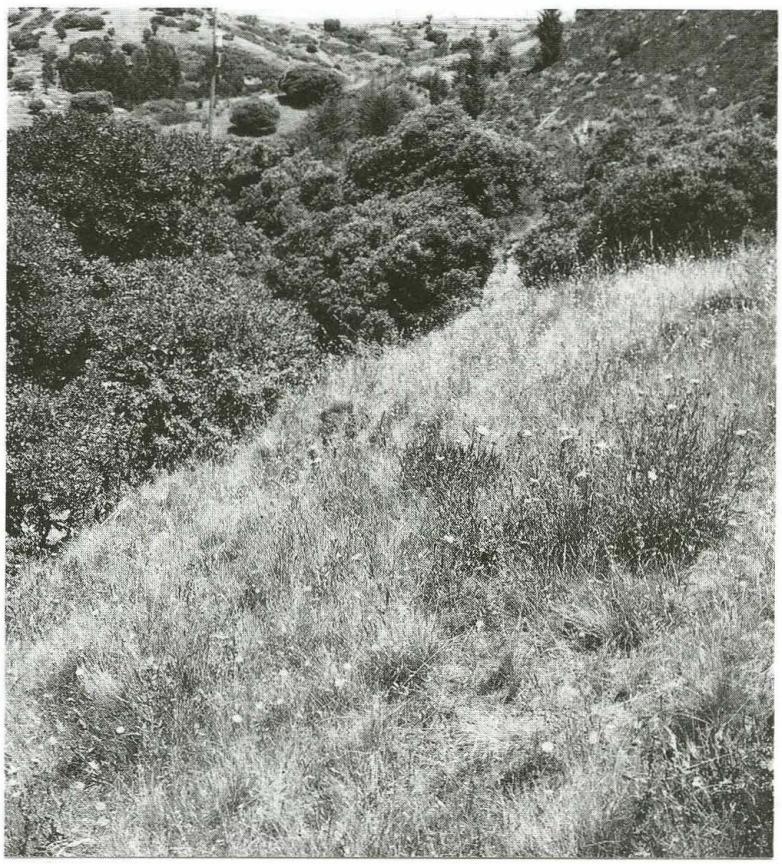

Fig. **107**. Gnorimoschemini habitat: Pt. Molate, Contra Costa Co. – 1968
Grassy bluff above bay margin with patches of *Grindelia hirsutula*, the host plant of *Gnorimoschema grindeliae,* at the site where this species was discovered in 1964. The land is property of the U.S. Navy, currently leased to the city of Richmond as a park. The nearby type locality at Pt. Richmond is administered as a Regional Park.

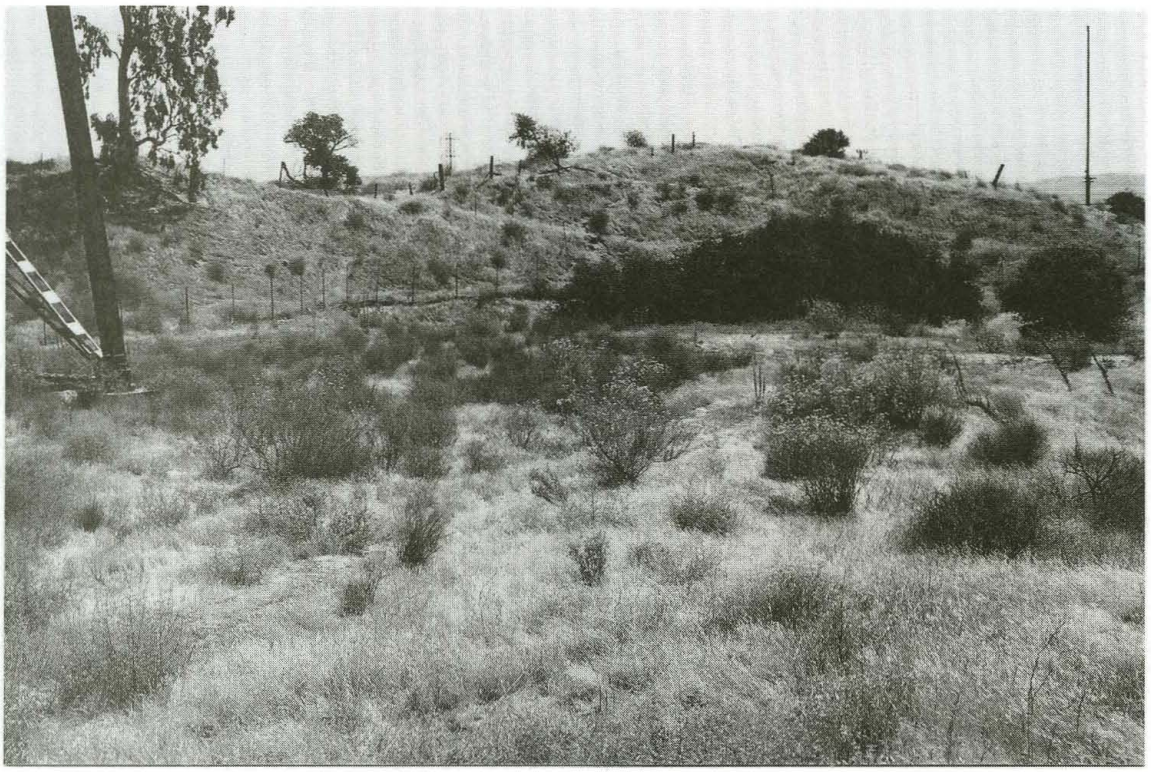

Fig. **108**. Gnorimoschemini habitat: Antioch, Contra Costa Co. – 1981
Weedy flat with scattered *Eriogonum nudum* (Polygonaceae), the host plant of the butterfly, *Apodemia mormo langei* (Riodinidae), a Federally Endangered Species; *Salsola tragus* (Chenopodiaceae); and *Senecio douglasii* (Asteraceae), the larval host of *Scrobipalpula antiochia*. The site was excavated from high riverine dunes in 1926 for construction of a power lines tower, now the property of Pacific Gas and Electric Co., adjacent to the Antioch National Wildlife Refuge.

Fig. **109**. Gnorimoschemini habitat: Antioch, Contra Costa Co. – 1978
Riverine bluff with patches of *Eriogonum nudum* (white flowers) and *Gutierrezia californica* (Asteraceae) (adjacent to fence), the host plant at the type locality of *Scrobipalpula gutierreziae*. This is a bluff cut from former high dunes for construction of a power lines tower in 1909 and also is property of Pacific Gas & Electric Co., situated between two parcels of the Antioch National Wildlife Refuge.

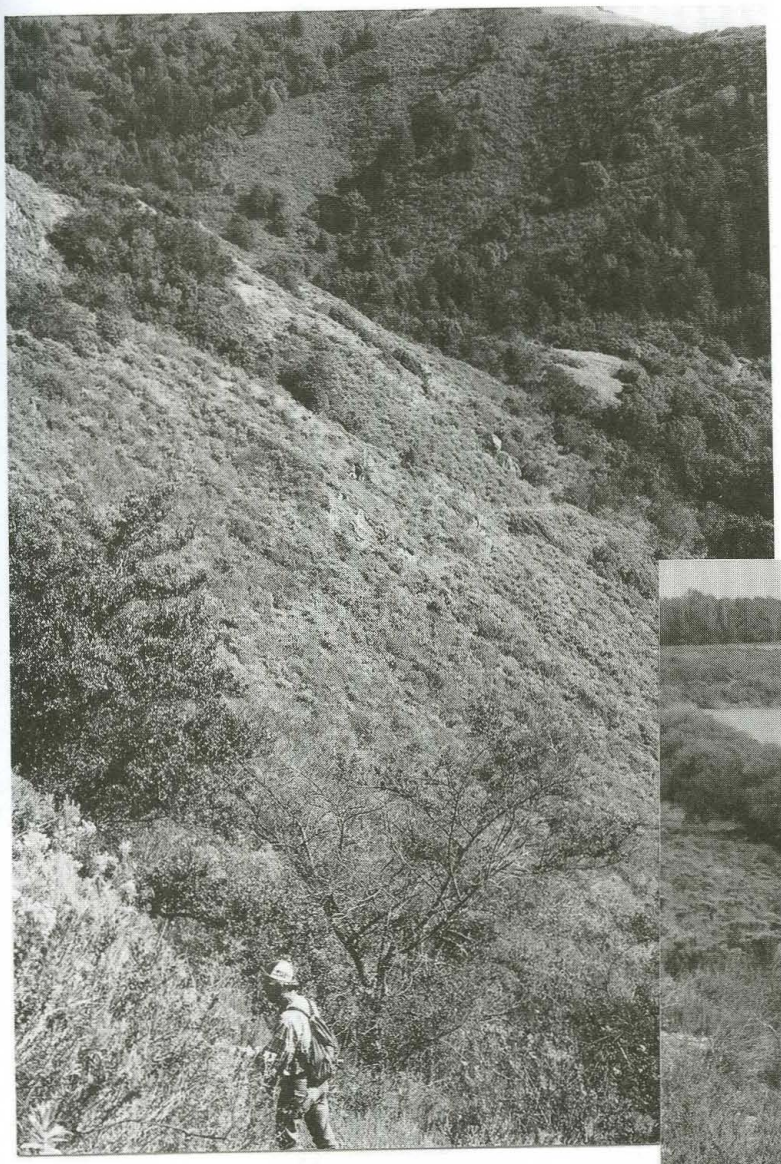

Fig. **110**. Gnorimoschemini habitat: Big Creek Reserve, U.C. Natural Reserve System, Monterey Co. – 1980
Coastal Sage Scrub on south facing slope a short distance inland from the ocean. This habitat is dominated by *Artemisia californica* (Asteraceae), the host of *Scrobipalpopsis interposita*. Red flowered plant between camera and the collector in foreground is *Castilleja latifolia*, the food plant of *Scrobipalpulopsis lutescella*. Eleven species of Gnorimoschemini occur at this locality.

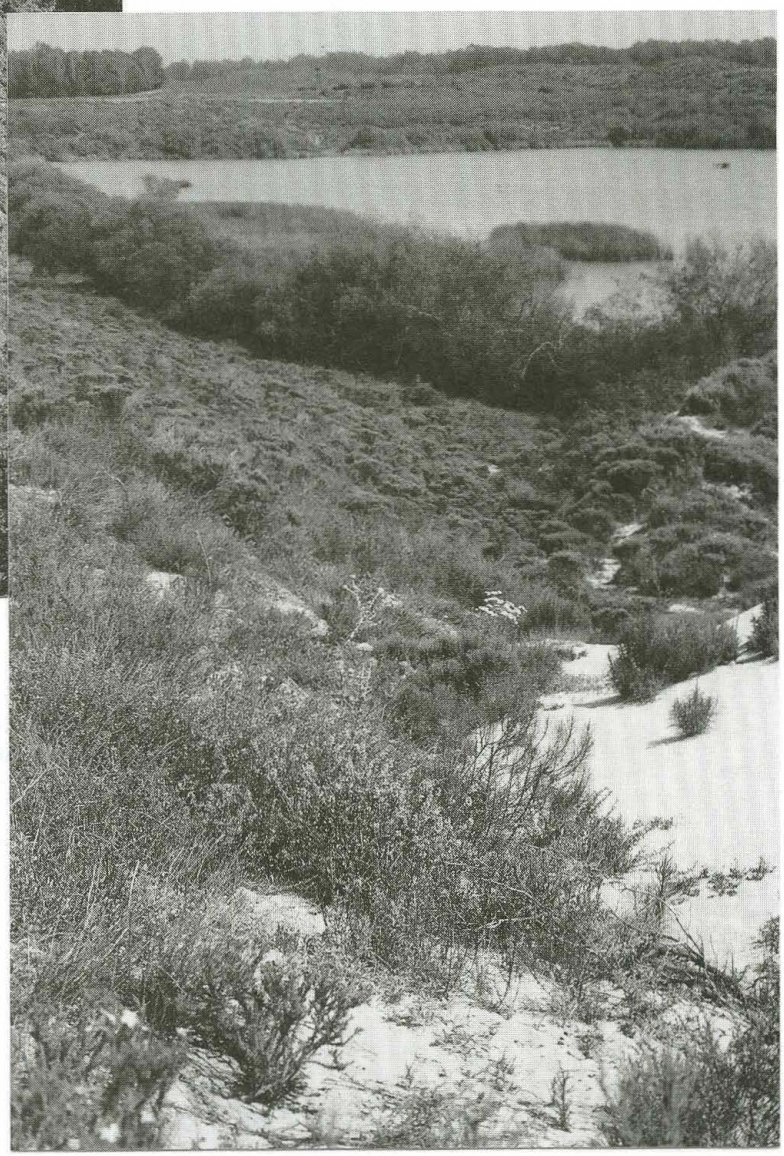

Fig. **111**. Gnorimoschemini habitat: Dune Lakes, San Luis Obispo Co. – 1972
Unstabilized dunes more than 1 km inland from the ocean meet stabilized deflation plain. Low shrubs in background towards lake are *Ericameria ericoides*, larval host plant of *Gnorimoschema ericameriae*. This is the type locality of *Areniscythris brachypteris* Powell (Scythrididae), the only known continental moth that is flightless in both sexes.

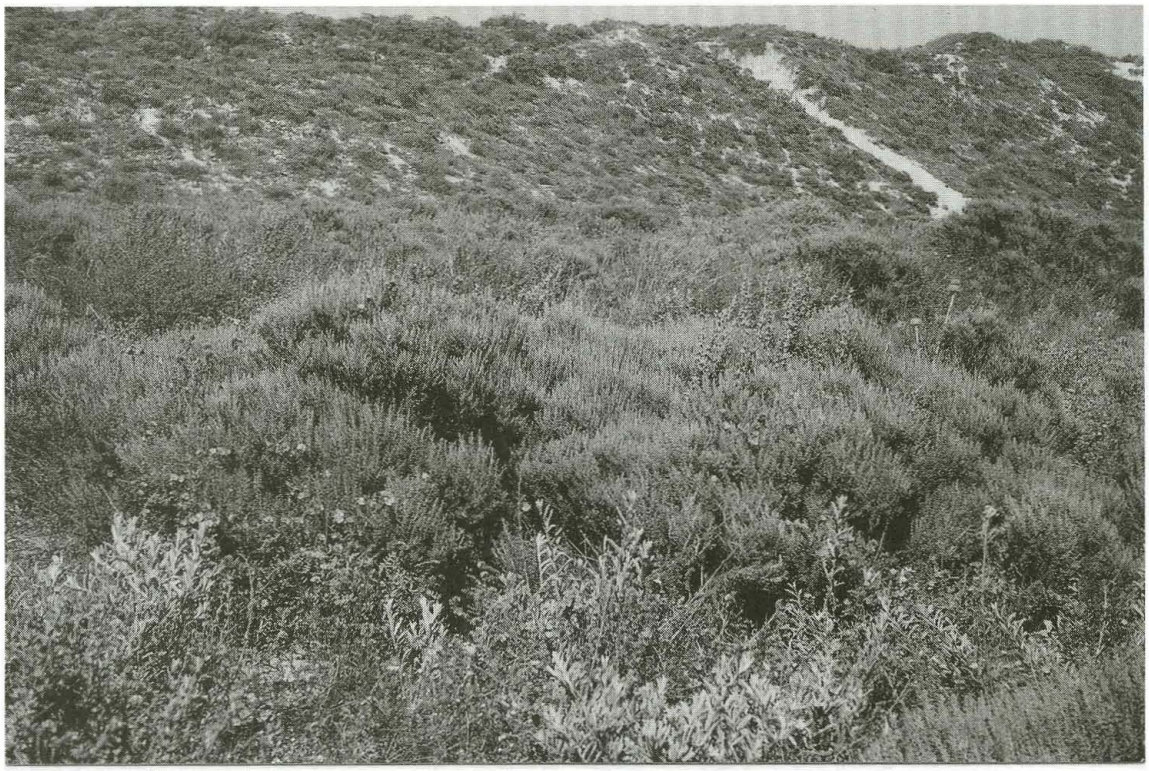

Fig. **112**. Gnorimoschemini habitat: Oso Flaco Lake, San Luis Obispo Co. – 1965
Stabilized Coastal Scrub dominated by *Ericameria ericoides*. This is the type locality of *Gnorimoschema ericoidesi*, which was collected here from 1965 to 1973.

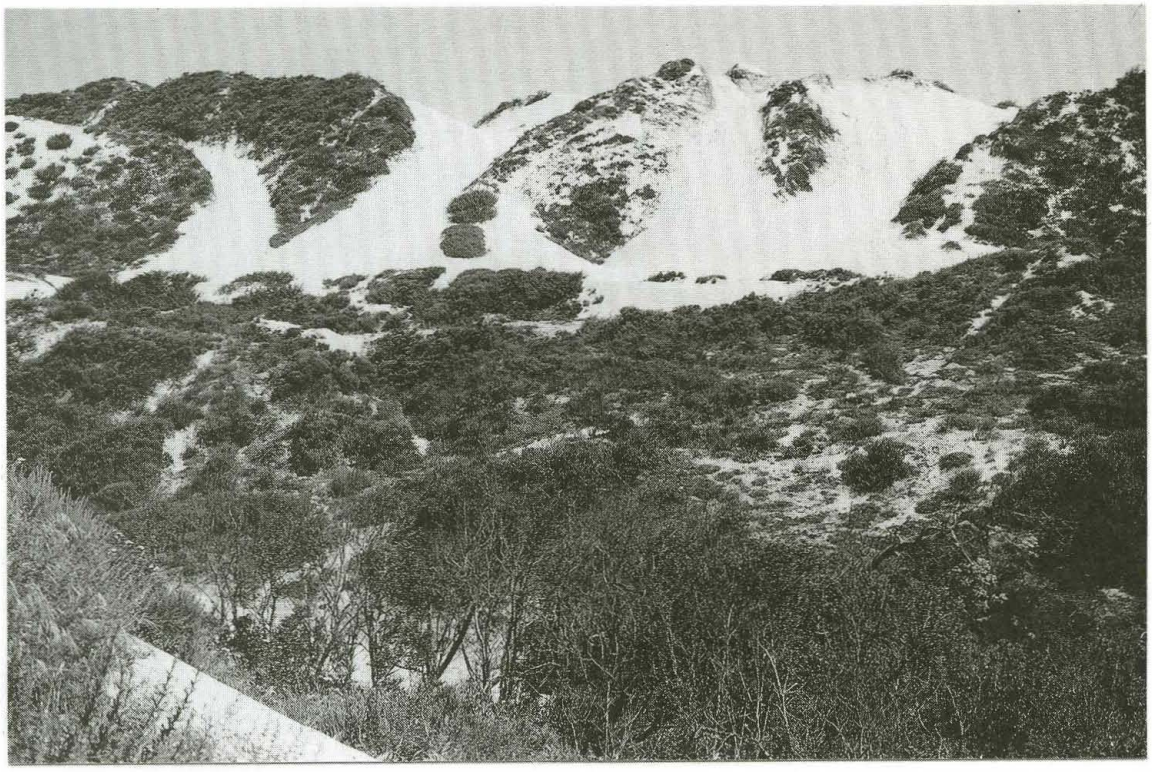

Fig. **113**. Gnorimoschemini habitat: Oso Flaco Lake, San Luis Obispo Co. – 1973
Same site as shown in Fig. 112, following several years of recreational Off-Road-Vehicle (ORV) activity (see Powell, 1981).

Fig. **114**. Gnorimoschemini habitat: Oso Flaco Lake, San Luis Obispo Co. – 1973
ORV enthusiasts' encampment, with the same sand ridge shown in Fig. 112-113 visible in background.

Fig. **115**. Gnorimoschemini habitat: Oso Flaco Lake, San Luis Obispo Co. – January 1984
Same site as shown in Fig. 112-113, following 12+ years of ORV activity. Administration of this locality was transferred from the County to The Nature Conservancy, and vegetation recovery efforts were initiated in 1982 (see Powell 1991). By 1995 an extensive, mainly unstabilized dune flora had developed. *G. ericoidesi* has not been observed since 1973.

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