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THREE ADDITIONAL *BACTRA* IN CALIFORNIA, ONE NATIVE BUT OVERLOOKED, ONE PROBABLY INTRODUCED, ONE NEW SPECIES (TORTRICIDAE)

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ABSTRACT. *Bactra maioriana* Heinrich, which was not recorded west of Utah previously, *B. priapeia* Heinrich, a Gulf Coast species believed to have been introduced into coastal southern California, and ***B. miwok***, new species (TL: China Camp, Marin Co.) are recorded. Diagnostic features for these and the two previously recorded species, *B. verutana* Zeller and *B. furfurana* (Haworth) are illustrated. Adults of *B. miwok* appear to be diurnal; early instar larvae mine leaves of *Cyperus* and presumably *Carex*.

Additional key words: Olethreutinae, range expansion.

Members of the genus *Bactra* Stephens (Tortricidae: Olethreutinae, Bactrini) are relatively narrow winged, mainly tan tortricids that resemble crambids when at rest. Larvae of several species in the Palaearctic, Nearctic, Hawaii, and India, feed in stems of *Carex*, *Cyperus*, *Scirpus* and other sedges (Cyperaceae), *Juncus* (rushes, Juncaceae), and *Typha* (cat-tails, Typhaceae) (Emmet 1979, Frick & Garcia 1975, Heinrich 1926, Fletcher 1932, Zimmerman 1978). There are more than 50 described species of *Bactra*, distributed primarily in pantropical and subtropical regions. Most of the species are both variable in forewing pattern and similar to one another, so that study of the genital structures is necessary to differentiate them. Diakonoff (1956, 1962, 1963, 1964, 1973) has illustrated most of the species with excellent, detailed drawings.

Parallel variation in forewing pattern was categorized and illustrated with photographs by Diakonoff (1962). The forewings show a complex pattern of pale and dark transverse markings ('fasciate type', considered by Diakonoff to be primitive and retained only in *B. furfurana*) or within a species often they are unicolorous tan or brown or may feature variable maculation ('maculate type') and/or a broad, dark dorsal half or median band from base to apex ('vittate type'). Most species display at least the unicolorous and vittate types.

Six species of *Bactra* occur in America north of Mexico, of which two have been recorded in California (Heinrich 1926, Diakonoff 1964):

Bactra verutana Zeller (TL: Dallas, TX) occurs throughout much of North America and is recorded in Puerto Rico, Paraguay, and South Africa (Diakonoff 1964). In California it is widespread at lower elevations, including coastal areas, Central Valley, and deserts (CAS, CDFA, LACM, UCB, UCD; see acknowledgements). The California race was designated as *chrysea* Heinrich (1926), but as pointed out by Diakonoff (1964), there is no justification in applying a subspecies name to any

subset of these variable populations. *B. verutana* often is numerous at lights and presumably is multivoltine (e.g., there are records for every month from April to December in the San Francisco East Bay area). Most collections have been made in July, August and September. The adults are small (male forewing length 5.6–8.4 mm, female 6.8–9.5 mm) and usually have a more or less unicolorous tan forewing or with reduced blackish maculation; a few exhibit the 'vittate type' pattern with a longitudinal dark streak. The genitalia of both sexes are diagnostic (Figs. 1, 6). The larvae feed in sedges, especially *Cyperus*, including weedy species, and the biology has been extensively studied in relation to possible biological control of nutsedges (Poinar 1964, Frick & Garcia 1975).

Bactra furfurana (Haworth) (TL: England) is a Holarctic species that also occurs widely in California but is more localized and less often encountered. Most of the records are more northern (North Coast, inland Mendocino Co., Sacramento Valley), although *B. furfurana* has been taken at La Jolla, San Diego Co. and Bishop, Inyo Co. (UCB). It appears to be absent from Lower Sonoran zones in the San Joaquin Valley and desert areas. The voltinism is not documented in California; collection records range from late April (Hopland Field Sta., Mendocino Co.) to mid July (Bishop), but there has not been seasonal monitoring at one locality. I have not seen *B. verutana* and *B. furfurana* occurring in close sympatry. The forewing, which is dark with variable pale markings ('fasciate type') and has a more acute apex, distinguishes *B. furfurana* from the other California species, as do the genitalia (Figs. 2, 7).

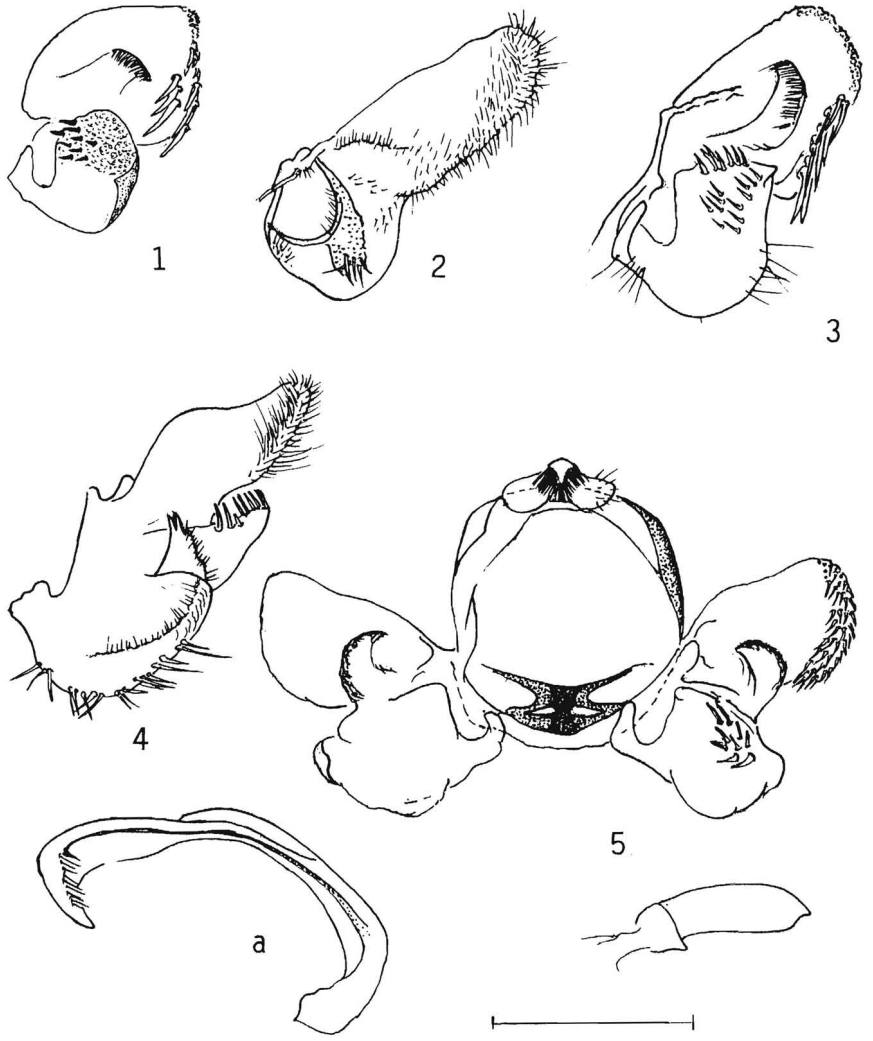
Three additional species have been confirmed as resident in California: *Bactra maioriana* Heinrich, which is a widespread but rarely collected, presumably native species; *B. priapeia* Heinrich, likely an introduced species in coastal southern California; and *B. miwok*, new species, the male of which has been known for 35 years, the female only recently.

Bactra maioriana Heinrich

Bactra maioriana, Heinrich 1923, Proc. Entomol. Soc. Washington, 25:105 (TL: VA).

This species is a widespread, apparently native, Nearctic insect. Diakonoff (1964) presented illustrations of the diagnostic genitalia and regarded *B. maioriana* to be distinct from any Old World species. The species is recorded in the Great Lakes region (Miller 1987) and westward to North Dakota (UCB) and Utah (Heinrich 1926). The larvae are reported to feed in stems of *Scirpus* and *Typha* (Heinrich 1926, Diakonoff 1964).

The Utah records, paratypes collected at Vineyard in 1914 and 1922, and Bear River Bay, Great Salt Lake (Braun 1925), are considered to represent native populations. No other western representatives were recognized until we took specimens at the Antioch National Wildlife Refuge, Contra Costa Co., Calif., in July 1990. At this site, both *Scirpus californicus* (C. Meyer) and *Typha latifolia* L. grow along the San Joaquin River. Because this is a shipping route, an introduction via cargo ships in recent times seemed to be a plausible explanation for the discovery of this disjunct population. During search of collections, however, I recovered additional records of *B. maioriana* from disparate parts of California. The widespread occurrence suggests that this species is native in the Pacific States but



FIGS. 1–5. Male genitalia of *Bactra* species. **1,** *B. vertutana* Z., valva, inner aspect (JAP prep. 6413, Bowman, Placer Co., Calif.); **2,** *B. furfurana* (Haw.), valva (redrawn from Diakonoff 1956, Europe); **3,** *B. maioriana* Heinr., valva (redrawn from Diakonoff 1964, paratype); **4,** *B. priapeia* Heinr., valva and **a,** aedeagus drawn to same scale (redrawn from Diakonoff 1964, holotype); **5,** *B. miwok* Powell, ventral aspect, aedeagus removed and shown dorsolateral aspect (holotype). [scale = 0.5 mm for Fig. 5].

has been overlooked, perhaps in part owing to its superficial similarity to the more abundant *B. verutana*. Individuals of *maioriana* tend to be larger (male 8.2 mm forewing length, female 8.5–10.5 mm in California examples) and darker colored, with a greater frequency of vittate type, but there is overlap in forewing phenotype. The two are sympatric at Antioch and Bundy Canyon, Riverside Co. Available records (Diakonoff 1964,

Miller 1987, present data) suggest a univoltine cycle, adults flying in late spring to early summer.

The male genitalia are similar to those of *B. verutana* and *B. miwok* (see diagnosis of latter, Figs. 1,3,5), while the female has distinctive, heavily sclerotized, rugose patches laterally in the VIII–IX intersegmental membrane (Fig. 8).

California data: Contra Costa Co.: Antioch National Wildlife Refuge, 1♂, 1♀ VII-10-90, at blacklight (Y.-F. Hsu & J. Powell, UCB) [JAP genit. preps. 6371, 6372]. Monterey Co.: Castroville, 1♀ VI-2-61 (W. H. Lange, UCD) [JAP prep. 6420]. Riverside Co.: Bundy Cyn. 1660', 9 mi. S Perris, 1♀ VII-20-76 (R. J. Ford, LACM) [JAP prep. 6405]. San Luis Obispo Co.: La Panza Campground, 12 mi. NE Pozo, 1♀ V-2-62 [at lights] (J. Powell, UCB) [JAP prep. 6449].

Bactra priapeia Heinrich

Bactra priapeia, Heinrich 1923, Proc. Entomol. Soc. Washington 25:105 (TL: LA).

This species has been recorded from Florida, Louisiana, the Gulf Coast of Texas, British Honduras, and Panama (Heinrich 1926, Diakonoff 1964). The adults are larger than any other North American *Bactra* (male 9.3 mm forewing length, female 10.1–10.9 in California examples), and the genitalia are markedly distinct in both sexes (Figs. 4, 9). Forewings of California specimens are pale, rusty, or dark tan without distinct markings, but maculate and vittate examples are reported by Diakonoff. The larval hostplant has not been recorded.

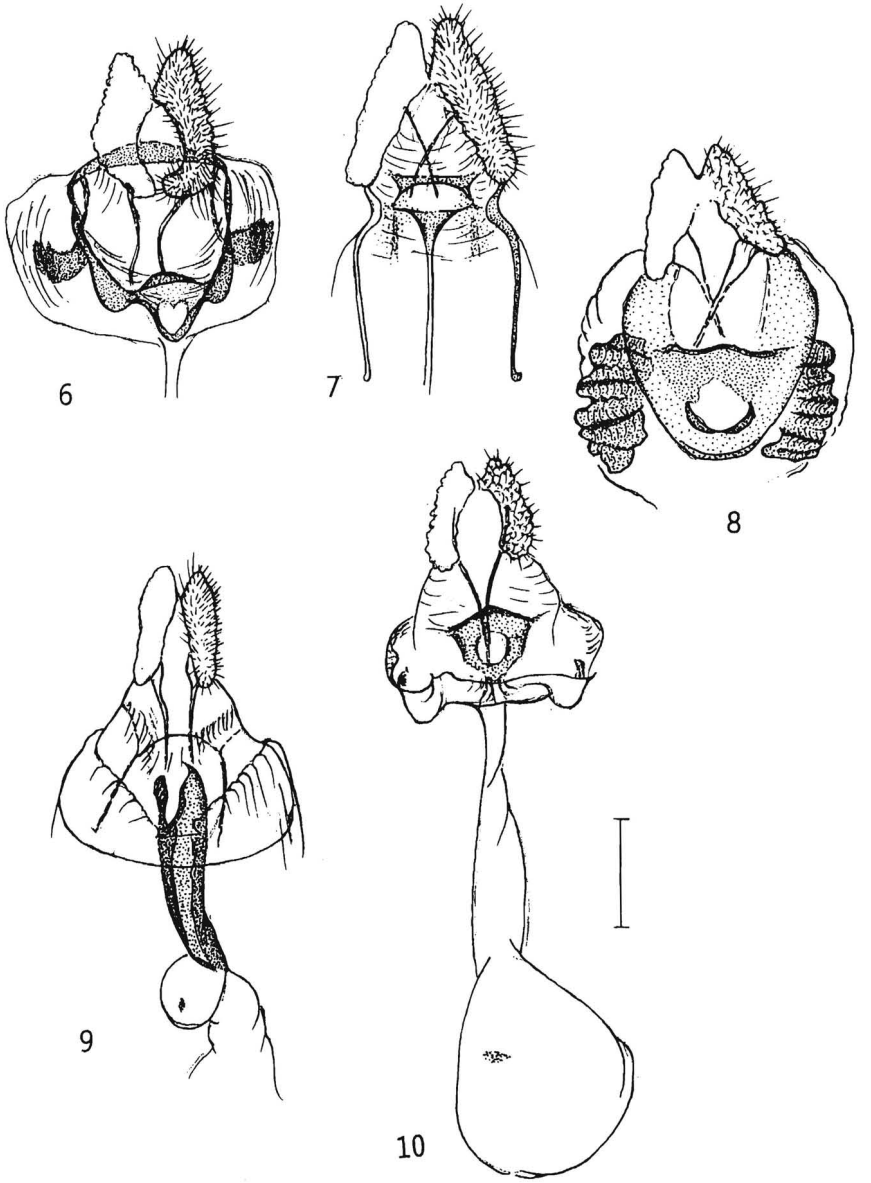
During a light trapping survey by the San Diego County Department of Public Health in 1959, R. A. Mackie recovered one female of *B. priapeia* at Mission Bay, an area subsequently converted from marshland to parks. Although I identified the species in 1960, it was not until 1987 that another record was obtained to confirm the residency of this species in California. Because the previous collection records are from areas adjacent to the Gulf of Mexico, it seems likely that *B. priapeia* is introduced in coastal southern California.

California data: Orange Co.: Aliso Cr., 0.5 km E Highway 1, nr. South Laguna, 1♂, 2♀ X-7/8-87, at lights (J. Powell, UCB) [JAP genit. preps. 6445, 6446]. San Diego Co.: Mission Bay, 1♀ IX-30-59, light trap (R. A. Mackie, UCB) [JAP prep. 501].

***Bactra miwok* Powell, new species**

Description. A small, almost uniformly dark brown species with only indistinct ochreous mottling on the forewings of some individuals. *Male*: forewing (FW) length 5.9–7.9 mm (30n); length 3.2–3.4 × width; termen strongly angled, nearly straight, very slightly convex, apex produced. Color of head and palpi concolorous with FW, in fresh specimens variable, dark brown tinged with dark ochreous-tan to dark rust-brown; pale examples faintly irrorate with pale ochreous, not defining a visible FW pattern. No 'maculate' or 'vittate' polymorphism known. FW underside gray, fringe pale rust-ochreous. Hindwing entirely dark gray, fringe pale gray, underside the same. Abdomen scaling dark shining gray, venter slightly paler gray. Genitalia (Fig. 5, drawn from holotype, JAP prep. no. 6390; 5n), similar to *B. maioriana* and *verutana*, with the major spurs of the cucullus slender, numerous (ca. 30), and broadly distributed along distal margin and posteriorly; major spurs of the valva basally fewer (10–12), also slender; saccular margin broadly expanded laterally. *Female*: FW length 6.3–7.0 mm (2n), length to width ratio within range of male. Phenotype similar to male, color probably comparably variable. Genitalia (Fig. 10, drawn from JAP prep. 7157; 2n), similar to *B. verutana*, but the ring around IX and lateral patches on the intersegmental membrane of that species only weakly sclerotized, lateral lobes more widely separated and displaced anteriorly from sterigma.

Types. *Holotype* ♂: CALIF: China Camp, Marin Co., April 18, 1959 (J. Powell) [JAP genit. prep. 6390]. *Allotype* ♀: CALIF: Miwok Meadow, China Camp St. Park, Marin Co., March 30, 1995 (J. Powell) [JAP prep. 7089]; both in UCB. *Paratypes* (30): CALIF: Marin Co.: same data as holotype, 1♂ [JAP prep. 555]; Miwok Mdw., China Camp St. Park, 2♂ III-30-94, 12♂ V-2-94, 9♂, 1♀ III-30-95 (J.Powell) [JAP preps. 7088 ♂, 7157 ♀]; Ring Mt., 1♂ III-30-85, 1♂ IV-11-94 (J. Powell). Monterey Co.: Asilomar, 1♂ V-17-59 (G. I. Stage)



FIGS. 6–10. Female genitalia of *Bactra* species: VIII–IX segments, sterigma, sclerotization of intersegmental membrane, and basal portion of ductus bursae, ventral aspect. **6,** *B. verutana* (JAP prep. 6950, Coachella Vy., Calif.); **7,** *B. furfurana* (Haw.) (JAP prep. 7194, Smartville, Calif.); **8,** *B. maioriana* Heinr. (redrawn from Diakonoff 1964, paratype); **9,** *B. priapeia* Heinr. (redrawn from Diakonoff 1964, Texas); **10,** *B. miwok* Powell (JAP prep. 7157, China Camp). [scale = 0.5 mm for Fig. 10].

[JAP prep. 7158]. Santa Clara Co.: 3 mi W New Almaden, 1♂ IV-18-69 (P. A. Opler) [JAP prep. 7162]. Sonoma Co.: Bodega, 1♂ V-3-36 (E. C. Johnston, USNM). Paratypes will be deposited in CDFA, CNC, LACM, Mississippi State U., U. Minnesota, USNM.

Diagnosis. The male genitalia of *B. miwok* are similar to *B. verutana* and *B. maioriana*, but the new species has more major spines of the cucullus (ca. 30), which are more broadly distributed distally and extended to the anterior margin; in *verutana* and *maioriana* these spines are less numerous (10–12), much stouter and arranged in two separated lines in *verutana* (Fig. 1), restricted narrowly to the distal margin and not reaching the posterior margin in *maioriana* (Fig. 3). The major spines of the basal part of the valva are quite short in *verutana*, varying from 6–8 to 15–20 among individuals, while they are longer and slender in *maioriana* and *miwok*, fewer in the latter (12–14) than in *maioriana* (22–24). The distal margin of the sacculus is more broadly expanded laterally in *miwok* than in the other two species, which have attenuated marginal extensions. In female genitla and associatred structures, the new species most closely resembles *B. verutana* (Fig. 6), with the sclerotized areas lateral to the sterigma reduced compared to that species, the lateral cup-like structures more widely separated and displaced anteriorly to the sterigma (Fig.10). The other three species discussed differ greatly in these structures (Figs. 7–9).

Biological Notes. The new species apparently is univoltine, available records of adults spanning late March to mid May. There has not been thorough survey to preclude a summer generation, but I made visits to Ring Mountain in late May, July, and September, and Miwok Meadow in late August. The vegetation was very dry and no *Bactra* were recovered from either site.

Lack of light attraction records suggests that this species is diurnal. The moths were netted during midday and early afternoon, and a few were observed to fly in direct sunshine without observer disturbance. Efforts to observe adults during crepuscular and matinal hours produced negative results. I visited the Miwok Meadow colony site on 10 April 1994 between 1810–1910 hr PST, just before and after sundown, and on 24 May 1994 at 0530–0615 hr PST. Observations of caged adults (5♂, 1♀) were inconclusive as to the normal diel periodicity. Adults remained 'alert' with the antennae erect during daylight hours and occasionally actively ran towards the light. It appeared they became more active in late afternoon sunshine and at dusk, but several moved after dark. Neither mating nor oviposition was observed, but the female deposited about 100 eggs during a 5-day period.

At Miwok Meadow adults occurred in a wet seepage meadow above tidal marshes along San Francisco Bay, in association with three species of *Carex* (*C. multicostata* Mackenzie, *C. praegracilis* Boott, and *C. tumulicola* Mackenzie) and *Juncus ?patens* E. Meyer, while at Ring Mountain they were taken in a narrow seepage gully on a steep slope in serpentine grassland, with what appeared to be one of the same and a fourth species of *Carex*, and both *Cyperus* and *Juncus*. However, no definite association with any one of the plants was observed, and pupal shells were not found. None of these plants has a sufficiently robust stem to support later instar larvae, particularly through winter, and I assume that late instar larvae feed at the base of the plant.

Early instar larval activity of *Bactra miwok* in the laboratory suggests that the larval biology is similar to that described for *B. verutana* by Poinar (l964). Eggs of *B. miwok* were deposited in variable clumps of usually 4 to 8 eggs (sometimes singly), usually regularly overlapped in pairs so that groups of 4, 6, or 8 were formed. The female, caged with a bouquet of two species of *Carex* from the field site, selected the semitranslucent, bract-like blades that subtend the green foliage as oviposition sites. No eggs were laid on inflorescences nor on the glass sides of the container. Incubation was rapid, requiring 6–7 days until hatching at 17–21° C. Poinar reported 3–4 days in *B. verutana* at 22° C. Provided with foliage of *Cyperus eragrostis* Lam., a native plant that behaves like a weed and has much larger leaves than the China Camp *Carex* species, the first instar larvae tunneled downward from cut leaf ends, in straight mines between the leaf veins. The frass-packed mines were visible within 2 days of hatching and reached 4–6 cm in length by day 4; by day 7 the leaves were drying and had folded along the midrib, and 2nd instar larvae made holes to the surface and fed between the folded leaf blade or entered new mines. According to Poinar (1964), mining in *B. verutana* extends down to the basal meristematic portion of the stem, where larvae complete development in 8–11 days in the lab at 24° C.

Larvae of *B. miwok* were not maintained on entire plants that would have enabled completion of feeding.

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