Journal of the Lepidopterists' Society
42(3), 1988, 218–230

A NEW SPECIES OF *OCALARIA* (NOCTUIDAE: CATOCALINAE) AND ANALYSIS OF SOME MORPHOLOGICAL CHARACTERS USEFUL FOR ELUCIDATING NOCTUID PHYLOGENY

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ABSTRACT. *Ocalaria cohabita* is described from 24 specimens captured on Barro Colorado Island, Panama. A key to adults of *Ocalaria* is provided, followed by a morphological comparison of *O. cohabita, O. oculata* (Druce) and *O. quadriocellata* (Walker). Particular emphasis is placed on characters that may prove useful in elucidating noctuid phylogeny, including features of head, legs, wings, abdominal segments 2 and 8, and genitalia.

Additional key words: morphology, Panama, *Ocalaria oculata, O. quadriocellata,* systematics.

Greig and DeVries (1986) described the gregarious diurnal roosting behavior of a small noctuid moth from Parque Nacional Corcovado in Costa Rica. This moth was an undescribed species of *Ocalaria* Schaus. Adults of this species were subsequently captured near the Smithsonian Tropical Research Institute on Barro Colorado Island, Panama, and sent to me for identification. Comparison with illustrations of Corcovado specimens showed that the Panamanian material was conspecific. The species is described below.

Ocalaria cohabita, new species
(Figs. 1–5, 10, 14, 16, 17, 20, 21, 24, 26)

Diagnosis. Forewing underside discal eyespot with double pupil, smaller pupil surrounded by iridescent deep-blue scales, lacking marginal blue-green scales; hindwing underside with solid brown band between postmedian and subterminal lines; male antenna serrate.

Male. Head. Haustellum unscaled; labial palp mainly dark gray-brown, first segment with some off-white scales dorsally and lateroventrally, smooth-scaled laterally but scales on dorsal and ventral edges projecting as a loose fringe, 2nd and 3rd segments uniformly dark gray-brown, smooth-scaled on all surfaces, subequal in length, elongate, ascending in life, at rest recurved dorsally over head (Greig & DeVries 1986:fig. 4), 2nd segment gibbous; antenna long, almost equal to forewing length, dorsally uniformly scaled dark gray-brown, ventrally serrate, sensory setae distinct, white; eyes large, bulbous, bare, unlashed; frons narrow, unscaled on lower half except for extreme edges, scales on dorsal half projecting anteriorly forming median ridge; frons, vertex, occiput dark gray-brown except for band of off-white scales bordering eye posteriorly. **Thorax.** Patagia, thoracic scaling concolorous with head, tegulae similar but with weak, transverse, median white band. **Legs.** All uniformly dark gray-brown dorsally, off-white ventrally; apexes of tibial and tarsal segments off-white, weakly so on forelegs, more strongly marked on hindlegs; tibiae unspined. **Forewing length** 13.4–16.0 mm (holotype 16.0 mm). **Wings** (Figs. 1, 2). Forewing ground color dark gray-brown, transverse bands pale gray, with weak purple iridescence in oblique lighting; space on forewing enclosed by costa, discal cell, antemedian line pale orange; eyespot black with off-center white pupil, surrounded by ring of pale orange; apical spot black with basal small white spot; ventral pattern similar to upper but more colorful; forewing pale gray, ventral of discal cell as far as postmedian line, eyespot as upper surface but with additional smaller white pupil posterodistal to main pupil, smaller pupil surrounded by deep blue iridescent scales visible only in oblique lighting, area between postmedian and subterminal lines violet-gray with central brown area, anterior part suffused with orange scales; pupil of apical eyespot much larger than on upper surface, rounded or square, subequal to main pupil of discal eyespot; distally veins R_5 and M_1, together with costal area to apical eyespot, orange; hindwing ground color pale gray, suffused costally with brown scales, discal lunule, antemedian, postmedian, and subterminal lines dark gray-brown, distinct; brown band present between postmedian and subterminal lines, bounded basally and distally by pale gray. **Abdomen.** Dorsally and ventrally transversely striped, anterior half of each segment pale gray, posterior half dark gray-brown. **Genitalia** (Fig. 3). Uncus with small apical hook; saccus ovoid; juxta ill-defined; valve simple, lacking appendages, with a strong constriction on the costa basally; aedeagus cylindrical, with bluntly-pointed apical process; vesica without cornuti.

Female. As described for male except antenna filiform, wings broader, more rounded, not as acutely pointed (Figs. 1, 2). Ratio of forewing length to maximum width perpendicular to costa averaging 2.28 in males (n = 12) and 2.11 in females (n = 11), the 0.17 difference being significant (P = 0.001, 1-tailed Mann-Whitney test because larger ratio expected in males). **Genitalia** (Fig. 4). Segment 8 annular; antrum membranous, undifferentiated from ductus bursae; corpus bursae membranous, ovoid, lacking signa; ductus seminalis broader than ductus bursae, arising from posterior end of corpus bursae.

Types. Holotype male: Panama, Barro Colorado Island, 20 May 1986, N. Greig. Paratypes: 1 female: Panama, Barro Colorado Island, 28 May 1986, P. J. DeVries (BMNH noctuid slide #12816); 11 males, 11 females: Panama, Barro Colorado Island, 18 August 1986, P. J. DeVries (BMNH noctuid slides #12803–12815). In British Museum (Natural History).

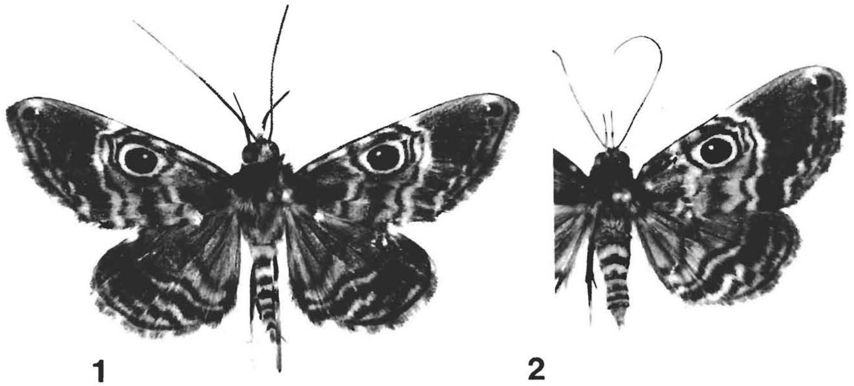
Life history. Nothing is known about the immature stages or larval hosts of any species of *Ocalaria.*

Variation. There is no major variation in wing pattern either between or within sexes. The pale orange forewing costal band may be weakly subdivided medially by ground color scales. However, older moths become worn and faded, eventually presenting a "washed-out" pale coloration. This phenomenon affects wings and body scales equally and appears due to a combination of scale loss and fading of brown pigments.

Key to Adults of *Ocalaria*

Ocalaria currently contains 7 described species (provenances and numbers examined are those of specimens held in BMNH): *dioptica* (Walker) (=*macrops* (Felder & Rogenhofer)) (Brazil: Amazonas, n = 2; Peru: Amazonas, n = 1; Bolivia, n = 2; French Guiana, n = 1), *guarana* Schaus (Brazil: Rio de Janeiro, n = 2; São Paulo, n = 1), *oculata* (Druce) (Guatemala: San Isidro, n = 56), *pavina* Schaus (Brazil: Rio de Janeiro, n = 9), *pavo* Schaus (Costa Rica: Sixola), *quadriocellata* (Walker) (Brazil: Cuiabá, n = 11) and *cohabita,* new species.

The couplet for *O. pavo* is based on a small water-color painting in BMNH, which lacks specimens of this species. This type of painting, probably commissioned by G. F. Hampson, has been found to be realistic and reliable as an identification guide (A. Watson pers. comm.).



FIGS. 1, 2. *Ocalaria cohabita*. **1**, Holotype male; **2**, Paratype female.

1. Discal eyespot on forewing underside with single white pupil (occasionally double in *O. quadriocellata*, not surrounded by deep blue iridescence), marginal iridescent blue-green scales; hindwing underside without solid brown band between postmedian and subterminal lines; male antenna bipectinate 2
   Discal eyespot on forewing underside with double pupil, smaller pupil surrounded by iridescent deep blue scales, lacking marginal blue-green iridescence; hindwing underside with solid brown band between postmedian and subterminal lines; male antenna serrate .... *cohabita*, new species
2. Area between postmedian and subterminal lines on upperside of both wings solid dark brown, edged with continuous pale cream lines .... *pavo* Schaus
   Area between postmedian, subterminal lines on upperside of both wings not solid dark brown, pale line bordering inner edge of subterminal line interrupted 3
3. Discal eyespot on forewing upperside subequal to apical eyespot; brown streak present in discal fold between median and postmedian lines .... *pavina* Schaus
   Discal eyespot on forewing upperside much larger than apical eyespot; brown streak in discal fold between median, postmedian lines absent 4
4. Forewing upperside, distal to discal eyespot, with conspicuous white spot often divided in half by brown scaling along vein M_3 .... *quadriocellata* Walker
   Forewing upperside without such spot 5
5. Forewing underside with white spot or streak below apical eyespot; pupil of apical eyespot small, no more than half width of eyespot in diameter, surrounding black scales conspicuous 6
   Forewing underside without white spot or streak below apical eyespot; pupil of apical eyespot large, subequal in diameter to width of eyespot, almost obliterating surrounding ring of black scales .... *oculata* Druce
6. Ground color dark brown; forewing upperside postmedian line cream, continuous across wing; discal eyespot on forewing underside without diagonal cream line below .... *guarana* Schaus
   Ground color off-white suffused with pale brown; forewing upperside postmedian line indistinct, not continuous across wing; discal eyespot on forewing underside with diagonal cream line below, originating from posterobasal corner of the eyespot .... *dioptica* Walker

Comparative Morphology of *O. cohabita*, *O. oculata*, and *O. quadriocellata*

In a previous cladistic analysis of Plusiinae (Kitching 1987), I described several characters useful in elucidating generic and higher level

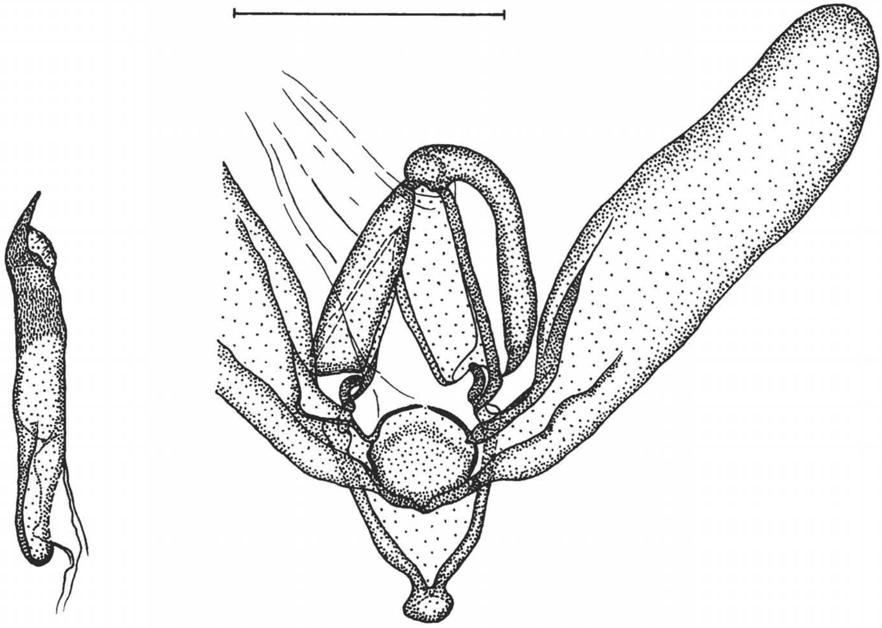


FIG. 3. *Ocalaria cohabita*, paratype male genitalia, BMNH noctuid slide #12804 (genitalia) and #12805 (aedeagus). Scale line = 1 mm.

interrelations on the proboscis, female frenulum, basal abdominal segments and abdominal segment 8. I have examined these structures in three *Ocalaria* (*O. cohabita*, *O. oculata* and *O. quadriocellata*) and here describe the results to facilitate future analyses of higher classification of Catocalinae. *Ocalaria oculata* and *O. quadriocellata* were chosen for detailed examination because they are well represented in the BMNH collection; the remaining species (several undescribed) were not because it was not my intention to revise the genus. Comparisons are also drawn, where appropriate, with equivalent conditions in Plusiinae and the taxa employed as outgroups in that study.

Labial palps. In all three *Ocalaria* species, the dorsal margin of segment 2 of the labial palp is markedly convex. This feature is more conspicuous in *O. quadriocellata* (Fig. 6) and *O. oculata* than in *O. cohabita* (Fig. 5) but there is no sexual dimorphism. The function of the bulge is unknown; examination at 400× revealed no obvious sensory structures or differential scale arrangements.

Antennae. Female *O. cohabita* have filiform antennae (Fig. 16) with relatively short subventral setae; males have longer, more conspicuous subventral setae, while the ventral surface of each segment is produced into a rounded triangular flange (Fig. 14), giving a serrate appearance

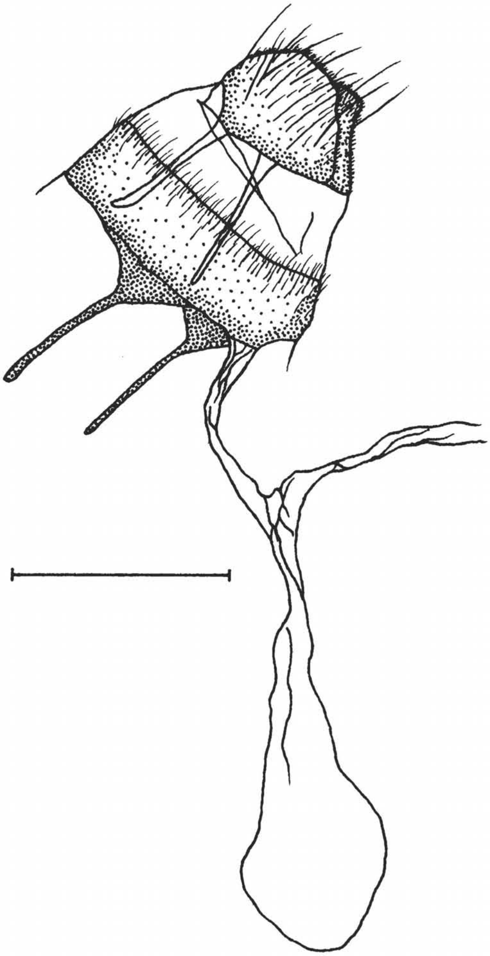
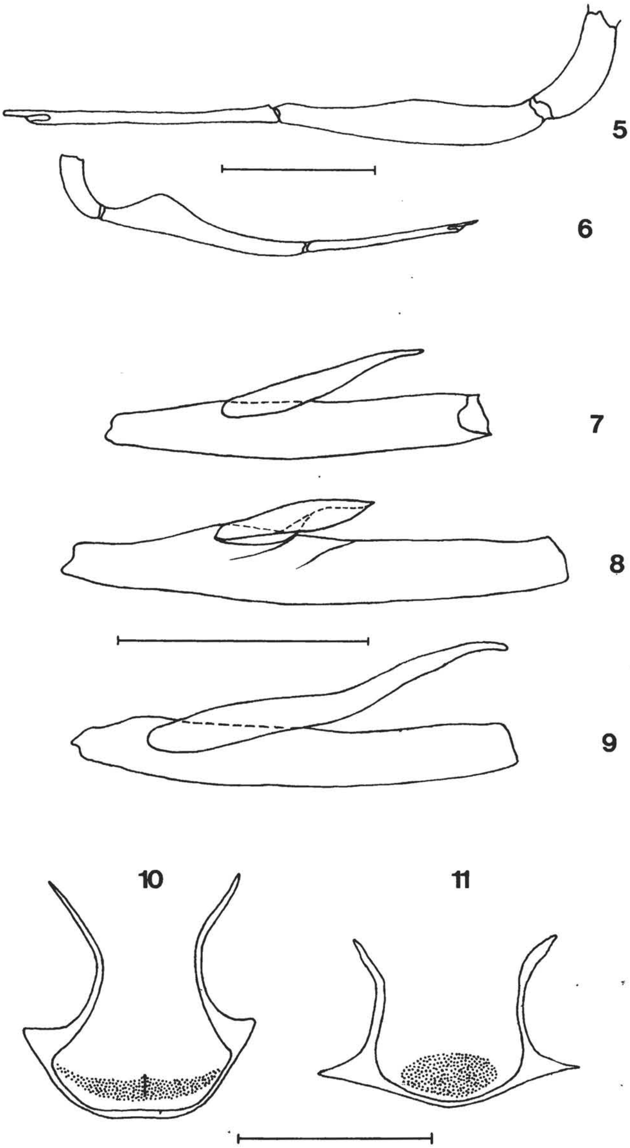


FIG. 4. *Ocalaria cohabita,* paratype female genitalia, BMNH noctuid slide #12816. Scale line = 1 mm.

to the antenna. Apically, this flange bears two setae and a sensillum styloconicum.

Antennae of female *O. quadriocellata* are also filiform, although the segments are longer than in *O. cohabita.* In contrast, male antennae of *O. quadriocellata* are strongly bipectinate (Fig. 12). Each pair of pectinations, which arise at the base of a segment, are long, slender, parallel-sided and bear a strong apical seta. Male *O. oculata* are similar but the pectinations are even longer and thinner (Fig. 15). Female *O. oculata* are unique among the three taxa studied in also having bipectinate



FIGS. 5–11. *Ocalaria* structures. 5, 6. Labial palps. **5,** *O. cohabita* male; **6,** *O. oculata* female. 7–9. Foretibiae. **7,** *O. oculata* female; **8,** *O. quadriocellata* female; **9,** *O. oculata* male. 10, 11. Male sternite 8. **10,** *O. cohabita*; **11,** *O. quadriocellata*. Stippling indicates extent of hairpencil scale insertions. Scale lines = 1 mm.

antennae (Fig. 13), although the branches are shorter than in either male *O. oculata* or *O. quadriocellata.*

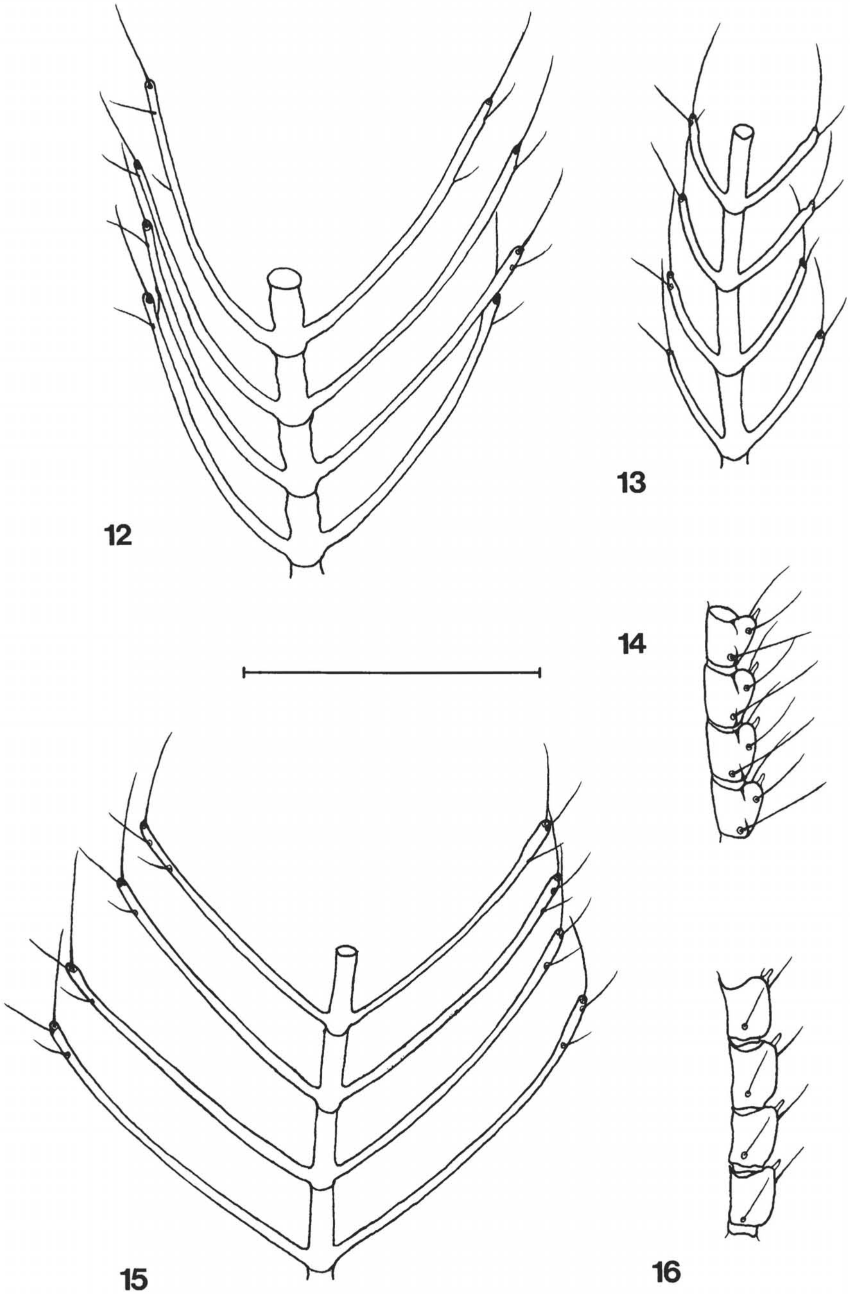
Proboscis. Proboscides in all three species are short, stout, and similar in general appearance to those of such genera as *Oncocnemis* Lederer (Cuculliinae), *Magusa* Walker (Amphipyrinae), *Stictoptera* Guenée (Stictopterinae) and *Paectes* Hübner (Euteliinae). *Ocalaria* also shares with these and other genera a nodular apex to the proboscis and ridged styloconic sensilla (which appear stellate in apical view), all of which suggests that this form of proboscis is plesiomorphic within Noctuidae. Concomitantly, the form of proboscis found in Plusiinae is apomorphic for that subfamily, although certain features appear to have been convergently derived in *Cucullia* Schrank and *Calophasia* Stephens (both Cuculliinae).

Epiphysis. The epiphysis in *Ocalaria* exhibits considerable variation in length. In both sexes of *O. cohabita* and female *O. quadriocellata,* it is small, being only about a quarter the length of the fore-tibia (Fig. 8). However, in male *O. quadriocellata* and *O. oculata,* the epiphysis is highly elongate and often exceeds the fore-tibial apex (Fig. 9). Female *O. oculata,* which have smaller antennal pectinations, also have a shorter epiphysis, but one that is still elongate compared to female *O. cohabita* (Fig. 7). This close correlation between epiphysis length and degree of development of antennal pectinations is strong circumstantial evidence to support the hypothesis that the primary role of the epiphysis is keeping the antenna clean. A long epiphysis is necessary in male *O. quadriocellata* and *O. oculata* to clean the long pectinations efficiently.

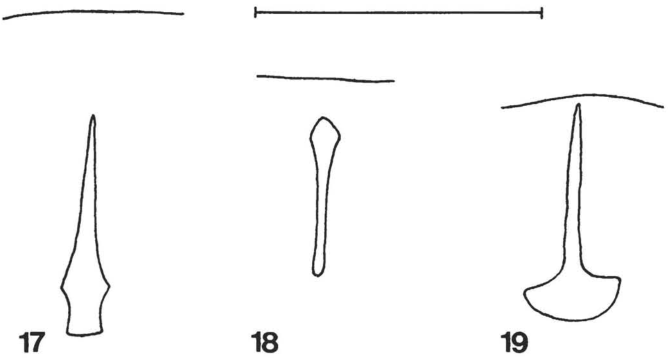
Wings. Venation of *Ocalaria* is typical quadrifine noctuid, although hindwing vein M_2 is somewhat weaker than either M_1 or M_3 and does not arise close to the base of M_3. A potential *Ocalaria* apomorphy in hindwing shape is the shallow concavity just beyond the midpoint of the costal margin, although this is weakly expressed in *O. oculata.* All *Ocalaria* examined have a trisetose female frenulum in which the setae are subequal in length, further corroborating the hypothesis that this state is plesiomorphic within Noctuidae (Kitching 1987).

Abdominal segment 2. In all noctuid genera examined so far, the anterior edge of tergite 2 (T2) bears an inflected flange. At its simplest, the flange is concave, uniformly narrow and difficult to discern in slide-mounted material, as in Stiriinae, Cuculliinae, Heliothinae, and basal plusiine tribe Omorphinini. The more derived Abrostolini display two subdorsal lobes directed medially. These fuse in Argyrogrammatini and Plusiini but leave a central rounded emargination. The ventral edge of the flange in Stictopterinae and Euteliinae is straight, with a median dorsal triangular inflection of T2 itself.

In general, the form of the T2 flange is highly invariant in large



FIGS. 12–16. *Ocalaria* antennae. **12,** *O. quadriocellata* male; **13,** *O. oculata* female; **14,** *O. cohabita* male, lateral view; **15,** *O. oculata* male; **16,** *O. cohabita* female, lateral view. Scale line = 1 mm.



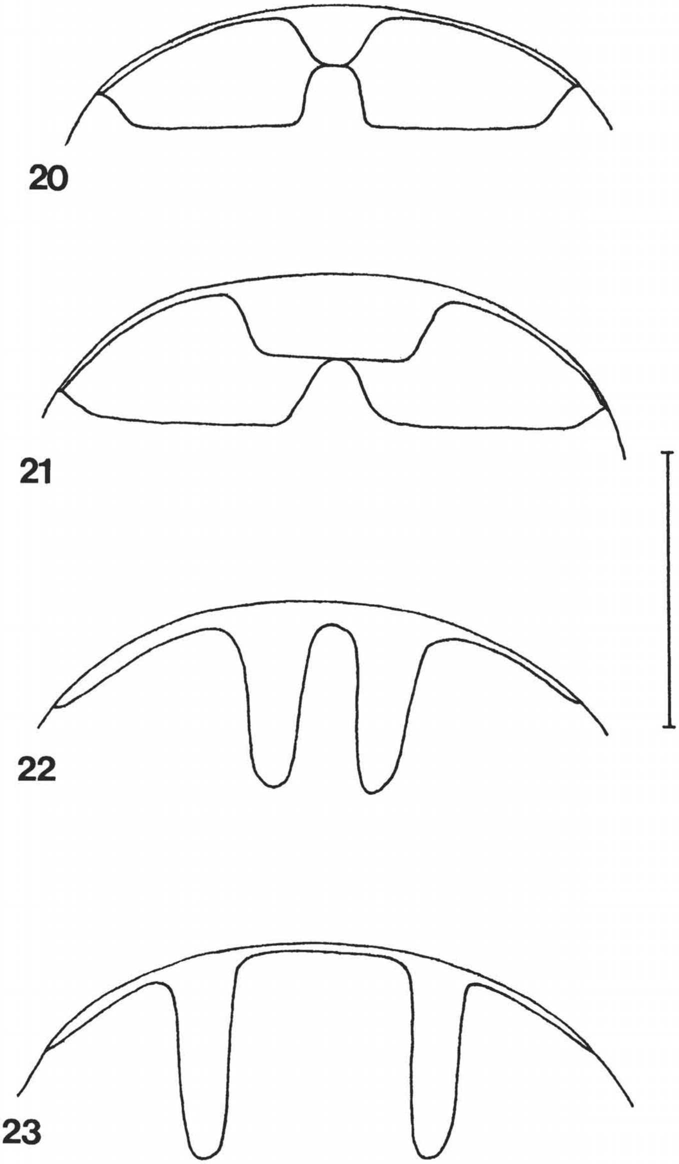
FIGS. 17–19. Male tergite 8. **17,** *O. cohabita*; **18,** *O. oculata*; **19,** *O. quadriocellata*. Posterior edge uppermost, with transverse line marking posterior margin of abdominal segment 8. Scale line = 1 mm.

taxonomic groups, such as tribes or subfamilies. However, in *Ocalaria*, the T2 flange is remarkably variable between species. The putatively basal *O. cohabita* shows a sclerotized dorsal inflection of T2 similar to that in Stictopterinae and Euteliinae, but with the median emargination typical of "higher" plusiines. In addition, the ventral edge of the flange is somewhat cut back laterally. This flange is sexually dimorphic in *O. cohabita*, a feature almost certainly correlated with the dimorphism observed in sternite 2 (St2). The female (Fig. 21) differs from the male (Fig. 20) in that the median emargination is not parallel-sided, while the dorsal inflection is much broader and has a straight ventral edge.

Ocalaria oculata and *O. quadriocellata* differ markedly in lacking the sclerotized dorsal inflection and in the extreme specialization of the flange. *Ocalaria quadriocellata* has a T2 flange formed of two broad, ventrally-directed, well-separated rounded lobes (Fig. 22). This trend is more noticeable in *O. oculata*, in which the lobes are long, narrow, and closer to the lateral edges of T2 than to the center (Fig. 23).

St2 in *O. oculata* and *O. quadriocellata* is typically noctuid in form, with no marked diagnostic features. It is a roughly square sclerite (Fig. 25), with convex lateral and posterior edges. The anterolateral corners are produced into a pair of apodemes, from which a sclerotized bar arises laterally. This passes anteriorly to the counter-tympanal hood. The anterior margin of St2 is broadly U-shaped.

Females of *O. cohabita* have a broadly similar St2, but it is slightly squarer, with marginally concave lateral edges, and the anterior margin is more V-shaped (Fig. 24). St2 of male *O. cohabita*, however, is markedly different (Fig. 26), which may be the first record of sexual dimorphism in this structure in quadrifine noctuids. The whole sclerite



FIGS. 20–23. Tergite 2 flange. **20,** *O. cohabita* male; **21,** *O. cohabita* female; **22,** *O. quadriocellata* male; **23,** *O. oculata* male. Scale line = 1 mm.

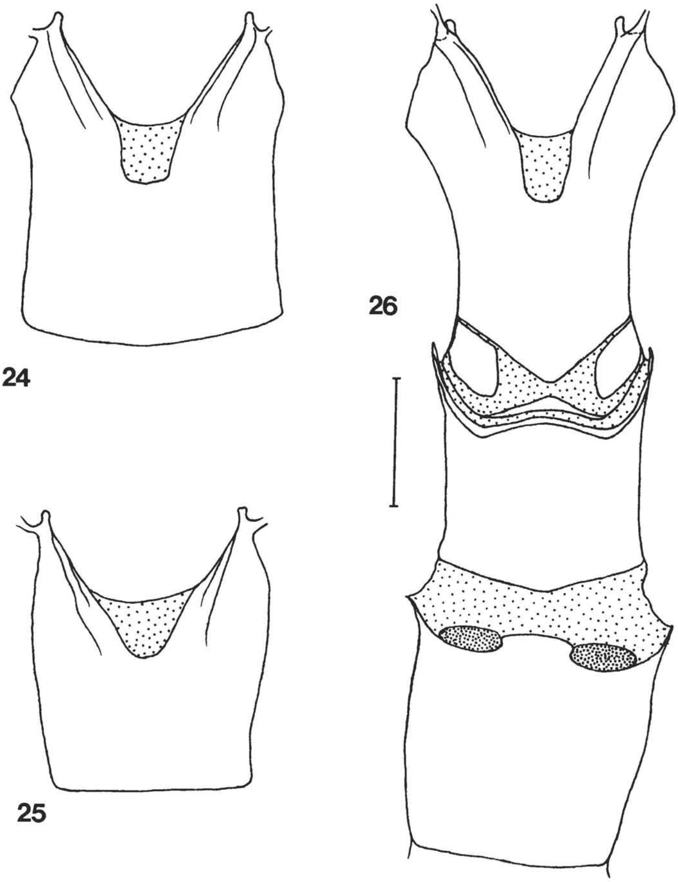
is elongate, with distinctly concave lateral margins. The anterior edge is V-shaped, while the posterior margin is produced as a broad, triangular point. Posterolaterally are two secondary sclerites in the intersegmental membrane between St2 and St3. In addition, the anterior corners of St3 (Fig. 26) are produced around the posterolateral edges of these secondary sclerites, a feature similar to that seen in numerous trifine species, where it is associated with the lever of male basal abdominal hair pencils (Birch 1970). The posterior margin of St3 is also produced to a median point, but is more obtuse than that of St2. Finally, on the anterior edge of St4 (Fig. 26) are two concavities that appear to house shallow glandular pockets. The function of this complex in male *O. cohabita* is a matter for conjecture but suggests that adult biology, particularly courtship, of this species might be usefully studied.

Male abdominal segment 8. The form of the male eighth tergite (T8) and sternite (St8) displays species-level diagnostic features in a number of noctuid subfamilies; for example, Plusiinae (Dufay 1970), Stiriinae (Hogue 1963), Heliothinae (M. J. Matthews pers. comm.). In addition, these sclerites have yielded characters useful in recognizing suprageneric taxa in Plusiinae (Kitching 1987).

The form of T8 in *Ocalaria* is characteristic, consisting of a median sclerotized longitudinal bar tapered posteriorly and expanded anteriorly. The three species differ in minor details: in *O. cohabita,* the bar does not reach the posterior margin of the segment and the anterior expansion has concave margins and a truncate apex (Fig. 17); in *O. oculata,* the anterior expansion is drawn out laterally into narrow points (Fig. 18); while in *O. quadriocellata,* the anterior expansion has a rounded apex (Fig. 19). In all three taxa, there appear to be two shallow pockets associated with the lateral edges of T8 anteriorly.

A8 bears a median weak tuft of hairs, barely differentiated into a pair of hair pencils, arising from a shallow, membranous, ventral pocket. St8 forms a thin sclerotized bar anterior to this pocket, with two concave bars running longitudinally on either side of the hair tuft. The anterolateral corners of St8 are produced as blunt triangular lobes. The form of St8 is similar in all three species, but whereas the anterior bar forms a blunt median point in *O. oculata* and *O. quadriocellata* (Fig. 11), in *O. cohabita,* it is broadly rounded with a somewhat straight central section (Fig. 10).

Male genitalia. *Ocalaria oculata* is very similar to *O. cohabita* (Fig. 3) except that the valve is of more uniform width basally, the saccus is acutely pointed and the aedeagal process is absent. In addition, the spines on the vesica basally are larger and more strongly sclerotized. Genitalia of *O. quadriocellata* are similar to *O. oculata* but the sacculus



FIGS. 24–26. *Ocalaria* sternites. 24, 25. Sternite 2. **24,** *O. cohabita* female; **25,** *O. quadriocellata* male; **26,** Sternites 2–4 *O. cohabita* male. Scale line = 1 mm.

bears a small rounded lobe basally and the saccus forms a less acute point.

Female genitalia. The posterior margin of St8 bears a fringe of persistent, brown, setose scales that may be apomorphic for *Ocalaria*. *Ocalaria oculata* is essentially similar to *O. cohabita* (Fig. 4) but differs in that the corpus bursae is not differentiated from the ductus bursae, being merely a long, slightly broader membranous sac; the ductus bursae is broader with a median annulus of longitudinal ridges and sclerotized granulations; and the ostium bursae is adorned with sclerotized granulations. The anal papillae are diagonally cut back dorsally to the origin of the posterior apodemes. *Ocalaria quadriocellata* is broadly similar to *O. cohabita*, except that the dorsoposterior parts of the anal papillae are drawn out into blunt, slightly downcurved points.

ACKNOWLEDGMENTS

This study was carried out partly during the tenure of a Junior Research Fellowship awarded by the Trustees of the British Museum (Natural History), which is gratefully acknowledged. I thank my colleagues at BMNH for support and comments, and the staff of the BMNH Photographic Unit for the photographs. Special thanks go to Nancy Greig and Philip DeVries for the opportunity to describe this species.

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Received for publication 4 November 1987; accepted 6 April 1988.

Journal of the Lepidopterists' Society
42(3), 1988, 230

ADDITIONAL MANUSCRIPT REVIEWERS, 1987

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