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A Revision of the Moth Genus *Lyttosis* (Lepidoptera, Geometridae)

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ABSTRACT

The genus *Lyttosis* Hulst is revised, and redescrptions are given for the genus and the two presently included species. Two new species are described: *sinuosa* and *heitzmanorum*. Keys and photographs are presented for all species and their genitalia. The genus is restricted in its distribution to eastern North America. Relationships with two Palearctic genera are discussed.

INTRODUCTION

The genus *Lyttosis* Hulst (1896) contained only the single species *unitaria* (Herrich-Schäffer) up to 1948; in that year Forbes placed *permagnaria* (Packard) in the genus. Another, undescribed species also belonged here; this has been known for quite a few years, as Kimball (1965) referred to it in his work on the Lepidoptera of Florida. Because a number of the relatively rare specimens of this group, including examples of the above-mentioned undescribed species, had accumulated in the collection of the American Museum of Natural History, I decided to undertake a revisionary study of *Lyttosis*. The present revisionary paper is the result. During the course of this study it was found that there were really two undescribed species in the genus. These are named, and the two previously known species are completely redescrbed, with keys provided to separate the four species by means of both maculation and genitalia.

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Prior to the publication of *Lytrosis* Hult, nearly all workers placed *unitaria* Herrich-Schäffer in the Old World genus *Hemerophila* Stephens. However, *Hemerophila* Stephens (1829) is a homonym of *Hemerophila* Hübner (1817); the former was renamed *Menophra* by Moore (1887), and the type species was designated as *abruptaria* Thunberg. The species of *Lytrosis* are not particularly closely allied to the European *abruptaria*. The latter has male antennae with about 55 segments, the terminal 18 simple, and the pectinations arise distally on each segment; in *Lytrosis*, the male antennae have about 75 segments, only a few terminal ones simple, and the pectinations arise basally on each segment. The male genitalia of *abruptaria* have a rounded uncus, the valves are long and slender, and the costa has a double projection; in *Lytrosis*, the uncus is terminally bilobed, the valves are broad, and the costa has a prominent costal arm bearing terminal spines. The female genitalia of *abruptaria* are quite small, and the ductus seminalis arises medially on the right side of the corpus bursae, whereas in *Lytrosis* these structures are very much larger, and the ductus seminalis arises posteriorly, near the ductus bursae.

Lytrosis appears more closely allied to *Phthonandria* Warren; its type species, by original designation, is the Japanese *atrilineata* Butler. The latter species has male antennae with about 55 segments; the terminal 11 or so are simple or serrate, and the pectinations arise basally on each segment. The male genitalia are similar to those of the species of *Lytrosis*, but the uncus is much more deeply cleft apically. Two characters that distinguish *atrilineata* from *Lytrosis* are the strongly pectinate female antennae, and the strongly swollen male hind tibia having a thick hair pencil; our species have simple female antennae, and only one (*permagnaria*) has a relatively slender hair pencil.

Lytrosis is most closely related to the North American genus *Euchlaena* Hübner. The diagnosis in the generic description of *Lytrosis* includes the characters that separate these genera.

In the present revision I am not following my usual practice of describing the more primitive species first, and then working up to the more specialized. The order of species has been reversed, as the one relatively common and widespread species (*unitaria*) is much more likely to be represented in collections, and hence available for study. The species with the most primitive characters (male with hind tibial hair pencil, vesica with separate spines, exerted on right side anterior of apex of aedeagus) is *permagnaria*, an extremely rare species.

During the course of this study, I have examined 173 specimens and 26 genitalic dissections; of this total, *unitaria* is represented by 123 moths and 10 dissections. It is much more usual to find males than females of

all the species represented in collections; the figures are 139 males and only 34 females, slightly more than a four to one ratio. It is assumed that the females do not react positively to light in the same manner as the males do.

All the specimens and genitalia illustrated herein are from the collection of the American Museum of Natural History, with two exceptions. Both are for *permagnaria*; the male genitalia are from a specimen in Bryant Mather's collection, and the female genitalia are from the collection of the United States National Museum.

ACKNOWLEDGMENTS

The author wishes to acknowledge with thanks the cooperation and aid of the following colleagues who have allowed him to study the types and specimens in their charge: Dr. J. M. Burns of the Museum of Comparative Zoology, Harvard University; Dr. D. C. Ferguson of the Systematic Entomology Laboratory, United States Department of Agriculture, for the United States National Museum, Smithsonian Institution; Dr. C. V. Covell, Jr., Department of Biology, University of Louisville, Kentucky; Mr. F. W. Mead, Florida Department of Agriculture, Division of Plant Industry, Gainesville; Messrs. J. Richard Heitzman, Roger L. Heitzman, and Robert Heitzman, of Independence, Missouri; Mr. Charles Kimball, of West Barnstable, Massachusetts; Mr. Bryant Mather, of Vicksburg, Mississippi; and Mr. Joseph Muller, of Lebanon, New Jersey.

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GENUS *LYTROSIS* HULST

Lytrosis HULST, 1896, p. 348. FORBES, 1948, p. 78.

DIAGNOSIS: This genus is very closely related to *Euchlaena* Hübner, and can be distinguished from it by the palpi having a longer and more curved second segment and a very short third segment, by the larger number of segments and the greater length of the pectinations of the male antennae, by the greater wingspread of the adults, and by the fact that the t. p. line of the upper surface of the forewings is sharply angled below the apex of the wing. In the genitalia, the species of *Lytrosis* may be separated in the males by the larger spining of the vesica, and in the females by the longer corpus bursae having its posterior end either truncate or angled and terminating in a point to the right of the ductus bursae.

Head, eyes large, broader than slightly raised front; tongue well developed; palpi with elongate, upwardly curving second segment, with

third segment short and generally inconspicuous, rising to middle of eye; antennae of male with about 75 segments, with very long pectinations (up to 1.1 mm. in length) arising in basal portion of segments, with apex having terminal few segments serrate or simple, and with each pectination having one, in some cases two, short terminal setae; antennae of female simple, of about 63 segments, with one or two short setae per segment. Thorax moderate, with patagia of mixed spatulate and hair-like scales varying from relatively weakly developed to elongate, and without tufts; fore tibiae unarmed, with process in male arising basad of middle and with hair pencil, in female smaller and arising near center of segment; hind tibia with two pairs of spurs, smaller in female than in male, the latter with tibia dilated and with or without hair pencil. Abdomen relatively slender and elongate, without tufts; ventral surface of third segment of males without row of setae and last segment without plate.

Forewings broadly triangular, alike in both sexes; 12 veins present; areole usually absent; R_1 united with Sc for short distance, R_{2+3} elongate, R_5 from stalk shortly before R_{3+4} ; M_1 from upper angle, with dc rather weak and curved or angulated; Cu_1 from below lower angle; fovea absent. Hind wings broad, tending to be concave between veins; frenulum strong in both sexes; Sc approximate to R near base or for almost one-half length of cell; R and M_1 from before upper angle; M_3 from lower angle; cell elongate, extending beyond middle of wing; Cu_1 from between one-fourth and one-half of distance between angle and Cu_2 .

Upper surface of wings varying in color from even pale gray to various shades of brown and yellow; forewings having t. p. line sharply angulate below apex. Under surface of wings varying from pale gray to yellowish brown, and at least outer cross line present on all wings.

MALE GENITALIA: Uncus triangular, terminal portion attenuate, with apex broad and strongly bilobed; socius absent; gnathos large, heavily sclerotized, broadly rounded medially; valves symmetrical, large, extending posteriorly beyond end of uncus, with large costal arm bearing two or three setae, remainder of valve simple but having elongate setae along costa and terminally; transtilla broad; anellus large, more or less quadrate, with narrow posterolateral extensions joining union of transtilla and valve; cristae absent; furca absent; tegumen and saccus broad, only slightly longer than wide; aedeagus shorter than combined lengths of tegumen and saccus, straight, rather wide; vesica armed with thick, finger-like spines, either all separate or in groups arising from sclerotized base.

FEMALE GENITALIA: Sterigma weakly sclerotized or membranous; ductus

bursae broad, narrow, heavily sclerotized; ductus seminalis arising from right posterior portion of corpus bursae; latter extremely long, occupying almost entire length of abdomen, slender, more or less of even width throughout, posterior end more or less heavily sclerotized and with longitudinal striations; signum present, roughly quadrate in outline.

EARLY STAGES: The eggs and larvae of *unitaria* have been described by Muller (1953).

FOOD PLANTS: These are known only for *unitaria*, and the three records in the literature are all trees, namely pin oak (*Quercus palustris* Muenchhausen), hawthorn (*Crataegus* sp.), and sugar maple (*Acer saccharum* Marshall).

TYPE SPECIES: *Lytrosis unitaria* Herrich-Schäffer; by original designation.
DISTRIBUTION: Eastern North America.

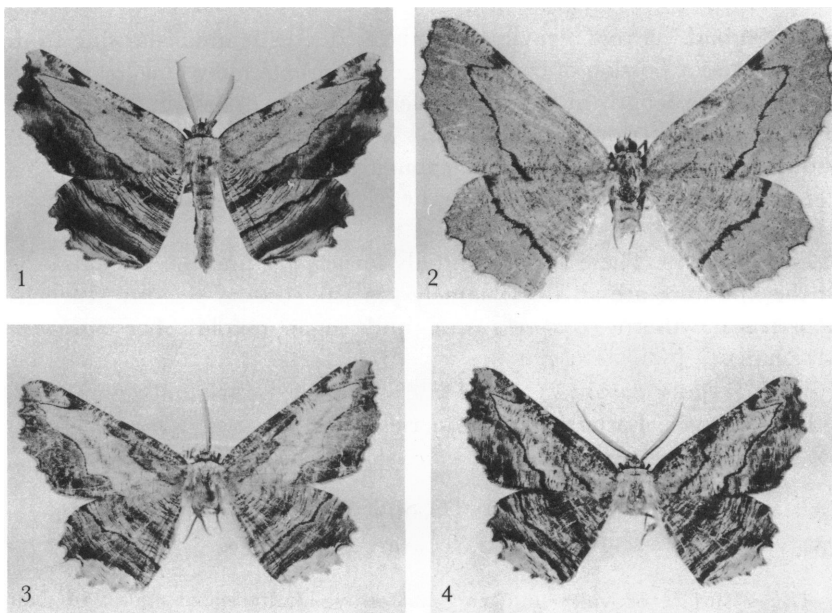
KEY TO SPECIES

BASED ON MACULATION AND COLOR

- 1. Upper surface of wings uniformly pale gray; hind tibia of male with hair pencil *permagnaria*
Upper surface of wings various shades of light brown, dark brown, and yellow; hind tibia of male without hair pencil 2
- 2. Upper surface of forewings with both t. a. and t. p. lines clearly defined and tending to be sinuous in course, and with median area yellowish or pale ochraceous gray, contrasting with noticeably darker brown and blackish brown basal and outer areas 3
Upper surface of forewings with both t. a. and t. p. lines tending to be relatively straight, the former tending to be weakly represented, and with median area not yellow, tending to be concolorous with basal area and only slightly paler than brown outer area *unitaria*
- 3. Upper surface of forewings with basal and outer areas pale to medium brown, and with median area light yellow *sinuosa*
Upper surface of forewings with basal and outer areas dark grayish brown or blackish brown, and with median area pale ochraceous gray *heitzmanorum*

BASED ON MALE GENITALIA

- 1. Valves with apex swollen, and covered with thick spines 2
Valves with apex not swollen, and covered with slender spines 3
- 2. Vesica armed with about six, separate, thick spines *permagnaria*
Vesica armed with about eight or 10 spines in two groups *unitaria*
- 3. Exserted vesica with spines extending more or less parallel with aedeagus *sinuosa*
Exserted vesica with spines extending at right angle to aedeagus *heitzmanorum*



FIGS. 1-4. Males. 1. *Lyttosia unitaria* (Herrich-Schäffer), Lakehurst, New Jersey, June 11-20 (F. Lemmer). 2. *L. permagnaria* (Packard), Oxford, Mississippi, August, 1949 (Hull). 3. *L. sinuosa*, new species, holotype, Smithville, New Jersey, June 22, 1949 (L. J. Sanford). 4. *L. heitzmanorum*, new species, holotype, 4 miles northwest of Warsaw, Missouri, May 31, 1949 (J. R. Heitzman). All $\times 1$.

BASED ON FEMALE GENITALIA

1. Ductus bursae flattened dorsoventrally, slightly swollen posteriorly, almost twice as wide as long; corpus bursae with posterior end enlarged on left side *permagnaria*
- Ductus bursae not as above; corpus bursae not enlarged posteriorly on left side 2
2. Ductus seminalis arising on right side of posterior end of corpus bursae 3
- Ductus seminalis arising dorsally from center of corpus bursae *sinuosa*
3. Corpus bursae with posterior margin set at about 30-degree angle to axis of structure *unitaria*
- Corpus bursae with posterior margin at approximately right angle to axis of structure *heitzmanorum*

Lyttosia unitaria (Herrich-Schäffer)

Figures 1, 5, 9, 13

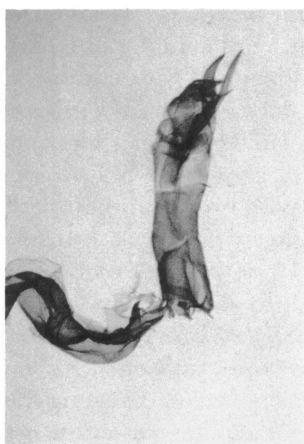
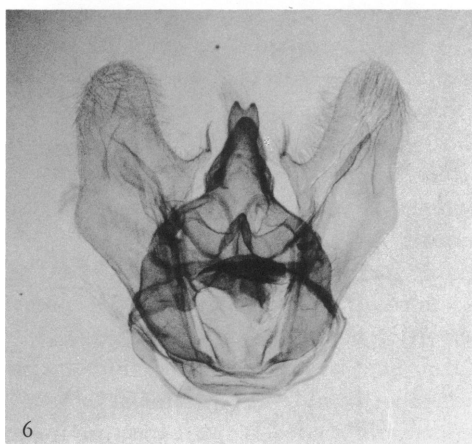
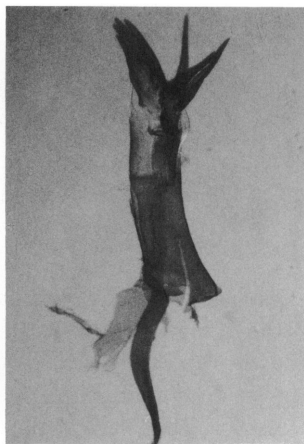
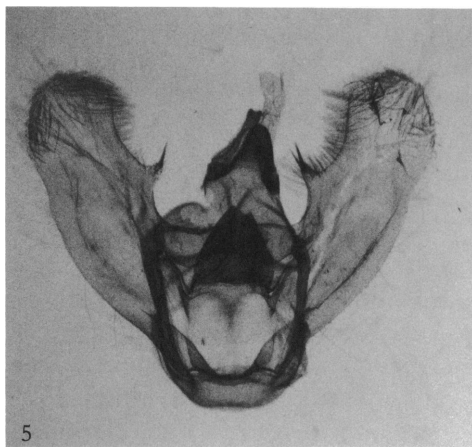
Synopsis unitaria HERRICH-SCHÄFFER, 1854 (1850-1858), p. 65.

Boarmia unitaria: HERRICH-SCHÄFFER, 1854 (1850-1858), p. 80, pl. 41, fig. 204.
Hemerophila unitaria: GUENÉE, 1857, p. 219. WALKER, 1860, pp. 317, 486. PACKARD, 1876, p. 447, pl. 11, fig. 29 (male). ANON., 1882, p. 24. GROTE, 1882, p. 49. BEUTENMÜLLER, 1890, p. 222. SMITH, 1891, p. 72. GUMPPENBERG, 1896, p. 330.
Lyttrosis unitaria: HULST, 1896, p. 348. DYAR, "1902" [1903], p. 322. SMITH, 1903, p. 76; 1910, p. 503. BARNES AND McDUNNOUGH, 1917, p. 116. FORBES, 1928, p. 602; 1948, p. 78. McDUNNOUGH, 1938, p. 167. JONES AND KIMBALL, 1943, p. 117. JERREL AND JAKUES, 1944, p. 465. TIETZ, [1952], p. 140. MULLER, 1953, p. 68. WYATT, 1954, p. 7. MOORE, 1955, p. 71. PRENTICE, 1963, p. 471. KIMBALL, 1965, p. 184. COVELL, 1970, p. 178.

DIAGNOSIS: This species can be separated from the others in the genus by the upper surface of the wings having various shades of brown or yellowish brown, by the forewings having an indistinct t. a. line and the median area being concolorous with the basal area of the wing.

MALE: Head, vertex and front dark brown, latter in some cases with paler scaling ventrally; palpi dark brown or dark grayish brown, with some paler scales terminally; antennae with about eight terminal segments serrate. Thorax above pale gray or gray, with small amount of brown scaling, and with narrow black band anteriorly next to head; below pale to dark grayish brown; legs light gray with variable amount of dark gray and dark brown scales; hind tibia without hair pencil. Abdomen light gray above and below, upper surface having variable number of brown, grayish brown, and blackish brown scales, and with at least each anterior segment having dark band posteriorly.

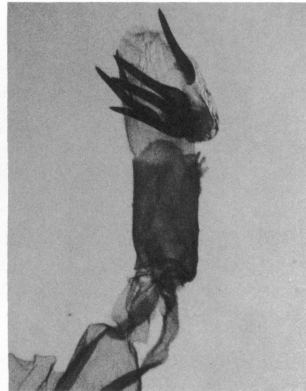
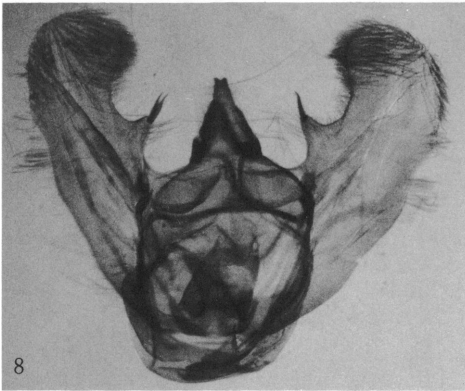
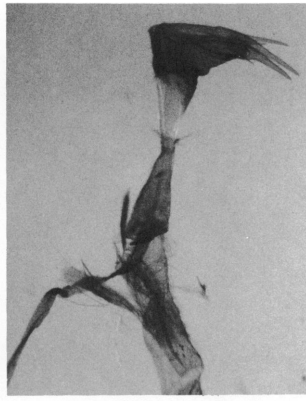
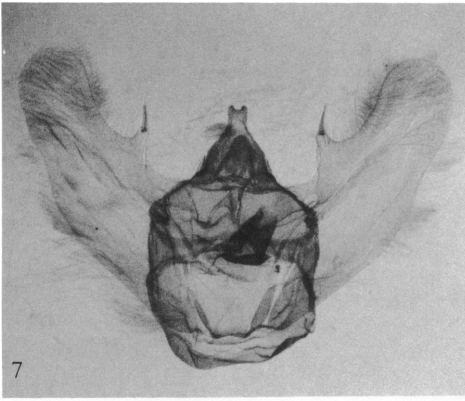
Upper Surface of Wings: Variable in color, being different shades of pale to dark brown, with basal two-thirds of forewings tending to be paler, often yellowish brown, than outer portion of wings; forewings with weakly developed and often incomplete t. a. line, its origin marked by blackish brown spot on costa one-third of distance from base, with line apparently swinging outwardly into cell, then sharply angled basally, meeting inner margin one-fifth of distance from base; discal spot small, round, dark; median shade line either weakly represented, incomplete, subparalleling t. p. line or absent; t. p. line arising on costa two-thirds of distance from base as prominent, inwardly directed dash about 2 mm. long, then sharply angled outwardly as slender line to within about 2 mm. of wing margin, sharply angled again and proceeding with slightly irregular course, more or less straight to inner margin, meeting latter basad of one-half of distance from base; s. t. line incomplete, pale; terminal area tending to be darkest in upper and lower portions of wing, separated by paler area; terminal line blackish brown, narrow, tending to be interrupted by veins; fringe variable in color, more or less concolorous with wing, in some specimens darkened opposite some veins. Hind wings concolorous with



FIGS. 5, 6. Male genitalia. 5. *Lytrosis unitaria* (Herrich-Schäffer), Conestee Falls, Brevard, North Carolina, June 21, 1941. 6. *L. sinuosa*, new species, paratype, Ocean County, New Jersey, June 15, 1952 (O. Buchholz).

forewings; basal two-thirds tending to be striate in rows of blackish brown scales parallel with extradiscal line; broad, dark, median band present, with discal dot included therein and often not separate; extradiscal line strongly represented, black, more or less straight, complete; subterminal area of wing darkened, in some specimens with nebulous pale band; terminal area in lower portion of wing concolorous with basal section of wing; terminal line incomplete; fringe similar to that of forewing.

Under Surface of Wings: Variable in color, ranging from pale yellowish

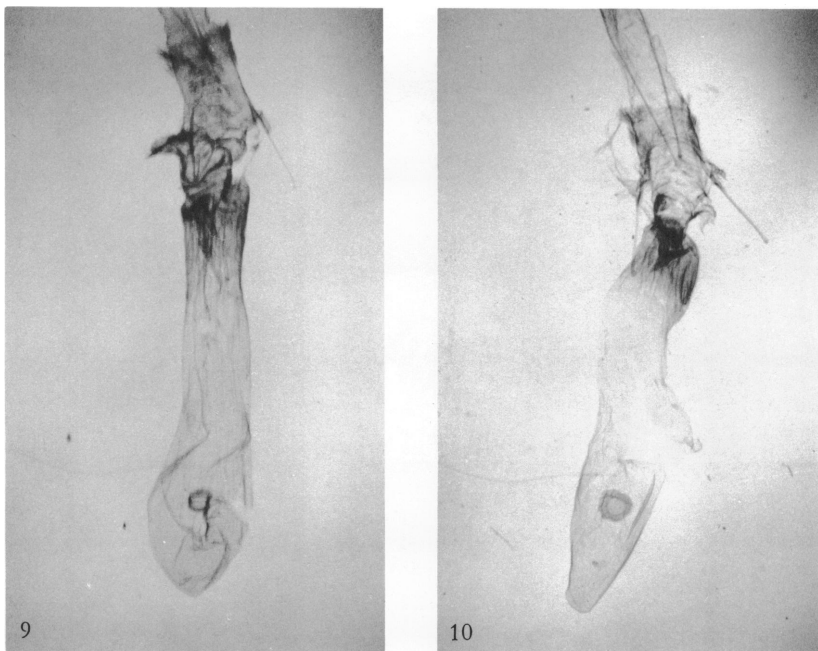


FIGS. 7, 8. Male genitalia. 7. *Lytrosis heitzmanorum*, new species, paratype, Tupelo, Mississippi, August 7, 1966 (C. Bryson). 8. *L. permagnaria* (Packard), Cleveland, Tennessee, May 24, 1970 (C. Bryson).

brown to dark brown, usually with outer portion of wings somewhat darker than basal area; t. p. and extradiscal lines complete, black, narrow, subparalleling outer margins of wings, outwardly dentate on veins; other cross lines absent in most specimens, although trace of s. t. line may be present on all wings; discal dots present on all wings, small, black; terminal line incomplete; fringe varying from being concolorous with, to darker than, wing.

Length of Forewing: 21 to 26 mm.

FEMALE: Similar to male, but tending to be slightly grayer in color and to have slightly less contrasting maculation.

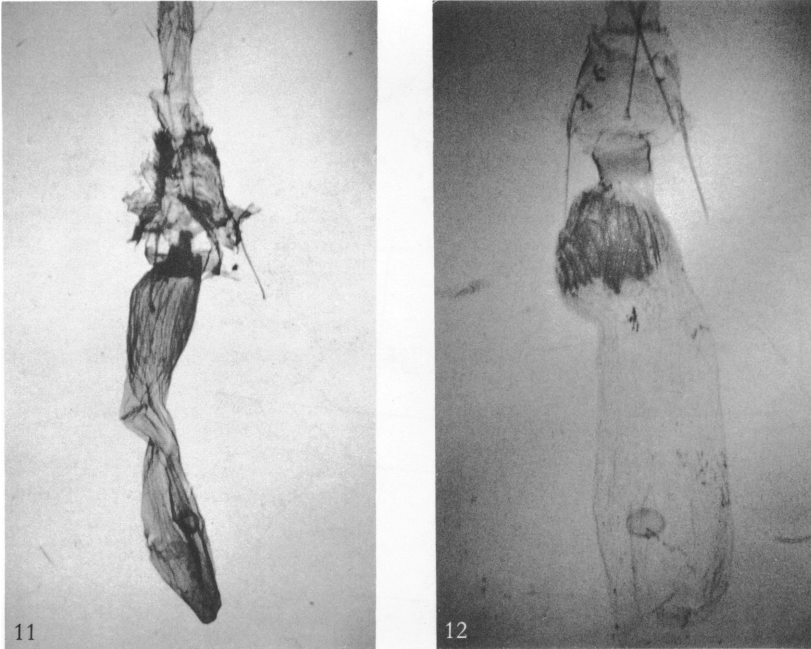


FIGS. 9, 10. Female genitalia. 9. *Lytrosis unitaria* (Herrich-Schäffer), Lakehurst, New Jersey, July 9-15 (F. Lemmer). 10. *L. sinuosa*, new species, allotype, Lakehurst, New Jersey, June 15, 1957 (J. Muller).

Length of Forewing: 24 to 30 mm.

MALE GENITALIA: Uncus with terminal attenuate portion almost twice as long as wide, about 0.1 mm. in width; gnathos with terminal portion bluntly rounded, apical portion as wide as, or wider than, terminal portion of uncus; valves with apical portion slightly swollen and tending to be covered with moderately thick setae; costal arm tending to be elongate and slender, with either two or three apical setae; anellus with posterior margin indented; aedeagus 1.0 to 1.1 mm. in length, often with spines of vesica protruding from posterior end; vesica armed with two groups of four or five thick spines apiece, each with smoothly sclerotized basal piece, anterior one with second basal plate; when exerted, posterior group of spines extending parallel with aedeagus, and spines of anterior group diverging at angle.

FEMALE GENITALIA: Sterigma membranous, tending to have a few transverse, curved folds; ductus bursae heavily sclerotized, about three times wider than long, occupying most of width of posterior end of corpus



FIGS. 11, 12. Female genitalia. 11. *Lytrosis heitzmanorum*, new species, allotype, 4 miles northwest of Warsaw, Missouri, May 31, 1969 (J. R. Heitzman). 12. *L. permagnaria* (Packard), holotype, Missouri.

bursae, and lying somewhat diagonally; ductus seminalis arising from right posterior point of corpus bursae; latter with posterior end sclerotized and with numerous longitudinal striations, asymmetrical, extending to point dorsally on right side; posterior apophyses 3.1 to 3.5 mm. in length.

EARLY STAGES: The egg and caterpillar have been described by Muller (1953).

FOOD PLANTS: Pin oak (*Quercus palustris* Muenchhausen; Muller, 1953); hawthorn (*Crataegus* sp.; Wyatt, 1954); sugar maple (*Acer saccharum* Marshall; Prentice, 1963).

TYPE: The location of Herrich-Schäffer's type is unknown.

TYPE LOCALITY: Tennessee.

DISTRIBUTION: Eastern North America (see fig. 13). The northern boundary is approximately at latitude 48° N., and ranges from southern Quebec and southeastern Ontario west to North Dakota. In the eastern United States *unitaria* occurs from southern Maine and Massachusetts south through Virginia, and down the Appalachian Mountains to North



FIG. 13. Distribution of *Lytrosis unitaria* (Herrich-Schäffer). In addition to the above localities, specimens have been examined from West Virginia; in the literature, the species is recorded from Iowa (Jerrel and Jaques, 1944), Oklahoma (Forbes, 1948), and Tennessee (Herrich-Schäffer, 1854 [1850-1858]).

Carolina, western South Carolina, and into northern Mississippi. On the west the approximate limit is longitude 100° W., ranging south into Texas. The specimen from Florida, recorded by Forbes (1948) is undoubtedly mislabeled, as Kimball (1965) did not report any specimens of this species from that state.

TIME OF FLIGHT: Mid May to mid August, with the majority of the specimens captured in June and July.

REMARKS: One hundred and twenty-three specimens (100 males and 23 females) and 10 genitalic dissections (seven males and three females) have been studied.

The upper surface of the wings varies in color, having different shades

of yellowish brown or grayish brown in the males; the females apparently are more constant, as they tend to be more uniformly brown and grayish brown. This variability is unquestionably individual in nature, as there does not seem to be any correlation with the geographic distribution.

***Lytrosis sinuosa*, new species**

Figures 3, 6, 10, 14

Lytrosis sp.: KIMBALL, 1965, p. 184.

DIAGNOSIS: This species may be distinguished from *unitaria* by having on its forewings more sinuous and more strongly represented t. a. and t. p. lines and by a paler, yellow median area that contrasts in color with both the basal and outer areas of the wings.

MALE: Head, vertex brownish gray, with brown scaling between bases of antennae; front and palpi with mixed dark gray, brown, and black scales; antennae with terminal 10 to 12 segments simple. Thorax above grayish white, with light brown scaling across patagia and thorax, and with black band anteriorly next to head; below pale gray to grayish brown; legs white or grayish white, with variable amounts of brown or brownish black scales; hind tibia without hair pencil. Abdomen light gray above and below, upper surface having variable number of brown, grayish brown, and brownish black scales, and with most segments having dark band posteriorly.

Upper Surface of Wings: Basal and outer portions of forewings medium brown, with contrasting yellow median area; pattern as in *unitaria*, but with both t. a. and t. p. lines more strongly and equally represented, more sinuous in course, and brown in color. Hind wings concolorous with forewings; similar to those of *unitaria* in pattern, but with extradiscal line tending to be slightly more sinuous in course; terminal area in lower portion of wing concolorous with median area of forewing.

Under Surface of Wings: Pale yellowish brown, more or less heavily suffused with dark brown and grayish brown scales and strigations; maculation similar to that of *unitaria*, but with wings tending to have more dark strigations, a larger discal dot on hind wings than on forewings, and to have a more prominent terminal line and fringe.

Length of Forewing: 24 to 27 mm.; holotype, 24 mm.

FEMALE: Similar to male, but tending to be duller and less contrastingly colored.

Length of Forewing: 27 to 29 (allotype) mm.

MALE GENITALIA: Similar to those of *unitaria* but differing mainly as follows: uncus variable, terminal portion weakly tapering and then having parallel sides, or with median constriction and slightly swollen terminal

portion, 0.2 to 0.3 mm. in width; gnathos with median portion either having straight or convex lateral margins, and with apex tending to be wider than that of *unitaria*; valves with apical portion not swollen, and covered with slender setae; costal arm variable in size and shape; anterior margin of valve varying from rounded to angulate; anellus with posterior margin rounded; aedeagus 1.8 to 1.9 mm. in length; vesica armed with two groups of three thick spines each, both with elongate, smoothly sclerotized basal piece; when exerted, both groups of spines extending more or less parallel with aedeagus.

FEMALE GENITALIA: Similar to those of *unitaria* but differing mainly as follows: ductus bursae more dorsoventrally flattened, along with posterior end of corpus bursae, situated somewhat diagonally; ductus bursae with raised dorsal lip; ductus seminalis arising dorsally from middle of right side near posterior end of corpus bursae; corpus bursae somewhat shorter (6 to 7 mm. instead of 7 to 10 mm.).

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Holotype, male, Smithville, Atlantic County, New Jersey, June 22, 1949 (L. J. Sanford); allotype, female, Lakehurst, [Ocean County], New Jersey, June 15, 1957 (J. Muller). The genitalia of the holotype are mounted on slide FHR 3813, and of the allotype on 16112. Paratypes: *New Jersey*: same data as holotype, two males; Ocean County, June 15, 1952 (O. Buchholz), one male; Lakehurst, [Ocean County], July 10, one female. *Virginia*: Ladysmith, [Mansemond County], found dead in gas station on June 27, 1969 (C. V. Covell), one male. *South Carolina*: Jackson, [Aiken County], May 9, 1959 (W. A. Tarpley), one male. *Mississippi*: "Ag. Coll." [State College, Oktibbeha County], May, 1893 (H. E. Weed), and "Ag. Coll., Mich." (*sic!*) (H. E. Weed), two males. *Florida*: Quincy, Gadsden County, May 2, 1967 (W. B. Tappen), one male; Torreya State Park, Liberty County, May 23, 1966 (G. W. Rawson), one male.

The holotype and allotype are in the collection of the American Museum of Natural History; paratypes are in the collections of that institution, the Museum of Comparative Zoology, the Florida Department of Agriculture, Division of Plant Industry, Gainesville, C. V. Covell, C. P. Kimball, and J. Muller.

DISTRIBUTION: Southeastern United States (see fig. 14). The species extends from the Pine Barrens of southern New Jersey as far south as northern Florida and west to Mississippi. Kimball (1965, p. 184) reported the species as occurring in Escambia County, Florida, late April, and in Tallahassee, Leon County, Florida, May; these specimens have not been examined.

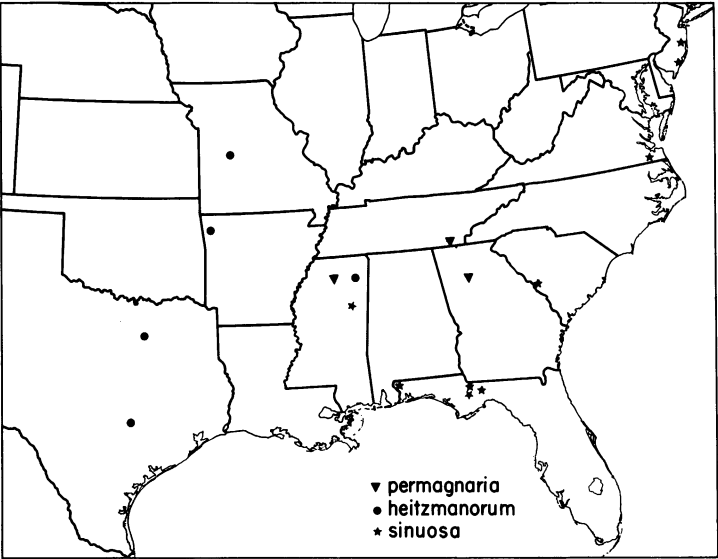


FIG. 14. Distribution of *Lytrosis sinuosa*, new species, *L. heitzmanorum*, new species, and *L. permagnaria* (Packard). In addition to the above localities, *permagnaria* is also known from Missouri.

TIME OF FLIGHT: Late April (in Florida) to mid July.

REMARKS: Twelve specimens (10 males and two females) and five genitalic dissections (three males and two females) have been studied.

The distribution of *unitaria* and *sinuosa* is generally allopatric, but the two species have been taken together at two localities. These are Jackson, Aiken County, South Carolina and Lakehurst, Ocean County, New Jersey.

ETYMOLOGY: The specific name is from the Latin *sinuosus*, referring to the sinuous nature of the t. p. line.

***Lytrosis heitzmanorum*, new species**

Figures 4, 7, 11, 14

DIAGNOSIS: This species is similar to *sinuosa* in the course of the cross lines on the upper surface of the forewings, but may be distinguished from it by the basal and outer portions of the forewings being much darker in color, often dark grayish brown or blackish brown, and with the median area being a pale ochraceous gray instead of yellow.

MALE: Head, vertex grayish white, with dark brown scaling at base of each antenna; front black with variable amount of grayish white scaling dorsally and ventrally; palpi with mixed pale gray, grayish black,

and black scaling; antennae with terminal nine or 10 segments simple. Thorax above pale grayish white, with a very few grayish black scales across patagia, and with black band anteriorly next to head; below grayish black anteriorly, becoming pale grayish white posteriorly; legs pale grayish white, with variable number of blackish brown and black scales; hind tibia without hair pencil. Abdomen pale gray above and below, upper surface with variable number of dark grayish brown and blackish brown scales, and with one or two anterior segments having black band posteriorly.

Upper Surface of Wings: Similar to that of *sinuosa* in pattern but with apical angle of t. p. line tending to be more acute; cross lines black; forewings with basal and outer areas pale gray, heavily covered with variable number and amount of brown, dark gray, and blackish brown scales and strigations; median area pale gray or ochraceous, more or less evenly covered with pale brown scales, and with a few grayish brown or grayish black strigations in some specimens. Hind wings concolorous with forewings or tending to be more heavily covered with black and grayish black strigations; similar to those of *sinuosa* in pattern.

Under Surface of Wings: Gray, more or less heavily marked with grayish black scales and strigations; pattern similar to that of *sinuosa*.

Length of Forewing: 22 to 26 mm.; holotype, 24 mm.

FEMALE: Similar to male, but tending to be less contrastingly colored; one specimen with upper surface more or less evenly covered with dark grayish brown strigations, practically obscuring pattern.

Length of Forewing: 26 to 29 mm.; allotype, 26 mm.

MALE GENITALIA: Similar to those of *sinuosa* but differing mainly as follows: uncus with terminal portion having parallel sides and being more or less square in outline, 0.2 mm. in width, and tending to have shallower median indentation; gnathos with evenly tapering sides; valves with costal arm shorter, bearing two spines; vesica armed with four or five spines, more slender and longer than those of *sinuosa*; when exerted, spines projecting at about right angle to aedeagus.

FEMALE GENITALIA: Similar to those of *sinuosa* but differing mainly as follows: sterigma without transverse ridges; ductus bursae not dorsoventrally flattened, wider than long, with lateral margins convex; ductus seminalis arising from right posterior end of corpus bursae; latter not dorsoventrally flattened posteriorly, with ductus bursae occupying slightly more than one-half of width of posterior end; corpus bursae tending to be more slender, 6.5 to 7.0 mm. in length.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Holotype, male, and allotype, female, 4 miles northwest of Warsaw, along Missouri state highway UU, Benton County, Missouri, May 31, 1969 (J. R. Heitzman); both specimens are from the collection of J. R. Heitzman. The genitalia of the holotype are mounted on slide FHR 16059, and of the allotype on 16126. Paratypes: *Missouri*: same data as type, May 21, 1962, June 4, 1966, June 3, 6, 1967, June 6, 1968, May 31, 1969, May 22, 1970 (J. R. Heitzman, Roger L. Heitzman, Robert Heitzman), 14 males and two females. *Arkansas*: Washington County, June 7, 1961 (L. J. Paulisson), one female. *Mississippi*: Tupelo, Lee County, August 7, 1966, May 20, 21, 22, 24, 1968 (C. Bryson), May 13, 16, 18, 19, 20, 21, 22, 1970 (J. Bryson), 11 males and four females. *Texas*: Bastrop County, April 24, 1963 (A. Blanchard), one male; Dallas, [Dallas County], (Boll), one female.

The holotype and allotype are in the collection of the American Museum of Natural History; paratypes are in the collections of that institution, the Museum of Comparative Zoology, J. Richard Heitzman, Roger L. Heitzman, Robert Heitzman, Bryant Mather, and Charles Bryson.

DISTRIBUTION: South-central portion of the United States (see fig. 14). This species is known from Missouri, Alabama, northern Mississippi, and eastern Texas.

TIME OF FLIGHT: Late April (southern Texas) to early August. The specimens collected by the Heitzmans were all taken at ultraviolet light, with the females flying between 9:30 and 10:30 P.M., and the males, with one early exception, were caught between 11:30 P.M. and 1:15 A.M.; all times are central standard (J. R. Heitzman, in letters).

REMARKS: Thirty-six specimens (27 males and nine females) and seven genitalic dissections (four males and three females) have been studied.

This species is unique in the genus in the manner in which the vesica is exerted; no other species has the spines of the vesica projecting at right angle to the aedeagus.

ETYMOLOGY: It gives me great pleasure to name this species after Mr. J. Richard Heitzman and his two sons, Roger L. and Robert Heitzman, of Independence, Missouri.

Lytrosis permagnaria (Packard)

Figures 2, 8, 12, 14

Stenotrachelys permagnaria PACKARD, 1876, p. 450, pl. 11, fig. 31 (type female). GROTE, 1882, p. 49. SMITH, 1891, p. 72; 1903, p. 76. HULST, 1896, p. 348. DYAR, "1902" [1903], p. 322. BARNES AND McDUNNOUGH, 1917, p. 116. McDUNNOUGH, 1938, p. 166.

Stenotrachelis (sic!) *permagnaria*: ANON., 1882, p. 24.

Hemerophila permagnaria: GUMPPENBERG, 1896, p. 311.

Lytrosis permagnaria: FORBES, 1948, p. 78.

DIAGNOSIS: This species can be separated from all other species in the genus by the upper surface of the wings being a uniform pale brownish gray. In addition, the angle of the t. p. line is about 5 mm. from the outer margin of the forewing; in all the other species, this distance is about 2 mm.

MALE: Head, vertex grayish white; front grayish black, with grayish white scales dorsally and ventrally; palpi dark brown or blackish brown. Thorax above pale gray, with a few grayish brown or grayish black scales, and with narrow black band anteriorly next to head; below pale gray; legs pale gray or grayish brown, with variable number of brown scales; hind tibia with hair pencil. Abdomen light gray above and below, upper surface with scattered grayish brown and a few dark brown scales, and with dark posterior bands on segments.

Upper Surface of Wings: All wings an even pale brownish gray, having a few, scattered brownish black scales; forewings with t. a. line obsolescent, marked on costa at two-fifths distance from base by large, diffuse spot, and weakly represented in lower portion of wing in some specimens; discal spot absent; t. p. line black, complete, arising on costa as large spot about two-thirds of distance from base, narrowing and curving outwardly to within 5 mm. of wing margin, then angled and subparalleling outer margin, being weakly sinuate, meeting inner margin just beyond middle; s. t. line absent or very weakly indicated by a few pale gray scales; terminal line brownish black, more or less interrupted by veins; fringe white, becoming brownish gray at vein endings. Hind wings with basal portion weakly strigate with brownish gray scales; discal dot absent; extradiscal line black, complete, thicker than on forewings, weakly S-shaped; subterminal area, terminal line, and fringe similar to those of forewings.

Under Surface of Wings: All wings uniformly light gray, with some brownish gray scales and strigations; discal dots black, present on all wings; outer cross line present on all wings, subparalleling outer margin of wings, and outwardly dentate on veins; terminal line tending to be slightly thinner and paler than on upper surface; fringe similar to that of upper surface.

Length of Forewing: 27 to 28 mm.

FEMALE: Not examined. According to Packard's original description and illustration, the female is similar to the male but may tend to have more dark scaling and strigations on the upper surface of the wings.

Length of Forewing: Approximately 29 or 30 mm.

MALE GENITALIA: Similar to those of *unitaria* but differing mainly as

follows: uncus with terminal lobes larger; valves with apical portion more strongly swollen; each costal arm with broader base, and bearing three apical setae; aedeagus 2.7 mm. in length; vesica armed with five separate, large, thick spines and one much smaller spine; when exerted, vesica curves back along side of aedeagus, with spines pointing posteriorly.

FEMALE GENITALIA: Similar to those of *unitaria* but differing mainly as follows: ductus bursae flattened dorsoventrally, slightly swollen posteriorly, maximum width 0.95 mm., almost twice as wide as long; ductus seminalis apparently arising from near end of corpus bursae ventrad of ductus bursae; corpus bursae with posterior end asymmetrical, swollen on left side, sclerotized, and having longitudinal striations, with small, bluntly pointed swelling ventrad of anterior margin of ductus bursae; corpus bursae with anterior portion membranous, of even width, having faint longitudinal striations, entire structure about 7.5 mm. in length; signum more or less flat, with narrow anterior projection. (The papillae anales are lacking, so an accurate measurement of the apophyses posteriores is impossible; the longest remnant of one of these apophyses is 2.5 mm.)

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPE: The holotype, female, is in the collection of the United States National Museum and is in poor condition. The genitalia are mounted on slide HWC 1324.

TYPE LOCALITY: Missouri, collected by C. V. Riley.

DISTRIBUTION: South central United States (see fig. 14). The species is known from single specimens from Missouri, northern Mississippi, Tennessee, and northwestern Georgia. The species appears restricted to areas of oak, hickory, and pine forests.

TIME OF FLIGHT: May and August.

REMARKS: Two male specimens and two genitalic dissections (one male and one female) have been studied.

This species is one of the rarest of the geometrids found in the United States. Heitzman has done extensive collecting in Missouri, the state in which the type specimen was collected, but he has never caught any specimens of this species.

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