

THE *EUPITHECIA* (LEPIDOPTERA: GEOMETRIDAE) OF TEXAS,
WITH THE DESCRIPTION OF A NEW SPECIES

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Abstract.—Twenty-three species of *Eupithecia* (Geometridae: Larentiinae) are listed from Texas. Nineteen of these are illustrated with figures of the adult male, male genitalia, inflated vesica, and sclerotizations of the eighth abdominal segment. One new species, *Eupithecia fredericki*, is described from western Texas. Ten of the included species represent new state records.

Eupithecia Curtis is a huge, cosmopolitan genus of small, usually obscurely colored geometrid moths. Most of the described species occur in the palearctic and nearctic regions, with over 160 species occurring in America north of Mexico, predominantly in forested areas in northern and western U.S.A. and in Canada. The moths are all similar in appearance, with elongate forewings and small rounded hindwings, usually colored gray or brown with obscure transverse markings. Many species are indistinguishable, or nearly so, in color and pattern and genitalic dissection is required for accurate species determination. The life history is unknown for most North American species, but the larvae so far known feed on foliage, buds, and flowers of many kinds of plants, including conifers. Many are host specific. Much interest was aroused by the recent discovery of several predatory species in Hawaii, in which the larvae are highly modified, enabling them to capture fruit flies and other small insects (Montgomery, 1983).

Eupithecia and related genera were last revised for North America by James H. McDunnough (1949). Since this revision, additional species have been described by Roger L. Heitzman and Wilbur R. Enns (1977), and Frederick H. Rindge (1952, 1956, 1963, 1985), who found also several of McDunnough's (1949) determinations to be in error. The authors' interest in this genus was aroused in April 1977, when the senior author succeeded in inflating the vesica of *E. prostrata* McDunnough (slide AB 4061), using the technique described by Charles L. Hogue (1963), with a few minor modifications. The results were so interesting that we felt all available species should be studied in the same manner. Over 100 vesica inflations were performed on Texas examples, showing great differences between species, including those quite similar in other respects, although there appeared to be little variation within each species. We felt, therefore, that this information would make a valuable contribution to the study of these moths. Prior publications have usually figured only portions of the male genitalia and not inflated vesica. Because much significance has been attached to the size and shape of the sclerotized structures within the aedeagus, it is obvious that vesica inflation best demonstrates these structures.

By mid 1984, 18 of the 22 species of *Eupithecia* known by us to occur in Texas had been successfully dissected, including inflation of the vesica. Of the remainder, insufficient material was at hand. Presented here are illustrations of these 18 species, including the adult male, male genitalia, inflated vesica, and eighth abdominal segment sclerotizations. Additionally, a new species of *Eupithecia* is described and illustrated. This description is to be attributed to the junior author only. The remaining four species, three of which appear to represent new Texas records, are listed in the text. The arrangement given follows that of Douglas C. Ferguson in the most recent checklist of North American Lepidoptera (Hodges et al., 1983).

VESICA INFLATION

For a detailed description of this technique, the reader is advised to study the method in Hogue (1963). Briefly, the operation is performed under a dissecting microscope, upon which the watch glass containing the aedeagus is immobilized in a wooden platform. The tip of the caecum of the aedeagus is cut off with microscissors, and in most cases, it is necessary to pull the vesica part way out posteriorly, to clear the anterior end of the aedeagus. This requires great care, as the vesica is easily damaged. We use 30 or 32 gauge hypodermic needles rather than glass cannulas, and these are attached to a 2 cc glass syringe. The bevel of the needle must be reduced to a blunt tip with fine grade emery paper, before use. The syringe and needle are held in place with modeling clay, so that both hands are free for manipulation of the aedeagus. The aedeagus is then inserted over the needle tip, pushing ahead the vesica beyond the entrance of the ductus ejaculatorius. Once in place, the aedeagus is secured to the needle with a knotted loop of nylon thread. Gentle pressure on the plunger will then result in inflation of the vesica. Occasionally, a portion of the vesica may be trapped between the aedeagus and needle, and it is then necessary to untie and repeat the process, making sure that the vesica is entirely ahead of the needle tip. Inflation is performed in water, usually with alcohol in the syringe. After initial inflation, the water in the watch glass may be replaced with alcohol and pressure continued to assure maximum inflation. If photography is contemplated, the aedeagus can be stained in advance, using mercurochrome, or, following inflation, with an alcohol soluble stain, such as eosin Y. At times, the vesica will take very little stain and is then difficult to photograph. The senior author has found dark blue or green gelatin filters to be of great help in improving the contrast in these cases.

Our figures of adults and genitalia are at varying degrees of magnification. Forewing length (in mm) is given for each adult figured. The segments in other figures represent 1.0 mm. The figures of the eighth abdominal segment show the sternite (ventral plate) on the right, except Fig. 4, which shows only the sternite. Genitalia dissections are by junior author; photography is by senior author.

Eupithecia peckorum Heitzman & Enns (1977)

Figs. 1-4

This distinctively marked, reddish brown species has been well described by Heitzman & Enns (1977) and Rindge (1985). Photos of a Texas male and its genitalia were sent to Heitzman, who confirmed its identity. Specimens were collected by us in Texas at Conroe, Montgomery Co., Huntsville State Park, Walker Co., and Town Bluff, Tyler Co., all in March.

***Eupithecia longidens kerrvillaria* Cassino & Swett (1924)**

Figs. 5-8

This taxon was reduced to subspecific rank by McDunnough (1949). Nominate *longidens* (Hulst) is not known to occur in Texas. Fresh specimens are greenish, quickly fading to gray. Recently collected Texas material includes the following: Kerr Co., Hunt, (March, October); Bexar Co., Ebony Hill Research Station (March); Bosque Co., Laguna Park (March); and Bell Co., Belton Reservoir (April).

***Eupithecia ornata* (Hulst) (1896)**

Figs. 9-12

This species is light gray with well defined blackish markings. It is well described by McDunnough (1949), who included New Mexico and Utah in its range. Rindge (1963) reported this species from British Columbia, Wyoming, and Arizona. Texas specimens in our collections include the following: Brewster Co., Big Bend National Park, Chisos Basin (March, April); Green Gulch (May, August); Jeff Davis Co., Mt. Locke (April, July, August); Davis Mountains State Park (April, August).

***Eupithecia maestosa* (Hulst) (1896)**

This name is tentatively applied to two females collected in Texas that match the description and figures of McDunnough (1949). Until males are collected in Texas, the identity will remain doubtful. Texas examples: Brewster Co., Big Bend National Park, Green Gulch, 29-IX-81, 2 ♀, genitalia on slides ECK 176 and ECK 180.

***Eupithecia edna* (Hulst) (1896)**

Figs. 13-16

This species is dark brownish gray, with heavy blackish markings. McDunnough (1949) reported its occurrence in Arizona and New Mexico. Rindge (1963) reported it from California. We collected this species in Texas only in Culberson Co., Sierra Diablo Wildlife Management Area (May, June, September), where it is common.

***Eupithecia placidata* Taylor (1908)**

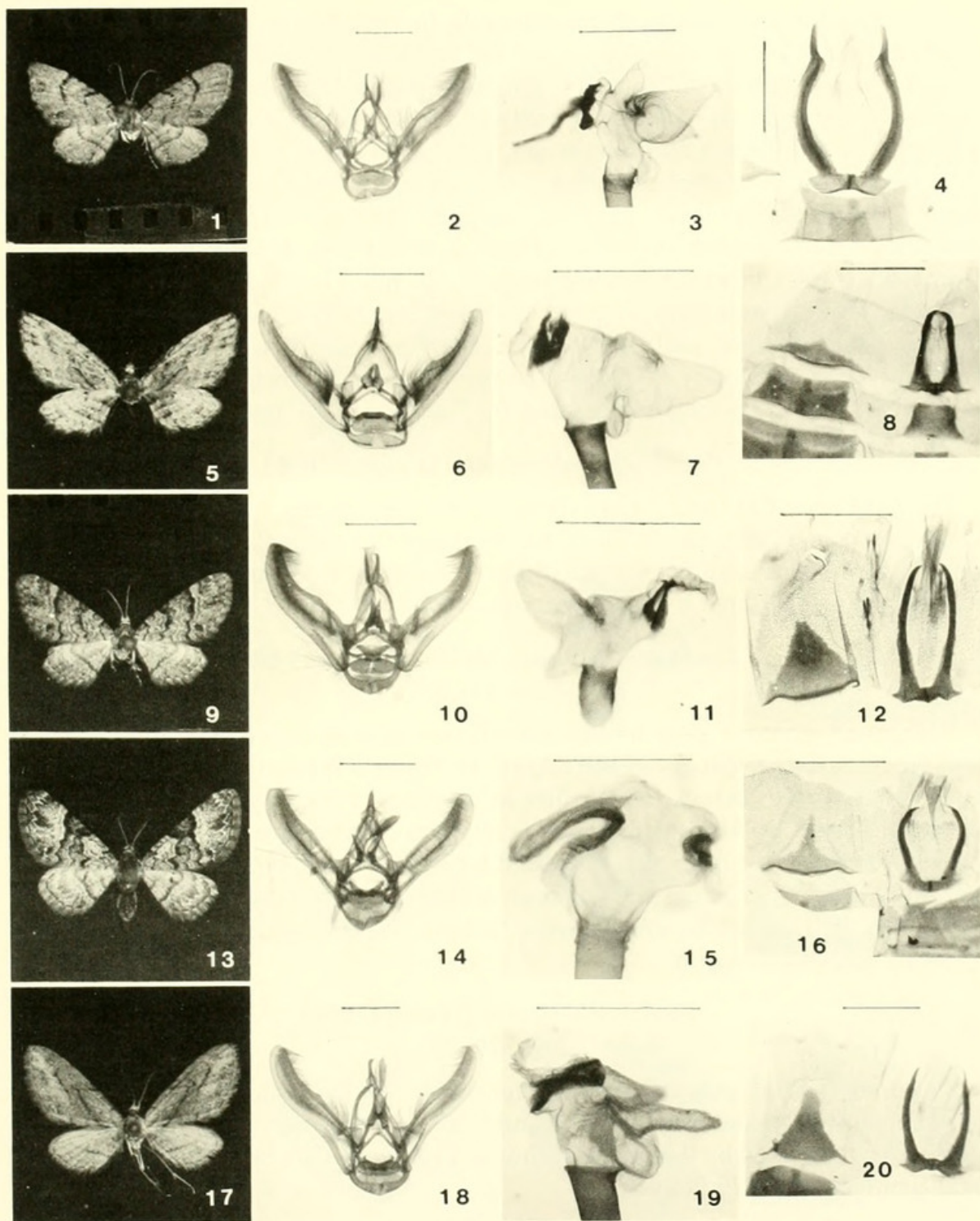
Figs. 17-20

This distinctively marked species may have yellowish green tints when fresh, but fades quickly to gray. McDunnough (1949) reported it from northern California and along the upper Pacific coast. Examples from Utah and Arizona were placed here tentatively. Photos of a Texas male and genitalia were sent to Klaus B. Bolte, who reported (in letter), "ECK 561 (Figs. 17-20) certainly appears to be *placidata*. The picture of the everted vesica matches my examples quite well." All Texas specimens were collected by us in Brewster Co., Big Bend National Park, Chisos Basin (March, September, October), and Green Gulch (August, September).

***Eupithecia miserulata* Grote (1863)**

Figs. 21-24

This taxon is by far the most widely distributed species in Texas and the most common in the eastern half of the state. Adults vary from dark gray to yellowish



Figs. 1-20. Left column, ♂; second column, ♂ genitalia; third, inflated vesica; fourth, 8th abdominal segment. All specimens from Texas. 1-4, *E. peckorum*, all from Conroe, Montgomery County: 1 and 3, 17-III-66, A. & M. E. Blanchard, slide AB 5259, forewing 9.2 mm; 2 and 4, 13-III-83, E. Knudson, slide ECK 609. 5-8, *E. longidens kerrvillaria*, Ebony Hill Research Sta., Bexar Co., 11-III-84, E. Knudson, slide ECK 1013, forewing 8.8 mm. 9-12, *E. ornata*, Mt. Locke, Jeff Davis Co., 5-VIII-69, A. & M. E. Blanchard, slide AB 5232, forewing 10 mm. 13-16, *E. edna*, all from Sierra Diablo, Culberson Co.: 13, 27-VI-81, E. Knudson, forewing 9.7 mm. 14-16, 1-IX-69, A. & M. E. Blanchard, slide AB 5233. 17-20, *E. placidata*, Big Bend Nat'l. Park, Chisos Basin, Brewster Co., 29-III-82, slide ECK 561, forewing 9.6 mm.

brown in color and also vary considerably in size. Males can be identified by examination of the antennae, in which the segments of the flagellum are swollen distally, and with long ciliate setae. The male genitalia are most distinctive, with very large hair pencils attached broadly to the dorsal surfaces of the valvae and possessing two kinds of modified scales, one hairlike and the other spatulate (Fig. 22). Texas examples were collected mainly from October to May, but have also been taken in the summer months. Examples in our collections are from the following Texas counties: Anderson, Bastrop, Bell, Bexar, Blanco, Bosque, Brown, Cameron, Cass, Culberson, Dallas, El Paso, Hardin, Harris, Harrison, Hemphill, Hidalgo, Hill, Montgomery, Orange, Presidio, San Jacinto, San Patricio, Tarrant, Travis, Tyler, Walker, and Washington. This species is known to feed on many different kinds of woody and non-woody plants. An example from San Jacinto county was reared by the junior author on flower petals of blackberry (*Rubus* sp.).

***Eupithecia coloradensis* (Hulst) (1896)**

We have seen only one Texas specimen of this species, a female, collected in Culberson Co., Nickel Creek, 26-V-81, by the junior author. The maculation and female genitalia are sufficiently distinctive to leave no doubt as to the correct identity (as determined by McDunnough, 1949).

***Eupithecia jejuna* McDunnough (1949)**

Figs. 25–28

This small, obscure, gray species is fairly common in eastern and central Texas and flies from late February to early April. In Texas, it is most likely to be confused with *E. swettii* Grossbeck, which flies at the same time of year and in many of the same localities. However, *swettii* is larger and differences in the antennae of the two species have been well discussed by Rindge (1985). *E. jejuna* flies from February to April in Texas and has been collected by us in the following counties: Anderson, Bell, Bexar, Bosque, Harris, Jackson, Kerr, Marion, Montgomery, San Patricio, and Washington.

***Eupithecia sierrae* (Hulst) (1896)**

Figs. 29–32

This long winged, gray species was reported by McDunnough (1949) from New Mexico, Arizona, and California. Rindge (1963) reported it from Utah. This species was collected by the senior author in Culberson Co., Sierra Diablo Wildlife Management Area, 29,30-V-73.

***Eupithecia bolteri* (Hulst) (1900)**

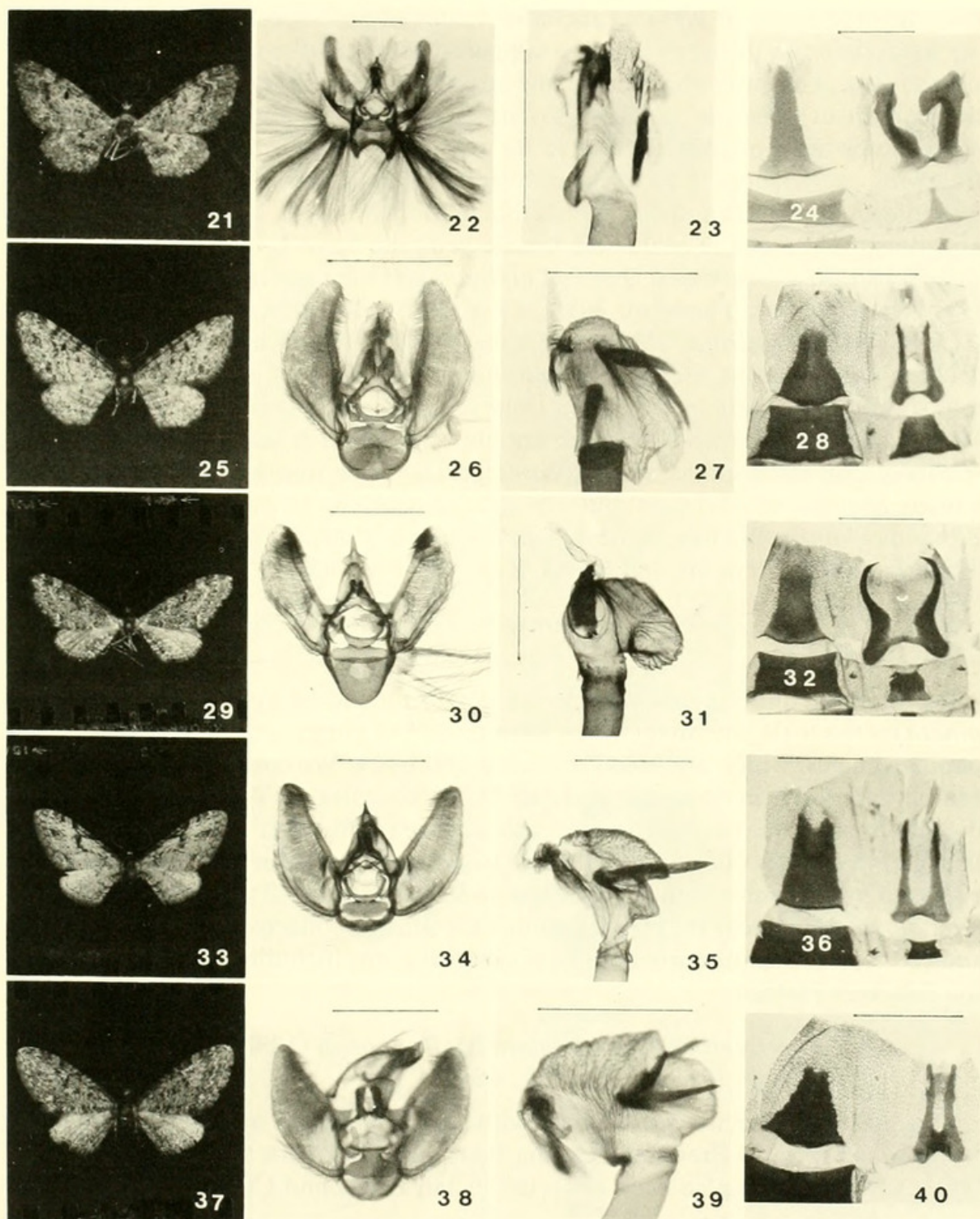
Figs. 33–36

This fairly large species, when fresh, is silvery gray, with brownish markings. It is the most abundant spring *Eupithecia* in the upper elevations of Big Bend National Park. We collected this species in March and April in the following Texas counties: Bexar, Brewster, Culberson, Jeff Davis, and Kerr.

***Eupithecia alpinata* Cassino (1927)**

Figs. 37–40

This species and the next, *prostrata* McDunnough, are obscurely marked gray moths, indistinguishable from each other in pattern. McDunnough (1949) noted



Figs. 21-40. Left column, ♂; second column, ♂ genitalia; third, inflated vesica; fourth, 8th abdominal segment. All from Texas. 21-24, *E. miserulata*, Laguna Atascosa, Cameron Co., 11-XI-79, slide ECK 1014, forewing 9.5 mm. 25-28, *E. jejuna*, 25, Houston, Harris Co., 2-III-70, A. & M. E. Blanchard, forewing 8.1 mm. 26-28, Tennessee Colony, Anderson Co., 22-III-81, E. Knudson, slide ECK 578. 29-32, *E. sierrae*, all from Sierra Diablo, A. & M. E. Blanchard: 29-31, 30-V-73, slide AB 5244, forewing 11.1 mm. 32, 29-V-73, slide AB 5218. 33-36, *E. bolteri*, all from Jeff Davis Co., A. & M. E. Blanchard: 33, Ft. Davis, 25-III-68, forewing 11.2 mm. 34-36, Mt. Locke, 3-IV-70, slide AB 5216. 37-40, *E. alpinata*, Ft. Davis, 25-III-68, A. & M. E. Blanchard, slide AB 5243, forewing 10.2 mm.

that the type series of *alpinata* included males of both species and he based the sex association in this revision on a supposed genitalic dissection of the holotype of *alpinata*. This was contrary to the sex association made at the time of the description of *prostrata* in 1938. To attempt to clarify the matter, the authors sent photos (as represented here) of the two species to K. Bolte, who made the following comments. "I have recently gone over the problems associated with *alpinata* and *prostrata* and discovered that in McDunnough, 1949, the descriptions and illustrations of the male and female genitalia have been mismatched. The male *prostrata* as illustrated is in fact *alpinata* and the male *alpinata* as illustrated is in fact *prostrata*. Therefore AB 5243 (Figs. 37–40) is *alpinata* and ECK 586 (Figs. 41–44) is *prostrata*." These findings are well borne out in the sex associations found in our material. McDunnough's comments about the male antennae of the two species are also reversed in the 1949 revision, as *alpinata* is the species with shorter, more numerous setae. The female of *alpinata* is easily distinguished by the long, pointed papillae anales. Both species occur together in the Davis and Chisos Mountains of Texas, but *alpinata* also occurs in central Texas, on the Edwards Plateau. We have collected *alpinata* in March and April in the following Texas counties: Brewster, Jeff Davis, Kerr, and Kimble.

***Eupithecia prostrata* McDunnough (1938)**

Figs. 41–44

See remarks under preceding species. *Prostrata* can be distinguished from *alpinata* by the male antennae, which have fewer but longer setae and by the female papillae anales, which are broad, rounded and hairy. We collected this species in March and April in Brewster and Jeff Davis counties of Texas. Curiously, the distribution of the two species in each author's collection was quite different, though most were collected in the same localities at the same time of year. Those collected by the senior author, in the late 1960's, showed a 10 to 1 ratio of *prostrata* over *alpinata*, whereas the junior author's specimens, collected in the early 1980's, showed a 5 to 1 ratio of *alpinata* over *prostrata*, not including the *alpinata* from the Edwards Plateau.

***Eupithecia persimulata* McDunnough (1938)**

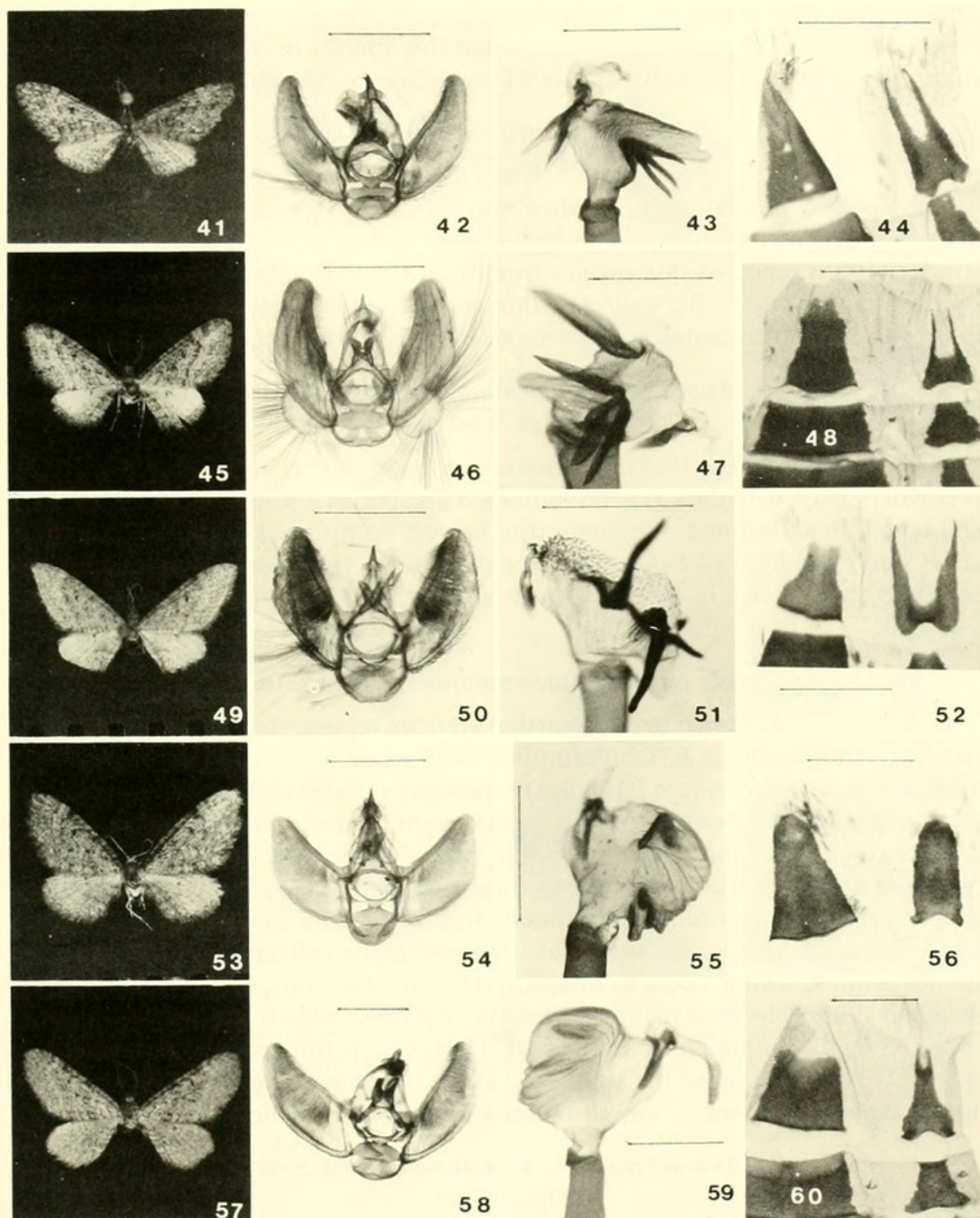
Figs. 45–48

This fall-flying species is dark gray, with a purplish sheen in fresh material. We found it common in Brewster Co., Big Bend National Park from late August to early October. It has also been collected in Jeff Davis and Culberson counties.

***Eupithecia matheri* Rindge (1985)**

Figs. 49–52

This species was described and illustrated by McDunnough (1949) as *herefordaria* Cassino & Swett. The differences between this species and the true *herefordaria*, which is known only from Arizona, are pointed out by Rindge (1985). Rindge has examined a dissected male and female from our material and identified them as *matheri*, including a female from Jeff Davis County. McDunnough (1949) also reported this species from Jeff Davis County (as *herefordaria*). This species is rather pale brownish gray and superficially similar to worn examples of *alpinata*



Figs. 41-60. Left column, ♂; second column, ♂ genitalia; third, inflated vesica; fourth, 8th abdominal segment. All from Texas. 41-44, *E. prostrata*, Big Bend Nat'l. Park, Green Gulch, 28-III-83, E. Knudson, slide ECK 586, forewing 9.0 mm. 45-48, *E. persimulata*, Big Bend Nat'l. Park, Chisos Basin, 14-IX-82, E. Knudson, slide ECK 1021, forewing 8.5 mm. 49-52, *E. matheri*, Ft. Davis, 29-III-83, E. Knudson, slide ECK 587, forewing 9.0 mm. 53-56, *E. swettii*, New Caney, Montgomery Co., 20-II-82, E. Knudson, slide ECK 576, forewing 10.1 mm. 57-60, *E. zygaeniata*, all from Laguna Park, Bosque Co.: 57 and 60, 28-III-81, E. Knudson, slide ECK 1010, forewing 12.5 mm. 58, 26-III-73, A. & M. E. Blanchard, slide AB 5196. 59, 27-III-73, A. & M. E. Blanchard, slide AB 5253.

or *prostrata*. The males can be distinguished by the antennal setae, which are longer than those of *prostrata*. We collected this species in Marion County (February), Kerr County (March), and Jeff Davis County (March, April).

***Eupithecia swettii* Grossbeck (1907)**

Figs. 53–56

This species may be greenish when very fresh, but the color quickly fades to brownish-gray. It is rather common in early spring in east Texas woodlands. Rindge (1985) reported this species from Texas based on information provided by the junior author. We collected this species in February and March in the following east Texas counties: Anderson, Harris, Marion, and Montgomery.

***Eupithecia zygadeniata* Packard (1876)**

Figs. 57–60

This is the largest *Eupithecia* species occurring in Texas. The color of the wings is powdery gray, with dark gray cross lines. This species is known only from Texas and is rare in collections. We found it to be very common at the type locality, in areas where the food plant *Zygadenus nuttalli* Gray (Liliaceae), is abundant. We collected this species in Bosque Co. (March), Comal Co. (May), and Kerr Co. (May).

***Eupithecia pusillata interruptofasciata* Packard (1873)**

This subspecies is considered a North American representative of the palearctic species, *pusillata* Denis & Schiffermüller. This name has been recently found to have priority over *sobrinata* (Hübner) (Ferguson *in* Hodges et al., 1983). Although this subspecies was described from Texas, no subsequent specimens have been collected in or near this state. According to McDunnough (1949), *interruptofasciata* was described from a series including three different species, the types being later restricted to two female specimens from Texas by Swett. Presumably the locality of the holotype is accurate, as it was evidently collected by Belfrage. This species is not known to occur in Missouri (Heitzman & Enns, 1978) or Mississippi (Rindge, 1985). The food plant is known to be juniper, which is abundant in areas collected by the authors in central Texas. However, as this species flies late in the year, it is possible that in the southern part of its range it flies very late, perhaps during the winter months, and thus could be missed by collectors.

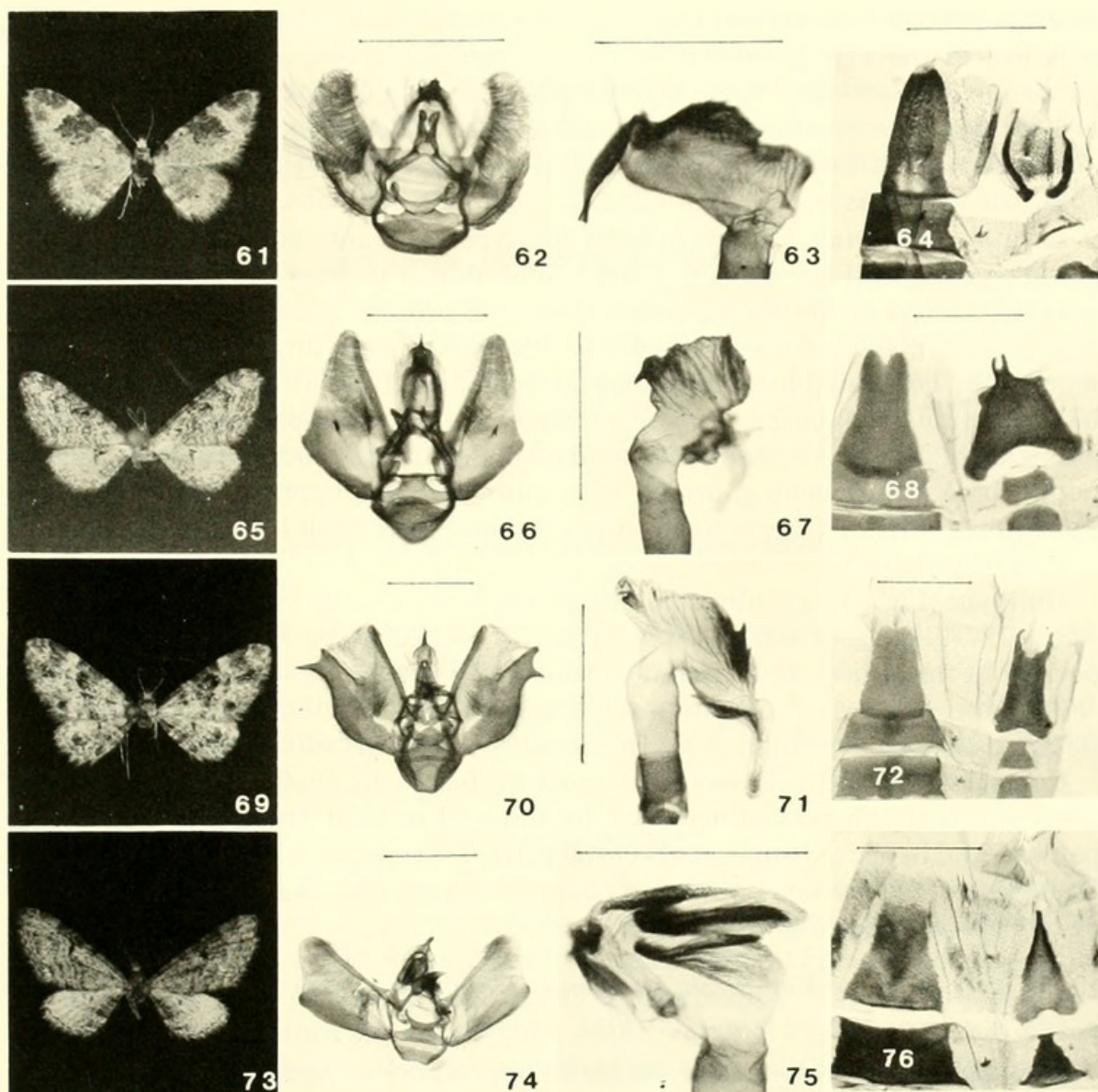
***Eupithecia fredericki* E. Knudson, NEW SPECIES**

Figs. 61–64

Male.—Head. Front pale ochreous, slightly bulging; vertex pale ochreous; labial palpi pale ochreous, porrect, barely exceeding front. Antennae with scape pale ochreous; flagellum with segments slightly longer than wide, clothed dorsally with two scale rows per segment, alternating whitish and brown; ventrally densely covered with very short setae.

Thorax pale ochreous above and beneath; legs pale ochreous with brownish scales along anterior surface of tibiae, tarsi faintly banded with brown at the joints.

Abdomen pale ochreous. 8th sternite (ventral plate) shown in Fig. 64, consisting of unequal sized, outwardly curved, tapering sclerotized rods, the longer being dextral.



Figs. 61–76. Left column, ♂; second column, ♂ genitalia; third, inflated vesica; fourth, 8th abdominal segment. All from Texas. 61–64, *E. fredericki*, new species, Sierra Diablo, 27-VI-81, E. Knudson, slide ECK 579, forewing 7.5 mm. 65–68, *E. huachuca*, Sierra Diablo, 16-IX-82, E. Knudson, slide ECK 565, forewing 7.9 mm. 69–72, *E. woodgatata*, Sierra Diablo, 16-IX-82, E. Knudson, slide ECK 529, forewing 8.3 mm. 73–76, *E. pertusata*, Big Bend Nat'l. Park, Chisos Basin, 2-X-67, A. & M. E. Blanchard, slide AB 5258, forewing 8.9 mm.

Upper surface of wings. Ground color pale ochreous, with numerous orange brown scales, especially over inner half, giving a pale orange shade to the naked eye. Maculation consists of violet-brown patches and spots, which are composed of blackish-brown scales, each narrowly tipped with white. Forewing with small violet-brown basal patch, extending from costal margin at basal $1/6$ to median vein, the dark scaling extending narrowly along costal margin to about $1/4$ the distance from base. Beginning at the mid-costal margin and extending to $1/4$ the distance from apex is a large rectangular violet-brown patch, which extends to just beyond median vein. Apical $1/6$ of wing violet brown, with the dark scaling extending narrowly along termen to tornus, as a terminal line. Within the apical

patch, a whitish subterminal line is visible, forming a sharp inward angle before it is lost in the pale ground color. Hindwing mainly pale ochreous, obscurely banded with violet-brown, the extradiscal line being the most conspicuous marking. Fringes of both wings faintly checkered with pale ochreous and light brown.

Undersurface of wings pale brownish. Forewing with costa darker brown and with pale ochreous postmedian band. Fringes pale ochreous.

Length of forewing 7.5 mm in both holotype and paratype.

Male genitalia (Figs. 62, 63). Uncus bifid, dorsal process narrow and sharply pointed, exceeding the broad, truncate, ventral process. Valvae short and broad, tapering slightly at apex, costa well sclerotized. Aedeagus broad, and about equal in length to combined lengths of uncus, tegumen, and saccus. Inflated vesica (Fig. 63) membranous at base, with a few weak striations and scobinations; apex with a long flattened sclerotized process and a small, curved process; superior surface with a broad outpouching, armed with numerous short spines. Hair pencils of 9th segment arising from a single small globular base, with long hairlike scales.

Female unknown.

Holotype (Fig. 61). ♂, Culberson Co., Texas, Sierra Diablo Wildlife Management Area, 27-VI-81, genitalia on slide ECK 579, collected by E. Knudson and deposited in the American Museum of Natural History.

Paratype. Some data as holotype, 1 ♂, genitalia on slide ECK 152, collected by E. Knudson and deposited in the National Museum of Natural History.

Remarks. This delicate species is most similar to *E. phyllisae* Rindge (1963), from which it can be distinguished by the well defined apical and basal dark patches, and by the asymmetrical ventral plate. This species is named for Frederick H. Rindge in recognition of the many contributions he has made to the knowledge of North American *Eupithecia*.

***Eupithecia huachuca* Grossbeck (1908)**

Figs. 65–68

This small grayish species is similar in appearance to *jejunata*, but the ranges of the two species do not appear to overlap in Texas. McDunnough (1949) reported this species from western Texas. We collected this species in Jeff Davis County (March, August, and September) and Culberson County (August).

***Eupithecia woodgatata* (Cassino & Swett) (1924)**

Figs. 69–72

This species was originally described as a *Prorella* and later transferred to *Eupithecia* by McDunnough (1949). As McDunnough points out, *woodgatata* is superficially very close to *Prorella albida* Cassino & Swett, which also occurs at the same places and times in western Texas. As the authors have fresh material for study, mention might be made of some apparent points of difference, which may aid in separation of the two species. Both species are pale yellowish brown with reddish brown maculation. In *albida*, the lines tend to be complete and well defined and the extreme base of the forewing is dark brown. Both species have a prominent dark brown mid-costal patch, adjacent to the discal spot. In *woodgatata* the lines tend to be less well defined and incomplete, the wing being more suffused with reddish brown. The extreme base is not noticeably darker. *E. woodgatata* also has a prominent dark brown patch along the outer margin of the forewing,

below apex, and another at the tornus. In addition, there is a small dark spot at the anal angle of the hindwing. These markings are not apparent in *albida*. There do not seem to be recognizable differences in the front or antennae of the two species, however the genitalia are very different. Specimens were collected by the junior author in Culberson Co., Sierra Diablo Wildlife Management Area, in September.

***Eupithecia cocoata* Pearsall (1908)**

This species is evenly dark brown with obsolescent maculation, except for prominent black discal dots. It was reported to occur in Missouri and Arkansas by Heitzman & Enns (1977). Texas examples were collected by the senior author in Brown Co., Lake Brownwood State Park, 9-IV-69, 1 ♂, 1 ♀, and 20-IV-66, 1 ♂. All were dissected soon after capture, before the senior author had begun to attempt inflation of the vesicae of *Eupithecia*.

***Eupithecia pertusata* McDunnough (1938)**

Figs. 73–76

This species is yellowish, heavily irrorate with dark brown and copper-colored scales. The costal margin is dark brown. *Pertusata* is known only from Texas and New Mexico (Rindge, 1963). We collected this species in Brewster Co., Big Bend National Park (May, September, and October), and Jeff Davis Co., Mt. Locke (April).

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