Entomological Society of America
Proposal Form for New Common Name or Change of ESA-Approved Common Name

Complete this form and e-mail to pubs@entsoc.org. Submissions will not be considered unless this form is filled out completely.

The proposer is expected to be familiar with the rules, recommendations, and procedures outlined in the “Use and Submission of Common Names” on the ESA website at https://www.entsoc.org/pubs/use-and-submission-common-names.

1. Proposed new common name: banana yucca leafminer

2. Previously approved common name (if any): n/a

   Order: Lepidoptera
   Family: Prodoxidae

Supporting Information

4. Please provide a clear and convincing explanation for why a common name is needed, possibly including but not limited to the taxon’s economic, ecological, or medical importance, striking appearance, abundance, or conservation status:

   Prodoxus phylloryctus larvae have been recently observed to damage several ornamental plantings of Yucca baccata in Mesa County, Colorado. There is minimal literature on this insect, described for the first time to science when it was documented in Dove Creek CO in 1988. We believe this is the only other area of Colorado that this moth has been documented. By giving this moth a common name, we hope to provide easier reference to this insect while we attempt to educate landscapers, homeowners, and the general public on this species of micro-lepidoptera. This yucca moth, Prodoxus phylloryctus, is non-pollinating and unlike other Prodoxus species.

5. Stage or characteristic to which the proposed common name refers. (If the description involves a physical feature, it is strongly encouraged that an image of the organism be provided with this submission.)

   Leaf feeding occurs which damages the yucca leaves. Their larvae feed within thicker areas of the leaves of banana yucca, causing damage to the plants vascular tissues. The tissue surrounding the leaf mines of P. phylloryctus becomes hardened and gall-like restricting water and nutrient movement. This ultimately results in entire leaf die off. Damage also occurs when the adults are finished pupating and exit the plant.
6. Distribution (include references): Known only from the type locality at Dove Creek in southwestern Colorado within the literature. Adult moths of *P. phylloryctus* have now been documented in multiple areas across Mesa County, Colorado.

7. Principal hosts (include references):
   Host Plant: *Yucca baccata*
   The thin-leaved yuccas, *Y. harrimaniae* and *Y. angustissima*, growing in the area, apparently do not host *P. phylloryctus*.

8. Please provide multiple references indicating clearly that the proposed name is already established and ideally widespread in use. If the name has been newly coined for purposes of this application, please state so: This is a brand new name coined for the purpose of this application.

9. Please identify any common names in use, including those used by indigenous peoples in the insect’s area of origin, that have been applied to this taxon, other than the one herein proposed, with references. Please justify why each alternate name is inadequate: n/a

10. Please identify any other organisms to which your proposed common name could apply, giving careful consideration to closely related taxa. Please justify why the proposed common name is (i) unsuitable for each of those taxa and/or (ii) better suited for the proposed taxon: n/a

11. Please document your efforts to consult with entomologists (including taxonomic specialists), colleagues, or other professionals who work with the taxon as to the suitability and need for the proposed common name. Please note that this is an important element of your proposal; proposals that do not document these steps are less likely to be successful.

   I have been in contact with Robert Hammon, Dr. Whitney Cranshaw, both retired long time entomologists for the CSU Extension Service that agree that banana yucca leafminer is a suitable common name. Robert Hammon stated he felt that banana yucca leafminer was the name that helps to describe the leaf mining behavior that the larvae are responsible for in banana yucca leaves and that this is the best name. I have also contacted Dr. Todd Giligan at APHIS who connected me with Dr. Chris Grinter and Dr. David Bettman at the Cal Academy, whom work some on micro leps with the Denver Museum of Nature and Science. Dr. Chris Grinter and I have separately reached out to one of the original describers, Dr. David Wagner, but we have not heard back. I feel that a common name is justified and that banana yucca leafminer as a common name would help more people improve their understanding of this insects' biology and behavior in our area.

   Proposed by (your name):
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A New Prodoxus from Yucca baccata: First Report of a Leaf-Mining Prodoxine (Lepidoptera: Prodoxidae)

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ABSTRACT Prodoxus phylloryctus, a new species of yucca moth, is described and illustrated. The larvae mine in the semisucculent leaves of Yucca baccata Torrey (Agavaceae); the surrounding leaf tissue hardens and becomes gall-like. P. phylloryctus occurs sympatrically with its sister-species, P. coloradensis Riley. The two are ecologically separated. Larvae of the latter live in floral stalks, and adults emerge about two weeks earlier. P. phylloryctus exhibited a 2:1 female-biased sex ratio. A skewed sex ratio was not observed in P. coloradensis nor has this phenomenon been reported in other yucca moths. Appreciable numbers of larvae of both Prodoxus species carry-over more than one year in a prolonged diapause. A phylogeny for prodoxine genera (sensu Davis 1987) is proposed.

KEY WORDS Insecta, female-biased sex ratio, prolonged diapause, Agavaceae

THE PRODOXINAE (sensu Davis 1987), the yucca moths and allies, comprise a monophyletic grouping of six genera endemic to North America: Agavenema Davis, Greya Busck, Mesepiola Davis, Parategeticula Davis, Prodoxus Riley, and Tegeticula Zeller (Frack 1982, Nielsen & Davis 1985, Davis 1987). They are among the better studied Microlepidoptera. C. V. Riley published extensively on the taxonomy and biology of the yucca moths in the 1880s and early 1890s. Recent summaries are provided by Powell & Mackie (1966), Davis (1967), Frack (1982), and Powell (1984b).

All previously recorded prodoxine larvae rely upon reproductive tissue of their host plants. In Greya only the early stages feed within the fruits; in other genera, the entire feeding to maturation occurs within fruits or sterile tissue of the inflorescence (carpel walls or floral scapes) (Riley 1892, Powell & Mackie 1966, Davis 1967, Powell 1984b). Prodoxus phylloryctus has obviated this dependence by exploiting vegetative tissues, the succulent leaves of Yucca baccata Torrey.

Prodoxus phylloryctus
Wagner & Powell, n. sp.

The following description emphasizes those characters that differ from Dove Creek, Colo., populations of P. coloradensis. It also covers features that may prove to be diagnostic, but were not discussed or figured in Davis’s (1967) redescription of P. coloradensis.

Adult (Fig. 1 and 2). Forewing length: male, 4.0-4.8 mm; female, 4.3-5.5 mm. Head: antenna with 31-34 segments, basal 12-16 with squamose white scales; vertex, frons white; labial, maxillary palpus irrorated with white, distal portion of maxillary palpus mostly white. Thorax: dorsum black, some white scales in tegula; legs with mixture of white and black scales, latter predominating ventrad; tarsi mostly white, distal portion of each tarsomere darkened. Wing pattern as in Fig. 1; fringe mostly of black scales. Forewing scales (dorsal surface, medial area) nearly parallel-sided, widest apically or subapically (Fig. 4). Abdomen: dorsum shiny gray with peppering of paler scales, mostly white-scaled ventrad.

Male Genitalia (Fig. 3). As in P. coloradensis (Davis 1967: Fig. 94). Lateral vincular lobe rounded. Valva (Fig. 3a-c) elongate, subequal to vinculum, ventral margin with 3-5 black teeth, inner face densely setose along costa at 1/2 and apex. Juxta (Fig. 3a) with caudal band of minute spinules, densest laterad. Aedeagus (Fig. 3d) with spinose thickenings at 3/5; apex flared with two subtending melanized areas, larger one (cornutus?) spiraling to point.

Female Genitalia. As in P. coloradensis (Davis 1967: Fig. 20). Bursa extending to caudal margin of A2.

Diagnosis. Morphologically most similar to P. coloradensis. Adults differing from P. coloradensis in the absence of white scales on the thoracic dorsum. The FW scales of P. phylloryctus tend to be parallel-sided and broadest subapically (Fig. 4); those of P. coloradensis are more ovate, broadest at 2/3 (Fig. 5). The dorsolateral vincular lobes of the male genitalia tend to be rounded in P. phylloryctus (Fig. 3a) and quadrate in P. coloradensis.

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Distribution. Known only from the type locality at Dove Creek in southwestern Colorado. Moths intermediate in color pattern between P. coloradensis and P. phylloryctus, but more closely resembling the latter, have been collected in Big Bend National Park, Tex., by E. Knudson.

Life History

Host Plant. Yucca baccata at the type locality. The thin-leaved yuccas, Y. harrimaniae Trelease and Y. angustissima Engelmann ex Trelease, growing in the vicinity of Dove Creek, Colo., apparently do not host P. phylloryctus. Moreover, within stands of Y. baccata, plants with thick succulent leaves support the preponderance of larvae. Of ca. 25 plants examined at Dove Creek, young, shaded, cultivated plants were preferred; few or no leaf mines occurred on 18 mature plants growing in full sun.

Egg. The newly deposited egg is whitish, elongate reniform, slightly broader at one end. All visible egg scars are confined to the lower (abaxial) leaf surfaces (although adults emerge from both surfaces). The lower half of thick, vigorously growing leaves is the preferred site of oviposition.

The eggs are laid in large aggregations. It seems likely that more than one female contributes eggs to some of the larger leaf mines; 109 adults eclosed from the largest mine (with additional larvae remaining in diapause).

Larval Biology. The larva feeds during summer, constructing a gallery that runs parallel to the leaf plane. The completed tunnel (Fig. 6) is somewhat clavate, 4.7-5.6 mm long by 1.4-1.9 mm in diameter (n = 10). At maturity the larva chews its way to either leaf surface, removing all tissue except for a thin, circular epidermal layer 0.94–1.22 mm in diameter (emergence window) (n = 20). This translucent operculum of tissue is then cut away and refastened to the leaf with silk in its original position. The window is subtended by a widening emergence tunnel 1.85–2.35 mm in
Fig. 4 and 5. Forewing scales: 4, *P. phylloryctus* and 5, *P. coloradensis*. Scale bar = 60 μm.

The tunnel contains a thin uniform screen of silk recessed about 0.5 mm below the emergence window (n = 20). The two-layered cocoon lies below the screen in the upper half of the larval gallery. The outer portion of the tan or peach colored, papyrus-like cocoon contains inclusions of frass and plant shavings, especially basally; the thin inner portion is glossy white.

The larvae develop either individually, or more commonly, in communal leaf mines (Fig. 7 and 8). Solitary mines ranged in size from 5–9 by 8–13 mm (n = 8). The largest communal mine measured 19 mm (the leaf width) by 121 mm and had 109 emergence windows as well as appreciable numbers of carryover diapausing larvae (an estimated 10–20%).

By October, the pale green, fully fed larvae were in diapause. Areas with larvae were discolored (Fig. 7), and the tissue around the larval gallery had become hardened and gall-like. Larval galleries had opercula (visible as light spots in Fig. 7) and screens at this time. Mines collected in late February and examined two weeks later were occupied by roughly equal numbers of larvae and pupae. At Dove Creek the adults fly in early June (J. Terry, personal communication).

Adults. Adults emerge in the morning between 0700 and 0930 hours PDST (n = 100). The adults are active throughout the daylight hours, although greatest activity occurs in the morning and late afternoon. During the hottest portion of the day, in direct sunlight, adults are relatively inactive, perching in shaded areas.

*Prodoxus phylloryctus* is slightly protandrous, the peak of male emergence occurring one day prior to that of females. The emergence schedule for 203 first-year adults from 1985 leaves overwintered at Russell Reserve, Contra Costa County, Calif., is given in Fig. 9.

No static pheromone-emitting postures were observed in either sex. Males move about containers actively courting females. A male chases a female and then backs up towards her with his valvae flared; this sequence is repeated either until copulation is effected or the female moves away (n = 5). One male attempted to pair with two dead females, which suggests that the female need not take an active role in at least the initial stages of mating and that a long-distance sex pheromone is not necessary to affect pairing.

Mating pairs were observed during all hours of the day; mating activity peaked in the morning.
and afternoon. Pairs in copula at sunset often remained together until the following morning. During the daylight hours, pairings were usually completed in 30–90 min.

**Sex Ratio.** One of the most interesting aspects of the biology of *P. phylloryctus* was the female-biased sex ratio of the first-year adults (Table 2). Adults that emerged in spring 1985 were 2.9:1 female-biased (*n* = 67, *Z* = 4.032, *P* < 0.0001); those that eclosed in 1986 from a second collection made in the fall of 1985 showed a bias of 1.9:1 (*n* = 316, *Z* = 5.513, *P* < 0.00001). Sex ratios from these two collections did not differ significantly. A fall 1985 collection of *P. coloradensis* from Dove Creek, made at the same time as that of *P. phylloryctus*, exhibited no significant sex bias, (males, *n* = 25; females, *n* = 19) (*n* = 44, *Z* = 0.905, *P* > 0.05) (Table 2).

**Prolonged Diapause.** Like many other prodoxines, both species exhibit prolonged diapause; moths arising from a single generation may develop one or more years later than those of the first season (Powell 1984a,b, 1987). We estimate that 80–90% of the larvae of both species produced adults in the first spring, with the remainder carrying over as diapausing prepupal larvae.

The above sex ratios of *P. phylloryctus* were based on emerging (first-year) adults and did not take into account the sex of carry-over larvae. If most of the remaining larvae were male, the ratios expressed above would change. Nevertheless, it is unlikely that the final ratio would be close to parity because the sex ratio in the closely related *P. coloradensis* collected from the same plants and held under identical conditions was not biased, sex-biased carry-over has not been observed in other *Prodoxus* species, and the number of remaining larvae is appreciably fewer than the number required to balance the ratios.

**Phylogenetic Considerations**

To evaluate whether the leaf-inhabiting nature of *P. phylloryctus* is a derived or ancestral condition within the Prodoxinae, we prepared a cladogram using morphological and biological characters (Fig. 10); autapomorphies were excluded. Davis (1967) felt *Mesepiola* occupied an intermediate position between *Prodoxus* and *Agavenema*. Our placement of *Mesepiola* relies on the findings of Frack (1982).

**Greya vs Mesepiola, Tegeticula, Parategeticula, Prodoxus, and Agavenema:** (1) All prodoxines except *Greya* feed on members of the Agavaceae, which is a unique specialization within the Incurvarioidea. (2) The larvae of all prodoxine genera except *Greya* (and *P. phylloryctus*) complete their development within reproductive tissues. The larvae of *Greya reticulata* (Riley) feed in the seed pods of *Osmorhiza chilensis* Hooker & Arnott [O. nuda Torrey *Washingtonia brevipes* Coulter & Rose], in the Apiaceae, for the first one or two stadia.
and then, apparently, abandon the seed pods (J.A.P., unpublished data). In this respect, the biology of *Greya* is similar to that of other incurvarioids (e.g., *Adela* Latreille, *Cauchas* Zeller (= *Chalceopla* Braun), *Lampronia* Stephens, *Nemophora* Illiger & Hoffmannsegg (Heath & Pelham-Clinton 1976)) and does not conform to known yucca moth biology (sensu Davis 1987).

*Mesepiola* vs *Tegeticula*, *Parategeticula*, *Prodoxus*, and *Agavenema*: (3) Larvae of *Mesepiola* possess abdominal crochets, these have been lost in other prodoxine genera. (4) In *Mesepiola*, L2 is closer to L1 on Al–8; in the remaining four genera, L2 is closer to L3 (Frack 1982).

*Tegeticula* and *Parategeticula* vs *Prodoxus* and *Agavenema*: (5) Females of *Parategeticula* and *Tegeticula* share enlarged maxillary tentacles that are used to pollinate their hosts. *Prodoxus* and *Agavenema* share several synapomorphies. (6) Both feed in inflorescence tissues other than the seeds—i.e., either in fleshy portions of the fruit or the floral stalk. (7) The larvae are legless and (8) possess only three stemmata. (9) Pupation occurs within the larval host tissue. (10) The pupal spines are reduced in size. Frack (1982) gives additional larval characters supporting this sequence.

Both Davis (1967) and Frack (1982) have proposed evolutionary–phylogenetic hypotheses for the relationships among the species of *Prodoxus* Riley. Although neither tree/cladogram is highly corroborated and both have unresolved polytomies, both studies accord *P. coloradensis* (the sister-species of *P. phylloryctus*) a derived position within the genus.

Relative to the Prodoxinae, as well as to the genus *Prodoxus*, *P. phylloryctus* appears to occupy a derived position, and therefore the evolution of leaf mining probably represents a recent development. The leaf-mining habit is not a novel development within the Incurvarioidae, however. All the Incurvariidae (sensu Nielsen) are leaf-miners, as are some members of the genus *Lampronia*, a primitive prodoxid genus distantly related to the nearctic Prodoxinae as defined here.

### Comparative Biology of *Prodoxus coloradensis* and *P. phylloryctus* at Dove Creek, Colo.

The sister-species of *P. phylloryctus*, *P. coloradensis*, is a wide-ranging, phenotypically variable species. Were it not for the biological differences between the two moths, we might have dismissed *P. phylloryctus* as merely a population of darkly colored *P. coloradensis*. However, because both species occurred sympatrically at Dove Creek, Colo., often on the same individuals of *Yucca baccata*, it was possible to make direct comparisons, which were independent of geographical or local environmental differences.

Foremost among the biological differences distinguishing these two species is the larval niche separation. Larvae of *P. coloradensis* mature in the floral rachis (*n* = 44), while those of *P. phylloryctus* develop only in the leaves (*n* = 383).

Laboratory emergences from stalks and leaves collected from the same plants, suggest that the

![Fig. 10. Cladogram showing relationships among the six genera of Prodoxinae (sensu Davis 1987).](https://academic.oup.com/aesa/article/81/4/547/17365)
two species fly allochronically at Dove Creek. Livestock from the October 1985 collection was divided in half and overwintered in open-sided cages at two locations: Blodgett Forest (BF), El Dorado County, elevation ca. 1,300 m, in the Sierra Nevada, and Russell Reserve (RR), Contra Costa County, elevation 250 m, in the Coast Range of California. Because the two lots were overwintered for different periods of time only comparisons within (and not between) treatments are valid.

In the spring of 1986 both lots were returned to Berkeley; containers were checked for emergences irregularly until 2 June 1986, and twice a day thereafter. Yucca baccata collections held over at BF produced adults of P. coloradensis from 15 to 22 May; adults of P. phylloryctus eclosed from 30 May to 10 June (Table 1). The emergence ranges for the RR lots appear to overlap in early June. However, the P. coloradensis adults recorded for 3 June in Table 1 were dead and desiccated at the time they were harvested; these adults had eclosed days earlier.

Carry-over larvae from the 1985 collections were again subjected to winter conditions at RR, from November 1986 through April 1987. The earlier emergence of P. coloradensis was repeated, with 17 adults appearing between 10 and 23 May; 7 P. phylloryctus eclosed later, after 23 May.

Although we do not know if adults of P. phylloryctus and P. coloradensis encounter one another in nature, we brought the two species together by refrigerating adults of P. coloradensis until P. phylloryctus emerged. Three pairings were attempted by placing one adult P. coloradensis with two to six P. phylloryctus of the opposite sex in a container with a gauze covering. In both cases in which males were used (17 and 18 d old), the males proved too weak to effect copulation. However, one 18-d-old P. coloradensis female managed to pair with a P. phylloryctus male for 90 min, suggesting that the two species are cross-attractive and mechanically compatible.

Other differences between P. coloradensis and P. phylloryctus include larval coloration and behavior. The diapausing larvae of P. phylloryctus are pale green (n = 13); those of P. coloradensis are whitish (n = 19). Larval coloration is not simply a function of leaf versus stalk feeding in Prodoxus. For example, the larvae of P. cinereus Riley and P. aenesescens Riley in floral stalks of Yucca whipplei stalks are green, whereas those of P. quinquepunctella Riley in several species of dehiscent yucca stalks are white.

When Yucca baccata collections were examined in late October, larval tunnels of P. phylloryctus had well-formed emergence windows (n = 200+) with subtending screens (n = 10). Not one larval excavation of P. coloradensis possessed a window; 18 dissected tunnels were still more than 1 mm from the stalk surface and remained that way until the following spring when the tunnels were extended to the stalk surface. The latter behavior is typical of stalk-inhabiting Prodoxus (Powell & Mackie 1966, Powell 1984b).

Discussion
Prodoxus phylloryctus and its sister-species P. coloradensis, coexist on the same individuals of Yucca baccata at Dove Creek. The former may represent a species that coexists alongside its progenitor, P. coloradensis. In all respects, the morphology and behavior of P. phylloryctus is derived relative to P. coloradensis. In addition, the geographic and host plant range of P. coloradensis is broader and may completely overlap that of P. phylloryctus.

Larvae of many Incurvarioidea depend on floral tissues, at least as early instars. This dependence is especially pronounced in the Prodoxinae (except Greya), in which the larvae mature within the fruit, receptacle, or floral stalk. Some members of the genus Prodoxus are doubly dependent, requiring flowering Yucca plants as well as the presence of Tegeticula or Parategeticula to pollinate the inflorescences. Prodoxus phylloryctus has invaded a unique niche—by using leaves, the larvae escape this immediate dependence on reproductive tissues.

The tissue surrounding the leaf mines of P. phylloryctus becomes hardened and gall-like by October. A similar phenomenon occurs around the larval galleries of P. y-inversus Riley and P. soriditus Riley, which feed in the fleshy portions of Yucca fruits. (Riley 1892, Frack 1982, Powell 1984b). Seed pods hosting Parategeticula develop internal cysts of differentiated tissue around the larval gallery (Powell 1984b).

First-year adults of P. phylloryctus were female-biased, with females outnumbering males nearly 2:1. Biased sex ratios are unusual among lepidopterans. Skewed ratios may result from biotic or abiotic factors that bring about differential mortality in the two sexes (e.g., Porter 1983) or there may be determinate genetic differences affecting the sex bias (Owen 1970, 1974; Scali & Masetti 1973; Clarke 1984). We are unable to determine whether the female-biased sex ratio of first-year P. phylloryctus is genetically predetermined or a plastic response to environmental parameters. To address this question, it will be necessary to monitor ratios from individual mines collected under different environmental regimens, as well as to record the sex ratios of the carry-over individuals in prolonged diapause.

Acknowledgment
We are very grateful to Jane Terry, Dove Springs, Colo., who first observed the leaf mines and to Robert Stevens, Colorado State University, who sent the first collection on to us. Mrs. Terry mailed us a subsequent collection of P. phylloryctus. Mary Ann Tenorio assisted with the scanning electron microscopy and darkroom
References Cited


Frack, D. C. 1982. Systematic study of prodoxine moths (Adelidae: Prodoxinae) and their hosts (Aga- vaceae), with descriptions of the subfamilies of Ade- lidae (s. lat.). M.S. thesis, California State Polytechnic University, Pomona.


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