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**ECOLOGICAL NOTES ON SPECIES OF CLERIDAE
(INSECTA: COLEOPTERA) ASSOCIATED WITH THE
PRAIRIE FLORA OF CENTRAL NORTH AMERICA**

Jonathan R. Mawdsley¹

ABSTRACT

The association of eighteen species of Cleridae (Coleoptera) with tallgrass and shortgrass prairie ecosystems in central North America is reported for the first time. New flower visitation, habitat association, distribution, and/or rearing records are reported for *Enoclerus analis* (LeConte), *E. coccineus coccineus* (Schenkling), *E. cordifer* (LeConte), *E. rosmarus* (Say), *E. zonatus* (Klug), *Placopterus thoracicus pallipes* (Wolcott), *Trichodes bibalteatus* LeConte, *T. bicinctus* Green, *T. nutalli* (Kirby), *Phyllobaenus dubius* (Wolcott), *P. knausii* (Wickham), *P. pubescens* (LeConte), *P. subfasciatus* (LeConte), *Isohydnocera albocincta* (Horn), *I. brunnea* (Horn), *I. curtipennis* (Newman), *I. tricondylae* (LeConte) and *Wolcottia pedalis* (LeConte). Diagnostic characters are presented to separate adults of *P. dubius*, a species endemic to the northern shortgrass prairie region, from the common and widespread *P. pubescens*.

INTRODUCTION

Members of the beetle family Cleridae (Insecta: Coleoptera) are often considered forest insects, since many species in this family are predators of bark and wood-boring beetles (Coleoptera: Scolytidae, Buprestidae, Cerambycidae) that feed on trees and woody plants (Balduf 1935). The existence of a group of clerid species that are closely associated with the native prairie or grassland flora in central North America has not been noted prior to the present paper. Clerids are not mentioned in early ecological studies of prairie insects, such as those of Shelford (1913) or Adams (1915), and more recent studies by prairie ecologists and clerid taxonomists have also overlooked the association of clerid species with prairie habitats. The following notes on eighteen species of Cleridae that are undoubtedly associated with prairies and the prairie flora were compiled after field studies in Colorado and Illinois, and the examination of several important North American collections of clerid beetles.

MATERIALS AND METHODS

Species of Cleridae included in the present report have either been collected at known prairie remnants, or collected in association with plant species typical of tallgrass or shortgrass prairie ecosystems (such as those listed by Sampson 1921, Owensby 1980, Vance et al. 1984, and Runkel 1989). Museum collections of clerid beetles examined for this study include: Cornell University Insect Collection (CUIC), National Museum of Natural History, Smithsonian Institution (NMNH), Snow Entomological Museum, University of Kansas (SEMK); University Museum, University of Colorado at Boulder (UCBC). For the new ecological records, I list the collection in which voucher specimens are deposited, as well as the locality where the voucher specimens were collected.

Information on the geographic distributions of species of Cleridae discussed in this paper can be found in the catalogue of Corporaal (1950) and the checklist of Barr (1975). The Corporaal catalogue also includes citations for anatomical descriptions and illustrations.

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Botanical nomenclature follows the online databases of the Missouri Botanical Garden (available on the World Wide Web at <http://mobot.mobot.org/W3T/Search/vast.html>).

The list of species below probably does not include all species of Cleridae found in North American grasslands. Many additional clerid species breed in trees attacked by bark or wood-boring beetles in prairie groves or open savannas, and adults of these species may at times be found on the flowers and foliage of prairie plants. I discuss several additional clerid species that are especially likely to be found at prairie remnants at the end of this paper. There is, at present, no comprehensive guide to the species of Cleridae from North America, and therefore no way to insure accurate identification of all species that might be encountered. The key to genera of Nearctic Cleridae by Barr (1962), the revision of North American *Trichodes* by Foster (1976), and the review and illustrations of species of Cleridae from Ohio by Knull (1951) will help prairie ecologists and coleopterists identify species of Cleridae found at prairie sites.

ECOLOGY OF PRAIRIE CLERIDS: AN OVERVIEW

Adults of the clerid species listed below are found on flowers and foliage in North American grasslands during spring, summer, and early fall. These adult clerids are predators of small beetles, wasps, flies, true bugs, aphids, and other insects found on vegetation; adults of *Trichodes* species may also feed on pollen. My field studies and information associated with museum specimens indicate that two of the most common predatory clerid species (*Enoclerus rosmarus* and *Phyllobaenus pubescens*) are generalist predators as adults. Other grassland clerid species may be more specialized in their predatory habits. Adults of most of the prairie clerid species can be found on a wide range of plant species, including plants with which their larvae are not known to be associated. Some flower-visiting adult clerids (particularly species in the genera *Trichodes* and *Enoclerus*) are densely pubescent and may serve as pollinators of native plant species, much like their relatives in the family Melyridae (Grant and Grant 1965).

For most of the clerid species included here, little is known of the larval biology and life history. Published accounts describe portions of the life histories of *Enoclerus rosmarus*, *E. zonatus*, *Trichodes bibalteatus*, *T. nutalli*, *Phyllobaenus pubescens*, and *Isohydnocera curtipennis* (Böving and Champlain 1920, Sabrosky 1934, Foster 1971, 1976). Larvae of these clerids exhibit a wide range of prey preferences: *T. nutalli* larvae feed on grasshopper egg masses; *T. bibalteatus* larvae parasitize nests of megachilid bees; while larvae of *E. rosmarus*, *E. zonatus*, *I. curtipennis*, and *P. pubescens* prey on immature stages of stem-boring and/or gall-forming insects. Most prairie clerids have annual life cycles, with mating and oviposition in spring and early summer, larval development during summer and fall, pupation either in fall or in early spring, and adult emergence in spring and early summer.

Family Cleridae

Subfamily Clerinae

Enoclerus analis (LeConte)

Notes: This is one of the most poorly known species of *Enoclerus* in North America, represented in most museum collections by few specimens. Wickham and Wolcott (1912) note that adults have been collected on flowers in grassland areas. Foster and Barr (1972) report the collection of an adult on *Melilotus albus* Lamarck. The larvae are unknown.

New rearing record: Adult reared from *Sporobolus* sp. (NM: Mesilla Park; NMNH).

Enoclerus coccineus coccineus (Schenkling)

Notes: Adults are usually collected on flowers, where they are quite active and readily take flight or tumble if disturbed (Wickham and Wolcott 1912). In New Mexico, the larvae are important predators of *Crossidius pulchellus* LeConte (Coleoptera: Cerambycidae) and other borers attacking roots of *Gutierrezia sarothrae* (Pursh) Britton and Rusby (see <http://taipan.nmsu.edu/snakeweed/bugs.html>). A disjunct population of this species from the Colorado Plateau was described by Barr (1976) as *E. coccineus desertus* Barr.

New flower visitation records: *Argemone squarrosa* Greene (NM: 20 miles NW Melrose; NMNH), *Cleome* sp. (WY: New Castle; NMNH), *Helianthus annuus* L. (TX: 3 miles W Estelline; SEMK), *Monarda citriodora* Cervantes ex Lagasca y Segura (TX: Devils River; NMNH), *Opuntia engelmanni* Engelmann (TX: Devils River; NMNH), *Opuntia* sp. (TX: 5 miles S Kingsville; SEMK), *Ratibida columnaris* (Sims) D. Don (TX: Devils River; NMNH), *Sophia obtuse* Greene (NM: 8.5 miles E Batil; NMNH).

Enoclerus cordifer (LeConte)

Notes: This is another poorly known species of *Enoclerus* associated with dry grasslands in central and southwestern North America. LeConte (1849) was the first to publish biological information for this species, stating that adults were collected on the foliage of *Artemisia tridentata* Nuttall. Wickham and Wolcott (1912) noted that adults are found on flowers. S. P. Cover of the Museum of Comparative Zoology (pers. comm.) reports that adults can also be found under objects on the ground in desert grasslands in the mountains of southeastern Arizona. The record below of an adult of this species feeding on eggs of a grasshopper in the genus *Melanoplus* (Orthoptera: Acrididae) is the first record of any species of *Enoclerus* feeding on grasshopper eggs. Species of the clerid genera *Trichodes* Herbst (Corporaal 1950; Foster 1976) and *Aulicus* Spinola (Barr and Foster 1979) are also known to feed on grasshopper egg masses.

New predation record: Adult collected while feeding on eggs of *Melanoplus* sp. (KS: Wichita; NMNH).

Enoclerus rosmarus (Say)

Notes: This is one of the most widespread and frequently collected species of Cleridae in eastern North America. Little is known about its biology, although adults are usually collected on flowers or foliage (Wickham and Wolcott 1912; Knoll 1951). Wolcott (1910) reported that adults were collected on foliage in damp meadows (possibly wet prairies) in Indiana. Böving and Champlain (1920) described the mature larva and reared adults from *Rhus* sp., while Dillon and Dillon (1961) noted that adults were especially abundant on the flowers of *Conyza canadensis* (L.) Cronquist. Adults from Illinois prairies that I kept in captivity fed readily on small floricolous beetles of the families Curculionidae, Dermestidae, and Mordellidae, as well as aphids, small flies, and small species of Hemiptera. I also observed adults at prairie sites in northern Illinois preying on small braconid wasps.

New flower visitation records: *Asclepias syriaca* L. (IL: West Chicago Prairie; CUIC), *Melilotus officinalis* (L.) Pallas (KS: Lawrence; SEMK), *Solidago* sp. (IL: West Chicago Prairie; NMNH), *Tradescantia virginiana* L. (IL: West Chicago Prairie; NMNH).

New rearing record: Adult reared from abandoned gall in *Solidago* sp. (OH: Congress; NMNH).

Enoclerus zonatus (Klug)

Notes: Adults are usually found on inflorescences, stems, and leaves of species of the genera *Agave*, *Yucca*, or *Dasylyrion*; their larvae feed on weevils and other insects boring in the stems and seed pods of these plants (Foster 1971; Foster and Barr 1972). Adults have also been collected at lights at night.

New flower visitation records: *Asclepias* sp. (KS: Medicine Lodge; NMNH), *Yucca glauca* Nuttall (CO: Boulder; UCBC).

Placopterus thoracicus pallipes Wolcott

Notes: The taxonomy of the genus *Placopterus* is currently under review and this taxon, which is largely allopatric with the nominate form, may represent a distinct species (W. F. Barr, pers. comm.). Although nothing has been published on the biology of *P. thoracicus pallipes*, the nominate form from eastern North America is a generalist predator associated with a wide range of habitat types and prey species (Böving and Champlain 1920; Foster and Barr 1972).

Distribution: I examined specimens from IA: Lake Okoboji; KS: Atchison, Manhattan, Onaga; MI: Detroit; MO: St. Louis; ND: Bottineau County, Section 3, Township 160; SD: Big Stone City (all NMNH).

Trichodes bibalteatus LeConte

Notes: This is the largest species of *Trichodes* in North America. Adults of species in this Holarctic and African genus occur on flowers, sometimes abundantly. As with many *Trichodes*, larvae of *T. bibalteatus* are predators in nests of leaf-cutter bees (Hymenoptera: Megachilidae; Foster 1976). The revision of North American *Trichodes* by Foster (1976) provides additional information on the ecology and distribution of *T. bibalteatus* and a key to Nearctic species of this genus.

Published flower visitation records: *Acacia greggii* Gray, *Acacia* sp., *Coreopsis tinctoria* Nuttall, *Gossypium* sp., *Helianthus* sp., *Opuntia* sp., *Pithecolobium* sp., *Prosopis glandulosa* Torrey, *Ratibida columnaris* (Sims) D. Don, *Ratibida* sp., *Rudbeckia* sp., *Verbesina encelioides* (Cavanilles) Gray (Foster 1976).

New flower visitation records: *Bidens* sp. (TX: 11 miles N Uvalde; SEMK), *Condalia obtusifolia* (Hooker) Weber (TX: Hidalgo Co., Starr Co.; NMNH), *Coreopsis cardeminaefolia* (De Candolle) Nuttall (TX: San Antonio; NMNH), *Hedeoma* sp. (TX: Cotulla; NMNH), *Hymenocarpus* sp. (TX: near Uvalde; NMNH), *Monarda citriodora* Cervantes ex Lagasca y Segura (TX: Clarendon; NMNH), *Rudbeckia amplexicaulis* Vahl (TX: Denton; NMNH), *Rudbeckia* sp. (TX: Dallas; NMNH).

Trichodes bicinctus Green

Published flower visitation records: *Ratibida columnaris* (Sims) D. Don (Foster 1976).

New flower visitation record: *Engelmannia pinnatifida* Nuttall (OK: 7 miles SW Lone Wolf; SEMK).

Trichodes nutalli (Kirby)

Notes: This species has a widespread but somewhat patchy distribution; adults may occasionally be abundant when they are encountered. Further studies of the biology of *T. nutalli* are needed; the only known larval host for this species is *Chloealtis conspersa* (Harris) (Orthoptera: Acrididae) (Foster 1976). Besides prairies, adults of *T. nutalli* have also been collected on flowers in pine barrens, boreal wetlands, and montane alpine habitats in northeastern North America.

Published flower visitation records: *Achillea millefolium* L., *Apocynum* sp., *Asclepias* sp., *Aster* sp., *Chrysanthemum leucanthemum* L., *Helianthus* sp., *Heracleum maximum* Bartram, *Melilotus albus* Lamarck, *Melilotus* sp., *Potentilla recta* L., *Rosa* sp., *Rubus* sp., *Rudbeckia hirta* L., *Spiraea* sp. (Foster 1976).

New flower visitation records: *Geranium parryi* (Engelmann ex A. Gray) A. Heller (CO: Boulder; NMNH), *Heracleum lanatum* Michaux (CO: Boulder;

NMNH), *Solidago* sp. (WI: Waupaca; NMNH).

Subfamily Hydnocerinae

Phyllobaenus dubius (Wolcott)

Diagnosis: Similar to *P. pubescens* (diagnosed and illustrated by Knull 1951) in coloration and general appearance, but body size usually larger (length 4.6-5.0 mm, compared to 3.3-4.7 mm in *P. pubescens*), frons and pronotum much more coarsely and densely punctate, and elytra proportionately longer and more slender.

Known distribution: Iowa and Nebraska (Barr 1975); also Montana and Colorado (reported here for the first time).

Notes: Based on the few collection records published to date, this species appears to be endemic to the northern shortgrass prairie region of central North America. Further investigations of this species' distribution and ecology are needed.

Distribution: CO: Boulder Co., Eldorado Open Space, 1967 m, 1.X.1996, malaise trap, creekside (1, UCBC); Jefferson Co., Doudy Draw Open Space, 27.VI.1994, malaise trap (1, UCBC). MT: Roosevelt Co., 15 miles NE Bainville, 12.VI.1996, sweeping vegetation in marsh (1, CUIC); no locality specified (1, NMNH).

Phyllobaenus knausii (Wickham)

Notes: The bright reddish-orange, black, and white coloration of this species is unusual in the genus *Phyllobaenus*, but is similar to the coloration of *P. tricolor* (Schaeffer). The elytra of *P. tricolor* have a median white transverse band of hairs that is lacking in *P. knausii*.

New flower visitation record: *Sapindus drummondii* Hooker and Arnott (KS: Meade Co.; SEMK).

Phyllobaenus pubescens (LeConte)

Notes: Based on the large number of specimens examined by the author, this species appears to be one of the most common and abundant clerid species associated with the prairie flora of North America. Adults and larvae have been previously recorded as predators of cotton boll weevils (Coleoptera: Curculionidae: *Anthonomus* spp.), gall-forming insects, and cocoons of species in the wasp genus *Microbracon* Ashmead (Hymenoptera: Braconidae) (Corporaal 1950; Knull 1951). More recent studies indicate that *P. pubescens* may be an important predator of insect pests in commercial cotton and sunflower plantations. Rogers et al. (1986) reported that larvae of this species were predators of the larvae of *Stibadium spumosum* Grote (Lepidoptera: Noctuidae), a pest of commercial sunflower plantations in the south-central USA, while Farrar (1985) reported that adults and larvae of *P. pubescens* were predators of *Heliothis zea* (Boddie) (Lepidoptera: Noctuidae), a pest of cotton.

New flower visitation records: *Amorpha fruticosa* Torrey (TX: Dallas; NMNH), *Asclepias latifolia* (Torrey) Rafinesque (TX: Dallas; NMNH), *Aster tanacetifolius* Kunth (TX: Raymondsville, 5 miles SW Tivoli; SEMK), "cactus" (TX: 19 miles N Tivoli; SEMK), *Callirhoe involucrata* (Torrey and A. Gray) Torrey (TX: Victoria; NMNH), *Cassia* sp. (TX: Victoria; NMNH), *Cicuta maculata* L. (KS: Lone Star Lake; SEMK), *Croton punctatus* Jacquin (TX: Cameron Co.; NMNH), *Gaillardia* sp. (TX: Boca Chica, McDade; SEMK), *Helianthus annuus* L. (wild, not cultivated) (IL: Monsanto; MO: Matthews, New Madrid, Portageville; TX: 6 miles N Raymondsville, 29 miles S Sarita; NMNH), *Helianthus petiolaris* Nuttall (KS: Lewis; SEMK), *Helianthus* sp. (TX: Victoria; NMNH), *Malvastrum apicatum* (L.) Gray (TX: Cameron Co.; NMNH), *Melilotus officinalis* (L.) Pallas (KS: Arkansas City; SEMK), *Monarda citriodora* Cervantes ex Lagasca y Segura (TX: Raymondsville, Wolfe City; SEMK), *Monarda pectinata*

Nuttall (TX: Matagorda; SEMK), *Monarda punctata* L. (TX: 17 miles N Vernon; SEMK), *Opuntia* sp. (TX: Victoria; NMNH), *Parthenium hysterophorus* L. (TX: Hidalgo Co.; NMNH), *Polytaenia nuttalli* De Candolle (OK: 2 miles S Jennings; SEMK), *Quamasia* sp. (TX: Denton; NMNH), *Rudbeckia amplexicaulis* Vahl (TX: Victoria; NMNH), *Rudbeckia grandiflora* (Sweet) Gmelin ex De Candolle (TX: Dallas; NMNH), *Rudbeckia hirta* L. (KS: 9 miles N Caldwell; SEMK), *Rudbeckia* sp. (OK: Ardmore; SEMK), *Sideranthus rubiginosus* (Torrey and A. Gray) Britton ex Rydberg (OK: Ardmore; NMNH), *Vernonia interior* Smith (KS: Manhattan; NMNH).

New rearing records: Adult reared from trap-nest of *Megachile brevis* Say (KS: Johnson Co.; NMNH), adult reared from stem of *Iva ciliata* Willdenow (TX: Victoria; NMNH), adult reared from flower head of *Rudbeckia amplexicaulis* Vahl (TX: Dallas; NMNH).

Phyllobaenus subfasciatus (LeConte)

Notes: This species belongs to a taxonomically difficult group in the genus *Phyllobaenus* DeJean that is greatly in need of revision. Another valid, described member of this group associated with grassland communities is *P. maritimus* (Wolcott) from the Atlantic coast of northeastern North America. All species in this group are metallic coppery-black or bluish-black in color and have rugosely punctate elytra with two transverse bands of pale pubescence, one at mid-elytron, the other at apical third or fourth.

New flower visitation records: *Amorpha canescens* Nuttall (KS: 3 miles S Sawyer; SEMK), *Helianthus petiolaris* Nuttall (KS: 5 miles N Bennington; SEMK), *Sapindus drummondii* Hooker and Arnott (KS: 8 miles W Hardtner; SEMK).

Isohydnocera albocincta (Horn)

Notes: Nothing has been published on this species' biology.

New habitat association: "Prairie vegetation" (TX: 2 miles E Reisel; NMNH).

Isohydnocera brunnea (Horn)

Notes: Nothing has been published on this species' biology.

New flower visitation record: *Echinacea angustifolia* De Candolle (KS: Hutchinson; SEMK).

Isohydnocera curtipennis (Newman)

Notes: Sabrosky (1934) provides a detailed account of the biology of this species. Larvae prey on gall-making insects associated with plants of the genus *Solidago*; the adults are found on flowers and stems of the host plants and other vegetation. Three voucher specimens from Sabrosky's study are in NMNH.

Isohydnocera tricondylae (LeConte)

Notes: According to W. F. Barr (pers. comm.), this species is associated with prairies in central North America. Nothing has been published about its biology.

Distribution: IA: Ames; KS: Manhattan, Onaga, Topeka (all NMNH).

Wolcottia pedalis (LeConte)

Notes: Nothing has been published about the biology of this species. S. W. Lingafelter (pers. comm.) indicates that it is common at tallgrass prairie sites in Kansas, where adults occur on flowers and foliage of many different plant species.

New habitat association: Tallgrass prairie (KS: Konza Tallgrass Prairie; NMNH).

Additional species of Cleridae associated with prairies and grasslands.

As noted above, other species of Cleridae will probably be recorded from

Nearctic grasslands in the future. In particular, five species of the subfamily Hydnocerinae probably also occur in savanna or prairie ecosystems. *Phyllobaenus pallipennis* (Say), *P. unifasciatus* (Say), *P. verticalis* (Say), and *P. humeralis* (Say) breed in trunks and limbs of oaks (*Quercus* spp.) and hickories (*Carya* spp.), but adults may occur on flowers and foliage of nearby herbaceous plants. Knull (1951) provided illustrations and diagnoses of these species, all of which can be readily separated from the other representatives of this genus discussed above. One other Nearctic clerid that is probably found in prairie habitats is *Isohydnocera tabida* (LeConte). Little is known about the biology of this species, which was also figured and diagnosed by Knull (1951).

W. F. Barr (pers. comm.) notes the presence of a complex of clerid species associated with desert grasslands in the southwestern United States. Although these species fall outside the geographic scope of this paper, I mention them here as evidence that the association of clerids with grassland habitats is not restricted to central North America. Clerid species associated with desert grasslands in the southwestern U. S. include *Aulicus dentipes* Schaeffer, *A. nigriventris* Schaefer, *Phyllobaenus longus* (LeConte), *P. rudis* (Gorham), *P. wickhami* (Wolcott), *Isohydnocera chiricahuana* Knull, and *Wolcottia sobrina* (Fall).

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