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GEOCORIS ULIGINOSUS, A BIGEYED BUG (HEMIPTERA: LYGAEOIDEA: GEOCORIDAE) ASSOCIATED WITH *PHLOX SUBULATA* IN MID-APPALACHIAN SHALE BARRENS. — Bigeyed bugs, so-called because of their prominent eyes (stylate or nearly so), were long placed as a subfamily (Geocorinae) of the family Lygaeidae. Geocorines now belong to a separate lygaeoid family, the Geocoridae, following division of a paraphyletic Lygaeidae into smaller, monophyletic families (Henry, 1997). *Geocoris uliginosus* (Say) is a common eastern North American species (Sweet, 2000) found statewide in Virginia from sea level to about 5,000 ft (1,525 m) on Mount Rogers (Hoffman, 1996). Species of *Geocoris* can be difficult to identify (Hoffman, 1996; Sweet, 2000), but *G. uliginosus* can be recognized east of the Mississippi (its range extends west to New Mexico and Texas; Ashlock & Slater, 1988) by its almost uniformly black coloration. Adults are oval with males about 3.3 mm and females about 3.5 mm long. This geocorid is found mainly around houses, along roadways, and in agroecosystems and other disturbed habitats (Readio & Sweet, 1982). Adults are fully winged (macropterous), which is typical of most species of *Geocoris* that occupy temporary habitats (Readio & Sweet, 1982; Sweet, 2000).

Geocoris uliginosus has been studied mainly in managed systems such as field crops (Whitcomb & Bell, 1964; Roach, 1980) and turfgrasses, where the principal prey of this generalist predator are chinch bugs, *Blissus* species (Lygaeoidea: Blissidae) (Dunbar, 1971; Reinert, 1978; Carstens et al., 2008). Numerous other small arthropods serve as prey (Crocker & Whitcomb, 1980), including eggs and neonate larvae of the fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Braman et al., 2003). As in many other species of *Geocoris*, cannibalism is common under laboratory conditions (Readio & Sweet, 1982; Sweet, 2000). During times of low prey densities, the omnivorous *G. uliginosus* can switch to scavenging and phytophagy (Sweet, 1960; Crocker & Whitcomb, 1980; Readio & Sweet, 1982; Carstens et al., 2008). Some plant feeding, which does not damage plants (Crocker & Whitcomb, 1980), might be needed for optimal performance (Sweet, 2000). *Geocoris uliginosus* can live as long as four months on a diet of sunflower seeds and water (Sweet, 1960). This mainly geophilous bug is found less often on plants than are syntopic congeners such as *G. punctipes* (Say) (Crocker & Whitcomb, 1980; Readio & Sweet, 1982; Sweet, 2000).

Studies of *G. uliginosus* in natural communities and associations with plants lacking economic importance are scant. Adults have been recorded from weeds in crop fields or other disturbed sites (Uhler, 1877; Blatchley, 1926; Altieri & Whitcomb, 1979, 1980; Wheeler, 1981). Here, I give records of this bigeyed bug from moss phlox, *Phlox subulata* L. (Polemoniaceae), mainly in Virginia shale barrens, and notes on its seasonal history. *Geocoris uliginosus* was collected in mid-Appalachian shale barrens during irregular intervals from 1989 to 1995 by shaking mats of phlox over a shallow white enamel tray, as described by Wheeler (2009). That paper also included a brief description of mid-Appalachian shale barrens. When nymphs were determined to instar, Roman numerals in the following records designate instars, with the preceding Arabic numbers indicating how many of each instar were observed. Voucher specimens have been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC.

Geocoris uliginosus on *Phlox subulata* in mid-Appalachian shale barrens:

MARYLAND: *Allegany Co.*, Country Club shale barren, Evitts Creek, Cumberland, 2 July 1994, 5 nymphs; Oldtown shale barren, E of Oldtown, 21 May 1995, 1-II, 2-III.

PENNSYLVANIA: *Bedford Co.*, Silver Mills shale barren, E of Inglesmith, 28 May 1992, 2-II.

VIRGINIA: *Alleghany Co.*, Potts Creek shale barren, Rt. 18, 2.5 km NE of Boiling Springs (17.0-17.5 km S of Covington), 4 June 1989, 2 adults; 2 June 1990, 1 adult; 23 June 1990, 1-I. *Highland Co.*, Head Waters shale barren, Rt. 616 nr jct. Rt. 250, 25 August 1990, 2 adults; 1 August 1993, 1 adult; 3 July 1994, 4 nymphs (instars III-V); 26 August 1994, 1 adult. *Montgomery Co.*, Flatwoods Rd. (Rt. 713), nr jct. Rt. 603, NE of Ironto, 18 April 1991, 1-I; 15 May 1993, 3-III. *Rockingham Co.*, George Washington National Forest, For. Rd. 87, W of Fulks Run, 1 October 1994, 2-V, 1 adult. *Shenandoah Co.*, Short Mountain shale barren, SE of Mount Jackson, 11 May 1991, 1-II; 12 April 1992, 1-I; 17-19 April 1992, 2-I, 1 adult; 17 May 1992, 1-I, 1-III.

WEST VIRGINIA: *Greenbrier Co.*, Kates Mountain barren, S of White Sulphur Springs, 23 June 1990, 1 adult.

Not all plants are colonized by *Geocoris* species even though they occupy suitable habitat for the bugs and harbor numerous potential prey (Crocker &

Whitcomb, 1980). *Geocoris uliginosus*, though not abundant (never >5 individuals/sample), was encountered consistently on *P. subulata* in shale barrens. The fact that nymphs of all instars were observed suggests more than an incidental association with the plant. Species of *Geocoris* oviposit on pubescent plant parts or in soil (Sweet, 2000). The presence in shale barrens of first instars of *G. uliginosus* suggests that eggs might be deposited on the glandular-hairy *P. subulata* or under mats of phlox. Adults of this geocorid overwinter (Froeschner 1944; Crocker & Whitcomb, 1980). In the present study, first instars were observed by mid-April in 1991 and 1992 in Shenandoah County, Virginia; a third instar was found in mid-May 1992 in this same county and early instars in late May in Allegany County, Maryland. Collection of a first instar in late June in Alleghany County, Virginia, suggests the beginning of a second generation. The mid- to late instars present in early July in Highland County, Virginia, might also belong to a second generation. Adults were found in shale barrens in early and late June, early and late August, and early October.

Even though species of *Geocoris* sometimes occur syntopically (Crocker & Whitcomb, 1980), *G. uliginosus* was the only geocorid collected from mats of moss phlox in shale barrens. *Geocoris uliginosus* tends to occur in shaded areas and xeric habitats, but also is found in open areas where the bugs occupy protected microhabitats such as crowns of bunchgrasses (Radio & Sweet, 1982; Sweet, 2000). Shale barrens are characterized by low surface moisture, as well as high irradiance and soil-surface temperatures (Platt, 1951; Keener, 1983; Braunschweig et al., 1999). The geocorid's use of the mat-forming *Phlox subulata* would provide shelter and a microenvironment with greater moisture and lower temperatures as compared to open areas of shale. Mats of moss phlox harbor an unusually diverse insect fauna, including hemipterans such as leafhoppers, plant bugs, psyllids, stilt bugs, and whiteflies (Wheeler, 1994; 1995a, b; 1997; 1999; 2009) that would provide potential prey for *G. uliginosus*. This bigeyed bug can be included with the reduviid *Fitchia aptera* Stål (Wheeler, 2000) among the few predacious insects associated with the numerous herbivores that feed on moss phlox in mid-Appalachian shale barrens.

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