The Distribution and Habitat of *Centruroides hentzi* (Banks) (Scorpiones, Buthidae) in Georgia

Dirk J. Stevenson[1,*], Greg Greer[2], and Matt J. Elliott[3]

Abstract - Field collections made by the authors in pineland ecosystems in southern Georgia during 2011 significantly expand the previously published range limits of the scorpion *Centruroides hentzi* in Georgia. We commonly found specimens beneath the exfoliating bark of *Pinus palustris* (Longleaf Pine) and *P. elliottii* (Slash Pine) snags, stumps, and logs in sandhills and pine flatwoods habitats, documenting this scorpion from 50 sites in 34 south Georgia counties, and extending the known range of *C. hentzi* 150 km north (from near Waycross, Ware County, GA) to Statesboro, Bulloch County, GA. Our collections indicate that the species is widespread in pine-dominated uplands throughout much of the lower and middle Coastal Plain of southern Georgia. We comment on the life history, ecology, and habitat requirements of the species based on this survey and the existing literature. In Georgia, *C. hentzi* is a characteristic associate of Longleaf Pine and Slash Pine ecosystems, is often locally abundant, and is part of an arthropod–vertebrate food web that includes the endangered *Picoides borealis* (Red-cockaded Woodpecker).

Introduction

Scorpion diversity in the eastern United States is notably low, with only 5 species occurring east of the Mississippi River (Shelley and Sissom 1995). Only 2 species are native to Georgia: *Vaejovis carolinianus* Beauvois (Vaejovidae) and *Centruroides hentzi* Banks (Buthidae) (Shelley and Sissom 1995). *Vaejovis carolinianus* (to 50 mm in length) is an upland species mostly restricted to the Piedmont, Ridge and Valley, and Mountain provinces; its overall range extends north and west of the Fall Line as far north as the Ohio River in central Kentucky (Gibbons et al. 1990, Shelley 1994). Although superficially similar to *C. hentzi* and sometimes found in pine-dominated landscapes, *V. carolinianus* has never been recorded from the Coastal Plain of Georgia or found sympatric with *C. hentzi*. The comparatively slender *C. hentzi* (Fig. 1), also small to medium sized (to 60 mm in length), is brown with yellowish stripes and appendages. Like other *Centruroides* species, adults exhibit sexual dimorphism, with males having lean bodies and elongated metastomal segments (Polis and Sissom 1990, Stahnke and Calos 1977). Stings to humans by *C. hentzi* and *V. carolinianus* are painful, but do not have lasting effects or serious medical consequence (D.J. Stevenson, G. Greer, and M.J. Elliot, pers. observ.; Muma 1967).

Prior to our study, the known distribution of *C. hentzi* included most of Florida, extreme southwestern Alabama, and extreme southern Georgia (Shelley

[1]The Orianne Society, 414 Club Drive, Hinesville, GA 31313. [2]Greg Greer Enterprises, Inc., 1469 Bollingbrook Road, Marietta, GA 30067. [3]Georgia Department of Natural Resources Nongame Conservation Section, 2065 US Highway 278 SE, Social Circle, GA 30025. [*]Corresponding author - dstevenson@oriannesociety.org.

and Sissom 1995). *Centruroides hentzi* was not formally reported from Georgia until 1995, when Shelley and Sissom (1995) mapped a number of records for the southern-most tier of Georgia counties (i.e., those counties contiguous with the Florida state line); localities published in their article included one Georgia barrier island (Cumberland Island). Shelley and Sissom (1995) treated *C. hentzi* records from urban areas well outside the perceived range as accidental human importations, including sites in Georgia (Harris and Muscogee counties), North Carolina (Brunswick, Carteret, and Durham counties), and South Carolina (Charleston County).

From previous field experience, we knew that: 1) *C. hentzi* was in fact much more widely distributed in Georgia than reflected by Shelley and Sissom (1995), the absence of museum specimens notwithstanding; 2) where populations occur, *C. hentzi* can be predictably found in pine-dominated habitats (especially sandhills and pine flatwoods) by peeling exfoliating bark from pine snags, stumps, and logs.

Methods

During 2011, we conducted diurnal surveys for *C. hentzi* at sites located throughout southern Georgia, with an emphasis on that portion of the Coastal Plain north of the *C. hentzi* localities mapped in Shelley and Sissom (1995). Our primary focus during these field surveys was to document *C. hentzi* from as many sites as possible, while sampling as far north in the Coastal Plain of Georgia as the presence of potentially suitable *Pinus palustris* Miller (Longleaf Pine) and

Figure 1. An adult *Centruroides hentzi* from Atkinson County, GA. Photo by Greg Greer.

P. elliottii Engelmann (Slash Pine) sandhills and pine flatwoods allowed. Although we often flipped surface cover objects (logs, pieces of bark, trash, boards, etc.) resting directly on the ground, our primary survey method was peeling the exfoliating bark from pine snags, stumps and logs—especially Longleaf Pine and Slash Pine, and occasionally *P. taeda* L. (Loblolly Pine). Late in our survey, we also searched for scorpions under the sloughing bark scales of living pines. Based on soil type and dominant vegetation (NatureServe 2011, Wharton 1978), we classified habitat type at each survey site as either "sandhill" or "pine flatwoods" (or in the case of barrier island sites, "maritime forest"). Sandhill habitats are xeric communities underlain by well-drained to excessively well-drained deep sandy soils; patches of bare sand and vegetation adapted to droughty conditions (e.g., Longleaf Pine, *Quercus laevis* Walter [Turkey Oak], *Yucca filamentosa* L. [Bear-grass]) characterize these habitats. Pine flatwoods (open, "savannah-like" woodlands) are mesic habitats occurring on acidic sandy soils; an organic hardpan layer located 46–60 cm beneath the ground surface causes soils to be saturated during wet periods. Longleaf and/or Slash Pine dominate the canopy, with common shrubs including *Myrica cerifera* L. (Wax Myrtle) and *Ilex glabra* Gray (Gallberry); a luxuriant and extremely diverse ground cover of grasses, sedges, and herbs including *Aristida stricta* Michaux (Wiregrass) is characteristic of frequently burned, high-quality examples of mesic pine flatwoods.

Specimens were captured with forceps, preserved in 75% ethanol, and deposited in the arthropod collection at the Georgia Museum of Natural History (GMNH) in Athens. We made inquiries with curators at the following museum collections in an effort to locate specimens of *C. hentzi* collected post-1990 in Georgia so that we might learn of recent records not reported by Shelley and Sissom (1995): Archbold Biological Station, Venus, FL; Auburn University, Auburn, AL; Clemson University, Clemson, SC; Florida State Collection of Arthropods, Gainesville, FL; Georgia Southern University (GSU), Statesboro, GA; GMNH, Athens, GA; Mississippi Entomological Museum, Mississippi State, MS.

Results and Discussion

In 2011, we collected 128 specimens of *C. hentzi* at 50 sites in 34 Georgia counties (Fig. 2). Shelley and Sissom (1995) reported *C. hentzi* from only 3 of these counties: Charlton, Clinch, and Ware (Fig. 2). At 32 (64.0%) of our collection sites, we classified habitat type as sandhill (this total included 10 sites that were highly disturbed or pine plantations); at 16 (32.0%) of our collection sites, we classified habitat type as pine flatwoods (including 8 sites that were disturbed or pine plantations); and at 2 (4.0%) of our collection sites, we classified habitat type as maritime forest (including 1 site that was disturbed). Microhabitat for our scorpion collections included: under log (n = 1 specimen, 0.8%); under bark of Longleaf Pine snag/stump/log (n = 49, 38.3%); under bark of Slash Pine snag/stump (n = 26, 20.3%); under bark of Loblolly Pine snag/stump (n = 4, 3.1%); under bark of unidentified pine snag/stump/log (n = 22, 17.2%); and under flaking

bark scales of living Slash Pine (n = 26, 20.3%). Our search of major museum holdings for recent (1990–present) *C. hentzi* records from Georgia located records from one site each in Bulloch and Toombs counties (GSU) and Camden and Miller counties (GMNH) (Fig. 2). New *Centruroides hentzi* localities for Georgia are compiled in Appendix 1.

Our *C. hentzi* records demonstrate that *C. hentzi* is common in sandhill and pine flatwoods environments and is essentially continuously distributed throughout much of the lower and middle Coastal Plain of southern Georgia. Furthermore, our records indicate that *C. hentzi* occurs widely in the Dougherty Plain, Tifton Uplands, and the recently exposed (Plio-Pleistocene) Coastal Plain Marine Flatlands physiographic provinces (Wharton 1978). Georgia barrier island records include Jekyll Island, Little Cumberland Island, St. Simon's Island (this study), and Cumberland Island (Shelley and Sissom 1995); additionally, we received a credible report of *C. hentzi* for Sapelo Island (W. Dopson, Brunswick, GA, pers. comm.). Our scorpion collections from Jekyll Island and St. Simon's Island were from upland maritime habitats forested with large scattered Slash Pines, *Quercus virginiana* Miller (Live Oak), *Juniperus virginiana* L. (Eastern

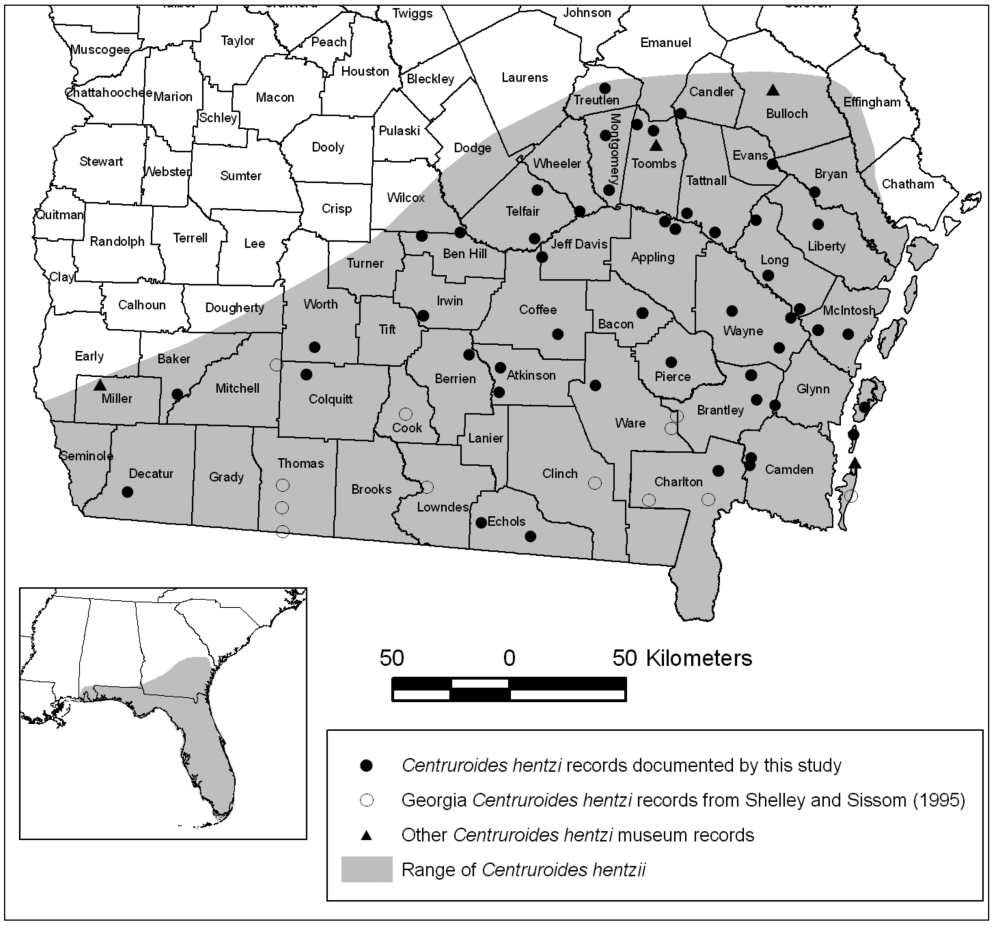

Figure 2. Distribution of *Centruroides hentzi* in Georgia.

Red Cedar), and *Sabal palmetto* (Walter) (Cabbage Palm); *Serenoa repens* Bartram (Saw Palmetto) was common in the shrub layer. At Jekyll Island, we collected several *C. hentzi* from a pine snag at the edge of a brackish marsh.

The northern-most locality (Statesboro, Bulloch County, GA) reported in this article is ca. 150 km north of the northern-most record previously published for the species (Shelley and Sissom 1995). Records for Statesboro include a specimen collected in 2009 from pineland habitat (since destroyed) located on the Georgia Southern University campus (L. Durden, Statesboro, GA, pers. comm.). Our repeated efforts to document *C. hentzi* farther north in Georgia were unsuccessful, even at seemingly optimal sites like the Fall Line Sandhills (Talbot and Taylor counties), Ohoopee Dunes (Emanuel County), and sandhills near the Savannah River at Yuchi Wildlife Management Area (Burke County).

At many sites where we documented *C. hentzi*, we found scorpions within only a few minutes of searching, often finding five or more specimens in the same pine snag. In November–December, we found large numbers of *C. hentzi* of various size classes under and within layers of flaking bark scales at the base of large, living Slash Pines. We collected *C. hentzi* during all months of the year except June and September. In summer 2011, southern Georgia experienced a period of extended hot temperatures and a protracted drought, which may explain our difficulty in locating specimens at this time.

Centruroides hentzi occurs in a region where freezing temperatures are sometimes experienced, and temperature may be a factor limiting the northern extent of the species' range. We suspect that individuals insulate themselves during cold weather by retreating into the interiors of snags/logs, or hiding deep beneath overlapping plates of exfoliating bark. Whitmore et al. (1985) discovered that a freeze-tolerant congener, *Centruroides vittatus* (Say), a species that ranges north to southern Missouri (Shelley and Sissom 1995), survives freezing temperatures by ice-nucleating activity (wherein potent ice-nucleating activity compartmentalized in the gut induced ice formation). There are numerous other Coastal Plain species (e.g., Saw Palmetto and *Drymarchon couperi* Holbrook [Eastern Indigo Snake]) that are widely distributed in the Coastal Plain of Georgia, but do not range north to the Fall Line (Diemer and Speake 1983, McNab 1980).

Little has been published relating to the life history and ecology of *C. hentzi*. Predators include the federally endangered *Picoides borealis* Vieillot (Red-cockaded Woodpecker) (Hanula and Engstrom 2000; J. Macey, Fort Stewart, GA, pers. comm.) and a large non-native anuran, *Osteopilus septentrionalis* Dumeril and Bibron (Cuban Treefrog) (Granatosky et al. 2011). Biologists monitoring Red-cockaded Woodpecker populations commonly encounter specimens of *C. hentzi* 2–12 m off the ground while scaling bark from living, mature Longleaf and Slash Pines as part of tree banding and artificial cavity installation (L. Carlile, Fort Stewart, GA, pers. comm.). Also of note, pitfall and funnel traps associated with terrestrial drift-fence arrays captured numerous *C. hentzi* from spring though autumn on both Fort Stewart, GA (in sandhill and pine flatwoods habitats; D. Stevenson, unpubl. data) and on Eglin

Air Force Base, FL (in sandhill habitats; D. Steen, Auburn University, Auburn, AL, unpubl. data), indicating that the species is not solely arboreal and frequently prowls overland, probably at night. *Centruroides hentzi*, like numerous other buthid species, may aptly be described as a non-burrowing errant scorpion because it does not dig a resident burrow and may be active both on the ground and on vegetation (McReynolds 2008).

Folkerts et al. (1993) include *C. hentzi* among their list of arthropods associated with xeric Longleaf Pine habitats in the southeastern US, mentioning that it is commonly encountered in Longleaf Pine habitats in Florida. Muma (1967) stated that *C. hentzi* occurs under litter, logs, stones, and under the bark of dead trees in Florida. Specimens reported in his paper included scorpions found beneath pine bark of snags and logs up to 7 m above the ground. Although our study did not quantitatively examine habitat characteristics of those sites where we found *C. hentzi* in Georgia, it was apparent from the collections reported herein, and from the previous experience of the authors, that *C. hentzi* frequents open-canopied, sunlit situations; a grassy or Saw Palmetto ground cover and exposed bare mineral soil lacking a heavy accumulation of leaf litter or pine needle litter typifies habitats supporting this scorpion. Additionally, with respect to microhabitat, it is clear that *C. hentzi* is strongly tied to pine bark on both living and dead trees, especially Longleaf Pine and Slash Pine, commonly sheltering beneath the exfoliating bark of pine snags and logs as well as the sloughing bark flakes present on live trees. Horn and Hanula (2002) found that Longleaf Pine had significantly more loose, flaking bark scales than Loblolly Pine, and documented greater arthropod abundance and biomass on Longleaf Pine; they concluded that bark structure is responsible for the greater arthropod abundance on Longleaf Pine. Interstices associated with the continuously sloughing bark of mature Longleaf Pine and Slash Pine support potential prey (roaches, spiders, silverfish; Horn and Hanula 2002) and provide shelters for *C. hentzi*. Specimens of *C. hentzi* exposed by removing bark flakes on live trees crawl rapidly over the outer layers of pine bark before squeezing into small cracks or fissures on the trunk proper or beneath flaking bark scales.

Naturally functioning examples of the major ecosystems inhabited by *C. hentzi* (sandhill and pine flatwoods) are pyric, fire-controlled communities with biotas that have evolved in response to frequent, low-intensity surface fires (Myers 1990). Pine snags and logs are continually created in these habitats via lightning strikes, hot wildfires or prescribed fires, beetle infestations, and windfalls caused by tornados and hurricanes (Earley 2004, Myers 1990). In addition to active diurnal searches, future efforts (sorely needed to elucidate the life history of this interesting scorpion) should consider drift-fence sampling and "blacklighting" field methods. We encourage studies of *Centruroides hentzi* that investigate reproductive biology, seasonal ecology (e.g., microhabitats preferred for refuges, foraging, and feeding) and population demographics.

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Appendix 1. New *Centruroides hentzi* localities for Georgia.

GEORGIA: *Appling County*: 15.9 km NE Baxley, Ten Mile Rd. at East River Rd. (17 R 384047, 3527372), 8 March, 2011, D. Stevenson (GMNH); 15.6 km NNE Baxley, Moody Forest Natural Area (17 R 0376287, 3531785), 8 March 2011, D. Stevenson (GMNH). *Atkinson County*: 12.2 km SSE Willacoochee (17 R 308351, 3457387), 29 January 2011, D. Stevenson, G. Greer, J. Jensen (GMNH); 3.5 km E Willacoochee (17 R 308749, 3467960), 4 March 2011, D. Stevenson (GMNH). *Bacon County*: 8.6 km ENE Alma, Mallard Rd. at St. Hwy. 203 (17 R 369779, 3491367), 15 March 2011, D. Stevenson (GMNH). *Baker County*: 1.9 km S St. Hwy. 91 along Ichawaynochaway Creek, Joseph W. Jones Ecological Research Center (16 R 739873, 3454295), 7 April 2011, G. Greer (GMNH). *Ben Hill County*: 10.9 km E Rebecca, St. Hwy. 90, 4.8 km E. of St. Hwy. 233 (17 R 274966, 3524501), 27 April 2011, G. Greer (GMNH). *Berrien County*: 6.8 km ESE Alapha, Cty. Rd. 237 at St. Hwy. 32 (17 R 295395, 3473395), 15 March 2011, D. Stevenson (GMNH). *Brantley County*: 7.8 km SE Hortense, St. Hwy. 110 at Fin Dig Rd. (17 R 416399, 3464621), 14 April 2011, D. Stevenson (GMNH); 6.2 km WSW Waynesville, St. Hwy. 259 at St. Hwy. 82 (17 R 418755, 3454159), 20 October 2011, D. Stevenson (GMNH). *Bryan County*: 12.4 km SSE Pembroke, Fort Stewart (17 S 442643, 3543334), 29 December 2011, D. Stevenson (GMNH). *Bulloch County*: Statesboro, 2007 (GSU); Statesboro, 2008 (GSU); Statesboro, 16 April 2009, M. Sutherland (GSU); Statesboro, Georgia Southern University Campus, April, 2009, L. Durden (GSU). *Camden County*: 3.1 km NW Jerusalem on Old Post Rd. (17 R 416547, 3429096), 20 October 2011, D. Stevenson (GMNH); 3.7 km SW Jerusalem on St. Hwy. 252 (17 R 415853, 3425985), 20 October 2011, D. Stevenson (GMNH); Little Cumberland Island (17 R 460798, 3424541), 20 November 2011, C.W. Dopson, Jr. (GMNH). *Candler County*: 8.0 km NW Cobbtown (17 S 386299, 3577097), 8 March 2011, D. Jones (GMNH); 8.0 km NW Cobbtown (17 S 386299, 3577097), 21 November 2011, D. Stevenson (GMNH). *Charlton County*: 12.2 km N Folkston at Newell (17 R 402488, 3423527), 31 March, 2011, D. Stevenson (GMNH). *Coffee County*: 10.3 km SE Douglas on St. Hwy 158 (17 R 333390, 3482279), 11 July 2011, D. Stevenson (GMNH). *Colquitt County*: 3.2 km S Doerun on St. Hwy. 133, Doerun Wildlife Management Area (17 R 225483, 3465041), 7 April 2011, G. Greer (GMNH). *Decatur County*: 7 km SSW Reynoldsville, Silver Lake Wildlife Management Area (16 R 722619, 3410966), 29 May 2011, G. Greer and C. Reuter (GMNH). *Echols County*. 16.2 km ESE Statenville, St. Hwy. 94 at Toms Creek (17 R 321696, 3395337), 23 December 2011, D. Stevenson and K. Briggs (GMNH); 5.9 km NW Statenville, St. Hwy. 94 at Rader Rd. (17 R 300525, 3401217), 23 December 2011, D. Stevenson and K. Briggs (GMNH). *Evans County*: 4.7 km SE Daisy, Evans Co. Public Fishing Area (17 S 425449, 3555272), 21 March 2011, D. Stevenson (GMNH). *Glynn County*: 4.1 km SSE Waynesville, Post Rd. at County Line Rd. (17 R 426819, 3451749), 14 April 2011, D. Stevenson (GMNH); Jekyll Island, Riverview Drive (17 R 459948, 3435229), 20 October 2011, D. Stevenson (GMNH); St. Simons Island, Lawrence Drive (17 R 466913, 3460017), 2 November 2011, G. Greer (GMNH). *Irwin County*: 10.6 km SW Ocilla (17 R 275593, 3490035), 25 February 2011, D. Stevenson and K. Briggs (GMNH); 10.6 km SW Ocilla (17 R 275593, 3490035), 24 March 2011, J. Jensen (GMNH). *Jeff Davis County*: 7.5 km W Snipesville, Flat Tub Wildlife Management Area (17 R 326713, 3515519), 27 March 2011, D. Stevenson (GMNH). *Liberty County*: 5.8 km NNE Hinesville, Fort Stewart (17 R 445190, 3529393), 3 May 2011, D. Stevenson and J. Macey (GMNH). *Long County*: 13.0 km WSW Ludowici, Griffin Ridge Wildlife Management Area (17 R 423947, 3507488), 3 March 2011, D. Stevenson and A. Day (GMNH);13. 0 km WNW Townsend, Townsend Wildlife Management Area (17 R 437179, 3492994),

7 March 2011, D. Stevenson (GMNH); 6.8 km SE Glennville (17 R 418489, 3531142), 23 April 2011, D. Stevenson (GMNH); 13.0 km WSW Ludowici, Griffin Ridge Wildlife Management Area (17 R 423947, 3507488), 8 November 2011, D. Stevenson (GMNH). *McIntosh County*: 7.4 km SW Townsend, Old River Rd. at Hardshell Rd. (17 R 445313, 3483977), 16 March 2011, D. Stevenson and D. Jones (GMNH); 6.8 km SSW Eulonia at St. Hwy. 17 (17 R 458107, 3482138), 20 October 2011, D. Stevenson (GMNH). *Miller County*: 9.5 km NW Colquitt, Mayhaw Wildlife Management Area (16 R 656540, 3472839), 18 August 2009, A. Cressler (Photograph) (GMNH). *Montgomery County*: 5.6 km NNE Ailey (17 S 353984, 3567570), 27 April 2011, D. Stevenson (GMNH); 2.5 km W Uvalde, Cty. Rd. 125, 0.2 km E of Bud Denton Rd. (17 S 355448, 3544066), 27 April 2011, G. Greer (GMNH). *Pierce County*: 6.0 km N Blackshear, Oak Hill Rd. at St. Hwy. 121/15 (17 R 382023, 3470220), 14 April 2011, D. Stevenson (GMNH). *Tattnall County*: 14 km SW Glennville, Big Hammock Natural Area at Mac Phillips Rd. (17 R 400787, 3525929), 8 March 2011, D. Stevenson (GMNH); 14.3 km W Glennville on Old River Rd. (17 R 388979, 3534136), 1 November 2011, D. Stevenson (GMNH). *Telfair County,* 7.2 km SE McRae, St. Hwy. 149, 2.6 km SW of St. Hwy. 441 (17 S 324694, 3544085), 23 March 2011, D. Stevenson (GMNH); 10.9 km ENE Jacksonville, Horse Creek Wildlife Management Area (17 R 323469, 3523262), 16 April 2011, D. Stevenson and J. Bauder (GMNH). *Toombs County*: 5.0 km N Lyons, St. Hwy. 130 at Piney Green Church Rd. (17 S 373836, 3568667), 23 March 2011, D. Stevenson and G. Greer (GMNH); 4.8 km SW Normantown, Claxton Rd. at St. Hwy. 297 (17 S 367390, 3572168), 26 October, D. Stevenson (GMNH); Lyons, 1 March 2010, B. Robinson (GSU). *Treutlen County*: 5.6 km NE Soperton, Cty. Rd. 183 (17 S 353622, 3587694), 21 October 2011, G. Greer (GMNH). *Ware County*: 22.2 km NW Waycross, N side of St. Hwy 82 (17 R 349642, 3460238), 15 March 2011, D. Stevenson (GMNH). *Wayne County,* 9.2 km SW Jesup, St. Hwy 203 at St. Hwy. 84 (17 R 408309, 3492158), 15 March 2011, D. Stevenson (GMNH); 9.4 km E Gardi, Penholloway Wildlife Management Area (17 R 433550, 3489128), 14 August 2011, D. Stevenson (GMNH); 13.8 km SSE Gardi, Wire Rd. at Flowers Break Rd. (17 R 428498, 3476334), 13 October 2011, D. Stevenson (GMNH). *Wheeler County*: 2.1 km NE Lumber City (17 R 342944, 3535166), 26 February 2011, D. Stevenson and K. Briggs (GMNH). *Wilcox County*: 18.2 km SSE Abbeville, St. Hwy. 129 at Bowens Mill Fish Hatchery (17 R 291398, 3526066), 25 April 2011, D. Stevenson (GMNH). *Worth County*: 9.6 km S Sylvester, St. Hwy. 33, 5.3 km S of Dixon Rd. (17 R 229100, 3476529), 7 April 2011, G. Greer (GMNH).