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Source: Florida Entomologist, 100(2) : 488-490

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.100.0214

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The use of root plates for nesting sites by *Anthophora abrupta* (Hymenoptera: Apidae) may be common within forested habitats

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Anthophora has a worldwide distribution and, containing about 450 species, is one of the most common genera within Apidae. Some species of *Anthophora* have been managed for pollination services (Stubbs & Drummond 1999), and *Anthophora abrupta* Say (Hymenoptera: Apidae) has been suggested as a potential species that could prove manageable for pollination of crops in the southeastern United States (Graham et al. 2015). Despite this potential, only a few types of nesting site structures have been documented. Other than vertical riverbanks (Frison 1922), only man-made structures, such as adobe walls (Norden & Scarborough 1982; Norden 1984), bags of colloidal clay (Graham et al. 2015), and clay banks underneath a porch (Rau 1929), have been documented as nesting sites for *A. abrupta*.

Anthophora abrupta is a commonly occurring species in the eastern United States (Mitchell 1962). It is a gregariously nesting bee species that has been documented nesting in clay-containing substrates (Norden 1984; Graham et al. 2015), often near riverbanks (Frison 1922). *Anthophora abrupta* is often known as the "turret-building bee" because the bees construct turret-like projections that cover the opening of their nest entrance (Rau 1929). The exact function of the turrets is unknown, but the structures may protect the nests from parasites or rain, provide a social purpose for aggregation, or possess a thermoregulatory function (Walsh & Riley 1868; North & Lillywhite 1980; Norden 1984). Although *A. abrupta* females are gregarious nesters, each individual constructs a separate tunnel that leads to a single nest (Norden 1984). To construct tunnels, female bees use water to soften the compacted and hardened clay (Rau 1929). Following construction, females waterproof their individual tunnel and nest with a glandular secretion from their Dufour's gland (Norden et al. 1980).

Tree falls due to weather events (e.g., hurricanes, tornadoes, high winds) are ecologically important forest disturbances that can create numerous novel niches (Schaetzl et al. 1989a; Greenberg & McNab 1998). Trees that fall often expose their root plate (or root wad), an intact mass of soil and root that, depending upon soil type, can contain large quantities of clay. Although root plates can persist in place for decades (Small 1997), the structures eventually form a relict tip-up mound where the vertical root plate once existed, along with a resulting depressed pit from which the previously intact root system was displaced (Schaetzl et al. 1989b). It has been well established that downed wood and snags within forested habitats contribute to biological richness for many invertebrates, vertebrates, and plants (Harmon et al. 1986; Berg et al. 1994). Here we provide evidence of vertical root plates in southeastern forests being utilized as *A. abrupta* nesting sites.

Seven *A. abupta* aggregation nests were found in root plates at 5 sites in the southeastern United States (Fig. 1). The first site was at the Bluebonnet Swamp Nature Center, East Baton Parish, Louisiana (30.371058°N, 91.106173°W), where 2 root plates were found containing *A. abrupta* nests. The first *A. abrupta* nest at this site was discovered in 2009 in a root plate (labeled BS1) from a hardwood tree that had fallen in 2008 due to Hurricane Gustav. This nest, situated approximately 50 m from the edge of a swamp, remained active for 4 yr, but the number of bees observed became less each year as the root plate turned into a low-profile tip-up mound. In 2012, a second nest was discovered in a root plate (BS2) approximately 25 m away from the first root plate at the Bluebonnet Swamp Nature Center. The second site was located in the Green River Game Lands in North Carolina (35.262792°N, 82.293511°W), where 2 root plates from fallen hardwood trees were found to contain an *A. abrupta* nest. The first root plate (GR1) with an *A. abrupta* nest was discovered in 2012 (Fig. 1) and was still active as of 2016. In 2016, a second root plate (GR2) containing an *A. abrupta* nest was located approximately 100 m from GR1. The third site was discovered in 2016 near Cedar Bluff, Alabama, along Mud Creek (34.180230°N, 85.481536°W) (Fig. 1), where an *A. abrupta* nest was found in an extremely large root plate (MC) of an oak tree (*Quercus* sp.; Fagaceae) that was situated approximately 10 m from a creek (Fig. 1). The fourth site was located along Salem Lake in North Carolina (36.104083°N, 80.166550°W), where a small, old root plate (SL) contained some visible turrets in 2016. One additional root plate (FB) was discovered at a fifth site in early 2017 within Fontainebleau State Park, St. Tammany Parish, Louisiana (30.332611°N, 90.015353°W). This root plate was heavily colonized with numerous intact turrets.

Particle sizes of the soils were determined by pipette-extraction methods (Robinson 1922). Table 1 shows the percentages of sand, silt, and clay within each of the 7 root plates that contained *A. abrupta* aggregations. Soil was sampled from all sites in 2016 except Fontainebleau State Park, which was sampled in 2017. Root plates BS1 and BS2 no longer had evidence of active nests when soil was sampled, whereas all other root plates had evidence of recent nests (visible, intact turrets).

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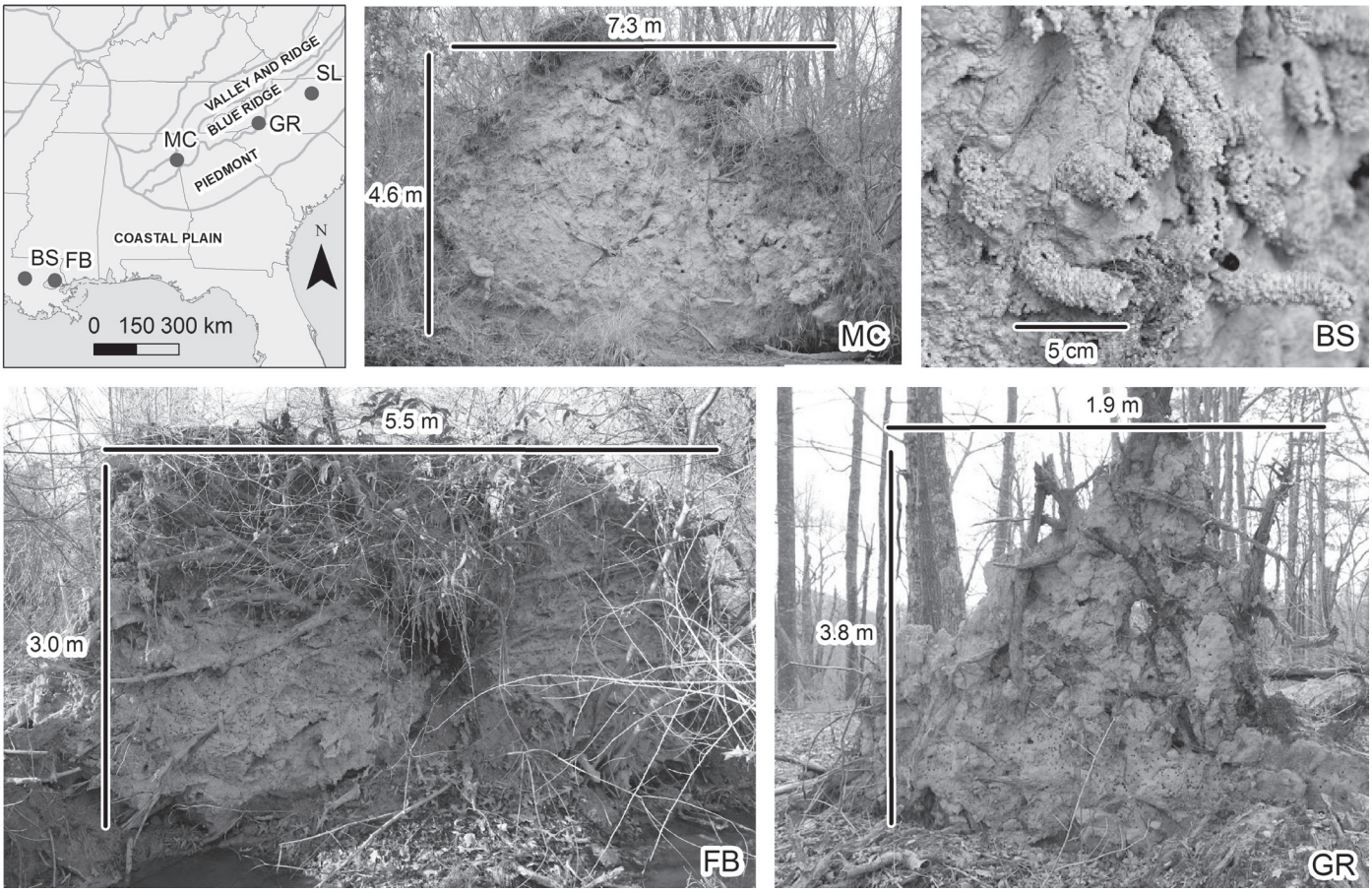


Fig. 1. Root plate examples from Green River Game Lands (North Carolina), Fontainebleau State Park (Louisiana), and Mud Creek (Alabama). Map depicts physiographic provinces and relative locations of root plate sites. Upper right picture shows close-up of *Anthophora abrupta* turrets from BS root plate. BS = Bluebonnet Swamp Nature Center (Louisiana), FB = Fontainebleau State Park (Louisiana), GR = Green River Game Lands (North Carolina), MC = Mud Creek (Alabama), SL = Salem Lake (North Carolina).

We located 7 root plates containing *A. abrupta* aggregations within 4 very distinct physiographic regions (Coastal Plain, Ridge and Valley, Piedmont, and Blue Ridge physiographic provinces). Previously described nesting sites of *A. abrupta* include vertical river banks, clay banks, and colloidal clay blocks (Frison 1922; Rau 1929; Graham et al. 2015). The primary nesting site of *A. abrupta* in forested habitats is unknown. Because vertical root plates are a common feature of forested habitats, these structures provide high-quality *A. abrupta* nesting sites in areas that have scarce availability of exposed clay or other compacted soil and, thus, may serve as the primary nesting material in forests for these bees. Although vertical riverbanks (Frison 1922) are the only documented natural nesting site of *A. abrupta*, with the advent of widespread dam building, this habitat may now be rare making root plates desirable structures for *A. abrupta* nests.

Cane (1991) showed that *Anthophora* (*A. abrupta* included) bees preferred soil with a relatively higher percentage of clay compared with soil types preferred by many other ground nesting bees. This preference of relatively higher clay content for nesting structure may give them the ability to monopolize the use of root plates that usually contain high percentages of clay. In our nested root plate samples, we found a range of clay concentrations (13–33%), but all *A. abrupta* nests occurred in a type of loam, consistent with the observation of Cane (1991).

Graham et al. (2015) showed that it is possible to expand nesting of *A. abrupta* by placing suitable nesting material nearby active nest sites. Other *Anthophora* species have been used as commercial pollinators in Germany (Thalmann & Dorn 1990) and Japan (Maeta et al. 1990) and have similar ecologies as *A. abrupta*. Therefore, *A. abrupta* displays features that may make it a suitable pollinator species for potential management (Graham et al. 2015). The use of root plates for nesting sites in multiple habitat types also provides potential for nests to be easily located and augmented with artificial nesting sites placed nearby root plates.

Table 1. Results from grain size analysis of each root plate that contained *Anthophora abrupta* nests. Listed are the percentages of sand, silt, and clay and the identified soil type.

	Content (%)			
Root plate	Sand	Silt	Clay	Soil type
BS1	30.5	51.8	17.7	silt loam
BS2	27.2	59.6	13.2	silt loam
FB	32.6	34.9	32.5	clay loam
GR1	57.6	17.2	25.2	sandy clay loam
GR2	43.7	22.4	33.9	clay loam
MC	47.5	38.1	14.4	loam
SL	65.8	17.4	16.8	sandy loam

Abbreviations indicate the origin of the root plates: BS1 & BS2 = Bluebonnet Swamp Nature Center, Louisiana; FB = Fontainebleau State Park, Louisiana; GR1 & GR2 = Green River Game Lands, North Carolina; MC = Mud Creek, Alabama; SL = Salem Lake, North Carolina.

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We thank Chase Kimmel for GIS assistance and Allyn Irvin for providing help with photographs. We also thank Niky Hughes, Andrew Vigueira, and Belinda Vigueira for sharing the location of the root plates. This research was funded through a United States Department of Agriculture-Joint Fire Science Program (project No. FA-FON0013-0001).

Summary

This is the first reported use of root plates by *Anthophora abrupta* Say (Hymenoptera: Apidae). Previous reported nesting sites were vertical riverbanks and several man-made clay structures. Root plates in forested habitats may be the preferred nesting site for *A. abrupta*.

Key Words: *Anthophora abrupta*; root plate; root wad; bee nest; forest

Sumario

Este es el primer informe del uso de placas radiculares por *Anthophora abrupta* Say (Hymenoptera: Apidae). Anteriormente los sitios de anidación reportados eran orillas verticales de rios y varias estructuras de arcilla hechas por el hombre. Las placas de raíces en hábitats del bosque puede ser el sitio de anidación preferido para *A. abrupta*.

Palabras Clave: *Anthophora abrupta*; placa de raíz; masa de raíz; nido de abeja; bosques

References Cited

Berg Å, Ehnström B, Gustafsson L, Hallingbäck T, Jonsell M, Weslien J. 1994. Threatened plant, animal, and fungus species in Swedish forests: distributions and habitat associations. Conservation Biology 8: 718–731.

Cane JH. 1991. Soils of ground-nesting bees (Hymenoptera: Apoidea): texture, moisture, cell depth and climate. Journal of the Kansas Entomological Society 64: 406–413.

Graham JR, Willcox E, Ellis JD. 2015. The potential management of a ground-nesting, solitary bee: *Anthophora abrupta* (Hymenoptera: Apidae). Florida Entomologist 98: 528–535.

Greenberg CH, McNab WH. 1998. Forest disturbance in hurricane-related downbursts in the Appalachian Mountains of North Carolina. Forest Ecology and Management 104: 179–191.

Harmon ME, Franklin JF, Swanson FJ, Sollins P, Gregory SV, Lattin JD, Anderson NH, Cline SP, Aumen NG, Sedell JR, Lienkaemper GW, Cromack K, Cummins KW. 1986. Ecology of coarse woody debris in temperate ecosystems. Advanced Ecological Research 15: 133–302.

Frison TH. 1922. Notes on the life history, parasites and inquiline associates of *Anthophora abrupta* Say, and some comparisons with the habits of certain other Anthophorinae (Hymenoptera). Transactions of the American Entomological Society 48: 137–156.

Maeta Y, Okamura S, Hisafumi U. 1990. Blueberry pollinators of south-western Japan, with pollinating behaviors of major species. Chugoku Kontyu 4: 15–24.

Mitchell TB. 1962. Bees of the Eastern United States. Volume II. The North Carolina Agricultural Experiment Station, Raleigh, North Carolina.

Norden BB. 1984. Nesting biology of *Anthophora abrupta* (Hymenoptera: Anthophoridae). Journal of the Kansas Entomological Society 57: 243–262.

Norden BB, Scarborough AG. 1982. Predators, parasites and associates of *Anthophora abrupta* Say (Hymenoptera: Anthophoridae). Proceedings of the New York Entomological Society 90: 181–185.

Norden B, Batra SW, Fales HM, Hefetz A, Shaw GJ. 1980. *Anthophora* bees: unusual glycerides from maternal Dufour's glands serve as larval food and cell lining. Science 207: 1095–1097.

North F, Lillywhite H. 1980. The function of burrow turrets in a gregariously nesting bee. The Southwestern Naturalist 25: 373–378.

Rau P. 1929. The biology and behavior of mining bees, *Anthophora abrupta* and *Entechnia taurea*. Psyche 36: 155–181.

Robinson GW. 1922. A new method for the mechanical analysis of soils and other dispersions. Journal of Agricultural Science 12: 306–321.

Schaetzl RJ, Burns SF, Johnson DL, Small TW. 1989a. Tree uprooting: review of impacts on forest ecology. Vegetatio 79: 165–176.

Schaetzl RJ, Johnson DL, Burns SF, Small TW. 1989b. Tree uprooting: review of terminology, process, and environmental implications. Canadian Journal of Forest Research 19: 1–11.

Small TW. 1997. The Goodlett–Denny mound: a glimpse at 45 years of Pennsylvania treethrow mound evolution with implications for mass wasting. Geomorphology 18: 305–313.

Stubbs CS, Drummond FA. 1999. Pollination of lowbush blueberry by *Anthophora pilipes villosula* and *Bombus impatiens* (Hymenoptera: Anthophoridae and Apidae). Journal of the Kansas Entomological Society 72: 330–333.

Thalmann U, Dorn M. 1990. Die Haltung der Pelzbiene, *Anthophora acervorum* (L.) und ihr Einsatz zur Nutzpflanzenbestaubung. Wissenschaftliche Zeitschrift der Martin-Luther Universität, Halle-Wittenberg 39: 15–21.

Walsh BD, Riley CV. 1868. The American Entomologist: An Illustrated Magazine of Popular and Practical Entomology. Volume 1. R. P. Studley & Co., St. Louis, Missouri.

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