



# The *Pheidole* (Hymenoptera: Formicidae) of Oklahoma: new species records and distributional notes

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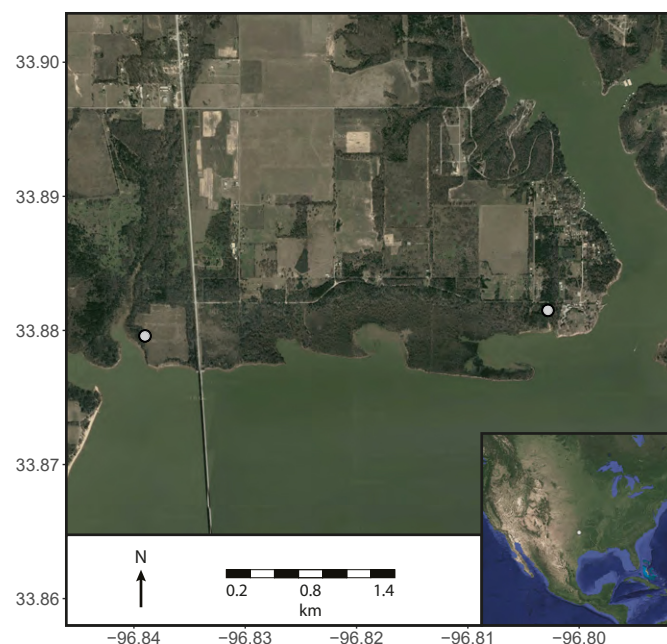
**Abstract:** Big-headed ants from the genus *Pheidole* (Hymenoptera: Formicidae) are diverse and ecologically important world-wide. Here we report the first record in Oklahoma for two species, *Pheidole pelor* and *Pheidole tysoni*, increasing the number of known *Pheidole* species in Oklahoma to twelve. We highlight two areas, north-western and southeastern Oklahoma, that may contain undocumented species based on their unique habitat, and stress the importance of surveying the regional fauna of these areas to create a proper baseline for monitoring the effects of environmental change.

**Key words:** ants; big-headed ant; biodiversity; native species; new record; University of Oklahoma Biological Station

Ants (Hymenoptera: Formicidae) are a conspicuous and important group of terrestrial arthropods (HÖLLDOBLER & WILSON 1990; LACH et al. 2010). They perform a variety of ecosystem services (DEL TORO et al. 2012), invade novel habitats (TSCHINKEL 2006; ROEDER & KASPARI 2017), form nomadic armies (KASPARI & O'DONNELL 2003), and have been used as bioindicators of ecosystems (ANDERSEN & MAJER 2004). Within the ants, the genus *Pheidole* ranks as one of the most speciose, morphologically diverse, and geographically distributed clades (WILSON 2003; ECONOMO et al. 2015). Workforces are comprised of two castes: minor and major workers. The latter have enlarged heads giving rise to their common name, the big-headed ants. Presently, there are over 1000 recognized *Pheidole* species (WILSON 2003) making up almost 8% of the approximate 15000 described ant species (ECONOMO et al. 2015; BOLTON 2016). However, few records exist for *Pheidole* in Oklahoma despite the state's numerous environmental gradients and potential for ant biodiversity (ROEDER & ROEDER 2016). Here we combine personal collections with literature and natural history museum records towards a better understanding of the genus' distribution.

New locality records for both *Pheidole pelor* Wilson 2003 and *Pheidole tysoni* Forel 1901 were found at the University of Oklahoma Biological Station (UOBS), which was initially

established in 1949 on the northern border of Lake Texoma (Figure 1). At the UOBS, approximately 131 ha of forest comprised of American elm (*Ulmus americana* L.), hackberry (*Celtis occidentalis* L.), and pecan (*Carya illinoensis* (Wangenh.) K. Koch) are located both west and north of the main lawn of the station grounds and surround 36 ha of fields that contain Indiangrass (*Sorghastrum nutans* (L.) Nash), Johnsongrass (*Sorghum halepense* (L.) Pers.), and little bluestem (*Schizachyrium scoparium* (Michx.) Nash). For *P. pelor*, workers were collected in the leaf litter of the woods, 200 m directly west of the main lawn of the station grounds on 10% sucrose and cricket baits (Figure 1; Table 1). For *P. tysoni*, workers were collected in a pitfall trap that was placed 15 cm underground in an old agricultural field (Figure 1; Table 1).



**Figure 1.** Map of the University of Oklahoma Biological Station (UOBS). Collection areas are denoted by grey points. The inset shows the location of the UOBS in North America.

**Table 1.** New locality records for *Pheidole* species at the University of Oklahoma Biological Station.

Species	Latitude	Longitude	Elevation	Collection Date	Catalog Number
<i>Pheidole pelor</i>	33.8815° N	96.8028° W	208 m	1 August 2016	OMNH-210930, OMNH-210931
<i>Pheidole tysoni</i>	33.8796° N	96.8390° W	194 m	15–17 March 2015	OMNH-210932, OMNH-210933

Specimens were identified using WILSON (2003). A series of measurements were taken for minor and major workers for the new species records using a Leica S8 APO stereo microscope. All measurements are in millimeters and reflect a set of standard measurements for morphological traits listed in the Global Ants Database (PARR et al. 2017). These include head width (HW), head length (HL), clypeus length (CL), mandible length (ML), femur length (FL), scape length (SL), Weber's length (WL), pronotum width (PW), inter-ocular width (IOW), eye width (EW), and eye length (EL). All available specimens for each species were measured which included one major and ten minor workers for *P. pelor*, and one major and six minor workers for *P. tysoni*. Measurement values are reported for minors as a mean with the range listed in parentheses and as a single value for majors. Digital color images were then taken using a Leica EC3 digital camera with FireCam software version 3.4.1 (Leica Microsystems Inc., Wetzlar, Germany). Images were compiled using Helicon Focus version 4.2.7 (Helicon Soft Ltd.) with scale bars added in Adobe Photoshop CS3 version 10.0.1 (Adobe Systems Inc., San Jose, CA, USA). One major and minor worker of each species are deposited as vouchers in the Sam Noble Oklahoma Museum of Natural History, while the others remain in the K.A. Roeder collection at the University of Oklahoma.

### ***Pheidole pelor* Wilson, 2003**

*Pheidole pelor* WILSON 2003: 547.

**Material examined:** OMNH-210930, KAR186 and OMNH-210931, KAR187; Figures 2–7.

### **Measurements (mm):**

Major — HW 0.95, HL 1.17, CL 0.30, ML 0.53, FL 0.77, SL 0.47, WL 1.11, PW 0.56, IOW 0.92, EW 0.10, EL 0.15

Minor — HW 0.60 (0.57–0.62), HL 0.55 (0.52–0.61), CL 0.20 (0.19–0.23), ML 0.36 (0.32–0.38), FL 0.55 (0.52–0.57), SL 0.44 (0.40–0.48), WL 0.68 (0.65–0.72), PW 0.34 (0.30–0.37), IOW 0.52 (0.50–0.54), EW 0.07 (0.06–0.07), EL 0.11 (0.10–0.12)

Ten minors and one major were collected between 0700–1700 h on 1 August 2016. *Pheidole pelor* belongs to the *lamia* species group, which according to WILSON (2003), contains four species that are found in the southern United States, Central America, and northern South America. The key morphological features that distinguish *P. pelor* from other members of this species group are majors that have (1) a phragmotic head that is rugoreticulate on the posterior half (Figure 2) and (2) parallel transverse carinulae on the anterior dorsum of the pronotum (Figure 4; WILSON 2003). Specimens that we collected were yellow to dark yellow and the major displayed the defining features of the *lamia* group:

a phragmotic head that incorporated a flattened clypeus and mandibles with deep antennal scrobes (WILSON 2003). As reported for *Pheidole lamia* Wheeler 1901, there may only be a few major workers per colony that are rarely seen aboveground (FEENER 1981). This species has rarely been collected, with the majority of localities occurring in central Texas around Austin, the type locality, approximately 400 km south of the UOBS. Specimens, however, have also been reported from Little River and Hempstead counties in Arkansas (GENERAL & THOMPSON 2009), which are 250 km and 300 km east of the UOBS

### ***Pheidole tysoni* Forel, 1901**

*Pheidole tysoni* FOREL 1901: 348 — WILSON 2003: 528.

**Material examined:** OMNH-210932, KAR188 and OMNH-210933, KAR189; Figures 8–13.

### **Measurements (mm):**

Major — HW 0.82, HL 0.91, CL 0.17, ML 0.50, FL 0.56, SL 0.42, WL 0.83, PW 0.44, IOW 0.73, EW 0.08, EL 0.12

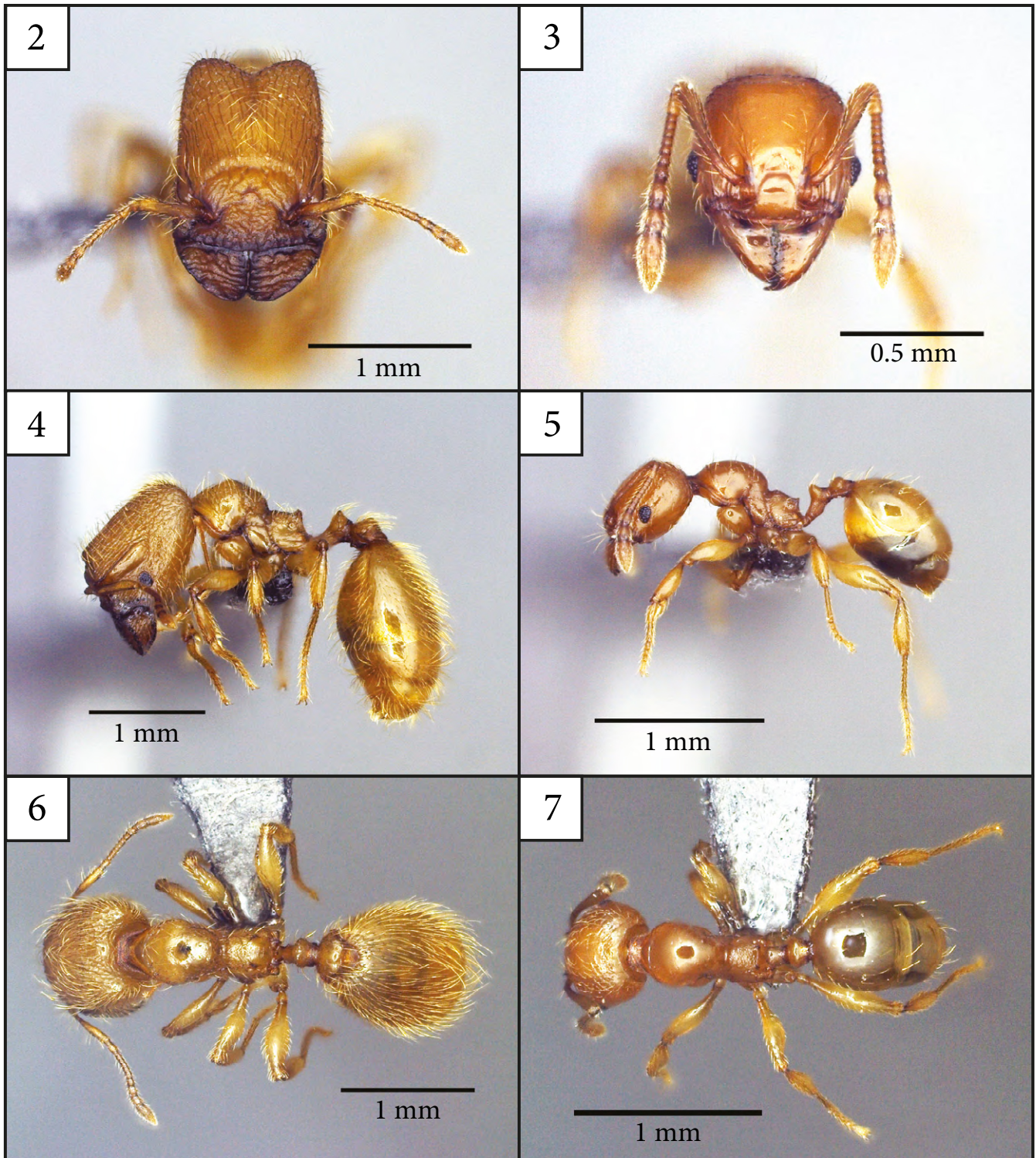
Minor — HW 0.48 (0.46–0.50), HL 0.47 (0.46–0.51), CL 0.13 (0.12–0.15), ML 0.28 (0.27–0.31), FL 0.38 (0.37–0.40), SL 0.38 (0.37–0.39), WL 0.52 (0.43–0.54), PW 0.26 (0.24–0.28), IOW 0.41 (0.39–0.42), EW 0.06 (0.05–0.06), EL 0.10 (0.09–0.11)

Six yellow minor and one major worker were collected from 15–17 March 2015. However, ants of this species were never observed foraging aboveground. *Pheidole tysoni* belongs to the *flavens* species group which are small in size (HW of major 1.2 mm or less) and lack a mesonotal convexity in lateral view (WILSON 2003). Members also have a thick antennal club but short antennal scape. A few key defining characters from WILSON (2003) that differentiate *P. tysoni* from others in this species group are (1) a yellow head with a dark circular spot in the center of the dorsal surface (Figure 8) and (2) carinulae along the lateral margins of the pronotal humeri (Figure 12). While this species has been reported from New York to Chihuahua (WILSON 2003), locality information in the middle of the distributional range is lacking due to poor sampling as the closest records to our collection are in Texas approximately 465 km west and in Arkansas approximately 370 km east of the UOBS (GENERAL & THOMPSON 2007; iDigBio 2016).

### **Distribution of *Pheidole* in Oklahoma by county**

Below we list distribution records for other *Pheidole* species in Oklahoma counties from literature sources (SMITH 1935; YOUNG & HOWELL 1964; SMITH 1979; WHEELER & WHEELER 1989; ALBRECHT 1995; ROEDER & ROEDER 2016), the Sam Noble Oklahoma Museum of Natural History





**Figures 2–7.** Photographs of *Pheidole pelor* (specimen numbers. OMNH-210930 and OMNH-210931) from the University of Oklahoma Biological Station. **2.** Head of major worker. **3.** Head of minor worker. **4.** Lateral view of major worker. **5.** Lateral view of minor worker. **6.** Dorsal view of major worker. **7.** Dorsal view of minor worker.

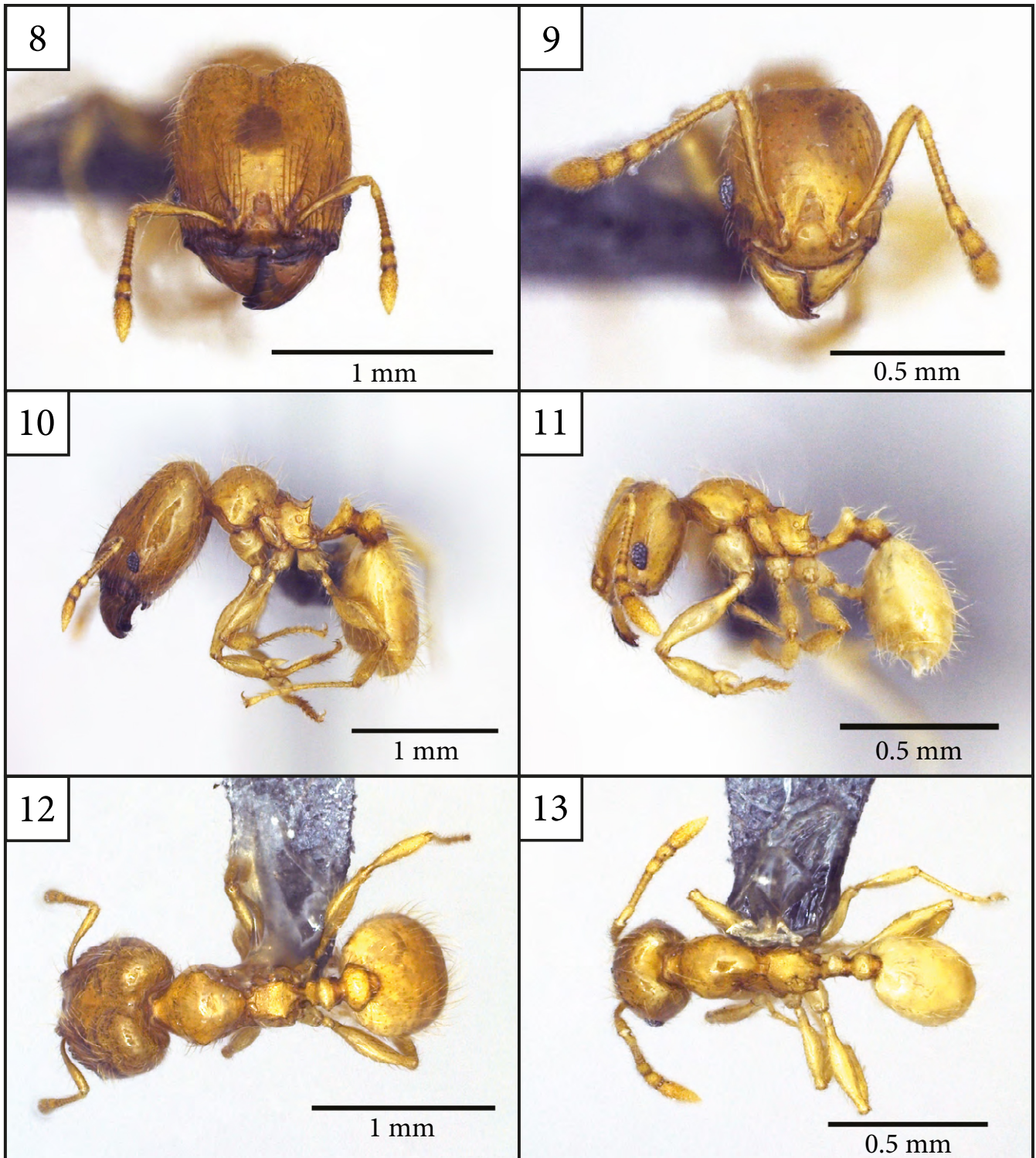
(SNOMNH 2016), and the integrated digitized biocollections (iDGBIO 2016).

*Pheidole bicarinata* Mayr, 1870 — Beaver, Beckham, Caddo, Canadian, Cimarron, Comanche, Craig, Grady, Harmon, Harper, Kay, Le Flore, Marshall, Noble, Nowata, Osage, Ottawa, Pawnee, Payne, Sequoyah, Texas, Washington, Woods, Woodward.

*Pheidole cockerelli* Wheeler, 1908 — Beckham, Comanche, Murray.

*Pheidole dentata* Mayr, 1886 — Alfalfa, Atoka, Beckham, Blaine, Bryan, Caddo, Choctaw, Comanche, Garfield, Grant, Greer, Harmon, Harper, Haskell, Hughes, Jackson, Kay, Kingfisher, Latimer, Le Flore, Major, Marshall, McCurtain, McIntosh, Noble, Oklahoma, Osage, Pawnee,

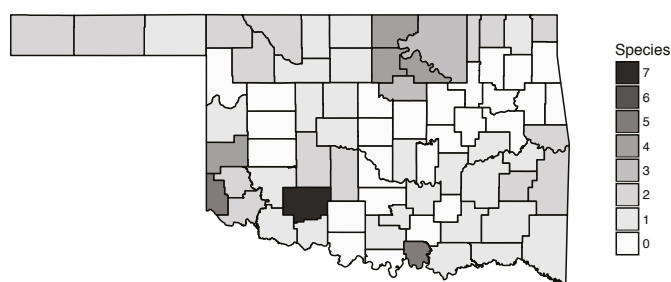




**Figures 8–13.** Photographs of *Pheidole tysoni* (specimen numbers OMNH-210932 and OMNH-210933) from the University of Oklahoma Biological Station. **8.** Head of major worker. **9.** Head of minor worker. **10.** Lateral view of major worker. **11.** Lateral view of minor worker. **12.** Dorsal view of major worker. **13.** Dorsal view of minor worker.

Payne, Pittsburg, Pontotoc, Pushmataha, Roger Mills, Sequoyah, Wagoner, Washington, Woods.  
*Pheidole desertorum* Wheeler, 1906 — Cimarron.  
*Pheidole hyatti* Emery, 1895 — Carter, Comanche, Cotton, Grady, Greer, Harmon, Jackson, Kiowa, Tillman.  
*Pheidole metallescens* Emery, 1895 — Marshall.  
*Pheidole morrisii* Forel, 1886 — Noble, Osage, Pawnee, Payne, Pottawatomie.

*Pheidole pelor* Wilson, 2003 — Marshall.  
*Pheidole pilifera* (Roger, 1863) — Cimarron, Comanche, Texas, Woodward.  
*Pheidole soritis* Wheeler, 1908 — Beckham, Comanche, Harmon, Latimer, McClain, Noble, Nowata, Ottawa, Pawnee.  
*Pheidole tetra* Creighton, 1950 — Comanche, Marshall.  
*Pheidole tysoni* Forel, 1901 — Marshall.



**Figure 14.** Species richness of *Pheidole* across the 77 counties of Oklahoma.

The number of known species of the ant genus *Pheidole* is now twelve in Oklahoma. However, for 88% of the counties, only two or fewer *Pheidole* species have been reported (Figure 14). With the majority of these belonging to *P. bicarinata* and *P. dentata*, the remaining 10 species are found on average in less than 5% of Oklahoma's counties. This lack of information is troubling, especially if ants are to be used to their fullest potential as bioindicators of ecosystems (ANDERSEN & MAJER 2004).

Across Oklahoma there are 32 state parks, 12 level III ecoregions, 10 nature conservancy preserves, and nine wildlife refuges. Many of these are in counties where low *Pheidole* species richness has been reported. For example, Beaver, Cimarron, and Texas Counties in northwestern Oklahoma are primarily High Plains or Southwestern Tablelands, which are elevated subhumid grasslands or semiarid grazing lands. Despite the potential for biodiversity in these two ecoregions, only three *Pheidole* species have been collected from these areas. Cimarron County specifically contains the only reported record for *P. desertorum* in Oklahoma. On the opposite side of Oklahoma, the counties of Love, Marshall, Bryan, Choctaw, and McCurtain make up the southeastern portion of the state as well as a fraction of the Cross Timbers, East Central Texas Plains, and South Central Plains ecoregions. These ecoregions originally contained both post oak savannas and oak-hickory-pine forests, however much of the Cross Timbers and East Central Texas Plains are now used as rangeland or pastures. Excluding Marshall County which is home to the UOBS, only a single species, the common *P. dentata*, has been found. As recent ant records have started to emerge from this area (ROEDER & ROEDER 2015; ROEDER et al. 2015), future discoveries undoubtedly await and will increase the most recently published estimate of 124 ant species in Oklahoma (ROEDER & ROEDER 2016). We suggest a greater focus should be placed on creating baseline data of native biodiversity in these potentially species rich regions. With such data, we could then monitor for shifts in species distributions that will help us better understand the impacts of climate change and habitat modification in this region of the USA.

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## LITERATURE CITED

- ALBRECHT, M. 1995. New species distributions of ants in Oklahoma, including a South American invader. *Proceedings of the Oklahoma Academy of Sciences* 75: 21–24.
- ANDERSEN, A.N. & J.D. MAJER. 2004. Ants show the way down under: invertebrates as bioindicators in land management. *Frontiers in Ecology and the Environment* 2(6): 291–298. doi: [10.1890/1540-9295\(2004\)002\[0292:ASTWDU\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2004)002[0292:ASTWDU]2.0.CO;2)
- BOLTON, B. 2016. An online catalog of the ants of the world. Accessed at <http://antcat.org/>, 9 March 2017.
- DEL TORO, I., R.R. RIBBONS & S.L. PELINI. 2012. The little things that run the world revisited: a review of ant-mediated ecosystem services and disservices (Hymenoptera: Formicidae). *Myrmecological News* 17: 133–146.
- ECONOMO, E.P., P. KLIMOV, E.M. SARNAT, B. GUÉNARD, M.D. WEISER, B. LECROQ & L.L. KNOWLES. 2015. Global phylogenetic structure of the hyperdiverse ant genus *Pheidole* reveals the repeated evolution of macroecological patterns. *Proceedings of the Royal Society B* 282: 20141416. doi: [10.1098/rspb.2014.1416](https://doi.org/10.1098/rspb.2014.1416)
- FEENER, D.H., JR. 1981. Notes on the biology of *Pheidole lamia* (Hymenoptera: Formicidae) at its type locality (Austin, Texas). *Journal of the Kansas Entomological Society* 54(2): 269–277.
- FOREL, A. 1901. Variétés myrmécologiques. *Annales de la Société Entomologique de Belgique* 45: 334–382.
- GENERAL, D.M. & L.C. THOMPSON. 2007. Ants (Hymenoptera: Formicidae) of Arkansas Post National Memorial. *Journal of the Arkansas Academy of Science* 61: 59–64.
- GENERAL, D.M. & L.C. THOMPSON. 2009. New distributional records of ants in Arkansas for 2008. *Journal of the Arkansas Academy of Science* 63: 182–184.
- HÖLLDOBLER, B. & E.O. WILSON. 1990. *The ants*. Cambridge: Harvard University Press. 732 pp.
- iDIGBIO (INTEGRATED DIGITIZED BIOCOLLECTIONS). 2016. Integrated Digitized Biocollections. Accessed at <https://www.idigbio.org/>, 23 August 2016.
- KASPARI, M. & S. O'DONNELL. 2003. High rates of army ant raids in the Neotropics and implications for ant colony and community structure. *Evolutionary Ecology Research* 5: 933–939.
- LACH, L., C.L. PARR & K.L. ABBOTT. 2010. *Ant ecology*. Oxford: Oxford University Press. 432 pp.
- PARR, C.L., R.R. DUNN, N.J. SANDERS, M.D. WEISER, M. PHOTAKIS, T.R. BISHOP, M.C. FITZPATRICK, X. ARRAN, F. BACCARO, C.R.F. BRAND, L. CHICK, D.A. DONOSO, T.M. FAYLE, C. GOMEZ, B. GROSSMAN, T.C. MUNYAI, R. PACHECO, J. RETANA, A. ROBINSON, K. SAGATA, R.R. SILVA, M. TISTA, H. VASCONCELOS, M. YATES & H. GIBB. 2017. GlobalAnts: a new database on the geography of ant traits (Hymenoptera: Formicidae). *Insect Conservation and Diversity* 10: 5–20.
- ROEDER, K.A. & M. KASPARI. 2017. From cryptic herbivore to predator: stable isotopes reveal consistent variability in trophic levels in an ant population. *Ecology* 98(2): 297–303.
- ROEDER, K.A. & D.V. ROEDER. 2015. New record of the ant subfamily Pseudomyrmecinae (Hymenoptera: Formicidae) from Oklahoma. *The Southwestern Naturalist* 60(4): 373–374. doi: [10.1894/0038-4909-60.4.373](https://doi.org/10.1894/0038-4909-60.4.373)
- ROEDER, K.A., D.V. ROEDER, J.D. KOURI & J.A. HELMS IV. 2015. A new latitudinal record for the ant genus *Leptogenys* (Hymenoptera: Formicidae) in North America. *Southwestern Entomologist* 40(3): 653–656. doi: [10.3958/059.040.0320](https://doi.org/10.3958/059.040.0320)
- ROEDER, K.A. & D.V. ROEDER. 2016. A checklist and assemblage

- comparison of ants (Hymenoptera: Formicidae) from the Wichita Mountains Wildlife Refuge in Oklahoma. Check List 12(4): 1935. doi: [10.15560/12.4.1935](https://doi.org/10.15560/12.4.1935)
- SMITH, D.R. 1979. Superfamily Formicoidea; pp. 1323–1467, in: K.V. KROMBEIN, P.D. HURD, D.R. SMITH & B.D. BURKS (eds.). Catalog of Hymenoptera in America North of Mexico. Washington: Smithsonian Institution Press.
- SMITH, M.R. 1935. A list of ants of Oklahoma. Entomological News 46: 235–264.
- SNOMNH (SAM NOBLE OKLAHOMA MUSEUM OF NATURAL HISTORY). 2016. Sam Noble Oklahoma Museum of Natural History-Recent Invertebrates Database. Accessed at <http://samnoblemuseum.ou.edu/>, 23 August 2016.
- TSCHINKEL, W.R. 2006. The fire ants. Cambridge: Harvard University Press. 752 pp.
- WHEELER, G.C. & J. WHEELER. 1989. A checklist of the ants of Oklahoma. Prairie Naturalist 21: 203–210.
- WILSON, E.O. 2003. *Pheidole* in the New World. A dominant, hyperdiverse ant genus. Cambridge: Harvard University Press. 794 pp.
- YOUNG, J.H. & D.E. HOWELL. 1964. Ants of Oklahoma. Stillwater: Oklahoma State University. 48 pp.
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