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Scientific Note

Ground-dwelling ants (Hymenoptera: Formicidae) in a mining area of Quipama, Boyacá, Colombia, with new species records

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Abstract. Mining is a process with great environmental impact that implies important consequences for biodiversity, including its loss. Here, we present a list of 13 species of ants that were collected in a high-impact mining exploitation area of Quipama, Boyacá, Colombia. Notably, the records of *Pheidole subarmata* Mayr, 1884 and *Camponotus ager* (Smith, 1858) are new for the department. Although the presence of these species indicates serious disturbance by human activity in the area, there is still a considerable diversity of ants. This study highlights the need for actions to ensure the management and rehabilitation of areas affected by mining.

Keywords: Biomonitoring, Boyacá, Formicidae, mining exploitation, new departmental records.

Mining, understood as the extraction of minerals and other geological materials of economic importance from the Earth's surface, has directly and indirectly caused a considerable impact on ecosystems. This is reflected in erosion, landslides, loss of vegetation and contamination of soil, groundwater and surface water. As a consequence, availability of food, water and wildlife habitats has been altered (Mosquera et al. 2019; Rehman et al. 2024), impacting the species richness, abundance and diversity of biological communities.

In Colombia, studies on mineral extraction and its impacts in regions of high biodiversity are lacking. However, mining is a relevant factor behind the loss of tree cover, affecting migration, reproduction rates, survival, and growth of organisms (Gonzalez et al. 2021). In many cases it remains unknown if species will be resistant to anthropogenic disturbance or if they may become locally extinct in the affected areas.

Given the impacts of mining, generating knowledge about the biodiversity found in these areas can contribute to the design of management and rehabilitation strategies. Additionally, it can help identify categorized and bioindicator species. Finally, it provides insight into the function of ecosystems by recognizing ecological relationships and environmental services they offer to society (Rojas et al. 2014; Agudelo-Martínez et al. 2018).

Rapid species inventories generate knowledge of the structure and function of an ecosystem at different hierarchical levels. Ants are ideal organisms to study in inventories due to their high diversity, abundance in almost all types of environments, variety of functions, rapid response to environmental changes, ease of sampling, and relatively good taxonomic resolution (Alonso & Agosti 2000). Using data obtained from rapid species inventories it is possible to estimate abundances with little sampling and processing time of the collected material. This information can be subsequently applied in studies on systematics, ecology, biogeography and ecosystem management (Arcila & Lozano 2003; Villareal et al. 2006; Cruz et al. 2017).

Given the scarce information on the richness and distribution of ants in Boyacá (Morales et al. 2022), especially in areas with mining activity, this communication provides the first report of ants from the municipality of Quipama, Boyacá, Colombia.

Sampling was carried out during the dry season in December 2019 in Quipama, Boyacá between the "La Floresta" trail and the mining area. This locality is characterized for having unprotected forest areas on terrain susceptible to erosion (UNGRD 2012). Three linear transects

each with 10 pit fall traps separated 10 meters from each other were set up for 72 hours. Spacing between transects was 150 m.

The collected specimens were identified using the keys by Fernández et al. (2019) and the online ant catalog of AntWeb images (AntWeb 2022). Specimens were also compared with material from collections previously identified by experts. The geographical distribution for the species in the department of Boyacá was verified with the work of Fernández et al. (2019). All specimens were deposited in the Entomological Collection of the Natural History Museum of the National Pedagogical University (MHN-UPN).

In total, 101 specimens of the family Formicidae belonging to five subfamilies, 10 genera, and 13 species were collected (Table 1). Notably, this includes two new records for the department of Boyacá, Colombia.

Pheidole subarmata Mayr, 1884
(Figs. 1A, 1B)

COLOMBIA, *Boyacá*: Quipama (La floresta, mining zone), 5°31'45.6"N 74°08'44.6"W, 860 m, 1 soldier, 15.XII.2019, Pitfall trap, A. Ávila leg. [MHN-UPN].

Distribution. Argentina, Bahamas, Barbados, Brazil, Colombia (Risaralda & Magdalena), Costa Rica, Cuba, Dominican Republic, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica. Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Saint Vincent and the Grenadines, Trinidad and Tobago (Fernández et al. 2019). A new department record to Colombia: Boyacá.

Remarks. *Pheidole subarmata* is commonly found in habitats severely disturbed by human activity, such as roadsides, agricultural fields, coconut groves, secondary rainforests, urban parks, and coastlines (AntWeb 2022). The workers are commonly found foraging and easily reach the bait, while the soldiers have hypogean habits (Camargo-Vanegas & Guerrero 2020).

Camponotus ager (Smith, 1858)
(Figs. 2A, 2B)

COLOMBIA, *Boyacá*: Quipama (La floresta, Zona minera), 5°31'40.7"N 74°08'42.1"W, 915 m, 14 spec, 15.XII.2019, Pitfall trap, A. Ávila leg. [MHN-UPN].

Distribution. Belize to Bolivia. In Colombia: Cundinamarca, Valle

Figure 1. High-resolution images of the head in full-face view and body profile. A-B *Pheidole subarmata (CASENT0178060)* Image by Abril Nobile, from www.antweb.org).

Figure 2. High-resolution images of the head in full-face view and body profile. A-B *Camponotus ager* (ECOFOG-BAF19-0036-02) Image by Frederic Petitclerc, from www.antweb.org).

Table 1. Species and number of individuals found in the mining area of Quipama, Boyacá.

Species	Individuals collected	Guild (based on bibliography: (Silvestre et al. 2003 and Martinez 2018)
Acromyrmex octospinosus (Reich, 1793)	1	Fungus grower
Atta cephalotes (Linnaeus, 1758)	31	Fungus grower
Camponotus ager (Smith, 1858)	12	Arboreal
Camponotus indianus Forel, 1879	5	Arboreal
Crematogaster limata Smith, 1858	2	Arboreal
Dolichoderus bispinosus (Olivier, 1792)	6	Arboreal
Ectatomma edentatum Roger, 1863	22	Predator
Ectatomma tuberculatum (Olivier, 1792)	1	Predator
*Mayaponera constricta (*Mayr, 1884)	1	Predator
*Odontomachus haematodus (*Linnaeus, 1758)	8	Predator
*Pachycondyla harpax (*Fabricius, 1804)	7	Predator
Pheidole sp1	1	Omnivorous
Pheidole subarmata Mayr, 1884	1	Omnivorous

del Cauca, Cauca (Fernández et al. 2019); Boyacá is a new department record to Colombia.

Remarks. *Camponotus ager* is moderately common in Colombia. Foraging workers have been collected on trees, on the ground, and in leaf litter. This species inhabits moist to wet mature forest habitats and is usually found as individual foragers in understory vegetation (AntWeb 2022). Although most active at night, they can be found during the day (Camargo-Vanegas & Guerrero 2020).

The present communication is an approximation to the myrmecofauna of an area impacted by mining activity, which provides

a basis for future studies in the conservation and management of biodiversity. The new record of *P. subarmata*, along with the presence of *Acromyrmex octospinosus* (Reich, 1793)*, Atta cephalotes* (Linnaeus, 1758)*, Crematogaster limata* Smith, F., 1858 and *Dolichoderus bispinosus* (Olivier, 1792) suggests that the ant community in the area has been maintained despite potential disturbance caused by mining. Additionally, the new record of *Camponotus ager* (Smith, 1858) and the presence of *Camponotus indianus* Forel, 1879 indicate the possible presence of mature forest habitats, since colonies of these species are found in dark or poorly lit and relatively stable areas (Agudelo et al. 2018).

Although rapid inventories are an effective method to quickly improve the knowledge on an ecosystem, a single inventory is not sufficient to characterize an area and estimate its natural values. Periodic inventories in the mining area of Quipama, Boyaca would allow us to compare and interpret changes in biological composition over time. According to another study conducted in different altitudinal gradients of the department of Boyacá, a rich fauna would be expected in the Quipama area (Morales et al. 2022). Additional studies in this region are warranted to successfully guide efforts in the management and rehabilitation of areas affected by mining.

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Authors' Contributions

AJAJ and RMJ: Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest of any kind.

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