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RESEARCH ARTICLE

High ant (Hymenoptera: Formicidae) diversity revealed in Akagera National Park in eastern Rwanda

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Ants represent a crucial component of terrestrial ecosystems owing to their roles in nutrient cycling, soil aeration and predation. However, myrmecological studies are relatively rare in the Afrotropics, including Rwanda. This study reveals high ant diversity within Akagera National Park in eastern Rwanda, an ecologically rich area comprising savannas, woodlands and wetlands. A nonsystematic sampling scheme was used across different habitats within the park, implementing various sampling techniques, namely pitfall traps, leaf litter sifting, Winkler leaf litter extraction, vegetation sweeping and hand collection from rocks, rotten wood and dead trees. The findings indicate a high diversity of ant species, with six subfamilies comprising 41 genera including 119 named species and 68 morphospecies. A minimum of 17 of these morphospecies represent undescribed species. Of the collected species, 149 were recorded for the first time in Rwanda. These findings highlight the status of Akagera National Park as a biodiversity hotspot. They also provide a baseline inventory for future entomological, ecological and conservation efforts in Akagera National Park. We recommend additional studies to formally describe the morphospecies currently confirmed as undescribed and to further investigate the status of the remaining unidentified morphospecies.

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INTRODUCTION

Ants represent a diverse and ecologically important group within the Hymenoptera (Parr et al. 2017). This order ranks among the most dominant, alongside the orders Coleoptera, Diptera and Lepidoptera (Eggleton 2020). Ants play crucial roles in ecosystems by aerating the soil, cycling nutrients and dispersing seeds, all of which are essential for maintaining environmental health (Underwood & Fisher 2006; Kovář et al. 2013; Tiede et al. 2017). Like other forms of biodiversity, ants are increasingly threatened by habitat destruction (Tiede et al. 2017; Cajaiba et al. 2023) and climate change (Parr & Bishop 2022; Helms 2023). Recent studies have highlighted that a considerable number of ant species are being introduced outside of their native ranges, primarily by human activities (Helms 2023; Aulus-Giacosa et al. 2024). Some of these species may be invasive and pose serious ecological threats by outcompeting native species (Lach 2021). For example, at least 520 ant species have been transported outside of their native range in Mediterranean regions (Wong et al. 2023), highlighting the need for monitoring and management strategies to safeguard native ants (Gentili et al. 2021).

Studies conducted in the Afrotropical region, encompassing sub-Saharan Africa and the surrounding islands (Hita Garcia et al. 2009; Kouakou et al. 2018; Nsengimana et al. 2023; Ambakina et al. 2024), have indicated a diverse ant fauna in the area (Fisher & Bolton 2016). The region is home to over 2 400 documented ant species (Economo et al. 2015), though the actual diversity is believed to be at least twice as high (Robertson 2000; Kass et al. 2022; Gomez et al. 2023). Furthermore, recent research has begun to reveal the distinctive adaptations of Afrotropical ants to different habitats, including savannas, rainforests and deserts (Molla et al. 2022). However, the lack of comprehensive taxonomic resources and the impacts of habitat loss, climate change and invasive species pose significant challenges to fully understanding the diversity and conservation status of these ants (Molla et al. 2022). Further research is crucial for uncovering the full extent of ant diversity and their ecological roles in the Afrotropical region (Dillon & Lozier 2019; Banks-Leite et al. 2020).

As in most countries in the Afrotropical region, ant studies are still relatively limited in Rwanda compared to other regions globally (Guénard et al. 2017; Dantas & Fonseca 2023). Recent research efforts have begun to uncover the richness of the country's ant fauna (Nsengimana & Dekoninck 2020). Rwanda's diverse landscapes, ranging from montane forests to habitats with distinct land use types, provide suitable environments for a high diversity of ant species (Nsengimana et al. 2018, 2021, 2023; Nsengimana & Dekoninck 2021). Prior to this study, 105 ant species had been recorded in Rwanda (Nsengimana et al. 2023), a limited number as this region is expected to have high ant diversity (Kass et al. 2022) with an estimate of over 400 species (Kass pers. comm.). There is a need for further myrmecological studies to document ant species diversity and an urgent call to fill the knowledge gaps regarding ants in eastern Rwanda. Responding to this need, two non-systematic ant sampling exhibitions (in 2022 and 2023) were conducted in Akagera National Park, eastern Rwanda. The findings supplement existing data on ant species diversity and highlight the importance of natural forests in savanna regions for the conservation of entomological diversity, particularly that of ants.

MATERIALS AND METHODS

Study site

The study was conducted in Akagera National Park (1°45′00″ S, 30°38′00″ E), located in eastern Rwanda approximately 1.300–1.825 m.a.s.l (Figure 1). The area is dominated by acacia trees (*Vachellia* spp. and *Senegalia* spp.) with open grasslands and flooded plains in the valleys (Gatali & Wallin 2015). The Akagera River runs along and partly through the park forming vast papyrus wetlands and lakes (Ndayisaba et al. 2017). Akagera National Park is home to a variety of wildlife, including many big game species. The Park has seen significant conservation success, with reintroductions of lions in 2015 and black rhinos in 2017, along with a recent addition of white rhinos in 2021 and 2025, marking its comeback as a prime wildlife sanctuary.

Sample collection and analysis

During two sampling expeditions (October 2022 and October 2023), each lasting 10 days, samples were collected by a group of myrmecologists from Rwanda, South Africa, the Ivory Coast, Kenya, Spain and Belgium, in collaboration with young researchers from Rwanda, Tanzania, Uganda and the Democratic Republic of Congo. Most sampling sites were inside the National Park, with the exception of Akagera village and Akagera Community Centre (Figure 1). At each site, ants were collected using pitfall traps, baiting, vegetation sweeping and hand searching in leaf-litter, soil, under and in rotten and fallen wood and under stones. Pitfall traps were set up at each sampling point and collected three days later. Leaf-litter was sifted in the field and placed in Winkler extractors which were hung indoors for shelter against wind and rain. The extracted specimens were collected after three days and kept in vials for later identification.

Identification was conducted following several publications. For genus level identification, Fisher and Bolton (2016) was used. For identification to species level we used different publications depending on the genus: *Anochetus* (Brown 1978), *Bothroponera* (Joma & Mackay 2017, 2020), *Calyptomyrmex* (Bolton 1981), *Cardiocondyla* (Rigato 2002), *Cataulacus* (Bolton 1982), *Hypoponera* (Bolton & Fisher 2011), *Leptogenys* (Bolton 1975), *Meranoplus* (Bolton 1981), *Monomorium* (Bolton 1987), *Nesomyrmex* (Hita Garcia et al. 2017), *Nylanderia* (LaPolla et al. 2011), *Paraparatrechina* (LaPolla & Fisher 2014), *Platythyrea* (Brown 1975), *Plectroctena* (Bolton & Brown 2002), *Polyrhachis* (Rigato 2016), *Simopone* (Bolton & Fisher 2012), *Strumigenys* (Bolton 2000), *Syllophopsis* (Bolton 1987), *Technomyrmex* (Bolton 2007), *Tetramorium* (Bolton 1976, 1980; Hita Garcia et al. 2010; Hita Garcia & Fischer 2014), *Tetraponera* (Ward 2022) and *Trichomyrmex* (Bolton 1987).

For genera that had not been previously revised, specimens were identified by comparing them with type specimen images available on AntWeb (www.antweb.org) or with reference specimens in our own collections: the AfriBugs Collection, Pretoria, South Africa (AFRC); Kiko Gomez Collection, Barcelona, Spain (KGAC); Royal Belgium Institute for Natural Sciences, Brussels, Belgium (RBINS); and Rwanda Ant Collection, Huye, Rwanda (RWAC). This was necessary for *Agraulomyrmex*, *Anillomyrma*, *Brachyponera*, *Camponotus*, *Carebara*, *Crematogaster*, *Dorylus*, *Euponera*, *Fisheropone*, *Lepisiota*, *Lioponera*, *Megaponera*, *Mesoponera*, *Myrmicaria*, *Paltothyreus*, *Parasyscia*, *Pheidole*, *Plagiolepis*, *Solenopsis* and *Tapinoma*. When no satisfactory match was found, the morphospecies was given a code for databasing purposes.

In some genera, we could confidently determine that certain Akagera morphospecies represent undescribed species. This was possible where recent revisions had been published and type specimen image availability was sufficient to exclude all possible described species, where no described species exist in Africa (e.g. *Anillomyrma*) or where the genus is currently undergoing revision that includes the description of material from Akagera (e.g. *Agraulomyrmex*). In other genera, especially in cases where not

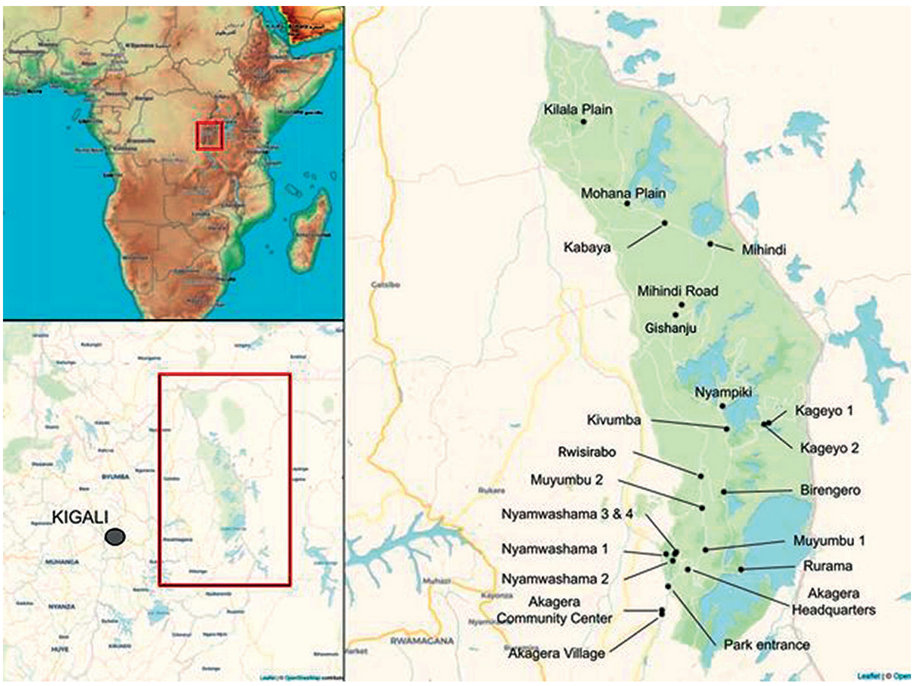

Figure 1: Area of study (top left: Location of Rwanda in Africa, bottom left: location of Akagera National Park in Rwanda, left: overview of the sampling locations in Akagera National Park)

all species type specimens have been imaged and made publicly available, such a determination could not be made. While many of the morphospecies in these genera may also represent undescribed species, this could not be determined with confidence. Thus, while a much higher number of the morphospecies collected may eventually prove to be undescribed, we have highlighted here only those for which this could be determined with a high degree of confidence. Voucher specimens have been deposited in the AFRC, KGAC, RBINS and RWAC collections.

RESULTS

A total of six subfamilies, including 41 genera containing 187 species including 119 named species and 68 morphospecies, have been recorded in this study. Of the recorded species, 149 were recorded for the first time in Rwanda (Tables 1, 2). In addition, 17 species were undescribed. These include *Anillomyrma* afrc-rw01, *Anochetus* kgac-anoch04 (Figure 2), *Camponotus* afrc-rw03 (Figure 3), *Lepisiota* afrc-rw01 (Figure

Table 1: Number of ant subfamilies, genera and species sampled from Akagera National Park

No.	Subfamily	No.	Genera	Number of species	Species recorded for the first time in Rwanda	Morphospecies/ undescribed species
1	Myrmicinae	1	*Anillomyrma*	1	1	1/1
		2	*Calyptomyrmex*	3	2	0
		3	*Cardiocondyla*	2	0	0
		4	*Carebara*	3	3	3/0
		5	*Cataulacus*	5	4	0
		6	*Crematogaster*	6	5	2/0
		7	*Meranoplus*	1	0	0
		8	*Monomorium*	20	19	9/0
		9	*Myrmicaria*	2	1	0
		10	*Nesomyrmex*	1	1	0
		11	*Pheidole*	16	15	14/0
		12	*Solenopsis*	3	3	3/0
		13	*Strumigenys*	6	3	0
		14	*Syllophopsis*	1	0	0
		15	*Tetramorium*	27	23	5/0
		16	*Trichomyrmex*	1	1	0
2	Formicinae	1	*Agraulomyrmex*	1	1	1/1
		2	*Camponotus*	15	12	5/1
		3	*Lepisiota*	20	19	13/10
		4	*Nylanderia*	2	0	1/0
		5	*Paraparatrechina*	1	0	0
		6	*Paratrechina*	1	1	0
		7	*Plagiolepis*	7	7	3/0
		8	*Polyrhachis*	3	1	0
3	Ponerinae	1	*Anochetus*	2	2	2/2
		2	*Bothroponera*	2	0	0
		3	*Brachyponera*	1	1	0
		4	*Euponera*	1	1	0
		5	*Hypoponera*	7	4	1/1
		6	*Leptogenys*	2	2	0
		7	*Mesoponera*	2	2	0
		8	*Paltothyreus*	1	0	0
		9	*Platythyrea*	1	1	0
		10	*Plectroctena*	2	1	0
4	Dorylinae	1	*Aenictus*	1	1	1/0
		2	*Dorylus*	4	2	1/0
		3	*Parasyscia*	1	1	1/1
		4	*Simopone*	1	1	0
5	Dolichoderinae	1	*Tapinoma*	6	6	1/0
		2	*Technomyrmex*	3	2	1/0
6	Pseudomyrmecinae	1	*Tetraponera*	2	0	0
	TOTAL		41	187	149	68/17

Table 2: Akagera National Park ant species list

Subfamily and species	New to Rwanda	Undescribed species	Morphospecies code
	Dolichoderinae		
Tapinoma acuminatum Forel, 1907	x		
Tapinoma danitschi Forel, 1915	x		
Tapinoma luridum connexum Santschi, 1914	x		
Tapinoma minimum Mayr, 1895	x		
Tapinoma schultzei (Forel, 1910)	x		
Tapinoma sp01	x	-	*Tapinoma* kgac-rw01
Technomyrmex arnoldinus Forel, 1913	x		
Technomyrmex pallipes (Smith, 1876)			
Technomyrmex sp01	x	-	*Technomyrmex* afrc-rw01
	Dorylinae		
Aenictus sp01		-	*Aenictus* sp01
Dorylus helvolus (Linnaeus, 1764)	x		
Dorylus nigricans molestus (Gerstäcker, 1859)			
Dorylus sp01	x	-	*Dorylus* dorala01
Dorylus wilverthi Emery, 1899			
Parasyscia sp01	x	x	*Parasyscia* afr-par37
Simopone laevissima Arnold, 1954	x		
	Formicinae		
Agraulomyrmex sp01	x	x	*Agraulomyrmex* afrc-rw01
Camponotus bayeri Forel, 1913	x		
Camponotus chrysurus Gerstäcker, 1871	x		
Camponotus maculatus (Fabricius, 1782)			
Camponotus orinobates Santschi, 1919			
Camponotus pompeius Forel, 1886	x		
Camponotus rufoglaucus syphax Wheeler, 1922			
Camponotus sp01	x	-	*Camponotus* afrc-rw01
Camponotus sp02	x	x	*Camponotus* afrc-rw02
Camponotus sp03	x	-	*Camponotus* afrc-ug01
Camponotus sp04	x	-	*Camponotus* kgac-rw04
Camponotus sp05	x	-	*Camponotus* kgac-rw05
Camponotus schoutedeni Forel, 1911	x		
Camponotus sericeus (Fabricius, 1798)	x		
Camponotus vestitus pectitus Santschi, 1930	x		
Camponotus vulpus Santschi, 1926	x		
Lepisiota affinis (Santschi, 1937)	x		
Lepisiota capensis anceps (Forel, 1916)	x		
Lepisiota capitata (Forel, 1913)	x		
Lepisiota depressa (Santschi, 1914)			
Lepisiota incisa (Forel, 1913)	x		
Lepisiota sp01	x	x	*Lepisiota* afrc-rw01
Lepisiota sp02	x	x	*Lepisiota* afrc-rw02
Lepisiota sp03	x	x	*Lepisiota* afrc-rw03
Lepisiota sp04	x	x	*Lepisiota* afrc-rw04
Lepisiota sp05	x	x	*Lepisiota* afrc-rw05
Lepisiota sp06	x	x	*Lepisiota* afrc-rw06
Lepisiota sp07	x	-	*Lepisiota egregia*_cf
Lepisiota sp08	x	-	*Lepisiota hirsuta*_cf
Lepisiota sp09	x	x	*Lepisiota* kgac-lep10
Lepisiota sp10	x	x	*Lepisiota* kgac-lep13

Table 2: continued

Subfamily and species	New to Rwanda	Undescribed species	Morphospecies code
Lepisiota sp11	x	x	*Lepisiota* kgac-lep18
Lepisiota sp12	x	x	*Lepisiota* kgac-lep19
Lepisiota sp13	x	-	*Lepisiota schoutedeni*_cf
Lepisiota spinosior ballaensis (Arnold, 1920)	x		
Lepisiota validiuscula (Emery, 1897)	x		
Nylanderia jaegerskioeldi (Mayr, 1904)			
Nylanderia sp01		-	*Nylanderia* afrc-rw01
Paraparatrechina umbranatis LaPolla & Cheng, 2010			
Paratrechina longicornis (Latreille, 1802)	x		
Plagiolepis brunni Mayr, 1895	x		
Plagiolepis pictipes Santschi, 1914	x		
Plagiolepis puncta Forel, 1910	x		
Plagiolepis sp01	x	-	*Plagiolepis* afrc-rw01
Plagiolepis sp02	x	-	*Plagiolepis* afrc-rw02
Plagiolepis sp03	x	-	*Plagiolepis* afrc-rw03
Plagiolepis vanderkelleni polita Santschi, 1914	x		
Polyrhachis gagates Smith, 1858			
Polyrhachis gerstaeckeri Forel, 1886	x		
Polyrhachis schistacea (Gerstäcker, 1859)			
Myrmicinae			
Anillomyrma sp01	x	x	*Anillomyrma* afrc-rw01
Calyptomyrmex barak Bolton, 1981			
Calyptomyrmex clavatus Weber, 1952	x		
Calyptomyrmex tensus Bolton, 1981	x		
Cardiocondyla emeryi Forel, 1881			
Cardiocondyla shuckardi Forel, 1891			
Carebara sp01	x	-	*Carebara* kgac-car127
Carebara sp02	x	-	*Carebara* kgac-car134
Carebara sp03	x	-	*Carebara* kgac-car135
Cataulacus egenus Santschi, 1911	x		
Cataulacus jeanneli Santschi, 1914	x		
Cataulacus kenyensis Santschi, 1935			
Cataulacus pullus Santschi, 1910	x		
Cataulacus traegaordhi Santschi, 1914	x		
Crematogaster bequaerti modica Santschi, 1926	x		
Crematogaster excisa Mayr, 1895	x		
Crematogaster jeanneli Santschi, 1914			
Crematogaster rectinota Forel, 1913	x		
Crematogaster sp01	x	-	*Crematogaster* kgac-credec02
Crematogaster sp02	x	-	*Crematogaster* knerigrp41
Meranoplus inermis Emery, 1895			
Monomorium afrum André, 1884			
Monomorium exiguum Forel, 1894	x		
Monomorium hanneli Forel, 1907	x		
Monomorium invidium Bolton, 1987	x		
Monomorium malatu Bolton, 1987	x		
Monomorium mictilis Forel, 1910	x		
Monomorium opacum Forel, 1913	x		
Monomorium rosae Santschi, 1920	x		
Monomorium sp01	x	-	*Monomorium* afrc-rw01

Table 2: continued

Subfamily and species	New to Rwanda	Undescribed species	Morphospecies code
Monomorium sp02	x	-	*Monomorium* afrc-rw02
Monomorium sp03	x	-	*Monomorium* afrc-rw03
Monomorium sp04	x	-	*Monomorium borlei*_cf
Monomorium sp05	x	-	*Monomorium fastidium*_cf
Monomorium sp06	x	-	*Monomorium* kgac-mon11
Monomorium sp07	x	-	*Monomorium* kgac-mon12
Monomorium sp08	x	-	*Monomorium* kgac-mon13
Monomorium sp09	x	-	*Monomorium* kgac-mon14
Monomorium symmotu Bolton, 1987	x		
Monomorium termitobium Forel, 1892	x		
Monomorium vaguum Santschi, 1930	x		
Myrmicaria opaciventris Emery, 1893			
Myrmicaria striata Stitz, 1911	x		
Nesomyrmex angulatus (Mayr, 1862)			
Pheidole liengmei Forel, 1894	x		
Pheidole megacephala (Fabricius, 1793)			
Pheidole sp01	x	-	*Pheidole* afrc-rw01
Pheidole sp02	x	-	*Pheidole* afrc-rw02
Pheidole sp03	x	-	*Pheidole* afrc-rw03
Pheidole sp04	x	-	*Pheidole* afrc-rw04
Pheidole sp05	x	-	*Pheidole* afrc-rw05
Pheidole sp06	x	-	*Pheidole* afrc-rw06
Pheidole sp07	x	-	*Pheidole* kgac-rw01
Pheidole sp08	x	-	*Pheidole* kgac-rw02
Pheidole sp09	x	-	*Pheidole* kgac-rw06
Pheidole sp10	x	-	*Pheidole* kgac-rw07
Pheidole sp11	x	-	*Pheidole* kgac-rw08
Pheidole sp12	x	-	*Pheidole* kgac-rw09
Pheidole sp13	x	-	*Pheidole* kgac-rw10
Pheidole sp14	x	-	*Pheidole* kgac-rw11
Solenopsis sp01	x	-	*Solenopsis* afrc-rw02
Solenopsis sp02	x	-	*Solenopsis* kgac-rw01
Solenopsis sp03	x	-	*Solenopsis* kgac-rw02
Strumigenys concolor Santschi, 1914			
Strumigenys marginata (Santschi, 1914)	x		
Strumigenys maxillaris Baroni Urbani, 2007	x		
Strumigenys rukha Bolton, 1983			
Strumigenys serrula Santschi, 1910			
Strumigenys thuvida (Bolton, 1983)	x		
Syllophopsis cryptobia Santschi, 1921			
Tetramorium aculeatum (Mayr, 1866)			
Tetramorium agna (Santschi, 1935)	x		
Tetramorium altivagans Santschi, 1914	x		
Tetramorium constanciae Arnold, 1917	x		
Tetramorium cristatum Stitz, 1910	x		
Tetramorium edouardi Forel, 1894			
Tetramorium eminii (Forel, 1894)	x		
Tetramorium ericae Arnold, 1917	x		
Tetramorium hortorum Arnold, 1958	x		
Tetramorium humbloti Forel, 1891	x		

Table 2: continued

Subfamily and species	New to Rwanda	Undescribed species	Morphospecies code
Tetramorium inezulae (Forel, 1914)	x		
Tetramorium jugatum Bolton, 1980	x		
Tetramorium mossamedense Forel, 1901			
Tetramorium nigrum Forel, 1907	x		
Tetramorium notiale Bolton, 1980	x		
Tetramorium opacum (Emery, 1909)	x		
Tetramorium phasias Forel, 1914	x		
Tetramorium sericeiventre Emery, 1877	x		
Tetramorium simillimum (Smith, 1851)			
Tetramorium sp01	x	-	*Tetramorium* afrc-rw01
Tetramorium sp02	x	-	*Tetramorium* afrc-rw02
Tetramorium sp03	x	-	*Tetramorium* afrc-rw03
Tetramorium sp04	x	-	*Tetramorium* afrc-rw04
Tetramorium sp05	x	-	*Tetramorium altivagans*_nr02
Tetramorium subcoecum Forel, 1907	x		
Tetramorium ultor Forel, 1913	x		
Tetramorium weitzeckeri Emery, 1895	x		
Trichomyrmex oscaris (Forel, 1894)	x		
Ponerinae			
Anochetus sp01	x	x	*Anochetus* kgac-anoch03
Anochetus sp02	x	x	*Anochetus* kgac-anoch04
Bothroponera soror (Emery, 1899)			
Bothroponera talpa André, 1890			
Brachyponera sennaarensis (Mayr, 1862)	x		
Euponera brunoi (Forel, 1913)	x		
Hypoponera angustata (Santschi, 1914)			
Hypoponera dema Bolton & Fisher, 2011			
Hypoponera dulcis (Forel, 1907)	x		
Hypoponera obtunsa Bolton & Fisher, 2011	x		
Hypoponera punctatissima (Roger, 1859)			
Hypoponera sp01	x	x	*Hypoponera rigida*_nr
Hypoponera tecta Bolton & Fisher, 2011	x		
Leptogenys ferrarii Forel, 1913	x		
Leptogenys stuhlmanni Mayr, 1893	x		
Mesoponera elisae (Forel, 1891)	x		
Mesoponera ingesta (Wheeler, 1922)	x		
Paltothyreus tarsatus (Fabricius, 1798)			
Platythyrea modesta Emery, 1899	x		
Plectroctena mandibularis Smith, 1858			
Plectroctena subterranea Arnold, 1915	x		
Pseudomyrmecinae			
Tetraponera mocquerysi (André, 1890)			
Tetraponera ophthalmica (Emery, 1912)	x		

4) and *Lepisiota* afrc-rw02 (Figure 5) among others (Table 1). Rare species were also found in this study, including *Simopone laevissima* (Figure 6), previously known from only the unique holotype specimen collected in Uganda (Bolton & Fisher 2012), and *Lepisiota spinosior ballaensis* (Figure 7), previously known from the type specimens collected in Zimbabwe (Davidson 1996) and one additional record from Zambia. Considering the composition of the identified species, the Myrmicinae subfamily was the best represented with half of the species (98 species), followed by the Formicinae (50 species) and Ponerinae (21 species) subfamilies. These three subfamilies account for 90% of the total identified ant species. *Tetramorium* was the most diverse genus (27 species), followed by *Monomorium* and *Lepisiota* (20 species each), *Pheidole* (17 species) and *Camponotus* (15 species). A detailed species list is presented in Table 2.

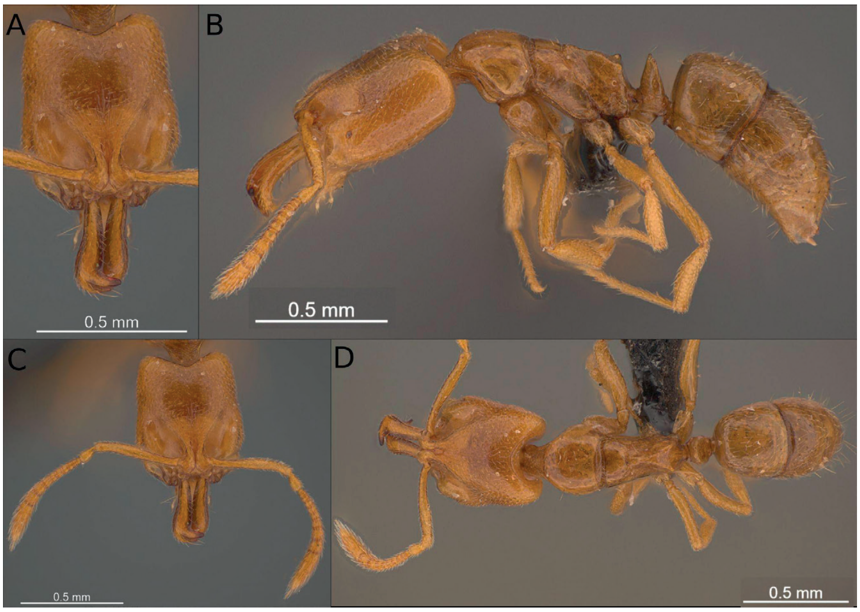

Figure 2: *Anochetus* kgac-anoch04 (KGCOL03619 f). (A) Head frontal view; (B) Dorsal view; (C) Head and antennae frontal view; (D) Lateral view. Images by K Gómez

Figure 3: *Camponotus* afrc-rw03 (CASENT0890343). (A) Head frontal view; (B) Dorsal view; (C) Lateral view. Images by D Molenaar

DISCUSSION

This study presents the findings from a recent survey of ants conducted in Akagera National Park, eastern Rwanda. The findings have increased the number of known ant species in Rwanda to 292, an increase of 278% from the 105 previously recorded (Nsengimana & Dekoninck 2020, 2023; Nsengimana et al. 2021, 2023). At the subfamily level, the species composition corroborates the findings of previous studies conducted in Rwanda (Nsengimana et al. 2018, 2023; Nsengimana & Dekoninck 2021), East Africa (Hita Garcia et al. 2009) and other

Figure 4: *Lepisiota* afrc-rw01 (CASENT0889937). (A) Head frontal view; (B) Dorsal view; (C) Lateral view. Images by D Molenaar

Figure 5: *Lepisiota* afrc-rw02 (CASENT0890152). (A) Head frontal view; (B) Dorsal view; (C) Lateral view. Images by D Molenaar

Figure 6: *Simopone laevissima* (CASENT0889438). (A) Head frontal view; (B) Dorsal view; (C) Lateral view. Images by P Hawkes

Figure 7: *Lepisiota spinosior ballaensis* (CASENT0889914). (A) Head frontal view; (B) Dorsal view; (C) Lateral view. Images by D Molenaar

Afrotropical regions (Fisher 1997; Mothapo & Wossler 2011; Kouakou et al. 2018; Ambakina et al. 2024).

The subfamily Myrmicinae had the highest number of genera and species, followed by the subfamily Formicinae. These subfamilies thrive owing to their plasticity, social complexity, flexible foraging strategies, diverse nesting habits and adaptability to different habitats and climate variability (Ramalho et al. 2017; Luo et al. 2023). These traits allow them to exploit a wide range of ecological niches (Ward et al. 2015), including opportunistic behaviour in disturbed areas (Tripp et al. 2000; Hita Garcia et al. 2013; Borowiec et al. 2020; Ward et al. 2024).

Within the subfamily Ponerinae, the genus *Hypoponera* was the most diverse. The distribution of *Hypoponera* species is influenced by a combination of ecological, biological and biogeographical factors. These ants tend to be cryptic species, nesting primarily in soil or decaying wood, which allows them to have a wide distribution in various habitats (Kass et al. 2022; Wang et al. 2024). They are predominantly found in tropical regions but can also adapt to temperate climates, with some species recorded across continents, from Europe to Australasia and the Nearctic (Schmidt & Shattuck 2014). Considering the Formicinae, the diversity of the genus *Lepisiota* in Akagera National Park must be considered exceptional. It should be explored in more detail in future ecological studies to ascertain the reasons for this high diversity, especially as some *Lepisiota* species are symbiotic with butterflies of the Lycaenidae family.

The rest of the subfamilies, Dolichoderinae, Dorylinae and Pseudomyrmecinae, contribute roughly 10% of the total ant species diversity. This is mainly due to specialised behaviour and ecological dependencies that reduce speciation opportunities compared to more generalist or opportunistic subfamilies (Borowiec et al. 2020). The Dolichoderinae are often ecologically restricted to specific habitats, such as arid environments, and include several dominant but not diverse genera (Ward et al. 2010). In contrast, the Dorylinae exhibit highly specialised behaviours, like nomadic colony movement and group predation, which limit their diversification owing to niche specialisation (Mizuno et al. 2023). Pseudomyrmecinae often live in symbiosis with plants, where they defend host plants in exchange for nutritional rewards. This reflects a dynamic history of co-diversification and adaptive specialisation that increases their ability to diversify broadly across varied ecosystems (Mayer et al. 2014; Chomicki et al. 2015).

The collection of rarely recorded species, namely the second samples ever recorded of *Camponotus vulpus*, *Hypoponera obtunsa*, *Hypoponera tecta* (second specimen ever collected), *Simopone laevissima* (second specimen ever collected) and *Tetramorium agna*, highlight the significance of the park as a refuge for species of potential conservation significance.

CONCLUSION AND RECOMMENDATIONS

This study provides the first assessment of ant diversity in Akagera National Park. The results demonstrate that the park hosts 41 genera and 187 species, including 149 species newly recorded for the country and at least 17 undescribed taxa, underscoring the park's importance as a biodiversity hotspot in the Afrotropics. The discovery of rare species previously known only from limited localities in Africa suggests that Akagera serves as a key refuge for both widespread and range-restricted taxa. Given the remarkable diversity and number of potentially undescribed species identified in this study, further systematic and long-term myrmecological surveys are essential to fully document the ant fauna of Akagera National Park. Furthermore, the taxonomic revisions and formal descriptions of the newly discovered morphospecies should be prioritised.

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