A Review of Habitat and Distribution of Common Stingless Bees and Honeybees Species in African Savanna Ecosystems

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Abstract

Background and Research Aims: Globally, concerns over a decline in insect pollinator abundance have been raised. Although bees were noted to be key pollinating agents for approximately 52 of the leading 115 global food commodities, they are currently exposed to risks ranging from a variety of diseases and environmental threats emanating from changes in land use, farming practices and climate change. The study reviewed the habitat and distribution of common stingless bees and honeybees species in African savanna ecosystems. The review focused mainly on (i) profiling stingless bee and honeybee species, habitat and distribution within African savanna ecosystems and (ii) assessing factors affecting stingless bees and honeybees in habitat selection within the savanna ecosystem.

Methods: A meta-synthesis of existing literature with a qualitative orientation was used for the review process and 90 published documents were consulted between 1970 and 2021.

Results: The review findings indicated that there are 19 stingless bee species and 13 subspecies of Apis mellifera found in Africa. The A. mellifera scutellata and A. mellifera adansonii were reported to be widely distributed across the African savanna ecosystem.

Conclusion: The migration and swarming of bees play a pivotal role in the general stingless bees and honey bee distribution within the savanna ecosystem.

Implications for Conservation: The persistence of stingless bees and honeybees within savanna ecosystems depends on the adoption of the best conservation policies derived from economic and ecological services associated with bee conservation.

Keywords

ecosystem, honeybees, savanna, stingless bees, species

Introduction

Globally there are approximately 25,000 described bee species and there are estimated to be 40,000 bee species existing in total (Ascher & Pickering, 2010; Eardley, 2004; Nkoba et al., 2016). The first honeybees are believed to have evolved from a wasp-like ancestor known as sphexio about 100 million years ago (Hepburn & Radloff, 1998). Honeybees (Apis mellifera) are the most widespread bee species in the African savanna ecosystem (Hepburn & Radloff, 1996, 1998; Moritz et al., 2005; Ruttner, 1988; Schmidt et al., 1995). Protected and non-protected African savanna has

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enormous and diverse ecosystems which support honeybees and stingless bees habitats. Several sustainable management initiatives have been implemented to ensure the effective conservation of honeybees and stingless bees in both protected and non-protected areas (Fitzpatrick et al., 2007). Apiculture (beekeeping) and meliponiculture (stingless beekeeping) are common practices in Africa which allows utilisation of honey from bees at the same time conserving them (Chuma et al., 2013; Rodriguez-Pose & Hardy, 2015). The intensity of both apiculture and meliponiculture influences honeybees and stingless bees habitat and distribution. An understanding of honeybees and stingless bees biology, ecology, diversity, habitat and distribution is critical to ensure effective conservation (Fitzpatrick et al., 2007).

Honeybees play a critical role in pollinating almost three-quarters of the world’s flowering plants (Deyrup et al., 2002; Free, 1970; Gels, 2002; Gupta, 2014; Hepburn & Radloff, 1998; Kevan & Viana, 2003; Knight et al., 2005). Modern agriculture values honeybee pollination services to be greater than 14 million dollars (De Lange et al., 2013; Free, 1993; Gallai et al., 2009; Morse & Calderone, 2000; Potts et al., 2010; Rigg, 2006; Riley et al., 1996). Honeybees are effective bio-indicators of the state of the environment since they interact strongly with water, air and vegetation (Henry et al., 2012; Porini et al., 1996, 2002). The conservation of honeybees in African savanna ecosystems faces a myriad of threats emanating mainly from pests and diseases, climate change, deforestation, industrialisation and urbanisation, agrochemicals from various agricultural activities (Bailey et al., 1983; De Lange et al., 2013; Genersch, 2010; Oldroyd, 2007; Patiny & Michez, 2007; Vet, 2001). Threats to honeybees and stingless bees habitats affect their population distribution.

Stingless bees have vestigial stings and they are generally small to medium-sized bees which stores honey and pollen in perennialcolonies (Eardley, 2004; Kajobe, 2007; Nkoba et al., 2016). In African savanna ecosystems, there are several stingless bees species which differ significantly in colour, colony and body sizes (Eardley, 2004; Kajobe, 2007). Stingless bees are classified as generalist feeders in terms of nests sites selection. Stingless bees feed on a wide range of flowers and can nest in artificial and natural structures, for example, felled trees, earthen banks, rocks and crevices. Stingless bees habitat and nesting requirements differ from one species to the other and this generally affects their distribution within the African savanna ecosystems (Fabre Anguilet et al., 2018; Kajobe, 2007; Nkoba et al., 2016). Nests architecture may differ significantly but in most cases, the brood cells could be horizontally or vertically, semicombs or clustered cells (Kajobe, 2007). Many species of stingless bees species especially those from warm moist tropics are unable to survive chilling temperatures and this generally affects their spatial distribution (Eardley, 2004; Nkoba et al., 2016). Stingless bees survive adverse weather conditions through effective adaption for example they have excellent insulation capabilities to protect exposed nests (Kajobe, 2007).

Habitat suitability plays a pivotal role in affecting honeybees and stingless bees species distribution within African savanna ecosystems (Kajobe, 2007; Naug, 2009; Schmidt et al., 1995; Strickland, 1982). Habitat provides food, water, cover, space and areas to reproduce for both honeybees and stingless bees (Brodschneider & Crailsheim, 2010). Both natural and anthropogenic factors within the habitat positively or negatively affect honeybees and stingless bees distribution. Indigenous forage species produce more nectar and pollen suitable to support several bees species in natural ecosystems (Gardiner, 2004; Hutton-Squire, 2014; Johannsmeier, 2001, 2007; Rukuni et al., 2006). On the other hand, artificial plantations and forests play a pivotal in supporting several bees species conservation. Alteration of both natural and artificial forage grounds directly or indirectly affects honeybees and stingless bees species in African savanna ecosystems (Kearns et al., 1998; Lietaer, 2009; Oldroyd, 2007; Strickland, 1982). This review focused mainly on reviewing common stingless bees and honeybees habitat and distribution in African savanna ecosystems.

**Methods**

**Research approach**

This review analysed the honeybee species and stingless bees habitat and population distribution in African savanna ecosystems. A review of relevant literature was used to gather data on the habitat and distribution of common stingless bees and honeybees species in African savanna ecosystems. To provide an in-depth insight into bee species habitat and population distribution in savanna ecosystems a narrative approach was used by engaging in literature and document analysis. Thematic analysis was used to analyse stingless bees and honeybees habitat and population distribution (Bowen, 2009; Thomas, 2006). Online academic data searches such as Google Scholar were used to collect data from several repositories, journals and databases. The search was done systematically through the use of focused keywords search including ‘honeybees’, ‘savanna ecosystem’, ‘stingless bees’, ‘nesting preferences’, ‘bees nest sites’, ‘habitat’, ‘sub-species’, ‘bees forage’, ‘population distribution’ and various combinations of such terms/phrases. The geographical location of the study sites and observation of such bees species was the main inclusion criteria used in the literature gathering. Publications and published observations of stingless bees and honeybees within African savanna ecosystems were reviewed. The retrieved literature included reports, books, journal articles, and conference proceedings. Literature was also obtained by the use of and/or employing the backward snowballing approach of literature identification through which relevant peer-reviewed articles in leading journals were identified and analysed. After the rigorous screening of a
# Table 1. Summary of types of stingless bee species found in the African savanna ecosystem.

| Scientific name                          | Geographical distribution                                                                 | Physical Characteristics                                                                                                                                                                                                                                                                                                                                 | Habitat                                                                                           | Diagnosed dimensions (mm) | 
|------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------|
| *Cleptotrigona* meliponina (Friese, 1912) | South Africa, Democratic Republic of Congo, South Africa, Tanzania, Sierra Leone          | -Dark brown integument often with a reddish tinge, to black. -Pale appendages and ventral surfaces of tarsi are sometimes yellow. Pale long hairs                                                                                                                          | -Nests in trees and forages widely                                                                                                                       | H: 1.3, S: 0.8, F: 3.2, B: 3.5-4.0 |
| Scientific name | Geographical distribution | Physical Characteristics | Habitat | Diagnosed dimensions (mm) |
|----------------|--------------------------|--------------------------|---------|--------------------------|
| **Hypotrigona gribodoi**  
(Magretti, 1884) | South Africa, Mozambique, Democratic Republic of Congo, Tanzania, Angola, North Sudan, South Sudan, Nigeria, Togo, Ghana | - Black integument with reddish-yellow mandible, antenna and distal tarsal segments. White vestiture and very sparse mainly on the lower region of the face. Scutum is highly punctate | Widely distributed across tropical savanna ecosystem and commonly found foraging flowers of *Accacia senegalensis*, *Antigonon leptopus*, *Acacia tortilis*, *Borerea vertiellata*, *Cissus* spp., *Dialium soyauxii*, *Indigofera* spp., *Mangifera indica*, *Ficus umbellatus*, *Spirostachys africana*, *Solenostemon sempervirens*, *Zea mays*  | 0.9–1.1 0.6–0.7 2.1–2.8 2.2–2.9 |
| **Hypotrigona ruspolii**  
(Magretti, 1898) | South Africa, Zambia, Tanzania, Kenya, Uganda, Democratic Republic of Congo, Angola, Cameroon, Nigeria, Ghana, North Sudan, Sierra Leone | - Weakly pinnate head and scutal vestiture, moderately shiny scutal punctation, scutum and notaulus usually conspicuous | Widely distributed within savanna ecosystem and known to forage flowers of *Oleander* spp., *Monopetanthus le-cestui* | na na na na |
| **Hypotrigona araujoi**  
(Michener, 1959) | South Africa, Mozambique, Zambia, Malawi, Tanzania, Kenya, Democratic Republic of Congo, Angola, Namibia, Cameroon, Nigeria, Togo, Ghana | - Dull scutum and slightly shiny in between punctures, black mandible and labrum, vestiture on vertex and scutum weakly plumose | Widely distributed within savanna ecosystem and known to forage flowers of *Oleander* spp., *Monopetanthus le-cestui* | na na na na |
| **Liotrigona bottegoi**  
(Magretti, 1895) | South Africa, Mozambique, Zimbabwe, Namibia, Tanzania, South Sudan | Moderately punctate scutum with reticulate sculpture and simultaneously shiny | Unevenly distributed in West, Central, East and Southern Africa savanna ecosystem. Found foraging in several flowers of: *Annona muricata*, *Barassus aethiopicum*, *Cesalpinia pulcherima*, *Carica papaya*, *Entada mannii*, *Eucalyptus* spp., *Luffa* spp., *Euphorbia* spp., *Terminalia glaucescens*, *Zea mays*  | na na na na |
| **Liotrigona parvula**  
(Darchen, 1971) | South Africa, Zimbabwe, Namibia, Angola, Zambia, Democratic Republic of Congo, Cameroon | Sparsely punctate smooth and shiny scutum | Sparsely distributed in West, Central, and Southern Africa. Found foraging in several flowers of: *Andropogon* spp., *Barassus aethiopicum*, *Combretum* spp., *Dalbergiella welwitchii*, *Hyparrhenia* spp., *Lippia* spp., *Terminalia* glaucescens, *Vitex doniana*  | na na na na |
| **Hypotrigona penna**  
(Eardley, 2004) | Ghana | Black to orangish-yellow mandible and labrum, legs and metasoma. Dull scutum to slightly shiny punctures | Mostly confined on the western part of Africa and found foraging in flowers of *Barassus aethiopicum*, *Combretum* spp.  | 0.9–1.1 0.6–0.7 2.1–2.8 2.2–2.9 |
| **Melipanula roubiki**  
(Eadley, 2004) | Ghana, Gabon | Yellow integument with maculation on parocular area occupying most of lower half | Mostly confined on the western part of Africa and found foraging in flowers of *Gissus* spp., *Didium sayauxii*, *Indigofera* sp.  | na na na na |
| **Cleptotrigona cubiceps**  
(Friese, 1912) | Ghana, Gabon | Very small and dark brown stingless bee without a corbicula | Mostly confined on the western part of Africa and found foraging in flowers of *Gissus* spp., *Didium sayauxii*, *Indigofera* sp.  | 1.3 0.8 3.2 3.5–4.0 |
| **Liotrigona gabonensis**  
(Pauly and Anguilet 2013) | Ghana, Gabon | Black to orangish-yellow mandible and labrum, legs and metasoma. Dull scutum to slightly shiny punctures | Nests in trees  | na na na na |

Note. H - head, S - scutum, F - forewing, B - body, na - non-available data. Source: Aidoo et al. (2011); Eardley (2004); Nkoba et al. (2016); Wille (1983); Kerr and Maule (1964); Pauly and Fabre Anguilet (2013).
pool of initially selected documents, the study used a total of 90 relevant documents which were then used for this review. This study reviewed literature covering 44 years (from 1977 to 2021).

Findings and Discussion

Stingless bees species habitat and distribution within African savanna ecosystems. Stingless bee species are quite small in size and look like small flies (Ascher & Pickering, 2010; Crewe et al., 1994; Eardley, 2004). The review showed that stingless bees are widely distributed within the African savanna ecosystem and their range does not extend into the Palaearctic region of Africa (Ascher & Pickering, 2010, Eardley, 2004; Kerr & Maule, 1964) (Table 1). A study by Eardley (2004) established that stingless bees belong to the Meliponini tribe and are social insects. There are six genera of stingless bees, comprised of 19 species that have been recorded in Africa (Eardley, 2004; Nkoba et al., 2016). Five of the stingless bees genera, that is, Meliponula (Cockerell), Dactylurina (Cockerell), Plebeina (Moure), Liotrigona (Moure) and Hypotrigona (Cockerell) workers collect nectar and pollen from flowers (Ascher & Pickering, 2010; Eardley, 2004; Nkoba et al., 2016). The genus Cleptotrigona (Moure) is known for robbing honey and pollen from other stingless bee species (Eardley, 2004). These bee species differs significantly in colour, size and other characteristics, for example, H. gribodoi is pale in colour while M. lendliana is black. Meliponula ferruginea has two distinctive colours, that is, black and brown. Meliponula nebulata has black in colour with a distinctive yellow spot on the head. In terms of sizes, Meliponula bocandei (9 mm) and M. nebulata (7 mm) are generally bigger species and H. gribodoi is smaller (2–3 mm) (Kajobe, 2007). Stingless bees have different nests sites

Figure 1. Plebeina hildebrandti nesting sites and nest architecture within savanna ecosystem: (a) steep-sided termite mound, (b) stingless bees nest within termite mound, (c) Plebeina hildebrandti entrance tube on a termite mound. Source: Namu (2008).

Figure 2. Hypotrigona gribodoi nesting sites and architecture within savanna ecosystem: (a) Hypotrigona gribodoi nest entry, (b) Hypotrigona gribodoi wooden nests, (c) Hypotrigona gribodoi colonies on the wall. Source: Namu (2008).
preferences, design and architecture. Nest entrance diameter ranges from 2mm to 20 mm. In most cases, the entrances for *M. bocandei* are funnel-shaped or V-shaped whereas the entrance of other species for example *H. ferruginea*, *M. lendliana* and *M. nebulata* are circular shaped (Kajobe, 2007).

Stingless bees nest in tree cavities, mounds, burrowed soil surfaces, man-made structures like walls of mud or cracks of buildings, drainage pipes, and poles among others (Figure 2) (Eardley, 2004; Nkoba et al., 2016; Tarakini et al., 2021). In natural habitats, trees form the major sources of nest sites (Kajobe, 2007). *M. bocandei* and *M. lendliana* have a wide range of nesting sites as they can nest in both tree cavities, termite mounds and the ground within protected areas and non-protected areas ecosystems (Fabre Anguilet et al., 2018; Gikungu, 2006; Kajobe, 2007).

Some of the stingless bees nests are very difficult to locate due to their small sizes (Gikungu, 2006; Nkoba et al., 2016). Most stingless bees nests are clustered in small uniform globular cells of wax and their larva are reared within these cells (Eardley, 2004; Nkoba et al., 2016; Namu, 2008) (Figures 1 and 2). Apart from that, many stingless bees species store pollen and honey in conspicuously large oval cells which are constructed close to the brood cell clusters.

### Table 2. Summary of *A. mellifera* sub-species species native to African savanna ecosystem.

| Common English name | Scientific name | Geographical distribution | Physical characteristics | Tongue length (mm) | Behaviour |
|---------------------|----------------|--------------------------|--------------------------|-------------------|-----------|
| East African bees   | *A. m. scutellata* (Lepeletier, 1836) | Burundi, Ethiopia, Kenya, South Africa, Tanzania, Zimbabwe | Small and slender body with intense yellow colour | 5.9 | St St St St |
| Telian bees         | *A. m. intermissa* (Buttel-Reepen, 1906) | South Africa | Long body, dark pigment and sparse hairs | 6.4 | St St St St |
| Mountain Bees/ East African bees | *A. m. littorea* (Smith, 1961) | Kenya, Tanzania | Small bees with relatively slender body having yellow tergites | 5.7 | St St St St |
| Cape bee            | *A. m. capensis* (Eschschoitz, 1822) | Endemic to South Africa | Small with slender body and dark in colour | 5.9 | M M M M |
| Madagascar honeybee | *A. m. nubica* (Ruttner, 1988) | Sudan | Small with slender body and intense yellow colour | 5.4 | St St St Na |
| Egyptian bees       | *A. m. unicolor* (Latreille, 1804) | Madagascar | Small slender, body and dark in colour | 5.6 | L L L M |
| Mountain Bees       | *A. m. monticola* (Smith, 1961) | Mount regions of Ethiopia | Long body, with dark colour and long hairs | 6.2 | L St St M |
| West African bees   | *A. m. adansonii* (Latreille, 1804) | Nigeria, Cote D’Ivoire, Cameroon, Nigeria, Uganda, Tanzania, Zambia, Sudan, Zimbabwe | Medium-sized, broad body with yellow markings | 6.2 | St St St St |
| Arabian honeybee    | *A. m. jemenitica* (Ruttner, 1988) | Uganda, Somalia, Sudan, Chad | Small, shorter setae and more yellow in colouration | 5.3 | Na Na Na Na |
| Ethiopia honeybee   | *A. m. simensis* | Ethiopia | Longer broad wings, larger than the *A. m. monticola* and *A. m. lamrckii* | 5.8 | Na Na Na Na |
| *A. m. major* (Ruttner, 1988) | Ethiopia | Body long, broad and dark with yellow markings | 7.0 | M St St Na |
| *A. m. sahariensis* (Baldensperger, 1932) | Ethiopia, Sudan | Bees are medium-sized, with a slender body with yellow markings | 6.3 | St St St L |
| Dwarf honeybee      | *A. florea* (Frabricius, 1787) | Kenya | Dwarf shaped, a worker is typically 7–10 mm in body length and its overall colouration is red-brown | 3.37 | Na Na Na Na |

Note. **T** – temperament, **A** – aggressiveness, **S** – swarming, **Ab** – absconding, **St** – strong, **M** – medium, **L** – low, **Na** – non-available data. Source: Gupta (2014); Hepburn et al. (2005); Neumann and Moritz (2002); Koeniger (1976).
Nests sites for other species, for example, the *M. bocandei* and *M. lendliana* are not sheltered from rain and other adverse weather conditions however their nests entry tubes can divert water away and the nests will be insulant (Gikungu, 2006; Kajobe, 2007, 2008). In terms of altitude and nest height selection, *M. bocandei* and *M. ferruginea* generally prefers higher altitude and higher nesting sites (Fabre Anguilet et al., 2018; Njoya, 2009). Nests sites selection is mainly determined by the availability of forage and protection from natural hazards and predators (Kajobe, 2007, 2008). *Meliponula beccarii* finds habitat in both protected and non-protected areas. *M. beccarii* prefer to nets in Eucalyptus plantations and open farmlands in non-protected areas (Kajobe, 2007, 2008). These bee species are known of their ability to cohabit with small white ants and some little beetles, however, it is not known if it is able to construct the cavities from which they fix their nests (Kajobe, 2007, 2008; Njoya, 2009). *M. beccarii* are built in the soil and exhibit architectural features which are typical to other genera which nest on the ground, for example, the *Plebeina*. The *Dactylurina staudingeri* in trees with exposed nests. *D. staudingeri* colonies are sited in fruit trees near bushes or infrastructures (Kajobe, 2007, 2008). The bee species is generally aggressive and in some cases, birds nests close to *D. staudingeri* nests for protection (Kajobe, 2007, 2008).

*Meliponula ferruginea* and *M. bocandei* nests in tree cavities and slightly above ground surfaces (Njoya, 2009; Roubik, 1999). In some cases, *M. ferruginea* and *M. bocandei* nest in artificial hollow hives used for honeybees (Njoya, 2009). The *M. ferruginea* species are capable of making their own cavities inside tree trunks (Njoya, 2009). The *M. bocandei* prefers warm temperature habitats especially savanna bushes with sparse tree distribution (Njoya, 2009). *M. bocandei* collects a wide range of pollen from the surrounding habitats (Njoya, 2009; Pauly & Hora, 2013). *Liotrigona bottegoi* species are capable of nesting in a wide range of sites for example crevices, walls bamboos and roofs of houses and abandoned hives (Njoya, 2009; Pauly & Hora, 2013). *Hypotrigna gribodi* prefers to nest in tree branches and forages on a wide range of flowers (Njoya, 2009; Kajobe, 2008). *H. gribodi* also nests in wall crevices in close proximity to each other and this suggests that there is limited intra-specific nesting competition (Aidoo et al., 2011; Kajobe, 2007; Kajobe, 2008; Njoya, 2009). The African savanna ecosystem is endowed with several stingless bees and honeybee species (Gupta, 2014; Nkoba et al., 2016). Some bee species are native in some parts of African countries, others are endemic to certain regions and others could have migrated naturally due to high capabilities of adaption. This review established a total of 21 stingless bee species in African savanna ecosystems (Table 1).

**Honeybee species, habitat and distribution within African savanna ecosystems**

The first scientific reports on African races of honeybees were given at the beginning of the 19th century (Gupta, 2014; Ruttner, 1988; Moritz et al., 2005). Most reports on honeybees within the savanna ecosystem were mere short, imprecise descriptions and no diagnosis was made. The first meaningful honeybees clarification using nomenclature principles was done by German entomologist von Buttel-Reepen in 1906 (Ruttner, 1988). Literature reveals that there are 12 subspecies of *A. mellifera* which are found within the savanna ecosystem (Gupta, 2014; Amssalu et al., 2004; Ruttner, 1988) (Table 2 and Figure 3).
ascertained that flora and climate affected honeybee behaviour and morphology. The geographical races of honeybees are a result of natural selection and they are not the result of choice or breeding (Amsalu et al., 2004; Gupta, 2014). Geographical races are distinct units, representing different genotypes adapted to different environments (Ruttner, 1988). The eastern, western and southern part of the African savanna ecosystem is dominated by East African bees (A.m. scutellata) and Western African bees (A. m. adansonii) bee species (Ascher & Pickering, 2010; Michener, 2007; Neumann & Moritz, 2002). These species are smaller compared to the European honeybees and their colonies have more swarms (Meixner, 2010). The Egyptian bee (A. mellifera lamarkii) is a relatively defensive race commonly found in the lower Nile valley and has black with yellow abdominal bands. The Tellian bees (A. m. intermissa) were found in marginal areas of the Sahel and savanna ecosystem (Michener, 2007). A. m. intermissa is black and produces more propolis than A.m. scutellata. A.m. scutellata is the most commonly used species in beekeeping due to its ability to produce more honey, swarms less and it is not very aggressive like the A m lamarkii (Corner, 1985; Gallmann & Thomas, 2012; Gupta, 2014).

Accurate and precise differentiation between honeybee races of similar appearance is critical (Corona et al., 2005; Gupta, 2014; Taylor, 1977). Due to close similarities of some races of European honeybees and Asian honeybees with African honeybees races, a genetic assessment was recommended to effectively distinguish honeybee species (Meixner, 2010). The genus Apis had a great ability to colonise a wide variety of environments, ranging from tropical to cool temperate due to its capability to adapt to different environments and ecosystems (Gupta, 2014; Tarakini et al., 2021; Taylor, 1977).

Threats to habitat and distribution of common stingless bees and honeybee species in African savanna ecosystems.

Threats to stingless bees and honeybee species in African savanna ecosystems are mainly from habitat loss and predation (Greenleaf et al., 2007). Anthropogenic activities such as industrialisation, expansion of agricultural activities and human settlement, poaching destroy habitats needed by stingless bees and honeybees species (Alkire & Foster, 2011; Eardley, 2004; Gallai et al., 2009; Lazarina et al., 2017; Tarakini et al., 2021). Human activities such as honey harvesting destroy or disrupt bee colonies in their habitats (Brown et al., 2017; Byrne & Fitzpatrick, 2009; Fabre Anguilet et al., 2018; Isaac & Reyer, 1989). Poor honey harvesting methods associated with predation from chimpanzees (Pan troglodytes) and honey badgers (Melivora capensis) (De Lange et al., 2013; Kajobe et al., 2007) can contribute to the depopulation of certain species of bees species thus affecting their general distribution (Fabre Anguilet et al., 2018; Hobbs, 2004; Kajobe, 2008). More research needs to be conducted in African savanna ecosystems on the loss of bee colonies from the predation of nests and other wild animals. However, some countries have developed commercial and subsistence apiculture and meliponiculture projects and this has helped to reduce the impacts of predation. Despite threats from both humans and wildlife, intensive apiculture and meliponiculture projects positively affect the habitat and distribution of common stingless bees and honeybees species in African savanna ecosystems (Fabre Anguilet et al., 2018; Gibbs & Muirhead, 1998; Klein et al., 2007).

Pests and diseases pose a threat to the habitat and distribution of bee species in African savanna ecosystems. Prevalence of pests and diseases such as small hive beetles, invasive varroa mite and American Foulbrood (AFB) in African ecosystems affects bee colonies survival thus affecting their general distribution. A study in Tanzania bee colonies observed a high presence of varroa and there is limited data in other savanna African countries on pests and diseases prevalence and their impact on both honeybees and stingless bees. Although there is limited data on the extent of the impact of pests and diseases on both honeybees and stingless in African savanna ecosystems, there is a need for research into entomopathogens and parasites of such bee species on the continent (Fabre Anguilet et al., 2018; Kremen et al., 2007).

Agrochemicals pose a serious threat to stingless bees and honeybees species habitat and distribution in African savanna ecosystems (Donovan, 1980; Kearns & Inouye, 1997; Porrini et al., 1996; Seeley, 1995, 2003; Visscher & Seeley, 1989). Intensive agriculture has resulted in the high use of agrochemicals such as pesticides to control pests and diseases and herbicides to control weeds. The use of neonicotinoids poses a threat to bee conservation in both wild and agro-ecosystems. Neonicotinoids damage the central nervous systems of insects, causing paralysis, tremors and deaths in bees at very low doses. Agrochemicals cause impaired odour discrimination, poor communication dances and this affects honeybees general foraging behaviour (Kearns & Inouye, 1997; Porrini et al., 1996). Exposure to agrochemicals reduces worker bees foraging performance, especially pollen collection efficiency (Kearns & Inouye, 1997; Porrini et al., 1996). Agrochemicals are also associated with reduced brood development and colony success (Kearns & Inouye, 1997; Porrini et al., 1996). Reduced colony success and high mortalities from direct or indirect poisoning greatly affect stingless bees and honeybees distribution within savanna ecosystems (Kearns & Inouye, 1997; Porrini et al., 1996).

Multiple factors associated with climate change affect honeybees and stingless bees habitat and their distribution. Climate change destroys habitats or creates inhospitable conditions for many bee species (Tarakini et al., 2021). Variations in vegetation as a result of climate changes alter vegetation flowering times thus drastically reducing the chances of some bee species to forage on the pollen of certain plant species. An increase in temperature affects brooding...
thus affecting the bee colonies, low temperatures associated with overwintering increase bee mortalities thus affecting bee colony sizes (Fabre Anguilet et al., 2018).

**Conclusion**

African savanna ecosystems are endowed with several stingless bees and honeybee species. Some stingless bee species are widely distributed across the savanna ecosystem and some are confirmed within limited regions of the ecosystem. There have been limited studies on stingless bees and honeybee species in many African savanna ecosystems. Information on bee habitat and distribution is critical in establishing databases on species absence or presence and updating inventories. Morphological description has allowed the identification of many stingless bees and honeybee species; however, the molecular analysis will help to resolve taxonomic challenges. The study revealed a total of 21 stingless bee species, 13 honeybee subspecies and one honeybee species found within the African savanna ecosystem. Due to limited studies in some African savanna ecosystems, stingless bees and honeybees were not reported in such countries thus causing bias in formation on their population and distribution. More studies on potential treats to stingless and honeybees should be strengthened in Africa considering the challenges of high habitat degradation. Anthropogenic activities from urbanisation, use of agrochemicals in agriculture and deforestation need to be closely monitored on their impact on bee habitat and distribution. Natural factors such as climate change, pests and diseases pose a threat to bee habitat and distribution and their impact must be assessed in many African savanna ecosystems. In addition, predation of stingless bees and honey bees from wild animals like honey badgers and chimpanzees as well as from humans needs to be evaluated to assess the impact. The future of stingless and honeybees conservation depends on the understanding of economic and ecological benefits through the formulation of policies that ensures the protection of habitats and best environmental management practices within savanna ecosystems.

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