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Beyond the well-known honey bees: an overview of stingless bees in Ecuador, their rearing, management, and threats

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Stingless bees are native to tropical climates. Ecuador, located in South America, has more than 200 species of stingless bees and a long ancestral history of using products derived from them, such as pot-honey, pot-pollen, cerumen, and propolis. The value of stingless bees also includes their role as pollinators, which directly impacts the availability of food for humans. Like other pollinators around the world, they are exposed to both anthropogenic and natural threats, which have been increasing due to environmental changes. Meliponiculture is a practice that not only makes use of stingless bee products but also promotes the care and conservation of meliponines within sustainable agroecological systems.

Keywords. Stingless bee keeping, meliponiculture, pot-honey.

Au-delà des abeilles mellifères bien connues : aperçu des abeilles sans dard en Équateur, de leur élevage, de leur gestion et des menaces qui pèsent sur elles
Les abeilles sans dard sont originaires des climats tropicaux. L’Équateur, situé en Amérique du Sud, compte plus de 200 espèces d’abeilles sans dard et possède une longue histoire ancestrale d’utilisation des produits qui en sont issus, tels que le miel, le pollen, le cérumen et la propolis. La valeur des abeilles sans dard réside également dans leur rôle de pollinisatrices, qui influence directement la disponibilité de la nourriture pour les êtres humains. Comme d’autres pollinisateurs à travers le monde, elles sont exposées à des menaces d’origine humaine ainsi qu’à des menaces naturelles, lesquelles se sont accrues en raison des changements environnementaux. La méliponiculture est une pratique qui permet non seulement de valoriser les produits dérivés d’abeilles sans dard mais aussi de favoriser la protection et la conservation des méliponines au sein de systèmes agro-écologiques durables.

Mots-clés. Abeilles sans dard, élevage des abeilles sans dard, méliponiculture, pot de miel.

1. INTRODUCTION

The phrase “no bees, no food” is closely associated with the honey bee (*Apis mellifera* Linnaeus), due to its role as the primary pollinator of important crops for human food. Between 2001 and 2022, global cropland increased by 80 million hectares (Potapov et al., 2022). Cropland areas have expanded in most parts of Africa, South America, and Southeast Asia, which have tropical and subtropical climates where stingless bees are distributed (Ramalho, 2004). There are more than 600 described species of stingless bees, which visit flowers from at least 221 plant families and 1,476 plant genera (Giannini et al., 2015; Campbell et al., 2019; Bulle Bueno et al., 2023). It is estimated that there are more than 200 species of these bees in Ecuador. Monoculture farming has impacted their health by reducing crop diversity, threatening their lives by shrinking their natural habitats, and exposing them to pesticides (Aizen et al., 2019; Ocaña-Cabrera et al., 2025). This narrative review aims to characterize the practice of raising stingless bees in Ecuador and describe the regional threats.

2. LITERATURE

2.1. Focus on stingless bees, unique features, and behaviour

Meliponiculture is the practice of raising stingless bees, primarily for commercial purposes such as the sale of pot-honey (Jha & Dick, 2010; Armas-Quiñonez et al., 2020), and other products like propolis, cerumen, and pot-pollen. It should be noted that certain genera of stingless bees (*i.e.*, *Plebeia*, *Trigonisca*, *Trigona*, *Paratrigona*, *Lestrimelitta*) are not managed for pot-honey production, due to both their diminutive size and their divergent dietary requirements (Villagómez et al., 2024a; Villagómez et al., 2024b), but also to the obligate kleptoparasitic behaviour of *Lestrimelitta limao*, a species commonly known as the “thief bee” for stealing resources from other stingless bees (von Zuben et al., 2016).

Meliponiculture provides pollination services to the ecosystem and is becoming a means of supporting and improving both human health (Barbiéri & Francoy, 2020) and the economy in rural areas of Ecuador (Erazo et al., 2023). Stingless bees differ from honey bees in several ways, including population size, which ranges from 300 to 80,000 individuals per colony, according to the species (Engel et al., 2023). The vast majority of stingless bees inhabit durable, perennial nests (de Portugal Araujo, 1963; Ribeiro & Bego, 1994). They vary in size, from 2 mm in the stingless genus *Trigonisca* (Roubik, 2018) to 15 mm in the genus *Melipona* (Michener, 2007). They have reduced wing venation, which is probably due to the small body size of their ancestors (Melo, 2020). Their nesting sites include tree cavities, termite nests (in a symbiotic interaction), wall cavities, and underground structures (Roubik, 2018; Grüter, 2020; da Costa Macedo et al., 2021). Social organization also varies among species; colonies have single queens (monogynous) and rarely multiple queens (facultatively polygynous, *i.e.*, *Melipona bicolor*) (Vollet-Neto et al., 2018; Bulle Bueno et al., 2023). Workers may be completely sterile or lay eggs regularly (Sommeijer et al., 1999; Bulle Bueno et al., 2020). *Melipona eburnea* and *Tetragonisca angustula*, two of the most commonly managed stingless bee species in Ecuador, have a guard caste due to age polytheism. However, age cannot be used to predict all aspects of labour division in stingless bee workers (Grüter et al., 2023).

Stingless bee queens usually mate with a single male (Vollet-Neto et al., 2017). Concerning brood rearing, worker stingless bees utilise the hypopharyngeal glands to regurgitate larval food into an empty cell (Costa & Cruz-Landim, 1999). This process is known as mass provisioning (Gilliam et al., 1985). Thereafter, the queen deposits an egg on the larval food, and the workers immediately seal the cell, maintaining this state until the stingless bee has completed its development and emerges (Grüter, 2020). In the absence of a functional sting, stingless bees use their mandibles for defence, as well as acid discharge, suicidal biting, joint attack, and sticky resins to immobilise enemies (Shackleton et al., 2015; Grüter et al., 2016).

2.2. Meliponiculture in Ecuador: concepts and terms

For many years, indigenous communities such as Quichuas in the Amazon (Paredes Bracho, 2022) have used products derived from stingless bees. These range from the utilitarian to the mythological, encompassing a wide array of disciplines including food, crafts, religion, and medicine (**Figure 1**). Nevertheless, these cultural values are under threat, primarily due to the loss of the stingless bees' natural habitat and the loss of ancestral knowledge that has not yet been documented by the scientific community (Quezada-Euán, 2018; Mera-Shiguango et al., 2022).

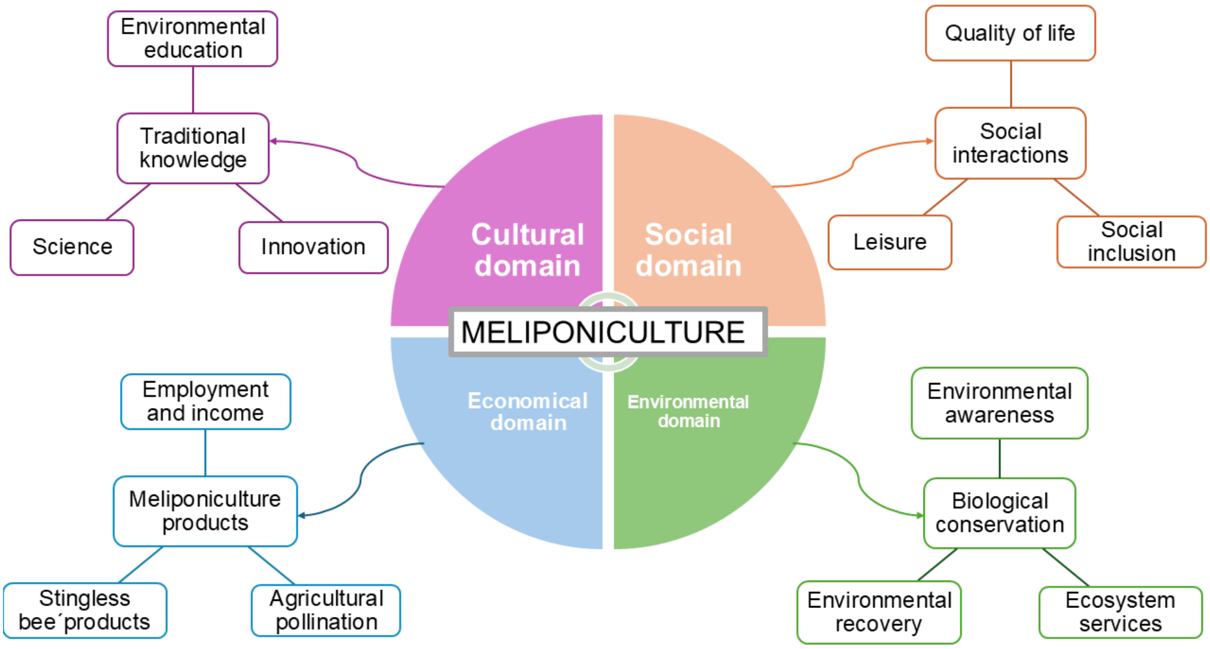

Figure 1. Domains of meliponiculture. (modified from Barbiéri et al., 2020) – *Domaines de la méliponiculture (adapté d'après Barbiéri et al., 2020).*

Nowadays, the popularity of meliponiculture in Ecuador is largely due to the COVID-19 pandemic, which negatively affected rural family economies while simultaneously boosting the purchase and use of pot-honey as a medicinal supplement for respiratory complaints. The development of initiatives that use this practice in agroecological systems, along with the renewed appreciation for native bee species over the European honey bee, has further contributed to its expansion (Naturaleza y Cultura Internacional, 2025; World Vision, 2025). This practice has advanced through the design and use of wooden boxes (modern nests) to improve the management of species such as *Melipona* (*Michmelia*) *rufiventris* Lepeletier, 1836 (Richard et al., 2019). In Ecuador, meliponiculture farmers transfer a nest of stingless bees, usually located in hollow trees that have fallen naturally to a modern, technical wooden box to facilitate and improve their management (Ocaña-Cabrera et al., 2024). Meliponiculture is practised in a variety of forms throughout the country including artisanal and subsistence models, as well as commercial, scientific, educational, conservation, and entomotourism models (Aldasoro Maya et al., 2023; Ocaña Cabrera, 2025).

In several Latin American countries, including Ecuador, the market price of meliponine honey ranges from 40–200 USD (35–173 EUR) per litre (Quezada-Euán, 2018). The value of stingless bee honey is determined by various factors, including the species of origin, the method of production, the regional availability, and the demand. A unique component of the pot-honey of stingless bees is trehalulose, a reducing disaccharide sugar that serves as an indicator of the authenticity and quality of a natural product (Zhang et al., 2022). The bioactive properties of stingless bee honey encompass a range of characteristics, including anti-cataract, anti-inflammatory, antimicrobial, antioxidant, antiproliferative, and neuroprotective effects (Vit et al., 2024).

2.3. Known and emerging threats to stingless bees in Ecuador

The ornamental use of *Spathodea campanulata* P. Beauv., 1805, as part of territorial ordinances in different cities in Ecuador, poses a threat to local biodiversity due to the potentially toxic nectar produced by the flower (Queiroz et al., 2014). In the country, 303 stingless bees were found dead inside 140 flowers of this plant (Padrón & Campaña, 2025), thereby contributing to native bee mortality due to the introduction of invasive species into the territory.

A further threat to the sustainability of this practice in Ecuador is the absence of regulations governing meliponiculture, coupled with the inexperience of new practitioners who join this practice out of economic ambition rather than for the conservation of these native bees (Quezada-Euán et al., 2022). The transfer of stingless bee colonies from one region to another, exhibiting divergent environmental characteristics, has been identified as a significant contributing factor to the invasive propagation of certain species of stingless bees in regions where they are not endemic (dos Santos et al., 2022). This phenomenon, although not yet formally documented in Ecuador, is of particular concern and requires further investigation to understand its full implications and potential impact on ecological balance. The substantial extraction of wild nests, propelled by economic ambition, and the subsequent division or micro-division of colonies to increase the number of nests, yet with a minimal survival rate due to the absence of biological criteria on the part of those engaged in this practice, are significant concerns. At the genetic level, the reduction in diversity leads to inbreeding or a genetic bottleneck that results in an increase in diploid male production (May-Itzá et al., 2021). The ongoing threat of predatory extractivism and habitat destruction has led to the local extinction of *Melipona quadrifasciata* in north-eastern Brazil (Araújo et al., 2016).

Pests and pathogens (*i.e.*, *Nosema ceranae*, *Lysinibacillus sphaericus*, deformed wing virus, or the acute bee paralysis virus), together with pesticides, especially neonicotinoids, and climate change, further intensify the threats already faced by stingless bees (Ocaña-Cabrera et al., 2025).

3. CONCLUSIONS

Meliponiculture in Ecuador has emerged as a means of economic support for families in rural areas of tropical regions. Its management and care focus on sustainable use of products such as pot-honey, while conserving its habitat and improving the genetic diversity of mixed crops or agroforestry systems, which families have returned to as an environmentally sustainable alternative.

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