# Prologue

## Stingless bees now and in the future

Bee keeping with honey bees (*Apis mellifera*) has played an important role in tropical, more sustainable development programs during recent years, mainly because the net profits from labor in conventional honey production are high compared to other agricultural activities. However, honey bee keeping is not always advisable in protected areas, and of course in the New World tropics, where honey bees are introduced, a long history and unique tradition surrounds the keeping of the native stingless bees (Meliponini). The latter cultural practice is also known from the Old World where it has existed for centuries, in parallel with the more common keeping of honey bees.

Stingless bees include a large number of different tropical and some subtropical species. As in honey bees, they form social colonies and provision their nests with honey and pollen, which are stored in pots made of beewax or cerumen. Although more species are expected to be found and described, the known worldwide diversity is presently 526 species: 411 in the New World and 115 in the Old World distributed as follows: 19 in Africa, 7 in Madagascar, and 89 in southeast Asia and Australia. Camargo and Pedro (2007) and Rasmussen (2008) provide all published references available on the taxonomy and biology of the stingless bees from those regions, thus making it relatively easy to acquire an overview, or background information, of what is already known and what needs to be studied and reported for each species. When it comes to evolutionary or comparative studies, stingless bees are also an excellent study organism for understanding advanced sociality, feeding specialization, and adaptive value of different nesting strategies. Both higher-level and some species-level molecular phylogenies are available for some groups (Ramírez et al., 2010; Rasmussen and Camargo, 2008; Rasmussen and Cameron, 2007; Rasmussen and Cameron, 2010) as are morphology-based phylogenies (e.g., Camargo and Pedro, 2003, Camargo and Pedro 2004, Gonzalez and Roubik, 2008).

The taxonomic knowledge of stingless bees is still limited in various groups and regions. Even for genera that have been subject to taxonomic study in recent years, there is always a chance of encountering undescribed species, because the melittofauna in many regions is still poorly sampled or known. Furthermore, some commonly encountered genera have never been revised and their species-level identification is, unfortunately, impossible without the careful examination of museum specimens, which are often located in many different countries. Even the species status, or species concept, of some remain to be clarified, including that of a few common species that are heavily used by rural communities and widely studied across the Neotropics. For example, the bee called *Tetragonisca angustula* (Latreille) is a common bee kept in hives, which ranges from Mexico to Argentina. It is probably composed of several undescribed species (Camargo and Pedro, 2007). Such taxonomic problems for a diverse and culturally and economic important group of bees translates into nomenclatural instability, which becomes an annoyance for non-taxonomists and confounds any comparative evolutionary or behavioral study. Chapter 11 discusses some of these issues.

Most of the stingless bee fauna of Central America can be identified with the taxonomic keys to species of Mexico (Ayala, 1999) and Panama (Roubik, 1992). The higher diversity in South America is more difficult to identify correctly, but many species can be identified using the available taxonomic revisions, and following the assignment to genus (an excellent generic key is Silveira et al., 2002), with keys such as those by JMF Camargo, JS Moure, SRM Pedro, and even the older keys by HF Schwarz. Afrotropical stingless bees can be identified with the taxonomic key of Eardley (2004), except for those from

Madagascar that can be recognized using Pauly et al. (2001). For the Indo-Malayan and Australasian region, the only genus-group key currently available is that of Moure (1961), although Deborah Smith (personal communication) is preparing a new exhaustive taxonomic key. Keys to the species of that region are presently only available for some areas (Rasmussen, 2013; Sakagami et al., 1990; Schwarz, 1937, Schwarz, 1939), with additional literature needed for poorly characterized genera, such as *Tetragonula*. For this genus, keys to the species of continental Asia (Sakagami, 1978) and Australia (Dollin et al., 1997) are better used. No workable key exists for *Austroplebeia* although a revision is near completion (A Dollin, personal communication). Thus, despite many advances, a significant amount of work remains to be done to fully understand the diversity of stingless bees worldwide. This is necessary to assure that such a taxonomic knowledge is available to the broad group of biologists working with these bees (Gonzalez et al., in press).

The increasing interest in stingless bees during recent years is evident just by looking at the publication rate of scientific papers related to these bees. Figure 1 was prepared by searching during June 2013 in the Thomson Reuters "Web of Science" database of scholarly literature for any topics related to "meliponi*", "*Trigona*", "stingless bee", or "trigonin*" from 1980 and until 2012. The asterisk retrieves searches of all derivations of a word, e.g., "meliponi*" will locate citations related to Meliponina, Meliponini, Meliponinae, Meliponidae, and *Melipona*. As observed in the figure, the rise in recorded publications is exponential, with less than 10 papers per year 30 years ago to now close to 120 publications per year. With such an amount of new research being made available almost on a daily basis, it is doubtless important to compile books such as the present one, which will serve as a starting point for all those entering stingless bee research.

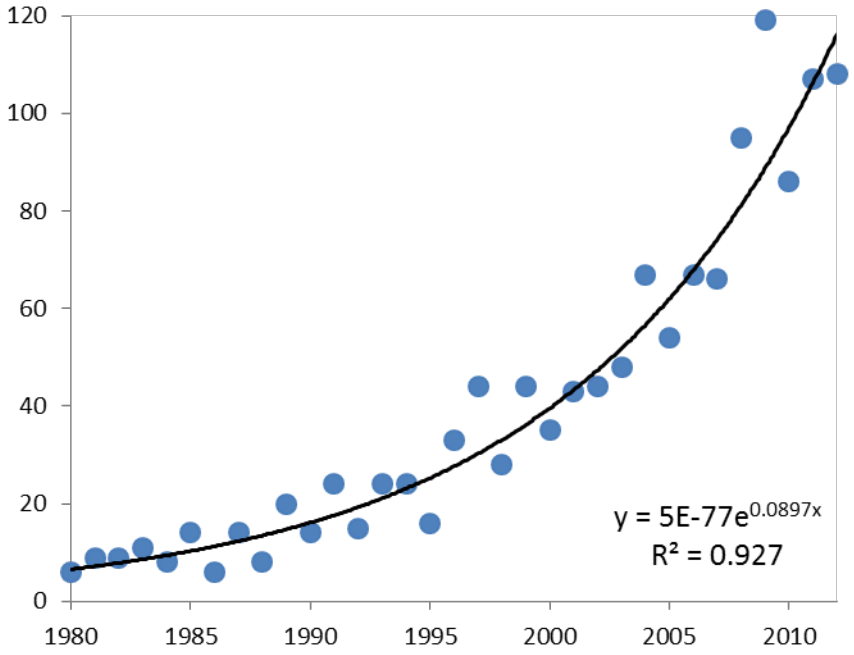


**Figure 1. Number of scientific papers on stingless bees published each year since 1980 to the present, as recorded by Web of Science.**

This edited book consists of 21 chapters, nearly of all them in English but with some in Spanish and Portuguese. The subjects treated in the book are as diverse, as the stingless bees themselves. The book includes contributions on meliponine cultural, medicinal, and educational values, palynology, systematics, foraging behavior, and fossil history. The nutritional, curative and gastronomical values of honey are

particularly interesting aspects covered in this book (chapters 3, 5, 7, 8, 10, 19), as are new recommendations outlining a quality standard for honey and related products which includes that of stingless bees (chapters 16, 17), as well as new methods for honey appreciation through a sensory evaluation (chapter 21)". The importance of this product, the honey and the book, might be much higher than expected. The honey gives stingless bees an important added value besides both crop pollination and ecosystem pollination service. Stingless bee honey is the key product that might contribute to the conservation and preservation of traditional knowledge of stingless bee keeping (and folk medicine), as reported in this volume from Quintana Roo in Mexico (chapter 1) and Brazil (chapter 2). That ancient appreciation of honey as a remedy and the art of keeping colonies required in-depth knowledge of the ecosystem service provided by the bees, *i.e.*, the necessity of pollen and nectar resources from tropical wildlands. Such knowledge is now transformed and modernly presented in environmental education programs, such as from Australia and Brazil, in chapters 6 and 12. In the past, long-term studies of flower visitation were a common practice to identify key plant species for stingless bee foraging. As documented here, this now can be done routinely, by sampling honey and pollen directly from the nest. The diversity and floral preferences of stingless bees can be quantified as proposed in chapter 3, 4 and 9, with chapter 13 explaining the different means of forager recruitment found among these bees. Modern techniques, such as an electronic nose (chapter 18), is a new way to categorize or identify stingless bee honey, thus providing a useful tool in the development and control of quality standards. In addition, the many names proposed for new species by the late JMF Camargo are explained in chapter 14, as well as the geological history of stingless bees, in chapter 15.

We are excited to introduce this new book on stingless bees, which provides an overview of the group and the current status of our knowledge of little-known details with tremendous importance to science and society. The editors and contributors of this book have done a terrific job putting this piece together. We hope that new students and researchers find it stimulating.

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***Claus Rasmussen***

Department of Bioscience, Aarhus University,
NyMunkegade, DK-8000 Aarhus C, Denmark

***Victor H. Gonzalez***

Department of Biological Sciences, Southwestern Oklahoma State University,
Weatherford, Oklahoma, USA
and
Division of Entomology, Natural History Museum, University of Kansas,
Lawrence, Kansas 66045, USA