




A tribute to Fernando A. Silveira and his contributions to bee research

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Fernando A. Silveira had the unique combination of being a sagacious scientist and a remarkable human being. Throughout his career, he made significant contributions to understanding bee diversity and keenly spread this scientific information to the academic community at large and beyond the university walls. His rich character, warm heart, strong voice and laughter are missed by those privileged to be Fernando's students, friends, mentors, and family. In this volume, we honor Fernando A. Silveira, who prematurely passed away at the age of 62, leaving three sons, his wife, and numerous friends.

Fernando Amaral da Silveira was born on May 8th, 1960, in Belo Horizonte (Brazil), where he spent his childhood and teenage years until he moved to the town of Viçosa in 1979 to become a student of agronomic engineering at the *Universidade Federal de Viçosa* (UFV). During approximately a decade as an undergraduate and then as a master's student, Fernando was mentored by Lucio Antonio de Oliveira Campos, whose teaching and mentorship were influential throughout his life. From Lucio Campos, Fernando absorbed a critical scientific sense and a deep curiosity about a wide range of themes associated with the evolution, ecology, taxonomy, and genetics of bees. Fernando graduated in 1985, and during those college years, he learned about beekeeping, general bee biology, and their diversity. Between 1982 and 1987, he published eight articles about beekeeping in newspapers and agricultural magazines. His Master's project shifted in a different direction and dealt with the native bee fauna of the Brazilian cerrado, allowing for an in-depth investigation of bee diversity and their association with plant hosts. Fernando defended his master's thesis (freely translated from Portuguese as 'The wild bee fauna of a cerrado area of the research station of Paraopeba, Minas Gerais state, and their food sources') in 1989 and one of the most influential papers about the bee fauna of the cerrado ever published derived from it (Silveira & Campos 1995). The principal Brazilian bee taxonomist at that time was Father Jesus Santiago Moure, a professor at the *Universidade Federal do Paraná* (Curitiba, Brazil), who visited Viçosa during Fernando's student years (Figure 1), worked together on a taxonomic project with him (Moure & Silveira 1992), and impacted his future interests in the field.

In 1992, Fernando Silveira embarked on his PhD at the University of Kansas, Lawrence, funded by the Brazilian National Council for Scientific and Technological Development (CNPq). Byron Alexander was a young faculty at KU interested in the systematics of bees and wasps, who acted as Fernando's PhD advisor. Kansas was also the academic home of Charles Michener, the leading bee taxonomist in the world, who had retired in 1989, before Fernando arrived in Lawrence but remained very active as emeritus professor and curator for the decades to follow. The exciting academic environment at KU was made possible by Fernando's direct support and interactions with Byron and Michener, among others, during the PhD years. The lively Entomology Department and the Snow Entomological Museum also included other faculty and students (in addition to visitors), making Lawrence a true world hub for entomological research (Figure 2). Fernando's PhD research (Figure 3) was on the systematics of Exomalopsini (Apidae), a project pursued in parallel to the reevaluation of the phylogenetic relationships within the long-tongued bees (i.e., Apidae+Megachilidae), resulting in two foundational publications published back-to-back in the same issue of the *Bulletin of the University of Kansas*: (Roig-Alsina & Michener 1993; Silveira 1993a), and the final results of his dissertation were later published in the same journal (Silveira 1995). These contributions clarified the meaning and circumscription of Exomalopsini (previously treated in diverse ways—contrast, e.g., Michener 1944 with Michener & Moure 1957), the placement of this tribe within Apidae, and its relationship to other tribes in the "exomalopsine line," later formalized as the subfamily Eucerinae (Bossert *et al.* 2019; Freitas *et al.* 2021), and the recognition and description of a new tribe: Teratognathini Silveira, 1995. His interests also included

comparative morphology as a source of valuable information for systematics (Silveira 1993b) and revisionary aspects of *Exomalopsis* taxonomy (Almeida & Silveira 1999; Silveira 1996, 2007a; Silveira & Almeida 2008).

After receiving his PhD from the University of Kansas in 1995, Fernando moved back to his hometown in Brazil, Belo Horizonte. He was initially supported by a post-doctoral fellowship granted by CNPq and later hired as a tenure-track faculty at *Universidade Federal de Minas Gerais* (UFMG). During his first years back in Brazil, Fernando advised students, and started a bee collection and a laboratory (1996–2016: ‘Laboratory of Bee Ecology and Systematics’, later renamed ‘Laboratory of Bee Systematics,’ and then ‘Laboratory of Insect Systematics’ when joined by a dipterist colleague and friend, Kirsten Lica F. Haseyama). His contact with undergraduates in classes in zoology and systematics attracted several disciples to the lab, who conducted regional surveys, and ecological, and taxonomic projects. Fernando supervised six PhD dissertations, 14 master’s theses, and ten honor’s theses, in addition to several more undergraduate students who served as volunteers in his team, having mentored at least 30 different individuals during his professorship.

Throughout his academic career, Fernando was constantly motivated to understand the distribution and diversity of bee assemblages using surveys of the fauna and their host plants (Alvarenga *et al.* 2020; Azevedo *et al.* 2008; Campos *et al.* 1989; Cure *et al.* 1992, 1993; Faria & Silveira 2011; Nemésio *et al.* 2012; Nemésio & Silveira 2004a,b, 2006a,b,c, 2007a,b, 2010; Pinheiro-Machado *et al.* 2002a; Silveira *et al.* 1993; Silveira 2004; Silveira & Campos 1995; Silveira & Cure 1993; Silveira & Godínez 1996; Williams *et al.* 2001). In addition to the publications derived from these surveys, collecting bees was a fundamental step toward building a taxonomic collection (Silveira & Alvarenga 2012), currently part of *Centro de Coleções Taxonômicas (CCT-UFMG)*, Belo Horizonte. That this is one of the largest bee collections in Brazil primarily thanks to decades of Fernando’s efforts to have an institutional



FIGURE 1. Fernando A. Silveira, Jesus Santiago Moure, Gabriel A. R. Melo (sitting, from right to left), and Marco Antonio Costa (standing) examining bees at the bee laboratory of the *Universidade Federal de Viçosa* (Viçosa, Brazil), ca. 1988. Photo provided by R.M.Carmo.

collection at his home university. The surveys also indicated the urgent need for a general treatise about bee diversity in Brazil that could serve as a guide not only for students of bees but also for the broader scientific community to the taxonomy of Brazilian bees. This urge gave rise to a homemade manual (initially used by Fernando and his students, as well as during bee identification workshops), and later published as a book: “*Abelhas Brasileiras: Sistemática e Identificação*” (Silveira *et al.* 2002). The book aggregated identification keys to all genera and subgenera known to occur in Brazil, an annotated checklist of the species found in the country accompanied by their distribution state-by-state and introductory chapters with information about bee biology, principles of collecting and preservation of specimens, morphology, systematics and biogeography of bees. This project was carried on before the publication of Michener’s magnum opus (Michener 2000). Two decades after *Abelhas Brasileiras* was published, this book has received over 1,000 citations (Google Scholar, accessed 03 November 2023).

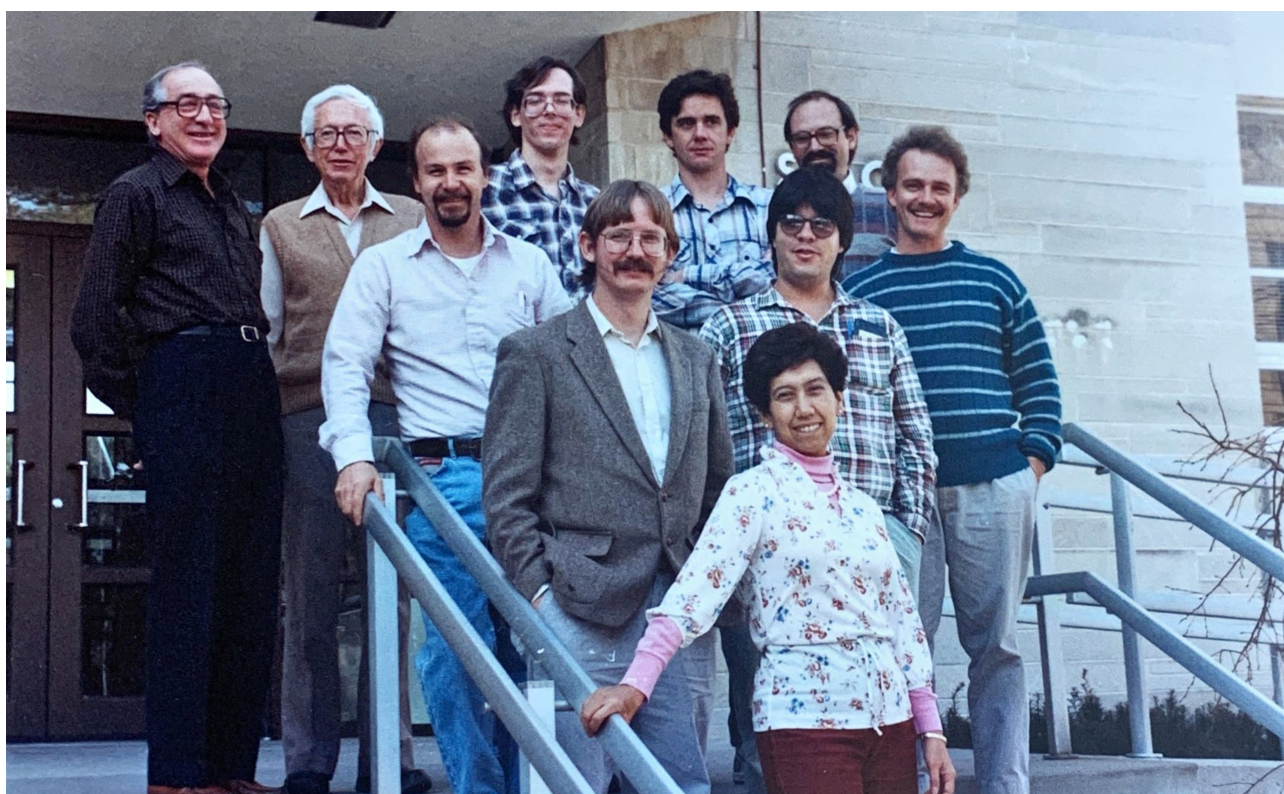


FIGURE 2. Picture from the George W. Byers Photograph Collection deposited at the Smithsonian Institution Archives: Wallace E. LaBerge, Charles D. Michener, Douglas Yanega, Robert L. Minckley, Arturo Roig-Alsina [left to right, top row], Robert W. Brooks, Byron A. Alexander, Fernando A. Silveira, David W. Roubik [middle row] Luisa Ruz [center bottom]. The back of the picture has handwritten annotations that allow the identification of the portrayed individuals and the following note: “bee students at Univ. of Kansas. Lawrence, 8 March 1991.” Courtesy of Smithsonian Institution Archives.

Fernando’s contributions to taxonomy, phylogenetics, and biogeography extended well beyond exomalopsine bees, having encompassed other taxa of Apidae, as well as Colletidae, Halictidae, and Megachilidae (Azevedo & Silveira 2005; Ferrari *et al.* 2016, 2017; Ferrari & Silveira 2015; Freitas *et al.* 2018, 2019, 2023; Freitas & Silveira 2017; Moure & Silveira 1992; Santos Júnior *et al.* 2015, 2019, 2022; Santos & Silveira 2009; Silveira 2009, 2007b; Silveira & Martines 2009; Vélez & Silveira 2006; Zama *et al.* 2019), totaling 22 new species and five new family-group taxa (Appendix). His contributions to bee biology were also important and considerably improved our knowledge of Brazilian bees (*e.g.*, Cardoso & Silveira 2012; Carmo *et al.* 2004; Martins *et al.* 1999; Pompeu & Silveira 2005; Silveira 1991, 2002; Simeão *et al.* 2015), and put their conservation on a solid foundation (Machado *et al.* 2008; Pinheiro-Machado *et al.* 2002b; Pires *et al.* 2008, 2014a,b; Silveira 2008; Silveira & Azevedo 2008; Silveira *et al.* 2008). Much of this work was done while training undergraduate and graduate students. Fernando had other significant impacts on the Brazilian bee community as well as the world bee community at large. Fernando participated in multiple editions of the *Encontro sobre Abelhas*, the Brazilian bee meetings traditionally organized in Ribeirão Preto, where he is remembered for his humorous and enjoyable talks, for enriching the discussions, and

for social mixing of his lab team with other attendees (Figure 4). He had numerous other informal collaborations, whether through identifying large numbers of bee specimens for other researchers or giving advice. His generous personality resulted in his spending considerable amounts of time helping others.



FIGURE 3. Fernando A. Silveira at his office of the University of Kansas (Lawrence, U.S.A.), 1994, during his PhD on the systematics of Exomalopsini. Photo provided by R.M.Carmo.



FIGURE 4. Fernando A. Silveira, Paulo Nogueira Neto, Bráulio F. S. Dias, and Jesus Santiago Moure surrounded by students from the Silveira Lab in the 2002 Brazilian bee meeting (*Encontro sobre Abelhas*) during a visit to *Fazenda Aretuzina* (São Simão, Brazil): Ana Cristina M. Lara, Maurício dos Santos Pompeu, Roselaini Mendes do Carmo, Roderic Breno Martines, Mariana Pimentel, Carolina Ferreira Cardoso (left to right, standing), and Rodrigo de Loyola Dias (sitting). Photo provided by R.B.Martines.

Fernando Amaral da Silveira passed away on August 07, 2022, after 26 years as a professor at the Zoology Department of UFMG (Belo Horizonte, Brazil). His legacy will long persist not just because of his scientific research, tireless contributions to the consolidation of biological collections and the foundation of a graduate program in systematic zoology at UFMG, but also because he was a superb mentor, friend, and human being.

Acknowledgments

I am thankful to Roselaine M. Carmo, Gabriel A.R. Melo, Robert Minckley, Elder F. Morato, Roderic B. Martines, and Carolina Cardoso Yazbeck for their generosity in sharing pictures, and chronological and factual information necessary for the historical accuracy of this work. Richard Gilreath (Smithsonian Institution Archives of the Smithsonian Libraries and Archives) kindly located and digitalized the photograph of Fernando Silveira from the George W. Byers Photograph Collection, 1956–1993. I am also indebted to Laurence Packer for his suggestions to improve this piece and grateful to Jason Gibbs and Laurence Packer for making this Festschrift possible.

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<https://doi.org/10.3161/00034541ANZ2019.69.3.008>

Appendix

Taxa proposed by Fernando A. Silveira

Species-Group Names (22 new names)

Apidae: Apinae

Bombus bahiensis Santos Júnior & Silveira, 2015 (in Santos Júnior *et al.* 2015)

Centris machadoi Azevedo & Silveira, 2005

Centris rupestris Azevedo & Silveira, 2005

Apidae: Eucerinae

Thygater carijo Freitas & Silveira, 2018

Thygater danunciae Freitas & Silveira, 2017

Exomalopsis alexanderi Almeida & Silveira, 1999

Exomalopsis atlantica Silveira, 1996

Exomalopsis campestris Silveira, 1996

Exomalopsis diminuta Silveira, 1996

Exomalopsis dubia Silveira & Almeida, 2009 [2008]

Exomalopsis eremalis Silveira & Almeida, 2009 [2008]

Exomalopsis griswoldi Silveira & Almeida, 2009 [2008]

Exomalopsis gualamba Silveira & Almeida, 2009 [2008]

Exomalopsis perikalles Silveira & Almeida, 2009 [2008]

Colletidae: Colletinae

Colletes altimontanus Ferrari & Silveira, 2015

Colletidae: Diphaglossinae

Caupolicana rupestris Zama, Ferrari, Coelho & Silveira, 2019

Mydrosoma sabarense Silveira & Martines, 2009

Mydrosomella caatinguensis Ferrari, Arantes, Silveira, 2016

Colletidae: Neopasiphaeinae

Actenosigynes mantiqueirensis Silveira, 2009

Halictidae: Halictinae

Megalopta atlantica Santos & Silveira, 2009

Megalopta guimaraesi Santos & Silveira, 2009

Megachilidae: Megachilinae

Megachile falcidentata Moure & Silveira, 1995

Family-group names (five new names)

Apidae: Eucerinae

Alloscirteticina Freitas & Silveira, 2023

Gaesischiina Freitas & Silveira, 2023

Melissodina Freitas & Silveira, 2023

Teratognathini Silveira, 1995

Thygaterina Freitas & Silveira, 2023