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A history of systematic studies of the bees of Cuba (Insecta: Hymenoptera, Anthophila)

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Abstract

A meticulous search was made for papers related to Cuban bees to define the historical context and periods in which studies of their taxonomy and natural history have occurred. Systematic studies of this group of insects began 230 years ago. Such studies are divided into several stages: European (1763–1896), North American (1896–1944), consolidation and current (1944–present). I present the current state of knowledge of natural history of Cuban bees, the status of the main entomological collections in the country, and experience in the use of bees as pollinators in Cuba.

Key words: bees, Hymenoptera, history of taxonomic studies, natural history, collections, Cuba

Resumen

Se efectuó una búsqueda minuciosa sobre los trabajos relacionados con las abejas de Cuba, en cada contexto histórico, para definir las etapas por la que han pasado los estudios de historia natural. Los estudios sistemáticos de este grupo de insectos comenzaron 230 años atrás. Estos, están divididos en varias etapas: europea (1763–1896), norteamericana (1896–1944), de consolidación y actual (1944–presente). Se presenta el estado actual del conocimiento de la historia natural, las características de las principales colecciones entomológicas y experiencia en la utilización de las abejas como polinizadores.

Palabras claves: abejas, Hymenoptera, historia estudios taxonómicos, historia natural, colecciones, Cuba.

Introduction

Bees, ants and wasps are included in the order Hymenoptera and with the Coleoptera, Lepidoptera and Diptera, form the four most numerous and diverse groups of insects. The

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world bee fauna contains around 20 000 species, in seven families (Finnamore and Michener 1993; Michener, 2000), while that of Cuba is less than 100 species in four families (Alayo 1976); the Stenotritidae, Andrenidae and Melittidae not being found there.

Bees are among the most popular insects, and are well known for their economic importance. Noteworthy are their production of honey, nutritious products, wax, propolis and drugs; pollination of many plants; and the advanced forms of social behavior which has evolved several times (Asis 1989, Werthein 1993, O'Toole and Raw 1999, Michener 1974, 2000, Stubbs and Drummond 2001).

The Cuban fauna, which has a high endemic component of 47.3% (Genaro and Tejuca 2001), consists of bees that range in length from less than 4 mm (e.g. *Hylaeus* spp.) to the robust, widely distributed and common carpenter bee, *Xylocopa cubaecola* Lucas which is 25 mm. In coloration bees range from black or reddish-brown, to metallic blue or green as among the Cuban halictids, *Augochlora, Agapostemon,* some *Lasioglossum* and *Temnosoma.*

At present, no melittologists live in the West Indies, and few entomologist there have a deep knowledge of these important insects. Faunas as diverse and localized as that of Hispaniola remain almost unknown. Contrary to many other Latin American countries or Antillean islands, Cuba has a long entomological tradition, beginning around 1840 (Alvarez 1958, Pruna 2001). Two Cuban entomologists who had a great impact on the studies of their time were Felipe Poey (1799–1891), the first entomologist of Latin America, and Carlos J. Finlay (1833–1915) whose ideas led to the recognition of the role of mosquitoes in transmission of yellow fever (Hogue 1993, Pruna 2001).

In this paper I present a historical overview of the stages of the systematic studies of Cuban bees, a survey of the main collections in the country and summarise what is known about bee natural history in Cuba.

Bibliographic information was obtained during my visit to different United States natural history museums libraries, from 1993 to 2000, as well as Pastor Alayo's personal library, Cuban libraries of the Institute of Ecology and Systematic (IES), Cuban National Museum of Natural History (MNHNCu) and Cuban National Museum of History of Sciences Carlos J. Finlay. The main Cuban collections of native bees were studied in order to evaluate their state of preservation and number of specimens: IES; MNHNCu; Charles Ramsden Museum, University of Oriente (MCRUO); Faculty of Agricultural Sciences, Central University of Las Villas (FAUCV), Oriental Centre of Ecosystems and Biodiversity (BIOECO), and the private collection of Fernando de Zayas (FZ).

Results

The first studies (1763–1896)

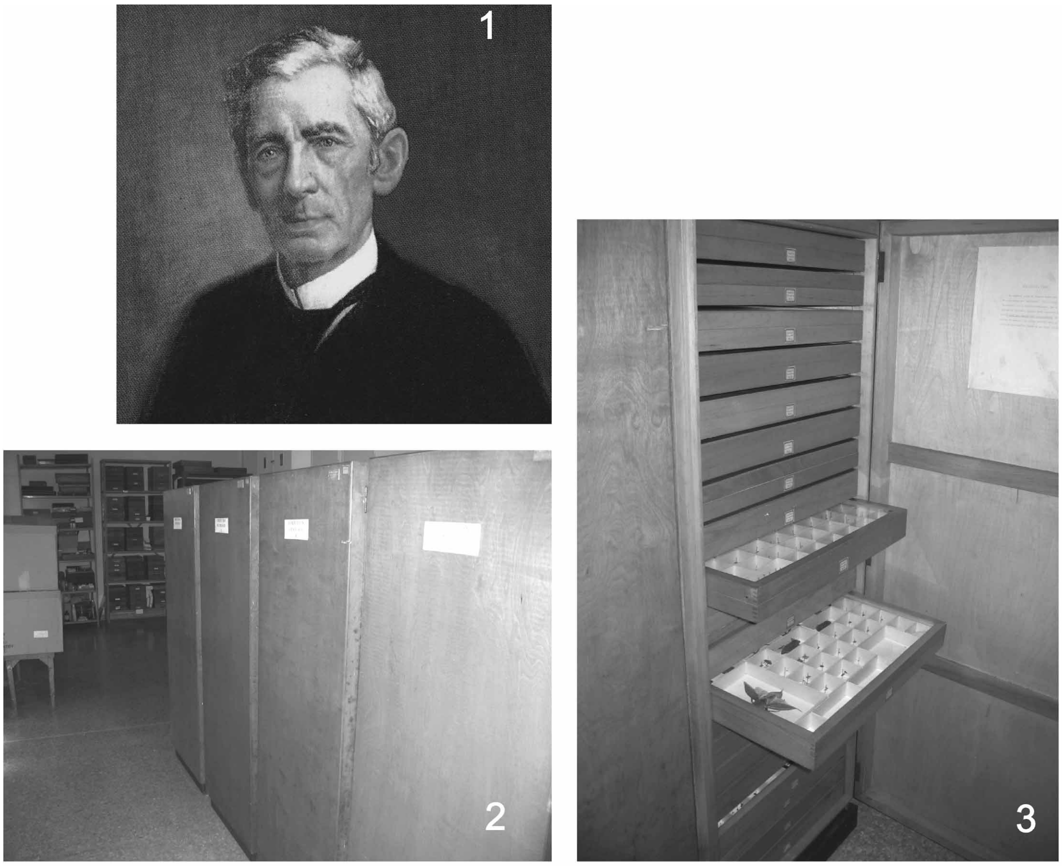
The history of the taxonomy of Cuban bees extends over 230 years. Most studies have been performed by taxonomists outside of Cuba. These, from their respective institutions, compared the material they were receiving and described the new species that appeared, in order to give them names, as is standard practice in taxonomy. Other species, whose distribution includes the island of Cuba, were studied first in other areas and later found to occur in Cuba.

The first Cuban bee species were described or studied by several European entomologists before 1860: M. Spinola (1840, 1851), I. A. Scopoli (1763), Johann C. Fabricius (1793, 1798, 1804), F. E. Guérin-Méneville (1835, 1844), A. Lepeletier (1841), R. Lucas (in Sagra, 1856) and C. E. Blanchard (in Cuvier, 1849). Due to the lack of detail on localities, the material was generally identified as coming from “Americae Meridionalis Insulis", that is, Cuba or another Caribbean island. Thus one cannot determine which was the first described Cuban bee. Genaro (1998*a*), however, demonstrated that the species *Coelioxys tridentata* described as *Apis tridentata* by Fabricius, in 1775, has Cuba as its type locality.

The English entomologist F. Smith (1853) catalogued the Hymenoptera deposited in the British Museum, including bees from Cuba, and he later described new species from the West Indies (Smith, 1879). The first author that summarized Cuban Hymenoptera was Guérin-Méneville (in Sagra, 1856). This author received specimens from Poey and Sagra to supplement the work of the latter on the natural history of the Island of Cuba, although bees were not abundant in the material. The only species described was *Xylocopa cubaecola*, by Lucas (Sagra, 1856).

After Sagra´s work, and stimulated by two great Cuban zoologists, Felipe Poey and Johann C. Gundlach (Fig. 1), Cresson produced thorough taxonomic revision of Cuban Hymenoptera, including the bees (Cresson 1865, 1869*a* and *b*). This included the description of many new species, since Cresson had at his disposal the Hymenoptera collection that Poey sold to the Entomological Society of Philadelphia, and also Gundlach’s collection borrowed from him. This gave Gundlach’s collection, now at the IES (Figs. 2 and 3), great historical and taxonomic value, since it contains many of Cresson’s primary types.

Felipe Poey preferred to study butterflies, from among all the insects. However, he carried out a detailed study (Poey 1851) on the nest structure and nesting behavior of the stingless bee *Melipona beecheii* Bennett (as *M. fulvipes* Guérin-Méneville). Later he wrote other works on the bee *Apis mellifera* L., as a producer of honey (Poey 1856–1858,1888*a* and *b*). Gundlach (1886), continued observations on Cuban entomology and provided the most complete account of the bees available at the time, with taxonomic data, diagnoses and distributions in Cuba. In this paper he also incorporated personal observations from field work, accounts of previously well-known Cuban species, and translated Cresson’s (1865, 1869*b*) descriptions. Dalla Torre (1896) catalogued the Hymenoptera of the world. This work, with many West Indian species, included records of species usually not clearly assigned to individual islands from the Caribbean region.



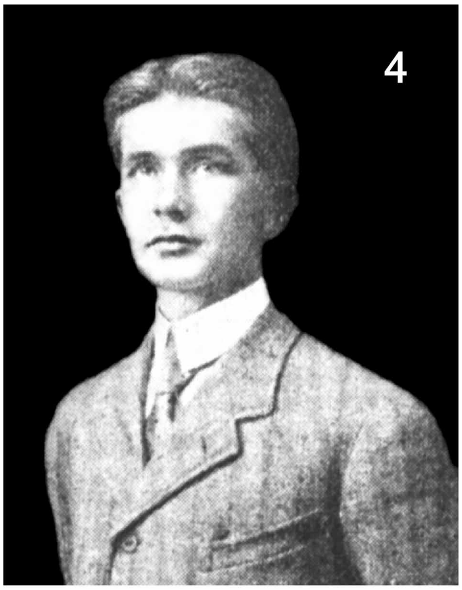
FIGURES 1–3. Gundlach and his collection. 1. J. C. Gundlach (1810–1896) (*Canvas at Cuban National Museum of History of Sciences*). He published the most complete account of Cuban bees until Alayo's (1973) catalog. 2 and 3. Gundlach´s collection is housed at the Institute of Ecology and Systematic (IES), Havana City. This important historical collection holds the largest number of primary insect types in Cuba.

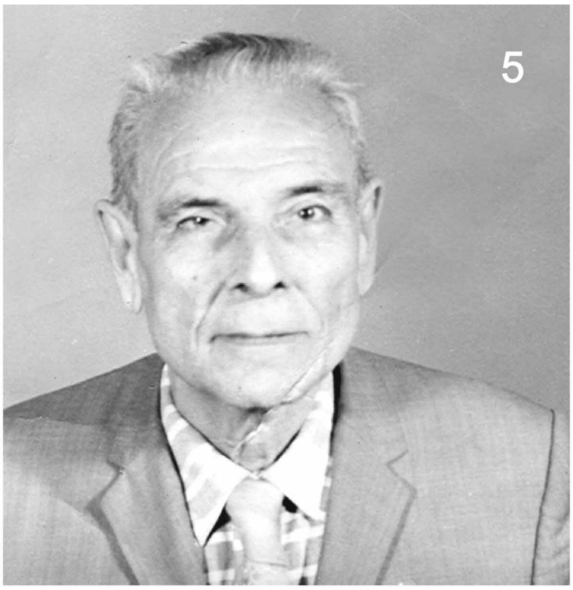
Second stage (1896–1944)

The next stage can be considered North American, because of the prevalence in the relevant literature of specialists from the United States. It was begun by the work of Ashmead (1896, 1900) and Friese (1899, 1900, 1902, 1908, 1911, 1921). Friese, a German author, provided lists of the Antillean bee fauna (Friese 1902, 1908). Both authors described new species from West Indian islands. Crawford (1915) described a Jamaican species (*Melissodes foxi*) and commented on species from Cuba. Cresson (1916) listed the holotypes of the new species described during his studies.

In an important contribution at the beginning of the 20th century, Charles F. Baker (Fig. 4), a North American who directed and worked in the Agronomy Experimental Station (EEA) at Santiago de las Vegas, 12 km SW of Havana, presented keys to separate species of halictines, and listed the bee species known from Cuba (Baker, 1906). He also described new species of *Lasioglossum* (as *Chloralictus*), which are small forms, not studied previously in Cuba. Unfortunately, this author did not designate holotypes and deposited his material mainly in his private collection, now at the United States National Museum of Natural History, Smithsonian Institution.

Cockerell (1898, 1904, 1905*a*, *b* and *c*, 1906, 1910*a*, *b* and *c*, 1919) examined many holotypes in the British Museum and Smithsonian Institution, offered keys to separate some West Indian species of genera *Megachile* and *Coelioxys*, wrote a species list and described new species. Other North American authors (Robertson 1902, Smith 1907, Sandhouse 1923), when studying the fauna of their continent, included descriptions and keys for West Indian species. Mitchell (1927) published new species of *Megachile* from the Antilles, but the two species he described from Cuba were synonyms of previously described species (Genaro 1998*a*). He also (Mitchell 1943) presented keys to separate the Neotropical subgenera of *Megachile*, including Cuban species. Schwarz (1932, 1944) revised the genus *Melipona* and commented about the introduction of *M. beecheii* (as *M. beecheii fulvipes*) into Cuba.





FIGURES 4–5. Entomologists in Cuba, working with bees. 4. Charles Fuller Baker (1872–1927). (*From Essig 1931*). His paper of 1906 is still useful and the only one available for the proper identification of *Lasioglossum* species, which are important pollinators of angiosperms. 5. Pastor Alayo (1915–2001). This Cuban entomologist contributed most to the study of bees. He never described a new species but collected and sent material to specialists. This allowed him to make a fine reference collection and to write an important introductory paper and catalog.

Consolidation stage and current (1944– 2005)

Charles D. Michener is considered to be the world authority on bees. The publication of Michener (1944), greatly furthered the taxonomic studies of bees. This classic paper defined and established morphological terms that improved the classification and created a favourable basis for the development of later studies, including phylogenetic analyses. At the University of Kansas, he created the largest collection of references about bees. His work has stimulated the development of specialists all over the world. Pastor Alayo (Fig. 5), a Cuban entomologist, had a continuing relationship with him, and sent material for identification, resulting in several papers published (Michener 1966, 1988*a* and *b*). For example, Michener (1988*b*) recorded the presence of the subfamily Lithurginae in the Antilles for the first time and described *Lithurgus antilleorum*, from the xeric coasts of the Greater Antilles.

His subsequent studies on bee natural history, with an emphasis on identification and phylogeny, are necessary references for any specialist of the group. Particularly important are Michener (1953, 1974, 1986, 2000); Michener and Fraser (1978); Michener *et al*. (1994) and Sakagami and Michener (1987).

In the 1950´s, the study of the bees of the Western Hemisphere was continued by North American entomologists. Cross (1958) revised the bees of the genus *Nomia*, subgenus *Epinomia*, including the Cuban species. LaBerge (1956, 1961) revised the genus *Melissodes* in North and Central America, redescribing species, describing new species and presenting keys. Mitchell (1960, 1962) studied the bees of the Eastern United States, including species whose distributions embrace the West Indies. Eickwort (1969) in his comparative morphological study and generic revision of the augochlorine bees deal with major works concerning the generic classification of Latin America Augochlorini. Urban (1970), in Brazil, published on the genus *Florilegus*, contributing keys and much historical data. Roberts (1972) revised the genus *Agapostemon* and offered a key to the species. Mitchell (1973, 1980) contributed novel results and new changes in the subgeneric classification of *Megachile* and *Coelioxys.* Timberlake (1980) revised the American and West Indian species of *Exomalopsis*. The studies of Centridini and some parasitic Apidae by Snelling (1984, 1985, 1986) also included Cuban species and in 1990 he revised the subgenus *Chelostomoides*, of the genus *Megachile* (as *Chalicodoma*), and presented keys and illustrations. Alexander and Schwarz (1994) published a catalog of the species of *Nomada* of the world, placing them into the species groups resulting from Alexander's (1994) phylogenetic studies. Brooks (1999) revised the genus *Anthophora* in the West Indies, and recorded *A. hilaris* Smith from Cuba. Brooks (1983, 1988) had previously published on this genus, including the Cuban species *A. atrata* Cresson. Moure (1960), an outstanding Brazilian taxonomist, had access to Fabricius's type material, deposited in various museums in Europe and clarified numerous nomenclatural problems of Western Hemisphere species.

P. Alayo promoted the systematic knowledge of Cuban bees. In the beginning (1931–1951) he was associated with S. C. Bruner, head of the Agronomic Experimental Station of Cuba. Later, he worked at the Institute of Biology of the Academy of Sciences in Havana. He collected bees and formed a very important collection, mainly from the eastern areas of the island. He sent much material to the most active specialists of his time. Since he feared to create synonyms and because he could not obtain permission to travel outside of Cuba, the impossibility of studying the holotypes of Cuban species deposited in North American museums prevented him from describing new species. He wrote a series of introductory articles about the orders of Cuban insects that stimulated and facilitated their study. Alayo (1973) classified the Hymenoptera of Cuba, in the most complete compilatory work to date. He reviewed the Apoidea and presented keys to separate the families, subfamilies, tribes and genera of bees, besides listing the known species (Alayo 1976).

Krombein *et al*. (1979) included species whose distributions embrace Cuba in their catalog of North American bees. Hurd (1978) classified the species of *Xylocopa* of the Western Hemisphere. Zayas (1981), as a part of his valuable overview of the Cuban Entomofauna, wrote about hymenopterans, offering pleasing illustrations, and comments in clear language on the Cuban bees. Unfortunately, his book was published on poor quality paper. Moure and Hurd (1987) presented much information in their catalog on the halictids of the Western Hemisphere. Carman and Packer (1997), in an electrophoretic study on *Halictus,* found differences among some studied populations and recognized two species existing under the name *H. ligatus* Say. These authors used the name *H. poeyi* Lepeletier, for the Southern form (Southeast of United States, Central America and Caribbean), which also occurs in Cuba, the type locality.

Ayala (1992) revised the stingless bees of Mexico (genus *Melipona*). This study included *M. beecheii* present in Cuba and Jamaica. Ayala commented on the wide use of this species in beekeeping (in this case, meliponiculture), and noted that domestication should have influenced its distribution.

The present author (JAG) has contributed to the study of the taxonomy of West Indian bees, describing new species, making taxonomic changes and expanding the known range of some species (Genaro 1994*a*, 1997, 1998*a*, *b* and *c*; 1999, 2001*a*, *b* and *c*, 2002, 2003, 2004).

Urban and Moure (2001) published a catalog of the subfamily Diphaglossinae, raising (without giving a rationale) *Alayoapis* from subgenus to genus. Moure and Urban (2002), and Urban and Moure (2002) continued with the publication of catalogue that deal with Neotropical species of Colletidae. Nevertheless, they did not include *Colletes granpiedresis* Genaro, in spite of its being published in a Central American journal (Genaro 2001*c*).

Raw (2002, 2004) has worked on the taxonomy of *Megachile* of the Americas, including Cuban species but overlooked Genaro’s (1998*a*) paper on distribution and synonymy of some Caribbean bees of this genus. Janjic and Packer (2003) performed a phylogenetic analysis of all *Agapostemon* species and made some biogeographyic speculations on the history of these bees. Engel (2004) determined the proper identity of the species known as *Halictus poeyi* Spinola. M. Engel (in press, a and b) will soon publish on Cuban bee taxonomy, describing two new species of *Sphecodes* and a new genus closely related to it.

Cuban collections

Scientific collections provide the basis for systematic and biogeographic studies. They contain the primary evidence for the existence of species, document their presence in local areas, and allow comparison and identification of taxa (Danks 1991, McGinley, 1992). Historically, the importance of the creation and preservation of natural history collections has not been widely appreciated in Cuba. The existence of collections has been due fundamentally to the personal efforts of a few dedicated zoologists performing taxonomic research. Among them, the names J. Gundlach, F. Poey, C. Ramsden, S. Bruner, C. de la Torre, C. G. Aguayo, P. Alayo, F. de Zayas, S. de la Torre, H. Grillo, J. de la Cruz, J. Fernández Milera, G. Silva, L. F. de Armas and G. Alayón appear most commonly. The climatic conditions of Cuba (high humidity and temperatures), and easy proliferation of pest organisms, quickly damage collections and elevate the cost of their maintenance.

Table 1 shows the characteristics of the main Cuban entomological collections that contain bees.

Taxonomic keys for identification

Keys allow identification in a quick and accurate way. Many taxonomic studies lack keys to differentiate species, thereby making the identifications that are indispensable as a basis for ecological, behavioral or biogeographical studies impossible. Table 2 lists the authors which presented keys to differentiate Cuban bees.

Other papers that are useful for the recognition of Neotropical bees, through allowing the identification of families, subfamilies, tribes and genera include Alayo (1976), Goulet and Huber (1993), Michener *et al*. (1994) and Michener (2000).

Natural history

Knowledge about the natural history of Cuban bees is limited. Their behavior, in an environment as diverse and with interspecific interactions as complex as in the tropics and subtropics, remains almost unknown. There are just a few papers dealing with these topics from Cuba. Scaramuzza (1938) discussed two parasites of the bee *Megachile* sp; Alayo (1982) observed the characteristics of the nests of *Anthophora atrata* Cresson; Alayón (1984) contributed data on the biology of *Melipona beecheii* (as *M. fulvipes*); Genaro (1994*b*, 1996*a*, *b*, *c* and *d*, 1997, 1998*a*), and Genaro and Sánchez (1992) published articles on interspecific relationships such as predation, inquilines, phoresy and parasitism, and also nesting behavior.

One of the most interesting behaviors appears in bees of the genus *Megachile*, some of which cut leaves of plants to build their nest cells. In a study on the behavior of the genus, Genaro (1996*a*) demonstrated that they have a preference for leguminous leaves, possibly because of the morphoanatomic characteristic of the leaves. Species of *Megachile* used plants of 25 families, of which 24.1% were introduced. The use of exotic plants demonstrated behavioral plasticity.

TABLE 1. Main Cuban collections of native bees with comments on their holdings.

Institution or collection	Aproximate number of specimens	Number of holotypes	Comment
IES	3 208	12 (belonging to Gundlach´s collection, Figs. 2 and 3)	Contains the Gundlach historic collection (with many primary types), the P. Alayo collection, and remains from the Santiago de Las Vegas Agronomic Experimental Station (with voucher specimens and complementary data about natural history). Also with recent collections of other entomologists.
MNHNCu	1 885	10	Collection with some primary types, and more accurate and reliable identifications than the other Cuban collections. The only one with material from Hispaniola, Puerto Rico and other West Indian islands.
MCRUO	200	0	Very important because it holds specimens collected at the beginning of 20th century, in natural areas of the East, many of which have disappeared or been degraded. Many specimens were transferred to other collections, mainly those at IES.
FAUCV	543	0	Contains material mainly from central areas of Cuba (especially Guamuaya Massif). Many specimens need identification.
BIOECO	296	0	Contains material from Eastern mountain areas, and around Santiago de Cuba.
FZ	390	0	Private collection of difficult access because owner limits entrance. Specimens with reliable identifications. Its conservation is endangered because of conditions of storage.

Sotolongo *et al.* (1997) studied pollen in brood cells of *Xylocopa cubaecola* and, León and Sánchez (1998) identified the pollen collected by this bee, demonstrating its generalist foraging habits. Díaz and Vale (2001) studied the behaviour of this carpenter bee as a pollinator of the orchid *Encyclia phoenicea* (Lindl.) Neuman.

It is necessary to deepen studies on the natural history of Cuba’s endemic taxa, especially those that may illustrate phenomena of broad interest. For example, phylogenetic studies of several groups are important for biogeographical analyses. *Habralictellus* group of the genus *Lasioglossum*, could be of importance in understanding the origin of sociality in insects and species of this genus present different degrees of social organization (Wcislo 1997, Michener 1990). *Habralictellus* is endemic to the West

Indies (Eickwort 1988), and was behaviorally unknown until I (Genaro 2001*a*) found up to six females of *L. sierramaestrensis* Genaro sharing the parental nest. The amount of cooperation and reproductive status of each female are questions to investigate.

TABLE 2. Taxonomic keys for the identification of species of Cuban bees, in chronological order.

Author and year	Taxa	Geographic area embraced by the key
Cockerell (1905*a*)	*Megachile, Coelioxys*	Some Neotropical *Megachile* species including West Indian ones, and some *Coelioxys* spp. from all over the world including *C. rufipes* Guérin from Cuba.
Baker (1906)	*Lasioglossum* (*Dialictus*) *Agapostemon, Augochlora*	Cuba
Smith (1907)	*Ceratina*	North and Central America, including Cuba
Cockerell (1910*a*)	*Augochlora*	Cuba
Schwarz (1932)	*Melipona*	South and Central America, including Cuba
LaBerge (1956)	*Melissodes* (*Melissodes*)	North and Central America, including Cuba
LaBerge (1961)	*Melissodes* (*Eumelissodes*)	North and Central America, including Cuba
Michener (1966)	*Caupolicana* (*Alayoapis*)	North America and West Indies
Roberts (1972)	*Agapostemon*	Throughout the Americas, including West Indies
Timberlake (1980)	*Exomalopsis*	North America , including West Indies
Snelling (1990)	*Megachile* (*as Chalicodoma*) (*Chelostomoides*)	North America, including Cuba
Genaro (1997)	*Megachile* [*Chalicodoma group sensu Michener* (*2000*)]	Cuba
Genaro (1998*b*)	*Ceratina*	Cuba and Hispaniola
Genaro (1999)	*Triepeolus*	Cuba
Brooks (1999)	*Anthophora*	Wets Indies
Genaro (2003)	*Colletes*	Cuba

The honey bee, A. *mellifera*, is an introduced bee in the New World (Michener 2000). It has probably deeply influenced the natural populations of other species by competing with native bees for food sources (flowers). Studies have demonstrated that the honey bee influences the patterns of foraging of native bees by competing (Eickwort and Ginsberg 1980, Buchmann 1996, Engel 2001*b*, Goulson 2003, Buchmann and Ascher 2005).This is because honey bees are social and generalists, so that in a single field hundreds of individuals may be collecting nectar from a wide variety of flowers, and throughout the whole year. This effect has not been investigated in Cuba, where bee hives have been introduced for the production of honey and for pollination. Honey bee introduction has been done in many places, including protected areas (e.g. Caguanes National Park, Sancti Spiritus; Zapata Swamp National Park and Alejandro de Humbolt National Park, Guantánamo). The impact of beehives in natural areas on the populations of native Cuban bees remains unknown.

We lack quantitative data to evaluate the current status of the populations of Cuban insects and bees are no exception (and this should be a major concern). An endemic bee, *Megachile armaticeps* Cresson (Fig. 6) is on the list of the threatened species of the International Union for the Conservation of Nature (IUCN). It was proposed (Genaro 1998*c*) as vulnerable due to the fragmentation and loss of its habitat and possible competition with the introduced *Megachile lanata* (Fabr.), which has led to it having a small population restricted to a very few places.

FIGURE 6. *Megachile armaticeps* (female) showing facial projections. This charismatic species is the only Cuban bee listed in the International Union for the Conservation of Nature "Red Book" of endangered and threatened species. There is need for more study to clarify the threatened status of this bee.

Biogeography of West Indian bees

Many workers have interpreted the biogeographic composition of the Neotropical fauna of bees, and consequently that of Cuba. Michener (1979) examined the distribution of the main groups of bees of the world (at the level of genera and subgenera) and speculated on the historical and ecological explanations of such distributions. Michener (2000), with more current data, interpreted the world patterns of distribution of the bees. Eickwort (1988) analyzed the origin, dispersal and biology of the sweat bees (Halictidae) in the Antilles. This work is important because it comments on the group *Habralictellus* (as a genus), endemic to the Antilles, and proposed routes for its arrival in Cuba. Other authors, as parts of their taxonomic studies (e.g. LaBerge 1956, Camargo *et al*. 1988) have tried to explain the distribution of their groups. For Roberts (1972), the dispersion and evolution of the genus *Agapostemon* in the West Indies was rapid, since none of the species occurs in the neighbouring continents. Janjic and Packer (2003) cited that *Agapostemon* originated in Central America, from there colonized North and South America and penetrated the West Indies at different times, by way of emerged lands or continuous land masses (Iturralde-Vinent and MacPhee 1999).

In Hispaniola, amber (fossil resin) contains insects that have been trapped and among them are bees. This permits comparison of the present fauna with that of the Miocene (Iturralde-Vinent 2001). The Miocene amber fossils bear the character of the modern faunas (Engel 1995, Engel 1999, Grimaldi and Engel 2005). Keeping in mind current paleogeographic models (Iturralde-Vinent and MacPhee 1999) we can assume that much of that fauna was also present in Cuba.

The members of the tribe Euglossini, well-known as orchid bees, inhabit the tropics of America and have developed a remarkable behavior associated with the pollination of orchids (Roubik and Ackerman 1987). In Cuba, representatives of this tribe are absent, in spite of the presence of 305 species of orchids (Llamacho and Larramendi 2005). Two species of orchid bee occur in Jamaica: *Euglossa jamaicensis* Moure and *E. ignita* F. Smith (Moure 1967, Kimsey and Dressler 1986, Engel 1999). This reaffirms the different paleogeographic history of Jamaica, which was associated for a longer time with Central America (Iturralde-Vinent and MacPhee 1999), and thus was populated with species that have not dispersed to Cuba, in spite of its being relatively near but separated by deep sea. Engel (1999) considered that the genus *Euglossa* was, in the past, more widely distributed in the Caribbean than it is today with subsequent extinction occurring, after the Proto Antilles's land mass became fragmented, islands submerged and reconstituted, and effects of climate changes took place.

Local faunal lists

Due to the lack of multidisciplinary studies that inventory the biota of Cuban areas, the difficulty in identifying the material and the absence of taxonomists, very few local listings of bees exist. Invertebrates have always remained behind in such inventories and despite their importance bees are not exception. Among the better known local lists are those of Rohwer and Holland (1917) for the Isle of Youth (as the Isle of Pines); García *et al*. (1973) for the Jibacoa-Cayajabos area of Havana province; and Portuondo and Fernández (2004) for the Eastern Mountains. Fernández *et al.* (2002) offered preliminary data about the Hymenoptera of Granma province, including bees. Genaro (2004) presented a list of the bees from the Isle of Youth and found no endemics, presumably due to its paleogeographic history and land connections to Cuba during low sea levels in the Pleistocene.

Until now, the Africanized honey bee or "killer bee" has not arrived in Cuba, due to the islands's oceanic isolation and infrequent commerce with neighbouring regions, where it has already arrived. This bee, *Apis mellifera scutellata* Lepeletier, introduced to Brazil in

1956, has dispersed widely in a short time. Cuba has strict quarantine control to avoid its entrance. By 1995 it had appeared in the southwest of the United States, extending northward as far as mild winter temperatures permit its survival (Michener 1982, Taylor 1985, Flakus 1993). Its fame resides in its aggressiveness and propensity to attack en masse and, on occasion causing death to mammals, including humans.

Studies on bees which are producers of honey

The tendency exists, even in Cuba, to believe that the term "bee" includes only or mainly the honey bee (*Apis mellifera* L.) that produces honey and wax. However, this species was introduced to Cuba by the middle 1700's (Romay 1796, Díaz 1985, Bande 1996) whereas there are approximately 90 species of autochthonous bees (Alayo 1973, 1976, Genaro 2002).

The Beekeeping Experimental Station (Estación Experimental Apícola) in Havana, belongs to the Ministry of Agriculture. It has promoted and guided studies of *Apis mellifera* and to a lesser extent, *Melipona beecheii.* The two bees produce honey and consequently are of economic importance. There are numerous studies dedicated to *A. mellifera*: organized meetings (e.g. symposia on propolis and apitherapy), journals dedicated to the topic (e.g. Ciencia y Técnica Agrícola, series Apicultura); translated and published information on beehives, diseases, and breeding techniques. Studies carried out in Cuba range from morphometry to biomedicine (composition, antimicrobial properties and medical therapeutic properties of propolis); and components, properties and uses of honey, pollen, royal jelly and bee venom in the treatment of various illnesses (Díaz and Domínguez 1985, Asis 1989, Werthein 1993, Rodríguez *et al*. 1995, Frias *et al*. 2000).

The keeping of stingless bees in Cuba is growing. Colonies are being domesticated and placed near homes by isolated farmers, without any training. They bring feral colonies to their homes and put them inside an empty tree-trunk (usually a palm-trunk) in order to obtain the honey to sweeten foods. For such reasons wild colonies of *M. beecheii* are disappearing from natural areas. In the Yucatán peninsula of Mexico, *M. beecheii* is threatened by environmental changes and by inappropiate management and conservation efforts (Villanueva-G *et al*. 2005). The situation in Jamaica is similar, where this stingless bee species might become extinct (A. Raw, pers. comm., 2005).

Use of bees in the pollination of crops

Historically, beekeeping has been mainly concerned with the production of honey, wax and propolis, with the use of two introduced species: *A. mellifera* and *M. beecheii*. In Cuba, there is no tradition of using bees in pollination. Farmers do not generally understand the advantages of pollination by bees for the improvement of the yield of crops and for obtaining better seeds (Kremen *et al*. 2004, Ricketts *et al*. 2004).

The promotion of the use of bees to pollinate crops began in 1997 (León 1997). Until now, it has been used for watermelon (Hernández and Lemus 1996*a*, León and Rivero

1999) and pumpkin (Hernández and Lemus 1996*b*). The species used in pollination have been: *A. mellifera* on a wide scale; *Melipona beecheii* in a few cases; and *Xylocopa cubaecola* occasionally at the Beekeeping Experimental Station for pollinating pumpkins (A. León, pers. comm., 1999). Much of the use of bees as pollinators has been in greenhouses (León and Rivero 1999).

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