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Checklist and distribution patterns of apoid wasps (Hymenoptera: Apoidea: Sphecidae and Crabronidae) of Cuba

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Abstract

Information on Sphecidae and Crabronidae is summarized for Cuba and an updated checklist is presented, including distributional data. The following new records are presented: CUBA, *Nitela* sp. and five undescribed species of *Trypoxylon*; BAHAMAS (Eleuthera Island), *Oxybelus analis*; HISPANIOLA, *Podium fulvipes, O. analis* and *Trypoxylon orientinum*; JAMAICA, *T. orientinum*; MONA ISLAND, *T. orientinum* and *Bembix americana antilleana;* NAVASSA ISLAND, *Trypoxylon* n. sp. and *Tachysphex dominicanus*. *Tachytes antillarum* Cameron, 1906 is newly synonymized with. *T. tricinctus* (Fabricius, 1804). The native fauna of apoid wasps of Cuba is composed of 89 species and contains three elements: species endemic to Cuba (44.2%); species endemic to the West Indies and shared among various islands (30.6 %); and continental species whose distribution includes the West Indies (25.9 %).

Key words: Hymenoptera, Apoidea, Sphecidae, Crabronidae, Cuba, checklist, distribution patterns

Resumen

Se resume el conocimiento sobre las avispas de las familias Sphecidae y Crabronidae, para Cuba. Se presenta una lista actualizada, incluyendo las distribuciones conocidas. Se citan los siguientes registros nuevos: CUBA, *Nitela* sp. y cinco especies no descritas de *Trypoxylon*; BAHAMAS (Isla Eleuthera), *Oxybelus analis*; HISPANIOLA, *Podium fulvipes, O. analis* y *Trypoxylon orientinum*; JAMAICA, *T. orientinum*; ISLA DE MONA, *T. orientinum* y *Bembix americana antilleana;* ISLA NAVASSA, *Trypoxylon* n. sp. y *Tachysphex dominicanus*. El nombre *Tachytes antillarum* Cameron es confirmado como sinonimia menor de *T. tricinctus* Fabr. La fauna nativa de Spheciformes de Cuba estuvo compuesta por 89 especies y contuvo tres elementos: especies endémicas de Cuba (44.2 %); especies endémicas de Las Antillas y compartidas por varias islas (30.6 %); y especies continentales cuya distribución incluyó a Las Antillas (25.9 %).

Palabras clave: Hymenoptera, Apoidea, Sphecidae, Crabronidae Cuba, lista de especies, patrones de distribución

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Introduction

The West Indies possess a high level of biotic endemism. This, together with their complex geologic and paleogeographic history, has received much attention from biogeographers (Liebherr 1988, Wood 1989, Woods and Sergile 2001). Geologists and biologists have not yet achieved agreement in a unified biogeographic history of the West Indies, although progress has been achieved (Iturralde-Vinent and MacPhee 1999, Woods and Sergile 2001, MacPhee and Iturralde-Vinent 2000, 2003).

Two main models of historical biogeography have been proposed: i). Vicariance; the proto-Antillean biota connected with North and South America in the late Cretaceous, which was broken into fragments by movements of tectonic plates, to form the current biotas of each island, versus ii). Dispersion; the organisms dispersing individually over water and land during the Cenozoic, to arrive independently at each island (Iturralde-Vinent and MacPhee 1999, Woods and Sergile 2001, Janjic and Packer 2003, Coelho 2004).

In this paper I consider biogeography of the apoid wasps with special reference to the Cuban fauna. These wasps are a diverse paraphyletic group from which bees arose (Brothers 1995; Finnamore 1993, Melo 1999). They prey upon a wide variety of invertebrates and show elaborate behaviour that can include sociality (summarized by Bohart and Menke 1976, Matthews 1991). The Cuban sphecids *sl* are well studied due to the efforts of Pastor Alayo (sumarized in Alayo 1973, 1976). Names of Cuban species also appear in the catalogs of Amarante (2002, 2005) and Pulawski (2005). Amarante (2005) reported 74 species of sphecids *sl* (Crabronidae and Sphecidae) from Cuba.

The goals of this paper are to; i) clarify the taxonomic composition of apoid wasps in Cuba; ii) establish the number of species and degree of endemism; iii) compile a species checklist; iv) determine the distribution patterns of these wasps in the Cuban Archipelago; v) analyze the biogeographic affinities of the Cuban species with other Caribbean areas; and vi) propose origins and arrival modes for them in the West Indies.

Material and methods

This analysis is based on literature, examination of specimens in major insect collections in the United States, Cuba, Dominican Republic and Puerto Rico, and collecting by the author in Cuba (1984–2004), Dominican Republic (2002–2005), Mona Island (2000) and Puerto Rico (1993–2000, 2005).

The principal source of published distributional information is Bohart and Menke (1976), Amarante (2002, 2005) and an updated on-line catalog by Pulawski (2005). These were complemented with other publications that provided more detailed distributional data and/or revisions of taxa: *Ammophila* (Menke, 1970), *Sceliphron* (Porter 1926; van der Vecht and van Breugel 1968); Sphecinae (Bohart and Menke 1963), *Astata* (Parker 1967),

Bembix (Evans and Matthews 1968), *Bicyrtes* (Bohart 1996), *Hoplisoides* (Bohart 1997), Gorytini (Bohart 2000), Gorytini and Crabronini (Pate 1947*a* and *b*), Stizini and Bembicini (Parker 1929), *Ectemnius* (Leclercq 1972,1991,1999), *Oxybelus* (Bohart 1993), *Tachysphex* (Pulawski 1988), *Tachytes* (Bohart 1979), *Liris* (Krombein and Shanks Gingras 1984), *Trypoxylon* (Richards 1934, 1969), *Psen* (van Lith 1975), *Pluto* (van Lith 1979), Psenini (Pate 1946), *Cerceris* (Giner-Marí 1941; Ferguson 1984) and Philanthinae, Crabroninae and Nyssoninae (Alayo 1968*a* and *b*, 1969).

The following papers contain lists of species by geographic areas. NORTH AMERICA: Krombein *et al.* (1979); CUBA: Alayo (1973, 1976); ISLA DE LA JUVENTUD: Alayo (1982), Rohwer and Holland (1917); CAYMAN ISLANDS: Askew (1994); BAHAMAS: Krombein (1953), Elliott *et al* (1979), Elliott (1984); JAMAICA: Fox (1891), Gowdey (1926, 1928); MONA ISLAND: Ramos (1946), Snelling (1992), Torres and Snelling (1992); GUANA ISLAND and VIRGIN ISLANDS: Snelling (1992; 1993*a* and *b*); PUERTO RICO: Wolcott (1951); DOMINICA: Evans (1972); GRENADA and GRENADINES: Woodruff *et al*., (1998); TRINIDAD: Starr and Hook (2003); WEST INDIES: Ashmead (1900). Other sources that contributed information about distributions are: Bohart (1993*b*), Genaro (1995), Genaro *et al.* (1995) and Ohl (1996). The West Indian geographic areas studied are showed in Fig. 1

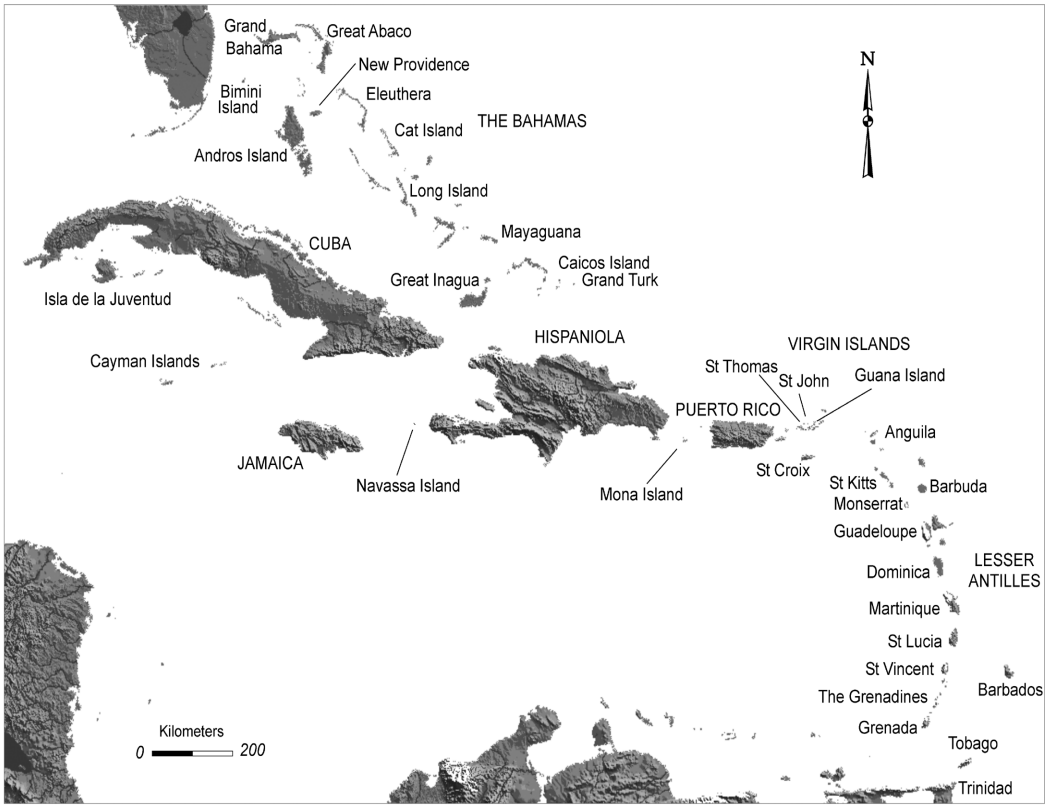

FIGURE 1. Map of the West Indies showing islands.

I visited the following institutions to study their collections. Institutional abbreviations are used in the text: Museo Nacional de Historia Natural de Cuba (MNHNCu); Instituto de Ecología y Sistemática, Ciudad de La Habana, Cuba (IESC); Florida State Collection of Arthropods, Gainesville (FSCA); Academy of Natural Sciences of Philadelphia (ANSP); American Museum of Natural History (AMNH); Museum of Comparative Zoology, Harvard University (MCZC); United States National Museum of Natural History (USNM); Snow Entomological Museum of the Natural History Museum, University of Kansas (SEMC); Canadian National Collection of Insects, Arachnids and Nematodes, Biosystematics Research Institute Ottawa (CNCI), Museo Nacional de Historia Natural de Santo Domingo, Dominican Republic (MHND); Museo de Entomología y Biodiversidad Tropical of the University of Puerto Rico (MEPR) and the Packer collection at the Department of Biology, York University.

The systematic arrangement used here follows Pulawski (2005). Species belonging to the following genera were not included in the percentage endemism analyses because they are only determined to genus level: *Spilomena*, *Stigmus* and *Nitela.*

Results

Annotated species list of Sphecidae and Crabronidae of Cuba

Family SPHECIDAE

Tribe Sceliphrini

1. *Podium tau* (Dalla Torre, 1897). = *Podium* sp A (Alayo 1976). Hispaniola and Cuba.

2. *Podium fulvipes* Cresson, 1865. USA (Florida), Cuba, Isla de la Juventud, Hispaniola (First record) and Mexico.

First records. HISPANIOLA, Dominican Republic, 8 Km S. Oviedo, Provincia Pedernales, vi.1986, colls. R. Miller and L. Stange (female, FSCA); 21 Km N Cabo Rojo, Provincia Pedernales, 20.vi.1976, colls. E. E.Grissell and E. Marcano (female, FSCA); near Filipinas, Larimar mine, Provincia Barahona, 26.vi.–7.vii.1992, colls. R. E. Woodruff and P. E. Skelley (male, FSCA); Cabarete Cave, Puerto Plata, 27.vi.1993, coll. R. E. Woodruff (female, FSCA).

3. *Sceliphron (Sceliphron) assimile* (Dahlbom, 1843). USA (Texas), Mexico to Panama, Cuba, Isla de la Juventud, Jamaica, Puerto Rico, Guana Island, Mona Island, St. Martin, St. Kitts and Montserrat.

4. *Sceliphron (Sceliphron) jamaicense* (Fabricius, 1775). =*S. annulatus* (Cresson, 1865).

Mexico, Cuba, Isla de la Juventud, Little Cayman, Bahamas (Long Island, Cat Island, New Providence Island, South Bimini Island, San Salvador Island), Hispaniola and Jamaica

5. *Sceliphron (Sceliphron) argentifrons* (Cresson, 1865). Cuba.

Tribe Sphecini

6. *Sphex cristi* Genaro, 2000. Cuba

7. *Sphex jamaicensis* (Drury, 1770). =*S. auriflua* Perty, 1833, =*S. lanierii* Guérin, 1844, =*S. fulviventris* Kohl, 1890. USA (Florida), Cuba, Isla de la Juventud, Little Cayman, Bahamas (San Salvador Island, Bimini Island) and Jamaica.

8. *Sphex cubensis* (Fernald, 1906). =*S. clavipes* Kohl, 1890, =*S. lanieri* Cresson, 1865. Cuba and Isla de la Juventud.

9. *Sphex dorsalis* Lepeletier de Saint Fargeau, 1845. =*S. singularis* F. Smith, 1856, =*S. dubitata* Cresson, 1872. USA (Florida to New Mexico), Mexico, Central America, Cuba, Jamaica, Hispaniola, Mona Island, Puerto Rico, Guana Island, St. Martin, St. Vincent, Guadalupe, Dominica, Trinidad, Brazil and Argentina.

10. *Sphex mandibularis* Cresson, 1869. Cuba and Hispaniola.

11. *Isodontia poeyi* Pate, 1948. Cuba and Isla de la Juventud.

12. *Isodontia bruneri* (Fernald, 1943). Cuba.

13. *Prionyx thomae* (Fabricius, 1775). North America, Mexico, Nicaragua, Panama, Cuba, Isla de la Juventud, Little Cayman, Bahamas (San Salvador Island), Jamaica, Hispaniola, Mona Island, Puerto Rico, Guana Island, St. Thomas, St. Vincent, Trinidad, Guyana, Venezuela, Colombia, Ecuador, Chile, Uruguay, Paraguay, Brazil and Argentina.

Tribe Ammophilini

14. *Ammophila apicalis* Guérin-Méneville, 1835. =*A guerinii* Dalla-Torre, 1897. Cuba, Isla de la Juventud, Bahamas (Long Island) and Jamaica.

15. *Ammophila cybele* Menke, 1970. Cuba.

Family CRABRONIDAE

Subfamily Astatinae

16. *Astata unicolor* Say, 1824. = *A. insularis* Cresson 1865, =*A. rufiventris* Cresson, 1872. North America, Mexico to El Salvador, Cuba and Jamaica.

Subfamily Bembicinae

Tribe Alyssonini

17. *Didineis aculeata* (Cresson, 1865). Cuba.

Tribe Nyssonini

18. *Epinysson orientalis* (Alayo, 1969). Cuba and Isla de la Juventud.

19. *Zanysson armatus* (Cresson, 1865). Cuba and Isla de la Juventud.

Tribe Bembicini

20. *Clitemnestra bipunctata* (Say, 1824). = *Ochleroptera jamaica* Pate. USA, Mexico (Sonora, Chihuahua, Sinaloa, Morelos, Puebla, Mexico DF, Coahuila, Durango, Baja California Sur, Zacatecas), Guatemala, El Salvador, Costa Rica, Cuba, Jamaica and Venezuela.

21. *Sphecius hogardii* (Latreille, 1809). USA (Florida, Key West), Cuba, Isla de la Juventud, Bahamas (Eleuthera, North and South Bimini Island), Hispaniola and Jamaica.

22. *Hoplisoides ater* (Gmelin, 1790). =*H. scitulus* (Cresson, 1865), = *H. tricinctus* (Fabricius, 1775). Cuba, Bahamas (Providence Island), Puerto Rico, Virgin Gorda Island and Guana Island.

23. *Hoplisoides jibacoa* (Alayo, 1969). Cuba.

24. *Hoplisoides jaumei* (Alayo, 1969). Cuba.

25. *Hoplisoides insularis* (Cresson, 1865). Cuba and Isla de la Juventud.

26. *Hoplisoides xerophilus* Alayo, 1969. =*H. confusus* (Alayo, 1969). Cuba.

27. *Bicyrtes spinosus* (Fabricius, 1794). =*B. dissecta* (Cresson, 1865). USA (Florida), Cuba, Isla de la Juventud, Hispaniola, Mona Island, Puerto Rico, St Thomas, Guana Island, Ecuador and Panama.

28. *Microbembex argentifrons* (Cresson, 1865). Cuba, Bahamas (Bimini Island) and Jamaica.

29. *Microbembex cubana* R. Bohart, 1976. =*M. armata* (Cresson, 1865). Cuba, Isla de la Juventud, Bahamas (Staniel Key).
The Antillean species of *Microbembex* are in need of revision in order to determine the correct species that occur on each island.

30. *Stictia signata* (Linnaeus, 1758). =*Apis vespiformis* DeGeer, 1773, =*Monedula insularis* Dahlbom, 1844. Florida to Argentina, Cuba, Isla de la Juventud, Cayman Island, Bahamas, Jamaica, Hispaniola, Mona Island, Puerto Rico, Guana Island, St. Vincent, St. Kitts, Grenada, Dominica, Guadalupe and Trinidad.

31. *Bembix americana* Fabricius, 1793. =*B. muscicapa* Handlirsch, 1893, =*B. separanda* Handlirsch, 1893, =*B. foxi* J. Parker, 1917. North America, Mexico, Cuba, Isla de la Juventud, Bahamas (Cat Island, Crooked Island, Long Island, South Bimini Island), Grand Cayman Island, Jamaica, Hispaniola, Mona Island (First record), Guana Island, Anegada Island, Puerto Rico, St. Thomas and St. Croix. Several subspecies of *B. americana* (a widely distributed taxon) were described by Evans and Mattews (1968). The taxon *B. americana antilleana* occurs in Cuba, Cayman islands, Bahamas, Jamaica and Hispaniola.

First record. MONA ISLAND, 13–16.ix.2000, colls. M. A García and J. A. Genaro (1 male, 2 females, MNHNCu).

Subfamily Crabroninae

Tribe Crabronini

32. *Rhopalum claviventre* (Cresson, 1865). Cuba.

R. claviventre was mentioned from Dominica (Evans 1972) based on one specimen that still has not been compared with the holotype. A previous record of *R. claviventre* for Grenada (Ashmead 1900) actually refers to another species: *R. grenadinum* (Pate) (Pate 1947*a*). Gowdey (1926) recorded it from Jamaica but according to Pate (1947*a*), who never examined the material, it may be another species. Until more specimens are studied I prefer to cite this species only for Cuba. It is clear that the genus is widely distributed in the Antilles, but its presence in collections is rare (Leclercq 2002). More material is needed for a better understanding of the species that occur on each island.

33. *Rhopalum soroanum* (Alayo, 1968). Cuba.

34. *Rhopalum montanum* (Alayo, 1968). Cuba.

35. *Rhopalum antillarum* Leclercq, 1957. Cuba, Ecuador and Venezuela. Described from one specimens labelled Cuba, still it is question by its author about the veracity of the label data (Leclerq 2002). Alayo (1976) never collected it. Specimens studied by Leclerq (2002) from Ecuador and Venezuela vary in coloration.

36. *Ectemnius (Apoctemnius) craesus* (Lepeletier and Brullé, 1835). Cuba, Jamaica, Hispaniola, Mona Island, Guana Island and Puerto Rico.

37. *Ectemnius (Hypocrabro) auriceps* (Cresson, 1865). Cuba and Bahamas (San Salvador Island).

38. *Ectemnius paluster* Alayo, 1968. Cuba.

39. *Ectemnius ferrasi* Alayo, 1968. Cuba.

40. *Ectemnius (Merospis) cyanauges* Pate, 1941. Cuba.

41. *Lestica (Solenius) cubensis* (Cresson, 1865). Cuba and Isla de la Juventud.

Tribe Oxybelini

42. *Oxybelus analis* Cresson, 1865. Cuba, Isla de la Juventud, Bahamas [Bimini Island, Eleuthera Island (First record)], Hispaniola (First record), Grenada, St. Martin, Bermuda and Nicaragua.

The records from Bermuda and Nicaragua by Bohart and Menke (1976) do not appear in Bohart (1993). First records. HISPANIOLA, Dominican Republic, La Descubierta, Lago Enriquillo, Provincia Barahona, xii.2004, coll. J. A. Genaro (1 female, JAG). BAHAMAS, Eleuthera Island, Rainbow Bay, 1.vii.1987, colls. D. B. and R. W. Wiley (1 male, CNCI).

43. *Oxybelus confusus* Alayo, 1968. Cuba.

Tribe Miscophini

44. *Lyroda antillana* Genaro and Portuondo, 2001. Cuba and Hispaniola.

45. *Nitela* sp.

First record: CUBA, Siboney, Santiago de Cuba, iii.1998, coll. A. Barrientos, yellow

pan (female, BIOECO; male lost); same data but collected: x.1997 (male, BIOECO); same data but collected: viii.1998 (female, BIOECO).

46. *Solierella sola* Genaro and Portuondo, 2001. Cuba.

Tribe Larrini

47. *Tachytes tricinctus* (Fabricius, 1804). = *T. antillarum* Cameron, 1906 **new synonymy;** =*T. cubensis* Cresson, 1865. Cuba, Bahamas (San Salvador Island), Guana Island, Mona Island and St. Thomas. Alayo (1976) suspected this synonymy. The original description of the male of *T. antillarum* (in Spanish) is sufficiently detalled to permit identify the species.

48. *Tachytes chrysopyga* (Spinola, 1841). = *T. insularis* Cresson, 1865. North America, Cuba, Isla de la Juventud, Jamaica, Guana Island, Mona Island, Puerto Rico, St. Thomas, St. Vincent, St. Lucia, Grenada, Dominica, Trinidad, Mexico to Argentina. The subspecies *T. chrysopyga argentipes* F. Smith occurs in the Caribbean area (Bohart 1979).

49. *Tachytes distinctus* F. Smith, 1856. USA, Cuba, Bahamas (North Bimini Island), Jamaica, Hispaniola, Mona Island, Puerto Rico, Mexico, Brazil and Argentina. Alayo (1973, 1976) mentioned it as a variety, with doubt, of *T. tricinctus.* Genaro (2004) wrote about the proper systematic status of the Cuban taxon and recorded it for the first time for the island.

50. *Tachysphex cubanus* Pulawski, 1974. Cuba and Jamaica.

51. *Tachysphex dominicanus* Pulawski, 1988. Cuba, Hispaniola; Navassa Island (First record).

First records. NAVASSA ISLAND, Antillas, 5.v.1999, coll. S. Navarro (female, CAS); ruins near Lulu Bay, 22 m. 18°23.75'N 75°01.07'W, 25.vii–3.viii.1998, W. E. Steiner, J. M. Swearinger *et al* colls, yellow pan traps on open weedy flats of lower terrace, limestone and red oolitic soil near coastal cliff (3 females, USNM); south part of RR trench, 72 m. 18°23.78'N, 75°00.85'W, 25.vii–4.viii.1998, W. E. Steiner, J. M. Swearinger *et al* colls, yellow bowl pitfall traps in red oolitic soil, open mixed forest with exposed limestone and patchy leaf litter (2 males, USNM).

52. *Tachysphex antillarum* Pulawski, 1974. Cuba, Isla de la Juventud and Puerto Rico.

53. *Tachysphex apicalis* W. Fox, 1893. =*T. fumipennis* Fox, 1893. North America, Mexico, Cuba and Hawaiian Islands.

54. *Tachysphex alayoi* Pulawski, 1974. USA (Florida), Bahamas (Eleuthera, Great Sale

Cay, San Salvador Island), Cuba, Isla de la Juventud, Little Cayman, Hispaniola, Mona Island, Jamaica, Guana Island, Puerto Rico and Virgin Islands.

55. *Liris fulviventris* (Guérin-Méneville, 1845). Cuba, Jamaica and St. Vincent Island

56. *Liris labiatus* (Fabricius, 1793) = *L. ignipennis* (F. Smith, 1856). Cuba, Hispaniola, Guana Island, Puerto Rico, Dominica and Barbados.

57. *Liris trifasciatus* (F. Smith, 1856). Cuba, Hispaniola, Puerto Rico and St. Vincent.

58. *Liris fuliginosus* (Dahlbom, 1843) = *L. vinulenta* (Cresson, 1865), *L. dahlbomi* (Cresson, 1865). USA (Florida), Mexico to Guatemala, Cuba, Isla de La Juventud, Jamaica, Guana Island, Puerto Rico, St. Vincent, Grenada and Dominica.

59. *Liris luteipennis* (Cresson, 1869). Cuba, Puerto Rico, St. Vincent and Grenada.

60. *Liris argentatus* (Palisot de Beauvois, 1811). =*L. murina* (Dahlbom, 1843). North America, Cuba, Bahamas (San Salvador Island). St. Martin Island and Venezuela.

61. *Liris antilles* Krombein, 1953. Cuba, Isla de la Juventud and Bahamas (South Bimini Island, San Salvador Island).

62. *Liris muspa* (Pate, 1943). USA (Texas, Florida) and Cuba.

Tribe Trypoxylini

63. *Trypoxylon* (*Trypargylum*) *subimpressum* F. Smith, 1856. =*T. excavatum* Cresson, 1865. Cuba, Isla de la Juventud and Hispaniola. A record from Grenada (Woodruff *et al*., 1998) needs confirmation because related species are very similar morphologically and it represents an otherwise extralimital.

64. *Trypoxylon* (*Trypargylum*) *cubense* Richards, 1934. Cuba.

65. *Trypoxylon* (*Trypargylum*) *mayri* Richards, 1934. Cuba.

66. *Trypoxylon* (*Trypoxylon*) *succinctum* Cresson, 1865. Cuba and Grand Cayman Island.

67. *Trypoxylon* (*Trypoxylon*) *orientinum* Richards, 1969. Cuba; Jamaica, Hispaniola and Mona Island.

First records. JAMAICA: Trelawny. Duncans, 23.viii.1966, colls. Howden and Becker (2 females, CNCI); HISPANIOLA, Dominican Republic, Los Ríos, Lago Enriquillo,

Provincia Independencia, 25.v.1985, colls. R. Miller and L. Stange (1 female, FSCA); Río Chacón, near El Naranjo, Provincia La Altagracia, 6.vi.1986, colls. R. Miller and L. Stange (1 male, FSCA); Parque Nacional Jaragua, Provincia Pedernales, xi.2003, coll. J. A. Genaro (1 female, JAG); La Herradura, Santiago, 26.i.1966, coll. E. J. Marcano (1 male, USNM); MONA ISLAND, 11–31.viii.1944, coll. H. A. Beatty (2 females, USNM); Los Cerezos, 18.xi.1955, (4 females, USNM); 14.ix.2000, coll. J. A. Genaro (11 females, 1 male MNHNCu, CNCI), near La Bajura around 60 females were observed coming to pools of water to collect mud.

68. *Trypoxylon* (*Trypoxylon*) n. sp. 1. Bahamas, Cuba, Hispaniola (Dominican Republic) and Navassa Island. Numerous specimens were collected during a 1998 expedition to Navassa Island, demonstrating that it was common.

69. *Trypoxylon* (*Trypoxylon*) n. sp. 2. Cuba and Jamaica

70. *Trypoxylon* (*Trypoxylon*) n. sp. 3. Cuba

71. *Trypoxylon* (*Trypoxylon*) n. sp. 4. Cuba

72. *Trypoxylon* (*Trypoxylon*) n. sp. 5. Cuba

Subfamily Pemphredoninae

Tribe Pemphredonini

73. *Spilomena* sp.

74. *Stigmus* sp. 1

75. *Stigmus* sp. 2

Tribe Psenini

76. *Pseneo garcesii* Genaro and Alayo, 2001. Cuba.
77. *Pseneo collantes* Genaro and Alayo, 2001. Cuba.

78. *Psen (Psen) venetus* Pate, 1946. Cuba.

79. *Mimumesa longicornis* (W. Fox, 1898). =*Psen floridana* Rohwer, 1910; =*Mimesa striatus* Viereck, 1901. North America (Canada, New York to Florida, Louisiana, Iowa), Central America and Cuba.

80. *Pluto arenivagus* Krombein, 1950. USA (Florida, Georgia and North Carolina) and Cuba.

The subspecies *P. arenivagus cubanus* van Lith, 1979 occurs in Cuba.

81. *Pluto argentifrons* (Cresson, 1865). Cuba, Jamaica, Mexico and Nicaragua.

Subfamily Philanthinae

Tribe Philanthini

82. *Philanthus banabacoa* Alayo, 1968. Cuba.

Tribe Cercerini

83. *Cerceris flavocostalis* Cresson, 1865. Cuba and Isla de la Juventud.

84. *Cerceris triangulata* Cresson, 1865. =*C. bilunata* Cresson, 1865. Cuba and Isla de la Juventud.

85. *Cerceris trinitaria* Alayo, 1968. Cuba.

86. *Cerceris festiva* Cresson, 1865. =*C. gratiosa* Schletterer, 1887. Cuba and Isla de la Juventud.

87. *Cerceris cubensis* Cresson, 1865. =*C. zonata* Cresson, 1865. Cuba, Isla de la Juventud and Bahamas (San Salvador Island).

88. *Cerceris hatuey* Alayo, 1968. Cuba.

89. *Cerceris cerverae* Giner-Marí, 1941. Cuba.

Discussion

Origin and occupation of the Antilles

The islands of the Greater Antilles, as habitats with conditions proper to support terrestrial life, are not older than the Middle Eocene (~40 my) (Iturralde-Vinent and MacPhee 1999, MacPhee and Iturralde-Vinent 2000, Penney 2005). Earlier islands must have existed, but due to repeated marine transgressions, subsidence and the K/T bolide impact and associated mega-tsunamis they were unlikely to be continuously subaerial

(emerged) entities (Iturralde-Vinent and MacPhee 1999). From the Eocene-Oligocene transition (35–33 ma) to the Middle Miocene (16 my–14 my) the subaerial exposure of land within the Caribbean basin was extensive. According to Iturralde-Vinent and MacPhee (1999) and MacPhee *et al*. (2003) a subaerial connection (whether continuous or punctuated by water gaps) called GAARlandia (Greater Antilles Ridge+Aves Ridge), connected Northwestern South America with larger land masses emergent on these ridges.

For these reasons, the West Indian terrestrial fauna is young. Amber deposits (from resin produced by the tree *Hymenaea protera* Poinar, Leguminosae) in the Dominican Republic contain insect fossils of high quality. The amber is estimated to be 15–20 my of age (Iturralde-Vinent and MacPhee 1996; Iturralde-Vinent 2001). Studies of the amber bees, ants and wasps suggest that the faunal representation is very similar to today's fauna, and assignable to modern genera or to extinct genera closely related to present day ones (Wilson 1985, 1988, Prentice and Poinar 1993, Engel 1995, 1997). Among the Dominican Republic amber ants, many genera became extinct and were substituted by others in later colonisations (Wilson, 1985, 1988). The late Quaternary climatological changes (mean temperature and humity, rainfall and variations in mean sea level) (Curtis *et al*. 2000, Iturralde-Vinent 2003) that affected the islands should also have affected the biota, including the wasps.

Ancestors of Cuban Sphecidae and Crabronidae originated outside of Cuba (in continental land masses) and dispersed to Cuba, through flight, or by wind (possibly hurricanes for the smaller ones like *Oxybelus*, *Nitela*, *Stigmus*). Once the species were within the present vicinity of Cuba, vicariance events may have had an influence in the formation of the current faunas of each island, although dispersion may be acting always. Vicariance (island-island) may have occurred when Caribbean neotectonism resulted in the subdivision of existing land areas (Iturralde-Vinent and MacPhee, 1999; MacPhee and Iturralde-Vinent, 2000), isolating populations of wasps that proceeded to evolve independently. For example, Cuba itself was composed of three separate large archipelagos in the Early Miocene (MacPhee *et al*., 2003).

There are three dispersal routes by which the Proto-Antilles could have received fauna since the Middle Eocene (Fig. 2): 1. From Florida (crossing the water gap between the neighbouring land masses; and, after the Bahamas emerged, by using them as stepping stone islands). 2. From Mesoamerica (from Yucatan, over the water gap from the close land mass; and by using the Nicaragua rise, in the late Oligocene-Middle Miocene by flight and use of stepping stones islands). 3. From Northern South America via GAARlandia, at the latest in the Eocene-Early Oligocene, by flight and use of stepping stone islands.

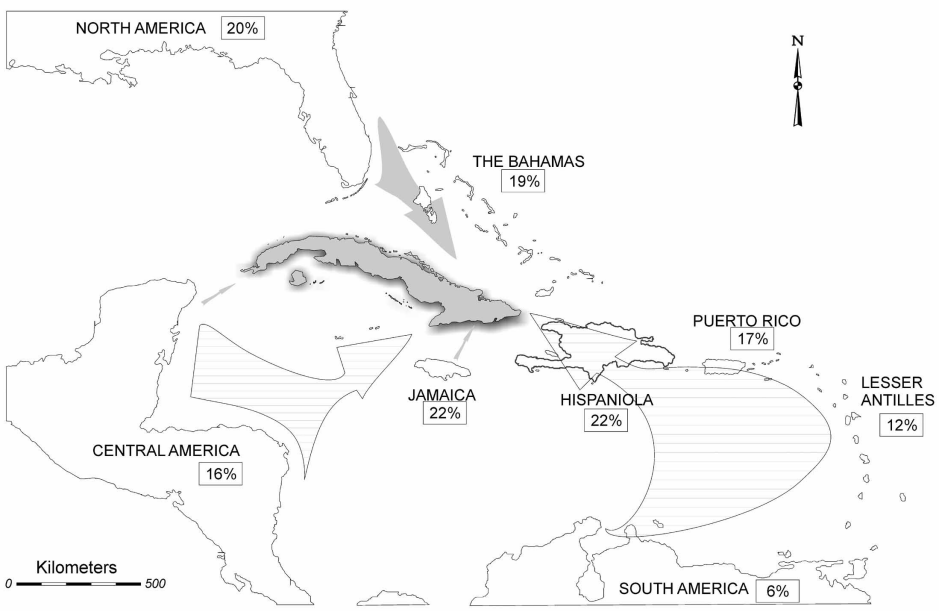

FIGURE 2. Probable dispersal routes for Sphecidae and Crabronidae into the West Indies through alternative scenarios. Stippled arrows show major dispersal corridors for the occupation of the Proto-Antilles, at about 35–33 mya. Percentages are for Cuban species shared with other areas.

The power of dispersion of the wasps from one island to another can be demonstrated by the species on Mona (64 km²) and Navassa (5.2 km²) Islands. Mona emerged much later (Pliocene or early Pleistocene) than the nearest lands that surround them (Smith *et al* 1994). Navassa was on its own tectonic plate and although its age as an emerged island is uncertain, it may have formed as a small coral atoll at the close of the Miocene Period about 5 million years ago, when these reefs began to emerge (W. Steiner and G. Alayón, pers. comm., 2006). Both oceanic islands entirely lacked any type of terrestrial connection (Burne *et al*. 1974, Peck and Kukalova-Peck 1981; Smith *et al* 1994), but they contain elements of the fauna of their nearest islands (Mona Island to Puerto Rico (42 miles) and Hispaniola (37 miles), and Navassa Island to Cuba (100 miles), Jamaica (70 miles) and Hispaniola (35 miles).

Composition of the apoid wasp fauna of Cuba

The native fauna of apoid wasps of Cuba consists of 89 species, grouped in 36 genera and two families: Sphecidae (15 spp) and Crabronidae (74 spp). The Crabronidae is composed of Astatinae (1 sp), Bembicinae (15 spp), Crabroninae (41 spp), Pemphredoninae (9 spp) and Philanthinae (8 spp). The genera with the largest number of species (and their percentage endemism) are: *Trypoxylon*, 10 (50%); *Liris*, 8 (0%); *Cerceris*, 7 (85.7%); *Hoplisoides*, 5 (80%); *Sphex*, 5 (40%); *Ectemnius*, 5 (60%) and *Tachysphex*, 5 (0%). The families Heterogynaidae and Ampulicidae do not ocur in Cuba.

There are two continental genera, *Trachypus* and *Chalybion*, that do not occur in Cuba. *Trachypus* is present in Hispaniola and Puerto Rico, with one species (*T. gerstaeckeri* Dewitz). The species of *Chalybion* that lives in Hispaniola (*C. zimmermanni* Dahlbom) is distributed throughout most of the United States (except Florida and a few other states), Mexico to Costa Rica.

Cuba shares the largest number of species with Hispaniola and Jamaica (22%), and with the North American continental land mass (20 %, Fig. 2). The West Indian distribution of many species is patchy and uneven. Further sampling throughout the Bahamas, Hispaniola and the Lesser Antilles will likely prove that many of the Cuban species are more widely distributed, and that the Cuban and Hispaniolan faunas are even more similar.

Of all Cuban Sphecidae *sl*.; *Prionyx thomae, Sphex dorsalis, Tachytes chrysopyga* and *Stictia signata* have the largest parts of their ranges outside of Cuba.

Distribution within the Cuban Archipelago

Any analysis of the distribution patterns of the apoid wasps will be incomplete without keeping in mind the historical background. Their distribution is still not fully documented and the current ecosystems of Cuba are not the same as those of the past. Nevertheless, some protected natural areas exist in Cuba and some are little-altered and their wasp fauna may not have been badly impacted by human activities. The information contained in historical collections is also of help.

The keys (offshore islands) of the Cuban Archipelago have not been well surveyed (except for the Sabana-Camagüey Archipelago) and the poorly sampled mountainous areas almost certainly contain unknown species. Additional field work will increase the sample size of species known from few specimens. The study of the fauna of the keys that surround Cuba is of interest because these sites may be faunal exchange areas from which species disperse to (or from) the main island.

The restricted distribution of some species like *Cerceris trinitaria, Cerceris hatuey* or *Oxybelus confusus* (each recorded from one or two localities only, Fig. 3) probably reflects limited sampling effort or infrequent use of innovative collecting methods such as yellow pan traps, Malaise traps and flight interception traps. Their actual distribution may be much larger, not limited by ecological conditions that restrict endemic species, as is the case with many terrestrial gastropod molluscs in Cuba (Espinosa and Ortea 1999). It is necessary to keep in mind that fragmentation and loss of habitats due to human activities have impacted the distribution of many species and Cuba is not an exception in this.

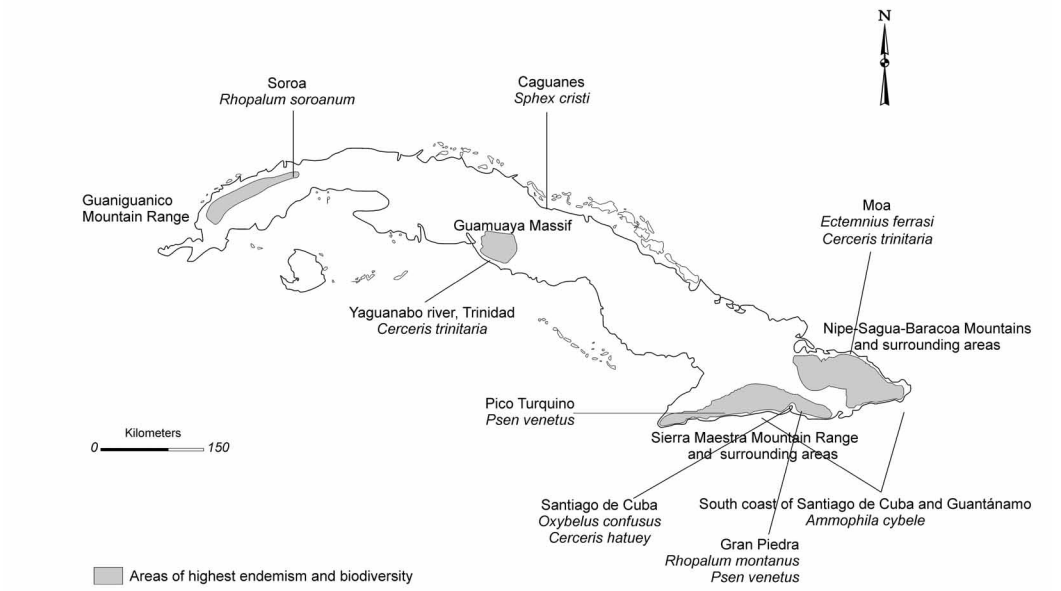

FIGURE 3. Map of Cuban areas of highest endemism and biodiversity, and only known localities for some species of apoid wasps.

The power of dispersal of wasps should be high, since they fly and readily colonize new areas (Evans 1975). However, some species have limited distributions because they are adapted to specific habitat conditions (nesting place, sources of nectar, availability of prey, or particular needs for temperature and humidity) (Evans 1966, Bohart and Menke 1976). Almost half the Cuban species (44.2 %) are endemic to the Cuban Archipelago. One example is *Ammophila cybele*, which is restricted to xeric areas in the south of the eastern provinces of Santiago de Cuba and Guantánamo. This wasp (with a body length of around 20 mm) and with a distinctive provisioning behavior (it provisions its nests with butterfly larvae and nests in bare ground as do other species of the genus) might yet be found in other places. *Sphex cristi*, a rare, big black wasp (around 30 mm in length), with orange wings, was recently discovered at Caguanes, Sancti Spiritus, Cuba (Fig. 3). This species is known only from females, which were observed nesting at the edge of big caves in this area (Genaro and Juarrero 2000).

The limited distributions of some species, such as *Oxybelus confusus* and *Cerceris hatuey* from around Santiago de Cuba (Fig. 3), could be an artifact of limited collecting effort. It is known that Pastor Alayo, an able entomologist and great collector, spent a lot of time exploring the Santiago de Cuba area, increasing the proportion of rare or new species there.

Among the species known from very few localities (Fig. 3) and for which more sampling should increase their geographic range in Cuba the following can be mentioned

Cerceris trinitaria (from the mouth of the Yaguanabo river, Trinidad and Moa, Holguín), *Rhopalum soroanum* (from Soroa, Pinar del Río), *R. montanus* (from Gran Piedra, Santiago de Cuba), *Ectemnius ferrasi* (from Moa, Holguín) and *Psen venetus* (from Gran Piedra and Pico Turquino).

The main Cuban mountainous regions of the East (Nipe-Sagua-Baracoa mountains and Sierra Maestra Mountain Range), Center (Guamuaya mountains) and West (Guaniguanico Mountain Range) contain the highest biodiversity and endemism of apoid wasps (Fig. 3). Some species of *Rhopalum*, *Cerceris*, *Psen*, *Pseneo*, *Hoplisoides* and *Trypoxylon* (four undescribed species) are known only from these areas. These mountains have well preserved habitats and suitable conditions for nesting in the ground or inside cavities, and with suitable availability of prey.

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