

Records and Distribution of New World Phlebotomine Sand Flies (Psychodidae, Diptera), With Special Emphasis on Primary Types and Species Diversity

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ABSTRACT

This article includes the records and distribution of Phlebotomine sand flies (Psychodidae, Diptera) in the New World based on the specimen collections housed in 2 repositories, the US National Museum of Natural History and the Museum of Entomology, Florida State Collection of Arthropods. Approximately 128 species have primary types housed in the 2 repositories, including holotypes (47 species, 3 subspecies), "types" (7 species), allotypes (52 species, 6 subspecies), lectotypes (4 species), paratypes (93 species, 10 subspecies), and neoallotype (1 species), mounted on slides, with a total of 1,107 type slides. For species diversity, collection data from 24 countries in the sand fly database were analyzed according to the number of species present, specimen records, decade of collections, and countries where collections were conducted.

Phlebotomine sand flies (Subfamily Phlebotominae, Family Psychodidae, Order Diptera) are of major health importance because they are capable of transmitting pathogens, including protozoans (*Leishmania*), bacteria (*Bartonella*), and viruses (Phleboviruses, sand fly fever).¹ Like mosquitoes, only female sand flies, particularly species of *Phlebotomus* and *Lutzomyia*, suck blood, including humans. Species of *Sergentomyia* species primarily feed on reptiles, and rarely bite man.² Of approximately 900 sand fly species, only about 70 species are capable of transmitting protozoan *Leishmania* parasites that cause visceral leishmaniasis (kala-azar) and various forms of cutaneous leishmaniasis (oriental sore, espundia, etc.) in man.^{3,4} A few sand fly species have been associated with Phlebovirus and other viruses,³⁻⁶ and only one, *Lutzomyia verrucarum* (Townsend) *sensu lato*, can transmit the bacterium *Bartonella bacilliformis* (Strong, Tyzzer, Brues, Sellards and Gastiaburu) causing bartonellosis (Oroya fever, Carrion's disease) in the Andean Region of South America.^{7,8} Ready⁹ reviewed the biology of Phlebotomine sand flies as vectors of disease agents, including the transmission cycles of human leishmaniasis both in the Old and New Worlds, mostly in rural communities. Additional Phlebotomine reviews also focused on sand fly biology,¹⁰ and emphasis on leishmaniasis control.¹¹

Leishmaniasis has a great impact on military operations, particularly those of the United States.¹² Since

World War II, more than 1,000 US service personnel were infected with cutaneous leishmaniasis.¹³ In Afghanistan (Operation Enduring Freedom, OEF) and Iraq (Operation Iraqi Freedom, OIF), more US soldiers have been exposed to significant leishmaniasis risk than any time since World War II. During the disease surveillance period from 2001-2006, there were 1,287 incident diagnoses/reports of leishmaniasis, both cutaneous (1,283 cases) and visceral (4 cases) forms, among OEF/OIF deployers.¹³ Furthermore, in an effort to establish the Leishmaniasis Control Program (LCP) during OIF, US military entomologists conducted comprehensive phlebotomine sand fly surveillance at Tallil Air Base (TAB), Iraq from April 2003-November 2004. They determined the biology and temporal distribution of sand flies at TAB, and noted the impact of sand fly vectors on military operations, including the leishmanial threat to deployed troops in Iraq.¹⁴⁻¹⁶

The phlebotomine sand flies are found between 50°N and 40°S, with the majority distributed in the tropics and subtropics, and none reported on Pacific Islands or in New Zealand. In the Old World, the anthropophilic *Phlebotomus* sand flies (and principally Leishmaniasis transmission) are confined in the subtropics (particularly in dry, semiarid areas), with a few human biting species in Africa south of the Sahara and none in Southeast Asia (although *Phlebotomus* species are found). In the New World (Nearctic and Neotropical Regions), the

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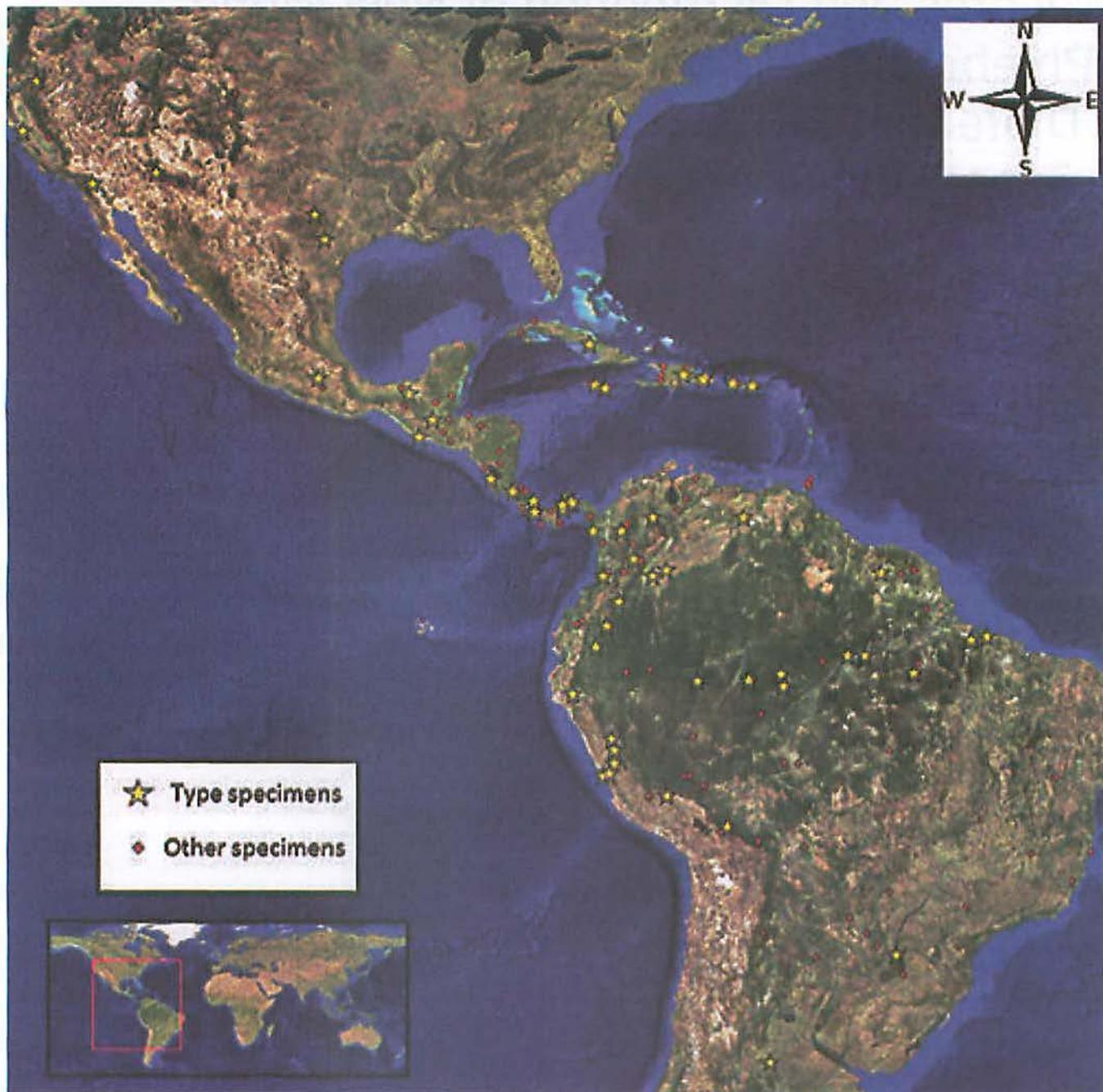


Figure 1. Phlebotomine sand fly collection sites on the New World, based on specimens deposited in the USNMNH and MEFSCA.

transmission of leishmaniasis is mainly in the tropics (particularly in the forests and savanna areas) of South America.²

In this article, we examine the types and related specimens of New World Phlebotomine sand flies housed in the US National Museum of Natural History (USNMNH), and those borrowed from the Museum of Entomology, Florida State Collection of Arthropods (MEFSCA). We record the collection data of sand flies, including their

geographical distribution, past and present taxonomic arrangement and related information. The species occurrence and diversity of these sand flies, according to the number of collections for each country over certain periods, were analyzed and reported. Other collection or occurrence data of sand fly specimens (including non-types, from the Nearctic and Neotropical Regions) from the 2 repositories (USNMNH and MEFSCA) were also examined and recorded, and will be posted later to the Walter Reed Biosystematics Unit (WRBU)/VectorMap

website (www.vectormap.org).¹⁷ They may be helpful in developing world sand fly taxonomic catalogs, and in creating sand fly vector risk maps and prediction distribution models for WRBU/VectorMap. In addition to increasing the knowledge of sand fly distribution, the collection holdings in these repositories, particularly the primary types, will assist future phlebotomine researchers in their taxonomic and related studies.

MATERIALS AND METHODS

Species Types and Related Specimens

New World Phlebotomine sand fly specimens used in this study are either housed in the USNMNH repository in Suitland, MD, or were borrowed from the MEFSCA in Gainesville, FL. The slide mounted specimens (about 10,000 slides in more than 300 slide boxes) were examined and their collection data were recorded. All collection data from both repositories were entered into the USNMNH/MEFSCA database. They were processed and used for analyses in this article. The primary types (holotypes, allotypes, neoallotype, paratypes, metatypes) of sand flies were examined for collection records and related information.

Other sand fly slides (more than 3,000 slides, mainly from Afrotropical and Palearctic Regions) housed in 5 other repositories were also examined and their collection or occurrence data were also recorded in separate databases. Those sand fly repositories included Institut de Recherche pour le Developpement, Montpellier, France; Institut Pasteur, Paris, France; Museum National d'Historie Naturelle, Paris, France; and Royal Museum for Central Africa, Tervuren, Belgium. However, data from the above 5 repositories were not included in this article, but may be processed for another report.

Species Diversity

The number of sand fly species according to each country in the New World was compiled in MS Excel and maps were constructed in ArcMap 10.1 (ESRI, Redlands, CA). Georeferences for individual specimens were determined and uncertainty calculated using the point-radius method.¹⁸⁻²⁰ Label data from each specimen was recorded verbatim and entered into an Excel spreadsheet. These text descriptions were then assigned coordinates using a web-based gazetteer.²¹ For named places, the geographic center of the locality was used as the latitude and longitude anchor. Once the coordinates were established,

a measurement of uncertainty was calculated for each point. This measurement is defined as the radius of a circle surrounding the coordinate anchor, indicating that the collection site is within this circle. The uncertainty measurement takes into consideration errors involving the extent of the named place, the geographic datum, map scale, and imprecision of collectors' location descriptions. All information including the verbatim locality description, gazetteer results and geo-referencing calculations were recorded and will be available for user review via VectorMap.¹⁷ The sand fly data from our database (USNMNH and MEFSCA) were sorted and ranked according to: (a) number of species per country, (b) number of collection records per species, and (c) number of records by decade of collections.

RESULTS

Species Types

The list of New World Phlebotomine species with type specimens housed in the USNMNH and MEFSCA is shown in Table 1, using the new taxonomic arrangements.^{22,23} The number of slides for each type and species and the country of type origin are also included in Table 1 at the end of this article. A comparison of the new^{22,23} and old⁴ generic and subgeneric classifications of types at both repositories is shown in Table 2 at the end of this article. About 139 species have primary types housed in those 2 repositories, including holotypes (49 species, 3 subspecies), "types" (8 species), allotypes (51

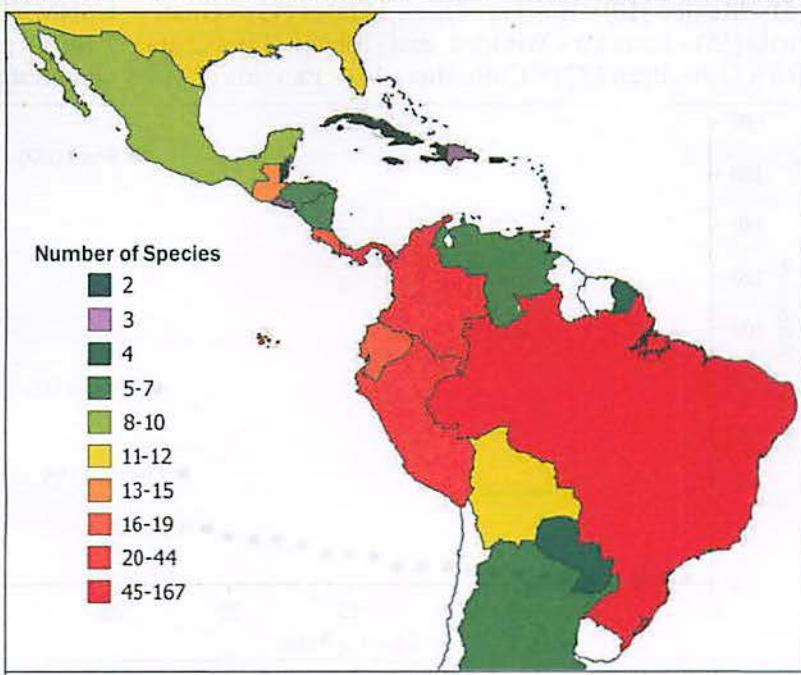


Figure 2. Map of the New World showing the number of New World Phlebotomine sand fly species in the USNMNH and MEFSCA sand fly database according to country of collection.

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species, 6 subspecies), paratypes (93 species, 10 subspecies), lectotypes (4 species), neoallotype (1 species), and metatype (1 species), mounted on slides, with a total of 1,113 type slides. The number of paratypes (103) ranged from 1 to 53/species or subspecies, with a total of 917. Those specimens on slides labeled "Type" could be considered as holotypes, but proper designations should be done later. Attempts to check for any additional primary types housed in the MEFSCA are still ongoing, and they will be listed in separate reports, if any types are found later. Species, without type specimens, will be posted later on the VectorMap website.¹⁷

Species Diversity

The total number of specimen slides considered in this database numbered 2,743. Depending on the amount of location detail, georeference uncertainty ranged from highest (country only information recorded) through to lowest (country, province and village information recorded), with an average of 234,678 m ($n=2,573$). Twenty-four countries of the New World were represented in our database of species collection record. The maps showing the collections sites in the New World countries, based on the specimens housed in the USNMNH and MEFSCA, are presented in Figures 1 and 2. They include (from smallest to largest number of species occurring in the collection database): Belize=Cuba=Haiti=Jamaica=Puerto Rico (2 species) < Dominican Republic=El Salvador (3) < French Guyana=Paraguay(4) < Nicaragua=Argentina=Honduras=Venezuela (5) < Mexico (10) < Bolivia=United States (12) < Guatemala (15) < Ecuador=Trinidad and Tobago (17) < Costa Rica (19) < Peru (22) < Colombia (44) < Panama (77) <

Brazil (167). These New World countries, with the top 4 countries (Brazil, Panama, Colombia, Peru) in the ranks according to the number of sand fly species present in the USNMNH/MEFSCA database, are shown in Figure 3. When the sand fly collection data were further analyzed according to the number of records present in the database, *Psychodopygus geniculatus* (Mangabeira) was the dominant species, followed by *Nyssomyia ylephiletor* (Fairchild and Hertig) and *Lutzomyia panamensis* (Shannon) (Figure 4). The number of New World sand fly records in the database according to the decade of collections is shown in Figure 5. Most collections were done during the 1950s followed by the 1970s then the 1940s. The earliest collection was done during 1906 and no collections in the database occurred beyond 1986. Based on the number of sand fly species in the database according to the country of collections, Brazil has the greatest number of species (167), followed by Panama (77), Colombia (44), and Peru (22) (Figure 3). Mapping species numbers by countries reveals that the greatest diversity appears to occur around equatorial regions (Figures 1 and 2). When the primary types were considered, according to the country of occurrence, Panama has the greatest number of primary types (21 species with holotypes), followed by Brazil (19 spp) and Colombia (7 spp) (Table 1).

COMMENT

The Phlebotomine sand fly collections, including primary types and voucher specimens, are essential for vector identifications, surveillance, and control efforts. The USNMNH and MEFSCA have voucher specimens of 7 (of 8) major species incriminated as vectors⁹ of various *Leishmania* species involved in the transmission of human leishmaniasis in the New World. Twenty of 27 suspected vector species⁹ of *Leishmania* in the New World have types and/or voucher specimens deposited in the 2 repositories. For example, the holotypes or "types" of the suspected vectors, namely *Nyssomyia anduzei* (Rozeboom), *Psychodopygus panamensis* (Shannon), and *Lutzomyia diabolica* (Hall), are found in the USNMNH. Considering the distribution records (mostly from 1940 to 1970) at our database (USNMNH/MEFSCA), there is an urgent need for additional collections of New World sand flies to obtain fresh voucher specimens for both molecular and morphological studies, and for safe deposits in the USNMNH, MEFSCA, or local Neotropical country repositories.

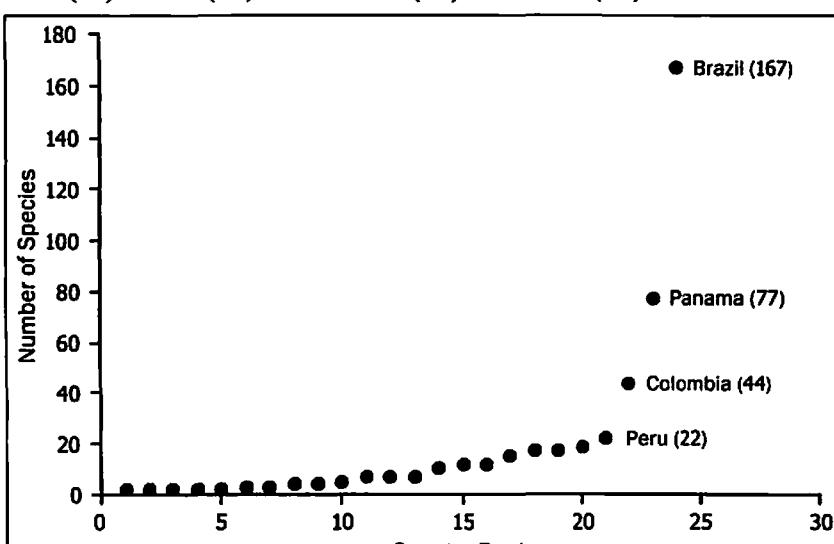


Figure 3. New World countries ranked according to the number of Phlebotomine sand fly species present in the USNMNH and MEFSCA sand fly database. The top 4 countries (and number of species) in the database are identified.

Specimen collections from USNMNH and MEFSCA were used in developing

the LUCID²⁴ interactive keys for the New World Neotropical Phlebotomine sand flies, particularly Neotropical Region (South and Central America, Southern Command, SOUTHCOM). Twenty-four morphological keys for males and females of the Neotropical Region (South and Central America), were created by L. M. Rueda with assistance from the WRBU staff, particularly J. Stoffer for the Automontage images which are now posted at the WRBU website,²⁵ namely:

- Phlebotomine Sand Fly Genera, Neotropical (SOUTHCOM): Females, Males
- Phlebotomine Sand Flies, Subgenera, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Dampfomyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Evandromyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Helcocyrtomyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Lutzomyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Nyssomyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Pintomyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Psathyromyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Psychodopygus* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Sciopemyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Species Grp. *Verrucarum* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males
- Subgenus *Trichophoromyia* Sand Flies, Adults, Neotropical (SOUTHCOM): Females, Males

The old arrangement of sand fly taxa by Young and Duncan⁴ was followed in the above keys. Other interactive keys for Africa and Central, Eastern, and Southwest Asia are still in preparation by the WRBU staff.

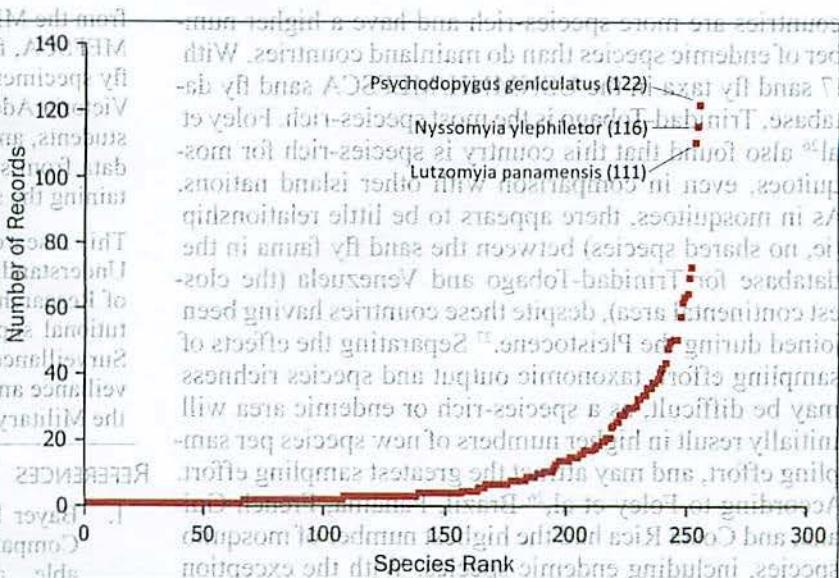


Figure 4. New World Phlebotomine sand fly species ranked according to the number of records present in the USNMNH and MEFSCA sand fly database. The top 3 most common species (and number of records) in the database are identified.

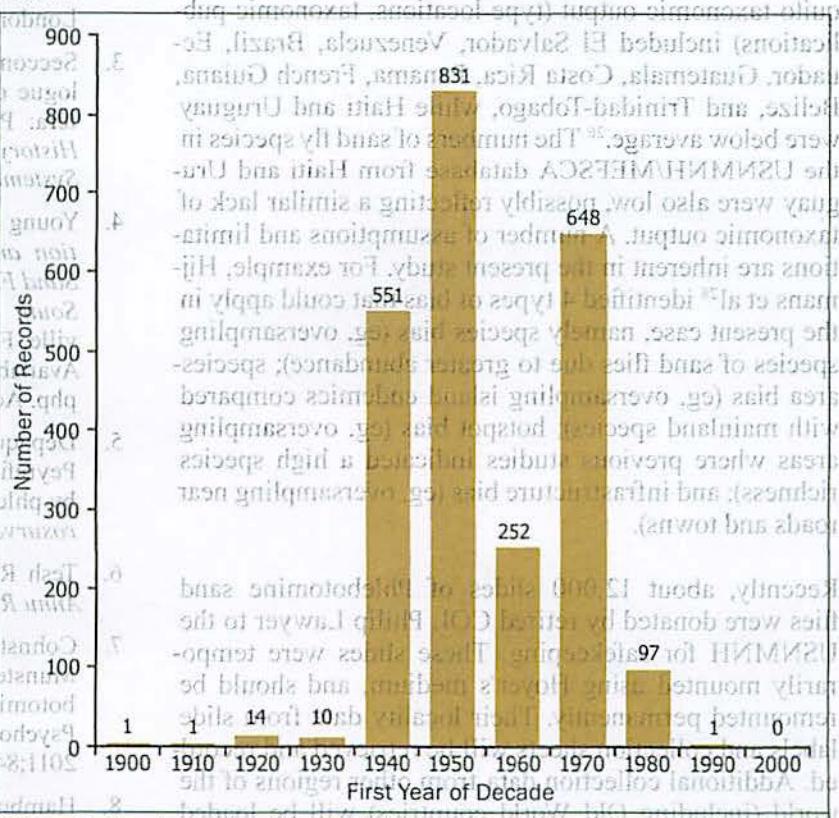


Figure 5. Number of New World Phlebotomine sand fly specimen records in the USNMNH and MEFSCA sand fly database according to decade of collection.

Concerning species diversity, a latitudinal biodiversity gradient was observed for mosquitoes, with species richness increasing toward the equator.²⁶ For mosquitoes, the total number of species increases with geographic area, according to a linear log-log relationship, and island

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countries are more species-rich and have a higher number of endemic species than do mainland countries. With 17 sand fly taxa in the USNMNH/MEFSCA sand fly database, Trinidad-Tobago is the most species-rich. Foley et al²⁶ also found that this country is species-rich for mosquitoes, even in comparison with other island nations. As in mosquitoes, there appears to be little relationship (ie, no shared species) between the sand fly fauna in the database for Trinidad-Tobago and Venezuela (the closest continental area), despite these countries having been joined during the Pleistocene.²⁷ Separating the effects of sampling effort, taxonomic output and species richness may be difficult, as a species-rich or endemic area will initially result in higher numbers of new species per sampling effort, and may attract the greatest sampling effort. According to Foley et al,²⁶ Brazil, Panama, French Guiana, and Costa Rica had the highest number of mosquito species, including endemic species. With the exception of French Guiana, this pattern is also seen for sand flies from the USNMNH/MEFSCA database. The list of New World countries with above average species-level mosquito taxonomic output (type locations, taxonomic publications) included El Salvador, Venezuela, Brazil, Ecuador, Guatemala, Costa Rica, Panama, French Guiana, Belize, and Trinidad-Tobago, while Haiti and Uruguay were below average.²⁶ The numbers of sand fly species in the USNMNH/MEFSCA database from Haiti and Uruguay were also low, possibly reflecting a similar lack of taxonomic output. A number of assumptions and limitations are inherent in the present study. For example, Hijmans et al²⁸ identified 4 types of bias that could apply in the present case, namely species bias (eg, oversampling species of sand flies due to greater abundance); species-area bias (eg, oversampling island endemics compared with mainland species); hotspot bias (eg, oversampling areas where previous studies indicated a high species richness); and infrastructure bias (eg, oversampling near roads and towns).

Recently, about 12,000 slides of Phlebotomine sand flies were donated by retired COL Philip Lawyer to the USNMNH for safekeeping. These slides were temporarily mounted using Hoyer's medium, and should be remounted permanently. Their locality data from slide labels and collection sheets will be retrieved and recorded. Additional collection data from other regions of the world (including Old World countries) will be loaded into VectorMap to enable further analysis of species diversity, and to create sand fly vector distribution models that will be useful for leishmaniasis risk assessments.

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Table 1A. Types of New World sand flies (Phlebotominae, Psychodidae) deposited in the USNMNH and MEFSCA, including country of type origin (continued through 1B, 1C, 1D).

Species	deposit to 2000 USNMNH 7109	Repository Type* (No. of Slides)	Country of Type Origin†
<i>Bichromomyia olmeca olmeca</i> (Vargas and Najera 1959)	1955-1960, 16-18	F: P(1); F: H, A, P(44)	Brazil
<i>Bichromomyia olmeca bicolor</i> (Fairchild and Theodon 1971)	1955-1960, 16-18	F: A, P(14); U: P(10)	Panama
<i>Bichromomyia olmeca noctiva</i> (Young and Arias 1982)	1955-1960, 16-18	F: H; P(14); U: P(10)	Brazil
<i>Brumptomyia galindoi</i> (Fairchild and Hertig 1947)	1955-1960, 16-18	F: H	Panama
<i>Brumptomyia hamata</i> (Fairchild and Hertig 1947)	1955-1960, 16-18	F: H, A, P(1)	Panama
<i>Brumptomyia leopoldoi</i> (Rodríguez 1953)	1955-1960, 16-18	F: P(3)	Panama
<i>Dampfomyia (Coromyia) steatopyga</i> (Fairchild and Hertig 1958)	1955-1960, 16-18	F: P(2); U: P(1)	Mexico
<i>Dampfomyia (Coromyia) vesicifera</i> (Fairchild and Hertig 1947)	1955-1960, 16-18	F: H, A, P(8); U: P(2)	Panama
<i>Dampfomyia (Coromyia) vespertilionis</i> (Fairchild and Hertig 1947)	1955-1960, 16-18	F: H, A, P(24)	Panama
<i>Dampfomyia (Coromyia) viriosa</i> (Fairchild and Hertig 1958)	1955-1960, 16-18	F: P(1); U: P(1)	Costa Rica
<i>Dampfomyia (Coromyia) zeledoni</i> Young and Murillo 1984	1955-1960, 16-18	F: H, P(1)	Costa Rica
<i>Dampfomyia (Dampfomyia) anthophora</i> (Addis 1945)	1955-1960, 16-18	U: P(1)	United States
<i>Dampfomyia (Dampfomyia) rosabali</i> (Fairchild and Hertig 1956)	1955-1960, 16-18	F: P(2)	Panama
<i>Dampfomyia (friceriae sedis) caminoi</i> (Young and Duncan 1994)	1955-1960, 16-18	F: H, A, P(1)	Mexico
<i>Evandromyia (Aldamyia) sericea</i> (Floch and Abonnenc 1944)	1955-1960, 16-18	U: H	Brazil
<i>Evandromyia (Aldamyia) williamsi</i> (Damasceno, Causey and Arouck 1945)	1955-1960, 16-18	U: H	Brazil
<i>Evandromyia (Evanidromyia) begonae</i> (Ortiz and Torres 1975)	1955-1960, 16-18	U: P(1)	Brazil
<i>Evandromyia (Evandromyia) inpaí</i> (Young and Arias 1977)	1955-1960, 16-18	F: P(11)	Brazil
<i>Evandromyia (Evandromyia) wilsoni</i> (Damasceno and Causey 1945)	1955-1960, 16-18	U: H	Brazil
<i>Hertigia hertigi</i> Fairchild 1949	1955-1960, 16-18	F: A	Costa Rica
<i>Lutzomyia (Helcocyrtomyia) botella</i> (Fairchild and Hertig 1961)	1955-1960, 16-18	F: H, P(6)	Panama
<i>Lutzomyia (Helcocyrtomyia) cirrita</i> Young and Porter 1974	1955-1960, 16-18	F: A, P(5)	Colombia
<i>Lutzomyia (Helcocyrtomyia) hartmanni</i> (Fairchild and Hertig 1957)	1955-1960, 16-18	F: H, P(10)	Panama
<i>Lutzomyia (Helcocyrtomyia) imperatrix</i> (Alexander 1944)	1955-1960, 16-18	U: H	Peru
<i>Lutzomyia (Helcocyrtomyia) noguchi</i> (Shannon 1929)	1955-1960, 16-18	U: T	Peru
<i>Lutzomyia (Helcocyrtomyia) peruvensis</i> (Shannon 1929)	1955-1960, 16-18	U: T	Peru
<i>Lutzomyia (Helcocyrtomyia) pesci</i> (Hertig 1943)	1955-1960, 16-18	U: L	Peru
<i>Lutzomyia (Helcocyrtomyia) strictivilla</i> Young 1979	1955-1960, 16-18	F: A, P(6)	Colombia
<i>Lutzomyia (Helcocyrtomyia) tortura</i> Young and Rogers 1984	1955-1960, 16-18	F: A	Ecuador
<i>Lutzomyia (Incertae sedis) tanyops</i> Young and Perkins 1984	1955-1960, 16-18	F: R(1)	United States
<i>Lutzomyia (Lutzomyia) battistini</i> (Hertig 1978)	1955-1960, 16-18	U: L, P(2)	Peru
<i>Lutzomyia (Lutzomyia) ichyi</i> (Floch and Abonnenc 1950)	1955-1960, 16-18	F: A, P(6)	Panama
<i>Lutzomyia (Tricholateralis) carvalhoi</i> (Damasceno, Causey and Arouck 1945)	1955-1960, 16-18	U: H	Brazil
<i>Lutzbomyia (Tricholateralis) cruciata</i> (Coquillett 1907)	1955-1960, 16-18	U: T	Guatemala
<i>Lutzbomyia (Tricholateralis) diabolica</i> (Hall 1936)	1955-1960, 16-18	U: T	United States
<i>Lutzomyia (Tricholateralis) falcata</i> Young, Morales and Ferro 1994	1955-1960, 16-18	F: P(7)	Brazil
<i>Lutzomyia (Tricholateralis) marinkelei</i> Young 1979	1955-1960, 16-18	F: A, P(3)	Colombia
<i>Martinsmyia gaspariannai</i> Martins, Godoy and Silva 1962	1955-1960, 16-18	F: P(1)	Brazil
<i>Martinsmyia waltoni</i> Arias, Freitas and Barrett 1984	1955-1960, 16-18	F: P(2); U: P(2)	Brazil
<i>Micropygomyia (Coquillettimyia) apache</i> (Young and Perkins 1984)	1955-1960, 16-18	F: A, P(2)	United States
<i>Micropygomyia (Coquillettimyia) stewarti</i> (Mangabeira and Galindo 1944)	1955-1960, 16-18	F: H; U: P(1)	United States
<i>Micropygomyia (Coquillettimyia) vexator</i> (Coquillett 1907)	1955-1960, 16-18	U: H	United States
<i>Micropygomyia (Micropygomyia) cayennensis cayennensis</i> (Floch and Abonnenc 1941)	1955-1960, 16-18	F: P(3)	Guatemala
<i>Micropygomyia (Micropygomyia) cayennensis hispaniolae</i> (Fairchild and Trapido 1950)	1955-1960, 16-18	U: P(2)	Dominican Republic
<i>Micropygomyia (Micropygomyia) cayennensis jamaicensis</i> (Fairchild and Trapido 1950)	1955-1960, 16-18	F: H, A, P(1)	Jamaica
<i>Micropygomyia (Micropygomyia) cayennensis macrasi</i> (Fairchild and Hertig 1948)	1955-1960, 16-18	F: (P1); U: (P1)	Mexico

*Key to Repository Type:

H=holotype (1 specimen)

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F=MEFSCA

P=paratype (1 or more specimens)

N=neoallotype (1 specimen)

T=Type (1 specimen)

U=USNMNH

†Based on types and repositories, as listed in adjacent column.

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Table 1B. Types of New World sand flies (Phlebotominae, Psychodidae) deposited in the USNMNH and MEFSCA, including country of type origin (continued).

Species	Repository Type* (No. of Slides)	Country of Type Origin†
<i>Micropygomyia (Micropygomyia) cayennensis puertoricensis</i> (Fairchild and Hertig 1948)	F: A, P(5); U: P(1)	Puerto Rico
<i>Micropygomyia (Micropygomyia) cayennensis viequesensis</i> (Fairchild and Hertig 1948)	F: H, A, P(4); U: P(2)	Puerto Rico: H, A, P(4); Panama: P(2)
<i>Micropygomyia (Micropygomyia) cubensis</i> (Fairchild and Trapido 1950)	F: H, A, P(5); U: P(1)	Cuba
<i>Micropygomyia (Micropygomyia) duppyorum</i> (Fairchild and Trapido 1950)	F: A, P(6); U: P(2)	Jamaica
<i>Micropygomyia (Micropygomyia) hispaniolae</i> (Fairchild and Trapido 1950)	F: A, P(8)	Dominican Republic: A, P(5); Haiti: P(3)
<i>Micropygomyia (Micropygomyia) pilosa</i> (Damasceno and Causey 1944)	U: H	Brazil
<i>Micropygomyia (Micropygomyia) xerophila</i> (Young, Brener, and Wargo 1983)	F: A, P(10); U: P(1)	United States
<i>Micropygomyia (Sauromyia) atroclavata</i> (Knab 1913)	U: P(1)	Trinidad and Tobago
<i>Micropygomyia (Sauromyia) ferreirana</i> (Barretto, Martins, and Pellegrino 1956)	U: H	Brazil
<i>Micropygomyia (Sauromyia) quechua</i> (Martins, Llanos, and Silva 1975)	F: A, P(1)	Peru
<i>Micropygomyia (Sauromyia) quinquefer</i> (Dyar 1929)	U: T, A	Argentina
<i>Migonemyia (Blancasmyia) cerqueirai</i> (Causey and Damasceno 1945)	U: H	Brazil
<i>Migonemyia (Blancasmyia) gorbitzi</i> (Blancas 1959)	F: A, P(50)	Panama
<i>Nyssomyia anduzel</i> (Rozeboom 1942)	U: H	Venezuela
<i>Nyssomyia trapidoi</i> (Fairchild and Hertig 1952)	F: H, A, P(29); U: P(2)	Panama
<i>Nyssomyia ylephiletor</i> (Fairchild and Hertig 1952)	F: H, P(36)	Panama
<i>Nyssomyia yulilli</i> Young & Porter 1972	U: H, A; F: P(20)	Colombia
<i>Oligodontomyia oligodontia</i> (Young, Pérez, and Romero 1985)	F: A, P(9)	Peru
<i>Pintomyia (Pifanomyia) andina</i> Osorno, Osorno-Mesa, and Morales 1972	U: P(1)	Colombia
<i>Pintomyia (Pifanomyia) boliviiana</i> (Velasco and Trapido 1974)	U: H	Bolivia
<i>Pintomyia (Pintomyia) christensenii</i> Young and Duncan 1994	F: H, A, P(34)	Panama: H, A, P(20); Colombia: P(12); Brazil (P2)
<i>Pintomyia (Pifanomyia) christophei</i> (Fairchild and Trapido 1950)	F: H, A, P(3)	Dominican Republic
<i>Pintomyia (Pifanomyia) gruta</i> Ryan 1986	F: P(1)	Brazil
<i>Pintomyia (Pifanomyia) moralesi</i> Young 1979	F: P(4)	Colombia
<i>Pintomyia (Pifanomyia) odax</i> (Fairchild and Hertig 1961)	F: A, P(17)	Panama
<i>Pintomyia (Pifanomyia) oresbia</i> (Fairchild and Hertig 1961)	F: A, P(2)	Panama
<i>Pintomyia (Pifanomyia) orestes</i> (Fairchild and Trapido 1950)	F: H, P(1)	Cuba
<i>Pintomyia (Pifanomyia) pla</i> (Fairchild and Hertig 1961)	F: H, A, P(10)	Panama
<i>Pintomyia (Pifanomyia) torvida</i> Young, Morales, and Ferro 1994	F: A, P(1)	Colombia
<i>Pintomyia (Pifanomyia) youngi</i> Feliciangeli and Murillo 1985	F: P(2)	Venezuela
<i>Pressatia camposi</i> (Rodriguez 1952)	F: A, P(31)	Panama
<i>Pressatia dysponeta</i> (Fairchild and Hertig 1952)	F: A, P(53)	Panama
<i>Pressatia trispinosa</i> (Mangabeira 1942)	F: H, A, P(7)	Colombia
<i>Psathyromyia (Incertae sedis) ignacioli</i> (Young 1972)	F: P(1)	Venezuela
<i>Psathyromyia (Forattiniella) barrettoi barrettoi</i> (Mangabeira 1942)	U: P(1)	Panama
<i>Psathyromyia (Forattiniella) barrettoi majuscula</i> (Young 1979)	F: A, P(15); U: P(2)	Panama: A, P(11); Colombia: P(3); Costa Rica: P(1); Ecuador (P=1); Nicaragua: P(1)
<i>Psathyromyia (Forattiniella) carpenteri</i> (Fairchild and Hertig 1953)	F: H, A, P(36)	Panama
<i>Psathyromyia (Forattiniella) runoides</i> (Fairchild and Hertig 1953)	F: H, A, P(28)	Panama
<i>Psathyromyia (Forattiniella) texana</i> (Dampf 1938)	U: T	United States

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F=MEFSCA

P=paratype (1 or more specimens)

N=neotype (1 specimen)

T=Type (1 specimen)

U=USNMNH

†Based on types and repositories, as listed in adjacent column.

**RECORDS AND DISTRIBUTION OF NEW WORLD PHLEBOTOMINE SAND FLIES (PSYCHODIDAE, DIPTERA),
WITH SPECIAL EMPHASIS ON PRIMARY TYPES AND SPECIES DIVERSITY**

Table 1C. Types of New World sand flies (Phlebotominae, Psychodidae) deposited in the USNMNH and MEFSCA, including country of type origin (continued).

Species	Repository Type* (No. of Slides)	Country of Type Origin†
<i>Psathyromyia (Psathyromyia) campbelli</i> (Damasceno, Causey, and Arouck 1945)	U: H	Brazil
<i>Psathyromyia (Psathyromyia) cratifer</i> (Fairchild and Hertig 1961)	F: H, P(1)	Mexico
<i>Psathyromyia (Psathyromyia) dasymera</i> (Fairchild and Hertig 1961)	F: H, A, P(45)	Panama: H, A, P(42); Mexico: P(1); Nicaragua: P(2)
<i>Psathyromyia (Psathyromyia) guatemalensis</i> Porter and Young 1986	F: A, P(1)	Guatemala
<i>Psathyromyia (Psathyromyia) shannoni</i> (Dyar 1929)	U: L, P(1); F: P(2)	Argentina: H; Panama: L, P(2); Peru (P1)
<i>Psathyromyia (Psathyromyia) soccula</i> (Fairchild and Hertig 1961)	F: P(2)	Panama
<i>Psathyromyia (Psathyromyia) souzastroi</i> (Damasceno and Causey 1944)	U: H	Brazil
<i>Psathyromyia (Psathyromyia) undulata</i> (Fairchild and Hertig 1950)	U: P(1)	Guatemala
<i>Psathyromyia (Psathyromyia) volcanensis</i> (Fairchild and Hertig 1950)	F: N, P(3)	Panama
<i>Psathyromyia (Xiphomyia) aclydifera</i> (Fairchild and Hertig 1952)	F: A	Panama
<i>Psychodopygus amazonensis</i> (Root 1934)	U: (L); F: P(1)	Peru: L; French Guyana: P(1)
<i>Psychodopygus ayrozai</i> (Barreto and Coutinho 1940)	F: P(2)	Panama
<i>Psychodopygus bispinosus</i> (Fairchild and Hertig 1951)	F: H, A, P(4)	Panama
<i>Psychodopygus carrai carrai</i> (Barreto 1946)	F: P(1)	Panama
<i>Psychodopygus carrai thula</i> (Young 1979)	F: A, P(27)	Panama: A, P(17); Colombia: P(10)
<i>Psychodopygus davisii</i> (Root 1934)	U: P(1)	Brazil
<i>Psychodopygus fairchildi</i> Barreto 1966	F: H, A, P(4)	Colombia
<i>Psychodopygus fairtigi</i> (Martins 1970)	F: H, P(1)	Colombia
<i>Psychodopygus nocticolus</i> (Young 1973)	F: A, P(7)	Colombia
<i>Psychodopygus panamensis</i> (Shannon 1926)	U: T	Panama
<i>Psychodopygus recurvus</i> (Young 1973)	F: A, P(12)	Colombia
<i>Sciopemyia nematoducta</i> Young and Arias 1984	F: A, P(23); U: P(8)	Brazil
<i>Sciopemyia pennyi</i> Arias and Freitas 1981	F: P(2); U: P(1)	Brazil
<i>Sciopemyia preclara</i> Young and Arias 1984	F: P(1)	Peru
<i>Sciopemyia servuloi</i> (Damasceno and Causey 1945)	U: H	Brazil
<i>Sciopemyia sordellii</i> (Shannon and Del Ponte 1927)	U: L	Argentina
<i>Trichophoromyia castanheirai</i> (Damasceno, Causey, and Arouck 1945)	U: H	Brazil
<i>Trichophoromyia dunhami</i> (Causey and Damasceno 1945)	U: H	Brazil
<i>Trichophoromyia gibba</i> Young and Arias 1994	F: P(1)	Brazil
<i>Trichophoromyia lopesi</i> (Damasceno, Causey, and Arouck 1945)	U: H	Brazil
<i>Trichophoromyia loretensis</i> (Lianos 1964)	F: P(1)	Peru
<i>Trichophoromyia meirai</i> (Causey and Damasceno 1945)	U: H	Brazil
<i>Trichophoromyia melloi</i> (Causey and Damasceno 1945)	U: H	Brazil
<i>Trichophoromyia napoensis</i> Young and Rodgers 1984	F: A, P(12)	Ecuador
<i>Trichophoromyia pabloi</i> (Barreto, Burbano, and Young 2002)	F: P(1)	Colombia
<i>Trichophoromyia reburra</i> (Fairchild and Hertig 1961)	F: H, A, P(2)	Panama
<i>Trichophoromyia rulli</i> Arias and Young 1982	F: P(31)	Brazil
<i>Trichophoromyia sinuosa</i> Young and Duncan 1994	F: H, P(1)	Peru
<i>Trichopygomyia elegans</i> Martins, Falcao and Silva 1976	U: P(1)	Peru
<i>Trichopygomyia ferroae</i> (Young and Morales 1987)	F: H, A, P(1)	Colombia
<i>Trichopygomyia martinezii</i> Young and Morales 1987	F: H, A, P(1)	Colombia
<i>Trichopygomyia ratcliffei</i> Arias, Ready, and Freitas 1983	U: P(5)	Brazil
<i>Trichopygomyia tiramula</i> (Fairchild and Hertig 1952)	F: H, A, P(28)	Panama
<i>Trichopygomyia wagleyi</i> (Causey and Damasceno 1945)	U: H	Brazil

*Key to Repository Type:

H=holotype (1 specimen)	A=allotype (1 specimen)
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N=neoallotype (1 specimen)	T=Type (1 specimen)
U=USNMNH	

†Based on types and repositories, as listed in adjacent column.

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Table 1D. Types of New World sand flies (Phlebotominae, Psychodidae) deposited in the USNMNH and MEFSCA, including country of type origin (continued).

Species	Repository Type* (No. of Slides)	Country of Type Origin†
<i>Trichopygomyia wilkersoni</i> Young and Rodgers 1984	F: A, P(1)	Ecuador
<i>Trichopygomyia witoto</i> Young and Morales 1987	F: H, P(1)	Colombia
<i>Viannamyia fariasi</i> (Damasceno, Causey, and Arouck 1945)	U: H	Brazil
<i>Warileya nigrosaccula</i> Fairchild and Hertig 1951	F: H	Panama
<i>Warileya phlebotomanica</i> Hertig 1948	F: H	Peru
<i>Warileya rotundipennis</i> Fairchild and Hertig 1951	F: H, A, P(6)	Panama
<i>Warileya yungasi</i> Velasco and Trapido 1974	F: P(1); U: H, P(1)	Bolivia

*Key to Repository Type:

H=holotype (1 specimen)

A=allotype (1 specimen)

F=MEFSCA

P=paratype (1 or more specimens)

N=neoallotype (1 specimen)

T=Type (1 specimen)

U=USNMNH

†Based on types and repositories, as listed in adjacent column.

Table 2A. Types of New World sand flies (Phlebotominae, Psychodidae), deposited in the USNMNH and MEFSCA, with old and new generic and subgeneric classifications (continued through 2B, 2C, 2D).

New Arrangement	Old Arrangement†
<i>Bichromomyia olmeca olmeca</i> (Vargas and Najera 1959)	<i>Lutzomyia (Nyssomyia) olmeca olmeca</i>
<i>Bichromomyia olmeca bicolor</i> (Fairchild and Theodor 1971)	<i>Lutzomyia (Nyssomyia) olmeca bicolor</i>
<i>Bichromomyia olmeca nociva</i> (Young and Arias 1982)	<i>Lutzomyia (Nyssomyia) olmeca nociva</i>
<i>Brumptomyia galindoi</i> (Fairchild and Hertig 1947)	<i>Brumptomyia galindoi</i>
<i>Brumptomyia hamata</i> (Fairchild and Hertig 1947)	<i>Brumptomyia hamata</i>
<i>Brumptomyia leopoldoi</i> (Rodriguez 1953)	<i>Brumptomyia leopoldoi</i>
<i>Dampfomyia (Coromyia) steatopyga</i> (Fairchild and Hertig 1958)	<i>Lutzomyia (Coromyia) steatopyga</i>
<i>Dampfomyia (Coromyia) vesicifera</i> (Fairchild and Hertig 1947)	<i>Lutzomyia (Coromyia) vesicifera</i>
<i>Dampfomyia (Coromyia) vespertilionis</i> (Fairchild and Hertig 1947)	<i>Lutzomyia (Coromyia) vespertilionis</i>
<i>Dampfomyia (Coromyia) viriosa</i> (Fairchild and Hertig 1958)	<i>Lutzomyia (Coromyia) viriosa</i>
<i>Dampfomyia (Coromyia) zeledoni</i> Young and Murillo 1984	<i>Lutzomyia (Coromyia) zeledoni</i>
<i>Dampfomyia (Dampfomyia) anthophora</i> (Addis 1945)	<i>Lutzomyia (Dampfomyia) anthophora</i>
<i>Dampfomyia (Dampfomyia) rosabali</i> (Fairchild and Hertig 1956)	<i>Dampfomyia (Dampfomyia) rosabali</i>
<i>Dampfomyia (Incertae sedis) caminoi</i> (Young and Duncan 1994)	<i>Lutzomyia caminoi</i>
<i>Evandromyia (Aldamyia) sericea</i> (Floch and Abonnenc 1944)	<i>Lutzomyia sericea</i>
<i>Evandromyia (Aldamyia) williamsi</i> (Damasceno, Causey, and Arouck 1945)	<i>Lutzomyia williamsi</i>
<i>Evandromyia (Evandromyia) begonae</i> (Ortiz and Torres 1975)	<i>Lutzomyia (Evandromyia) begonae</i>
<i>Evandromyia (Evandromyia) inpal</i> (Young and Arias 1977)	<i>Lutzomyia inpal</i>
<i>Evandromyia (Evandromyia) wilsoni</i> (Damasceno and Causey 1945)	<i>Lutzomyia wilsoni</i>
<i>Hertigia hertigi</i> Fairchild 1949	<i>Hertigia hertigi</i>
<i>Lutzomyia (Helcocyrtomyia) botella</i> (Fairchild and Hertig 1961)	<i>Lutzomyia (Helcocyrtomyia) botella</i>
<i>Lutzomyia (Helcocyrtomyia) cirrita</i> Young and Porter 1974	<i>Lutzomyia (Helcocyrtomyia) cirrita</i>
<i>Lutzomyia (Helcocyrtomyia) hartmanni</i> (Fairchild and Hertig 1957)	<i>Lutzomyia (Helcocyrtomyia) hartmanni</i>
<i>Lutzomyia (Helcocyrtomyia) imperatrix</i> (Alexander 1944)	<i>Lutzomyia (Helcocyrtomyia) imperatrix</i>
<i>Lutzomyia (Helcocyrtomyia) noguchi</i> (Shannon 1929)	<i>Lutzomyia (Helcocyrtomyia) noguchi</i>
<i>Lutzomyia (Helcocyrtomyia) peruvensis</i> (Shannon 1929)	<i>Lutzomyia (Helcocyrtomyia) peruvensis</i>
<i>Lutzomyia (Helcocyrtomyia) pescei</i> (Hertig 1943)	<i>Lutzomyia (Helcocyrtomyia) pescei</i>
<i>Lutzomyia (Helcocyrtomyia) strictivilla</i> Young 1979	<i>Lutzomyia (Helcocyrtomyia) strictivilla</i>
<i>Lutzomyia (Helcocyrtomyia) tortura</i> Young and Rogers 1984	<i>Lutzomyia (Helcocyrtomyia) tortura</i>
<i>Lutzomyia (Incertae sedis) tanyopsis</i> Young and Perkins 1984	<i>Lutzomyia tanyopsis</i>
<i>Lutzomyia (Lutzomyia) battistinii</i> (Hertig 1978)	<i>Lutzomyia (Lutzomyia) battistinii</i>
<i>Lutzomyia (Lutzomyia) lichyi</i> (Floch and Abonnenc 1950)	<i>Lutzomyia (Lutzomyia) lichyi</i>
<i>Lutzomyia (Tricholateralis) carvalhoi</i> (Damasceno, Causey, and Arouck 1945)	<i>Lutzomyia (Lutzomyia) carvalhoi</i>

*Based on WRBU²² and Galati.²³

†Based on Young and Duncan⁴ and various references.

**RECORDS AND DISTRIBUTION OF NEW WORLD PHLEBOTOMINE SAND FLIES (PSYCHODIDAE, DIPTERA),
WITH SPECIAL EMPHASIS ON PRIMARY TYPES AND SPECIES DIVERSITY**

Table 2B. Types of New World sand flies (Phlebotominae, Psychodidae), deposited in the USNMNH and MEFSCA, with old and new generic and subgeneric classifications (continued).

New Arrangement	Old Arrangement [†]
<i>Lutzomyia (Tricholateralis) cruciata</i> (Coquillett 1907)	<i>Lutzomyia (Lutzomyia) cruciata</i>
<i>Lutzomyia (Tricholateralis) diabolica</i> (Hall 1936)	<i>Lutzomyia (Lutzomyia) diabolica</i>
<i>Lutzomyia (Tricholateralis) falcata</i> Young, Morales and Ferro 1994	<i>Lutzomyia (Lutzomyia) falcata</i>
<i>Lutzomyia (Tricholateralis) marinellei</i> Young 1979	<i>Lutzomyia (Lutzomyia) marinellei</i>
<i>Martinsmyia gaspariannai</i> Martins, Godoy and Silva 1962	<i>Lutzomyia (Lutzomyia) gaspariannai</i>
<i>Martinsmyia waltoni</i> Arias, Freitas and Barrett 1984	<i>Lutzomyia (Nyssomyia) waltoni</i>
<i>Micropygomyia (Coquillettimyia) apache</i> (Young and Perkins 1984)	<i>Lutzomyia apache</i>
<i>Micropygomyia (Coquillettimyia) stewarti</i> (Mangabeira and Galindo 1944)	<i>Lutzomyia (Helcocortomyia) stewarti</i>
<i>Micropygomyia (Coquillettimyia) vexator</i> (Coquillett 1907)	<i>Lutzomyia (Helcocortomyia) vexator</i>
<i>Micropygomyia (Micropygomyia) cayennensis cayennensis</i> (Floch and Abonnenc 1941)	<i>Lutzomyia (Micropygomyia) cayennensis cayennensis</i>
<i>Micropygomyia (Micropygomyia) cayennensis hispaniolae</i> (Fairchild and Trapido 1950)	<i>Lutzomyia (Micropygomyia) cayennensis hispaniolae</i>
<i>Micropygomyia (Micropygomyia) cayennensis jamaicensis</i> (Fairchild and Trapido 1950)	<i>Lutzomyia (Micropygomyia) cayennensis jamaicensis</i>
<i>Micropygomyia (Micropygomyia) cayennensis maciasi</i> (Fairchild and Hertig 1948)	<i>Lutzomyia (Micropygomyia) cayennensis maciasi</i>
<i>Micropygomyia (Micropygomyia) cayennensis puertoricensis</i> (Fairchild and Hertig 1948)	<i>Lutzomyia (Micropygomyia) cayennensis puertoricensis</i>
<i>Micropygomyia (Micropygomyia) cayennensis viequesensis</i> (Fairchild and Hertig 1948)	<i>Lutzomyia (Micropygomyia) cayennensis viequesensis</i>
<i>Micropygomyia (Micropygomyia) cubensis</i> (Fairchild and Trapido 1950)	<i>Lutzomyia (Micropygomyia) cubensis</i>
<i>Micropygomyia (Micropygomyia) duppyorum</i> (Fairchild and Trapido 1950)	<i>Lutzomyia (Micropygomyia) duppyorum</i>
<i>Micropygomyia (Micropygomyia) hispaniolae</i> (Fairchild and Trapido 1950)	<i>Micropygomyia (Micropygomyia) hispaniolae</i>
<i>Micropygomyia (Micropygomyia) pilosa</i> (Damasceno and Causey 1944)	<i>Lutzomyia pilosa</i>
<i>Micropygomyia (Micropygomyia) xerophila</i> (Young, Brener and Wargo 1983)	<i>Lutzomyia xerophila</i>
<i>Micropygomyia (Sauromyia) atroclavata</i> (Knab 1913)	<i>Lutzomyia (Micropygomyia) atroclavata</i>
<i>Micropygomyia (Sauromyia) ferreirana</i> (Barreto, Martins and Pellegrino 1956)	<i>Lutzomyia ferreirana</i>
<i>Micropygomyia (Sauromyia) quechua</i> (Martins, Lianos and Silva 1975)	<i>Lutzomyia quechua</i>
<i>Micropygomyia (Sauromyia) quinquefer</i> (Dyar 1929)	<i>Lutzomyia quinquefer</i>
<i>Migonemyia (Blancasmya) cerqueirai</i> (Causey and Damasceno 1945)	<i>Lutzomyia (Evandromyia) cerqueirai</i>
<i>Migonemyia (Blancasmya) gorbitzi</i> (Blancas 1959)	<i>Lutzomyia gorbitzi</i>
<i>Nyssomyia anduzei</i> (Rozeboom 1942)	<i>Lutzomyia (Nyssomyia) anduzei</i>
<i>Nyssomyia trapidoi</i> (Fairchild and Hertig 1952)	<i>Lutzomyia (Nyssomyia) trapidoi</i>
<i>Nyssomyia ylephiletor</i> (Fairchild and Hertig 1952)	<i>Lutzomyia (Nyssomyia) ylephiletor</i>
<i>Nyssomyia yuilli</i> Young & Porter 1972	<i>Lutzomyia (Nyssomyia) yuilli yuilli</i>
<i>Oligodontomyia oligodontia</i> (Young, Pérez and Romero 1985)	<i>Lutzomyia oligodontia</i>
<i>Pintomyia (Pifanomyia) andina</i> Osorno, Osorno-Mesa and Morales 1972	<i>Lutzomyia andina</i>
<i>Pintomyia (Pifanomyia) boliviiana</i> (Velasco and Trapido 1974)	<i>Lutzomyia boliviiana</i>
<i>Pintomyia (Pintomyia) christensenii</i> Young and Duncan 1994	<i>Lutzomyia (Pintomyia) christensenii</i>
<i>Pintomyia (Pifanomyia) christopheli</i> (Fairchild and Trapido 1950)	<i>Lutzomyia christopheli</i>
<i>Pintomyia (Pifanomyia) gruta</i> Ryan 1986	<i>Lutzomyia gruta</i>
<i>Pintomyia (Pifanomyia) moralesi</i> Young 1979	<i>Lutzomyia moralesi</i>
<i>Pintomyia (Pifanomyia) odax</i> (Fairchild and Hertig 1961)	<i>Lutzomyia odax</i>
<i>Pintomyia (Pifanomyia) oresbia</i> (Fairchild and Hertig 1961)	<i>Lutzomyia oresbia</i>
<i>Pintomyia (Pifanomyia) orestes</i> (Fairchild and Trapido 1950)	<i>Lutzomyia orestes</i>
<i>Pintomyia (Pifanomyia) pia</i> (Fairchild and Hertig 1961)	<i>Lutzomyia pia</i>
<i>Pintomyia (Pifanomyia) torvida</i> Young, Morales and Ferro 1994	<i>Lutzomyia torvida</i>
<i>Pintomyia (Pifanomyia) youngi</i> Feliciangeli and Murillo 1985	<i>Lutzomyia youngi</i>
<i>Pressatia camposi</i> (Rodriguez 1952)	<i>Lutzomyia (Pressatia) camposi</i>
<i>Pressatia dysponeta</i> (Fairchild and Hertig 1952)	<i>Lutzomyia (Pressatia) dysponeta</i>
<i>Pressatia trispinosa</i> (Mangabeira 1942)	<i>Lutzomyia (Pressatia) trispinosa</i>

*Based on WRBU²² and Galati.²³

†Based on Young and Duncan⁴ and various references.

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Table 2C. Types of New World sand flies (Phlebotominae, Psychodidae), deposited in the USNMNH and MEFSCA, with old and new generic and subgeneric classifications. (continued).

New Arrangement	Old Arrangement [†]
<i>Psathyromyia (Incertae sedis) ignacioi</i> (Young 1972)	<i>Lutzomyia ignacioi</i>
<i>Psathyromyia (Forattiniella) barrettoi barrettoi</i> (Mangabeira 1942)	<i>Lutzomyia barrettoi barrettoi</i>
<i>Psathyromyia (Forattiniella) barrettoi majuscula</i> (Young 1979)	<i>Lutzomyia barrettoi majuscula</i>
<i>Psathyromyia (Forattiniella) carpenteri</i> (Fairchild and Hertig 1953)	<i>Lutzomyia carpenteri</i>
<i>Psathyromyia (Forattiniella) runoides</i> (Fairchild and Hertig 1953)	<i>Lutzomyia runoides</i>
<i>Psathyromyia (Forattiniella) texana</i> (Dampf 1938)	<i>Lutzomyia texana</i>
<i>Psathyromyia (Psathyromyia) campbelli</i> (Damasceno, Causey and Arouck 1945)	<i>Lutzomyia (Psathyromyia) campbelli</i>
<i>Psathyromyia (Psathyromyia) cratifer</i> (Fairchild and Hertig 1961)	<i>Lutzomyia (Psathyromyia) cratifer</i>
<i>Psathyromyia (Psathyromyia) dasymera</i> (Fairchild and Hertig 1961)	<i>Lutzomyia (Psathyromyia) dasymera</i>
<i>Psathyromyia (Psathyromyia) guatemalensis</i> Porter and Young 1986	<i>Lutzomyia (Psathyromyia) guatemalensis</i>
<i>Psathyromyia (Psathyromyia) shannoni</i> (Dyar 1929)	<i>Lutzomyia (Psathyromyia) shannoni</i>
<i>Psathyromyia (Psathyromyia) soccula</i> (Fairchild and Hertig 1961)	<i>Lutzomyia (Psathyromyia) soccula</i>
<i>Psathyromyia (Psathyromyia) souzastroi</i> (Damasceno and Causey 1944)	<i>Lutzomyia (Psathyromyia) souzastroi</i>
<i>Psathyromyia (Psathyromyia) undulata</i> (Fairchild and Hertig 1950)	<i>Lutzomyia (Psathyromyia) undulata</i>
<i>Psathyromyia (Psathyromyia) volcanensis</i> (Fairchild and Hertig 1950)	<i>Lutzomyia (Psathyromyia) volcanensis</i>
<i>Psathyromyia (Xiphomyia) aclydifera</i> (Fairchild and Hertig 1952)	<i>Lutzomyia aclydifera</i>
<i>Psychodopygus amazonensis</i> (Root 1934)	<i>Lutzomyia (Psychodopygus) amazonensis</i>
<i>Psychodopygus ayrozai</i> (Barreto and Coutinho 1940)	<i>Lutzomyia (Psychodopygus) ayrozai</i>
<i>Psychodopygus bispinosus</i> (Fairchild and Hertig 1951)	<i>Lutzomyia (Psychodopygus) bispinosus</i>
<i>Psychodopygus carrerai carrerai</i> (Barreto 1946)	<i>Lutzomyia (Psychodopygus) carrerai carrerai</i>
<i>Psychodopygus carrerai thula</i> (Young 1979)	<i>Lutzomyia (Psychodopygus) carrerai thula</i>
<i>Psychodopygus davisi</i> (Root 1934)	<i>Lutzomyia (Psychodopygus) davisi</i>
<i>Psychodopygus fairchildi</i> Barreto 1966	<i>Lutzomyia (Psychodopygus) fairchildi</i>
<i>Psychodopygus fairtigi</i> (Martins 1970)	<i>Lutzomyia (Psychodopygus) fairtigi</i>
<i>Psychodopygus nocticulus</i> (Young 1973)	<i>Lutzomyia (Psychodopygus) nocticola</i>
<i>Psychodopygus panamensis</i> (Shannon 1926)	<i>Lutzomyia (Psychodopygus) panamensis</i>
<i>Psychodopygus recurvus</i> (Young 1973)	<i>Lutzomyia (Psychodopygus) recurva</i>
<i>Sciopemyia nematoducta</i> Young and Arias 1984	<i>Lutzomyia (Sciopemyia) nematoducta</i>
<i>Sciopemyia penni</i> Arias and Freitas 1981	<i>Lutzomyia (Sciopemyia) penni</i>
<i>Sciopemyia preclara</i> Young and Arias 1984	<i>Lutzomyia (Sciopemyia) preclara</i>
<i>Sciopemyia servulolimai</i> (Damasceno & Causey 1945)	<i>Lutzomyia (Sciopemyia) servulolimai</i>
<i>Sciopemyia sordellii</i> (Shannon and Del Ponte 1927)	<i>Lutzomyia (Sciopemyia) sordellii</i>
<i>Trichophoromyia castanheirai</i> (Damasceno, Causey and Arouck 1945)	<i>Lutzomyia (Trichophoromyia) castanheirai</i>
<i>Trichophoromyia dunhami</i> (Causey and Damasceno 1945)	<i>Lutzomyia (Trichophoromyia) dunhami</i>
<i>Trichophoromyia gibba</i> Young and Arias 1994	<i>Lutzomyia (Trichophoromyia) gibba</i>
<i>Trichophoromyia lopesi</i> (Damasceno, Causey and Arouck 1945)	<i>Lutzomyia (Trichophoromyia) lopesi</i>
<i>Trichophoromyia loretensis</i> (Llanos 1964)	<i>Lutzomyia (Trichophoromyia) loretensis</i>
<i>Trichophoromyia meirai</i> (Causey and Damasceno 1945)	<i>Lutzomyia (Trichophoromyia) meirai</i>
<i>Trichophoromyia melloi</i> (Causey and Damasceno 1945)	<i>Lutzomyia (Trichophoromyia) melloi</i>
<i>Trichophoromyia napoensis</i> Young and Rodgers 1984	<i>Lutzomyia (Trichophoromyia) napoensis</i>
<i>Trichophoromyia pabloi</i> (Barreto, Burbano and Young 2002)	<i>Lutzomyia (Trichophoromyia) pabloi</i>
<i>Trichophoromyia reburra</i> (Fairchild and Hertig 1961)	<i>Lutzomyia (Trichophoromyia) reburra</i>
<i>Trichophoromyia ruii</i> Arias and Young 1982	<i>Lutzomyia (Trichophoromyia) ruii</i>
<i>Trichophoromyia sinuosa</i> Young and Duncan 1994	<i>Lutzomyia (Trichophoromyia) sinuosa</i>
<i>Trichopygomyia elegans</i> Martins, Falcao and Silva 1976	<i>Lutzomyia (Trichopygomyia) elegans</i>
<i>Trichopygomyia ferroae</i> (Young and Morales 1987)	<i>Lutzomyia (Trichopygomyia) ferroae</i>
<i>Trichopygomyia martinezii</i> Young and Morales 1987	<i>Lutzomyia (Trichopygomyia) martinezii</i>
<i>Trichopygomyia ratcliffei</i> Arias, Ready and Freitas 1983	<i>Lutzomyia (Trichopygomyia) ratcliffei</i>
<i>Trichopygomyia triramula</i> (Fairchild and Hertig 1952)	<i>Lutzomyia (Trichopygomyia) triramula</i>
<i>Trichopygomyia wagleyi</i> (Causey and Damasceno 1945)	<i>Lutzomyia (Trichopygomyia) wagleyi</i>

*Based on WRBU²² and Galati.²³

†Based on Young and Duncan⁴ and various references.

RECORDS AND DISTRIBUTION OF NEW WORLD PHLEBOTOMINE SAND FLIES (PSYCHODIDAE, DIPTERA),
WITH SPECIAL EMPHASIS ON PRIMARY TYPES AND SPECIES DIVERSITY

Table 2D. Types of New World sand flies (Phlebotominae, Psychodidae), deposited in the USNMNH and MEFSCA, with old and new generic and subgeneric classifications (continued).

New Arrangement	Old Arrangement [†]
<i>Trichopygomyia wilkersoni</i> Young and Rodgers 1984	<i>Lutzomyia (Trichophoromyia) wilkersoni</i>
<i>Trichopygomyia witoto</i> Young and Morales 1987	<i>Lutzomyia (Trichopygomyia) witoto</i>
<i>Viannamyia fariasi</i> (Damasceno, Causey and Arouck 1945)	<i>Lutzomyia (Viannamyia) fariasi</i>
<i>Warileya nigrosaccula</i> Fairchild and Hertig 1951	<i>Warileya nigrosaccula</i>
<i>Warileya phlebotomanica</i> Hertig 1948	<i>Warileya phlebotomanica</i>
<i>Warileya rotundipennis</i> Fairchild and Hertig 1951	<i>Warileya rotundipennis</i>
<i>Warileya yungasi</i> Velasco and Trapido 1974	<i>Warileya yungasi</i>

*Based on WRBU²² and Galati.²³

[†]Based on Young and Duncan⁴ and various references.

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