

First Collection Records of Phlebotomine Sand Flies (Diptera: Psychodidae) From New Jersey

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ABSTRACT The phlebotomine sand flies *Lutzomyia* (*Psathyromyia*) *shannoni* (Dyar) and *Lutzomyia* (*Helcocyrtomyia*) *vexator* (Coquillett) are reported for the first time from New Jersey. Both species were collected from ultraviolet CO₂-baited Centers for Disease Control light traps during a state-wide phlebotomine survey conducted in 2007 and 2008. *L. shannoni* has previously been reported from New Jersey; however, this observation was made in error. These collections do not represent a northern range expansion for either species.

KEY WORDS phlebotomine, sand fly, leishmaniasis, *Lutzomyia shannoni*, *Lutzomyia vexator*

The phlebotomine sand fly genus *Lutzomyia* contains ≈400 species (Young and Duncan 1994), of which 14 are found in North America (Young and Perkins 1984). We report, for the first time, collections of *Lutzomyia* (*Psathyromyia*) *shannoni* (Dyar) and *Lutzomyia* (*Helcocyrtomyia*) *vexator* (Coquillett) from New Jersey. These are the first collections of any phlebotomine from within the state, and the only two species known to occur in the northeastern United States. Previous reports of *L. shannoni* from southern New Jersey (Ostfeld et al. 2004, Duprey et al. 2006) were erroneously based on misinterpretation of a map marker located over Wilmington, Delaware, as being within New Jersey (Young and Perkins 1984) (R. Ostfeld, personal communication).

L. shannoni is associated with hardwood forest habitats ranging from Argentina to the northeastern United States (Young and Perkins 1984). Adult flies are generally collected from, or in proximity to, buttress roots and other tree hole habitats (Comer et al. 1993). Phlebotomines are weak fliers, and neither sex of *L. shannoni* dispersed >163 m in previous mark-recapture studies (Alexander 1987). Within the United States, the species has been collected from Arkansas, Alabama, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Ohio, South Carolina, and Tennessee (Young and Perkins 1984, McHugh 2005, Haddow et al. 2008, Minter et al. 2009). *L. shannoni* populations on Osabaw Island, Georgia, produced as many as three generations from April through November and overwintered as larvae (Comer et al. 1993). Female *L.*

shannoni exhibit facultative autogeny in the laboratory, although they will readily take multiple blood-meals to facilitate egg development (Young and Perkins 1984, Young and Duncan 1994). Oviposition and larval development occur in cryptic habitats (crevices, burrows, tree holes) rich in organic detritus (Rosabal and Miller 1970). This species feeds on large warm-blooded hosts, including deer, swine, and humans (Comer et al. 1994).

L. vexator has a broad distribution, ranging from Mexico to the Canadian provinces of Alberta and Ontario, and spans both coasts of the United States. It has been recorded from Alabama, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Kentucky, Louisiana, Maryland, Montana, Mississippi, New Mexico, New York, Ohio, Oklahoma, Tennessee, Texas, Virginia, Washington, and Wyoming (Young and Perkins 1984, Ostfeld et al. 2004, Haddow et al. 2008, Minter et al. 2009). The species has been recorded from diverse habitats ranging from grassland and pasture to mixed hardwood forests (Chanotis and Anderson 1968, Ostfeld et al. 2004). Gravid females oviposit within fecal chambers of rodent burrows, where the larvae feed on feces before pupation and emergence. The host preferences of wild *L. vexator* populations are poorly characterized; however, they have been reported to feed on various reptiles and amphibians (Chanotis and Anderson 1964).

Materials and Methods

An extensive phlebotomine sand fly survey was performed in New Jersey during 2007 and 2008. Fifty-four collection sites spanning all 21 counties and five physiographic provinces were sampled for *Lutzomyia* spp. using incandescent and ultraviolet (UV) Centers for Disease Control (CDC) light traps (BioQuip, Rancho Dominguez, CA) hung from tree branches at a height of 0.75 m from trap hood to ground. Traps were sup-

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plemented with a canister of compressed CO₂ gas fitted with a 15 psi regulator. A CO₂ volume of 500 ml/min was maintained by a flow rate orifice (Clarke Mosquito Control, Roselle, IL) attached to rubber tubing. The tube end was hung adjacent to the trap hood. Each site had two traps, one incandescent and one UV, running concurrently for a single trap night. Sites were sampled from the period 1 June through 30 September, coinciding with the New Jersey State Vector Surveillance Program. In addition, individual New Jersey county mosquito control programs from 10 counties provided bycatch from New Jersey Light Traps (John W. Hock, Gainesville, FL) used to track adult mosquito populations. Adult male *Lutzomyia* spp. were identified using the keys of Young and Perkins (1984) and placed in the Rutgers University Entomological Museum.

Results and Discussion

The first and only record of *L. shannoni* from New Jersey is represented by a single male collected from an UV CDC light trap on 27 August 2007. The site was located in Salem County, Pennsville (39°38'N, -75°29'W), and consisted of a deciduous hardwood forest located in the extreme southwest of the inner coastal plain province at an elevation of approximately 2 m. Tree type was predominantly oak (*Quercus* spp.) interspersed with low-lying holly (*Ilex* spp.). Subsequent collections from this site and the surrounding area in August 2007 and July 2008 yielded no other specimens.

We collected the first records of *L. vexator* (six males and nine females) in New Jersey from incandescent and UV CDC light traps on 29 July 2008. The site was located in Sussex County, Sussex (41°15'N, -74°30'W), at an elevation of 290 m within the highlands region of the Appalachian Mountains. Tree type consisted primarily of red maple (*Acer rubrum*) and oak (*Quercus* spp.). Rocky outcroppings of crystalline metamorphic rock were plentiful, as were rodent burrows, exposed tree roots, and extreme slope, all of which have previously been associated with *L. vexator* (Ostfeld et al. 2004). A subsequent collection made from the same site during the trap night of 10 August 2009 yielded large numbers of phlebotomines. A single UV light trap placed 1 m from the base of a steep rock shelf collected 104 *L. vexator*. An identical trap placed 12 m away collected 20 sand flies. Additionally, eight locations within a 1,200-m radius of the initial collection site were sampled for *L. vexator*, with all collecting sand flies. Expanded surveillance yielded collections of one to four sand flies from three additional locations as far away as 25 km, indicating this species is distributed throughout extreme northwestern New Jersey, but is only locally abundant. No phlebotomines were discovered in collections from any New Jersey light traps, which were not baited with CO₂.

Four species of the protozoan genus *Leishmania*, *Leishmania chagasi*, *Leishmania mexicana*, *Leishmania major*, and *Leishmania panamensis*, are able to develop to infectious promastigote stages within *L. shannoni*

(Travi et al. 2002, Lawyer et al. 1987, Claborn et al. 2009, Ferro et al. 1998). All four pathogens are infective to humans and are causative agents of visceral (*Le. chagasi*), cutaneous (*Le. mexicana*, *Le. major*), and mucocutaneous (*Le. panamensis*) leishmaniasis. The fly has only been implicated in transmission of *Le. mexicana* to date (Lawyer and Young 1987). Comer et al. (1990) found *L. shannoni* to be an overwintering reservoir and competent vector of vesicular stomatitis virus New Jersey serotype in Georgia. Collections of this species from Delaware have been made farther north along the Atlantic coast; thus, this collection does not represent a northerly expansion of its range.

L. vexator exhibits vector-borne disease potential among cold-blooded vertebrates. Anderson and Ayala (1968) found that California toads (*Bufo boreas halophilus*) became infected with an unknown trypanosome after feeding on infected *L. vexator*. Hemogregarines of the genus *Hepatozoon*, thought to be derived from wild snakes, have been isolated from this sand fly (Ayala 1973). It is the primary vector of *Plasmodium mexicanum*, or saurian malaria, in the western fence lizard (*Sceloporus occidentalis*) (Ayala 1971). The eastern fence lizard (*Sceloporus undulatus*) is highly susceptible to *P. mexicanum*, as 69% showed infection after a single *L. vexator* bite (Klein et al. 1987).

The presence of these hematophagous insects within New Jersey, coupled with their vector potential, warrants further study as to their exact range, host preference, and vectorial capacity. Ostfeld et al. (2004), in responding to a *Leishmania infantum* outbreak in a New York foxhound kennel, light-trapped the immediate area for potential phlebotomine vectors. They recorded the first specimens of *L. vexator* in the state <10 km away from the disease focus. A follow-up study conducted between April 2000 and December 2003 noted at least one hunting club in New Jersey with hounds positive for *Leishmania* spp. (Duprey et al. 2006). Although the authors hypothesized dog-to-dog mechanical transmission as the cause for the *Leishmania* outbreak, the discovery of *L. shannoni* within New Jersey coupled with previous isolations of this pathogen should extend vector research within the state beyond the borders of mosquitoes.

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