

SCIENTIFIC NOTE

NEW RECORDS OF MOSQUITOES IN BOLIVIA AND NORTHWESTERN ARGENTINA

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ABSTRACT. Two mosquito species, *Culex (Culex) hepperi* and *Culex (Culex) maxi* are reported for the first time for Bolivia, in Tarija department. *Aedes (Ochlerotatus) stigmaticus* and *Mansonia (Mansonia) indubitans* are the first records in Aniceto Arce province, in Tarija department, southern Bolivia. In addition, *Aedes (Protomacleaya) alboapicus* and *Culex (Phytotelmatomyia) renatoi* are reported for the first time in the northwestern region of Argentina. *Anopheles (Nyssorrhynchus) nuneztovari* s.l. is reported for the first time in Jujuy and Tucumán provinces, and *Aedes (Ochlerotatus) raymundi* and *Anopheles (Anopheles) neomaculipalpus* are the first reports in Tucumán province. The 3 species are extending their geographical distribution in these provinces. Data on the collection localities and comments about the medical relevance of some species are also presented.

KEY WORDS Culicidae, distribution, mountainous rainforest, South America

The family Culicidae includes more than 3,600 mosquito species distributed worldwide except Antarctica (Wilkerson et al. 2015). Some species are known vectors of pathogens such as arboviruses, nematodes, and protists that cause diseases, which affect humans and domestic animals (Chan-Chable et al. 2020). The mosquito fauna listed for Bolivia is updated here, reporting 2 new species in the country and extending the geographical distribution of 2 other species in southern Bolivia. This country is characterized by high levels of mosquito species diversity, but it is likely that new species will be discovered in the near future (Lardeux et al. 2009, WRBU 2022). Mosquito fauna of Argentina is also updated, reporting and extending the geographical distribution of some species. The last report on the northwestern region was carried out by Dantur Juri et al. (2020). The authors updated the list of species, increasing the number of species in the region to 184, and for Jujuy, Salta, and Tucumán provinces to 65, 100, and 64 species, respectively.

The research was conducted at different localities situated in the subtropical mountainous rainforest of Aniceto Arce province (Bolivia), and Salta, Jujuy,

and Tucumán provinces (Argentina) (Fig. 1). In Bolivia, collection sites were located in the southern area of the piedmont forest of the subtropical mountainous rainforest. In this area, the extraction of valuable woods such as *Podocarpus parlatorei* Pilg., *Juglans australis* Griseb., *Cedrela angustifolia* DC., and others, has been constant and this activity continues to affect the biodiversity of the rainforest today. Candado Chico and La Florida are included in this area near the border with Argentina. These localities are mainly located in a residual primitive forest with modifications resulting from human activities. The predominance of corn (*Zea mays* L.), followed by sugarcane (*Saccharum officinarum* L.) and potato (*Solanum tuberosum* L.) crops, and the raising of cattle, sheep, pigs, and goats are typically observed. The climate is semi-warm humid, with no winter thermal change and a well-defined dry season (Rocha Olivio 2013). In Argentina, collection sites were located within 2 major areas (northern and southern areas) of the piedmont zone of the subtropical mountainous rainforest. The northern area is characterized by the presence of trees, e.g., *Calycophyllum multiflorum* Griseb. and *Phyllostylon rhamnoides* (Pois.) Tauber, with a dense shrub stratum up to 2 m high composed of lianas, climbers, and epiphytes. Yuto, included in this northern area, is considered as a natural habitat situated in a primitive forest with several modifications due to land use. The southern area of the rainforest presents *Tipuana tipu* (Benth) and *Enterolobium contortisiliquum* (Vell.) Morong as the main trees. La Florida and Sargento Moya, included in this area, are mainly located in a residual primitive forest with modifications resulting from human activities (Brown and Grau 1995; Dantur Juri et al. 2012, 2020).

Adult mosquitoes (M = male, F = female) were collected with the Centers for Disease Control and

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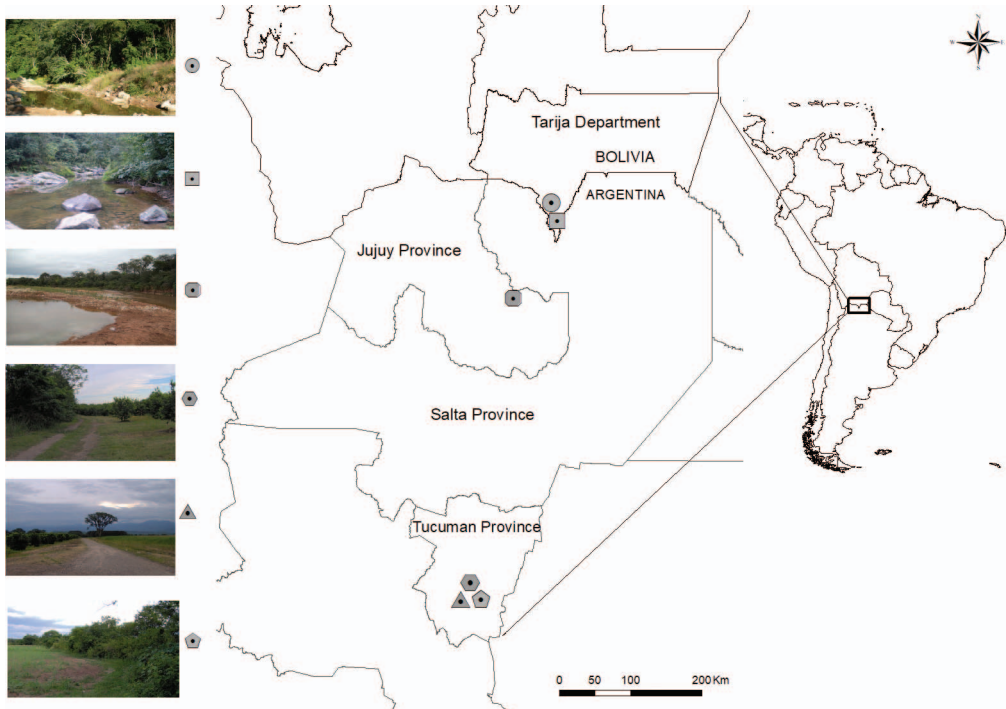


Fig. 1. Localities of mosquito collections in Bolivia and Argentina. Within each gray symbol, each characteristic dot indicates the collection localities. In Bolivia: square = Candado Chico; circle = La Florida (Tarija department). In Argentina: octagon = Yuto (Jujuy province); triangle = Sargento Moya; pentagon = La Florida; hexagon = Capitán Cáceres (Tucumán province).

Prevention light traps baited with carbon dioxide and with mechanical aspirators. Mosquito identification keys used in this study included Lane (1953), Darsie (1985), and Forattini (2002). Voucher specimens confirming these new records were deposited in the collection of Fundación Miguel Lillo, Tucumán, Argentina. The genus and subgenus abbreviations used in this paper are those defined by the Walter Reed Biosystematics Unit (WRBU 2007).

The distribution, material examined, localities, collection date, number of collected specimens, collectors (Coll.), and taxonomists (Det.) are listed below with a brief description of the species of medical importance. The species listed below are the first records from Bolivia, in Tarija department:

Culex (Culex) hepperi Casal and García. Distribution: Anguilla, Antigua and Barbuda, Argentina, Uruguay. Material examined: Tarija, Candado Chico (22°40'59"S, 64°25'60"W), 11-I-2011, 1F; Coll.: Dantur Juri, Laci, and Carrizo; Det.: Dantur Juri and Stein.

Culex (Culex) maxi Dyar. Distribution: Argentina, Brazil, Paraguay, Uruguay. Material examined: Tarija, Candado Chico, 11-I-2011, 1F; Coll.: Dantur Juri, Laci, and Carrizo; Det.: Dantur Juri and Stein. Medical relevance: Specimens of *Cx. maxi* were found naturally infected with the Venezuelan equine

encephalitis (VEE) virus during 2003-2004 in the province of Chaco, Argentina (Pisano et al. 2010).

The species listed below are the first records for Aniceto Arce province, in Tarija department:

Aedes (Ochlerotatus) stigmaticus Skuse. Distribution: Santa Cruz (Cercado, Chiquitos, Cordillera, Ichilo, Sara), Tarija (Gran Chaco), Beni (Ballivian), Cochabamba (Chapare). Material examined: Tarija, Candado Chico, 12-I-2011, 1F; Coll.: Dantur Juri, Laci, and Carrizo; Det.: Dantur Juri and Stein.

Mansonia (Mansonia) indubitans Dyar and Shannon. Distribution: Santa Cruz (Cereado, Chiquitos, Florida, Iehilo, de Chives, Sara, Velaseo, Cordillera, Valle Grande, Warnes), Pando (Abuna, Manuripi, Suárez), Beni (Cercado, Vaea Diez, Yaeuma, Moxos, Ytenez, Marban), Cochabamba (Carrasco, Chapare), Chuquisaca (Calvo, Azero), Tarija (Gran Chaco), La Paz (Caupolicán). Material examined: Tarija, La Florida (21°39'49"S, 63°18'58"W), 14-III-2012, 1F; Coll.: Dantur Juri, Laci, and Carrizo; Det.: Dantur Juri and Stein. Medical relevance: West equine encephalitis (WEE) virus was isolated from specimens identified as *Mansonia* spp., between 1982 and 1983 in Santa Fe province, Argentina (Sabattini et al. 1998).

The following species are reported for the first time from the northwestern region of Argentina:

Aedes (Protomacleaya) alboapicus Schick. Distribution: Chaco. Material examined: Tucumán, S. Moya (27°13'S, 65°39'W), 15/VIII/2004, 2F; La Florida (27°13'S, 65°33'W), 16/VIII/2004, 1F, 06/IX/2004, 1F; Coll.: Dantur Juri and Oroño; Det.: Martínez Villarroel and Dantur Juri.

Culex (Phytotelmatomyia) renatoi Lane and Ramalho. Distribution: Buenos Aires, Chaco, Corrientes, Entre Ríos, Misiones. Material examined: Tucumán, S. Moya, 16/I/2005, 1F; Coll.: Dantur Juri and Oroño; Det.: Martínez Villarroel and Dantur Juri. The species listed below are the first records for Jujuy and Tucumán provinces.

Jujuy Province: *Anopheles (Nyssorhynchus) nuneztovari* Gabaldón s.l. Distribution: Salta. Material examined: Jujuy, Yuto (23°6'S, 64°46'W), 26/X/2005, 15F, 27/X/2005, 2F, 8/XII/2005, 1F; Coll.: Dantur Juri, Laci, Carrizo, and Vianconi; Det.: Sallum Mureb and Dantur Juri. Medical relevance: *An. nuneztovari* s.l. is the major vector of malaria parasites in western and southern Venezuela and northern Colombia (Zapata et al. 2007, Abou Orm et al. 2017). In Suriname, it was reported as potential vector of *Plasmodium falciparum* Welch in different epidemic outbreaks (Faran 1980). It is also considered a secondary vector of *P. falciparum* in the Brazilian Amazon (Forattini 2002, Galardo et al. 2007).

Tucumán Province: *Aedes (Och.) raymondi* Del Ponte, Castro, and García. Distribution: Formosa, Jujuy. Material examined: Tucumán, S. Moya, 04/IV/2003, 1F, 21/IV/2003, 1F, 12/IV/2004, 1F; Coll.: Dantur Juri and Oroño; Det.: Martínez Villarroel and Dantur Juri.

Anopheles (Anopheles) neomaculipalpus Curry. Distribution: Chaco, Corrientes, Formosa, Misiones, Salta, San Juan, Santa Fe. Material examined: Tucumán, S. Moya, 13/V/2005, 1F; Coll.: Dantur Juri and Oroño; Det.: Sallum Mureb and Dantur Juri. Medical relevance: Natural infection of *An. neomaculipalpus* with *P. falciparum* parasite was detected in Colombia (Herrera et al. 1987), and it was also observed that *An. neomaculipalpus* was positive for natural infection with *Plasmodium vivax* Grassi and Feletti in southern Venezuela (Moreno et al. 2005).

Anopheles (Nyssorhynchus) nuneztovari Gabaldón s.l. Distribution: Salta. Material examined: Tucumán, S. Moya, 27/II/2002, 8F, 29/IV/2002, 2F, 2/V/2002 5F, 08/X/2002, 2F, 20/IV/2003, 3F, 13/V/2003, 6F, 15/II/2005, 1F, 29/XII/2005, 1F, C. Cáceres (27°10'N, 65°36'W), 20/XI/2003, 1F, 20/XII/2005, 4F; Coll.: Dantur Juri and Oroño; Det.: Sallum Mureb and Dantur Juri. Medical relevance: See same species reported above, for Jujuy province.

The records of *Cx. hepperi* and *Cx. maxi* in Tarija department are the first for Bolivia. The presence of *Ae. stigmaticus* and *Ma. indubitans* in the Yungas ecoregion in Aniceto province indicates that these species are extending their geographical distribution in Tarija department, from the adjacent province of

Gran Chaco. Both Aniceto and Gran Chaco provinces border northern Argentina. For Argentina, the present report updates the list of species recorded from the northwestern region of the country and increases the total number of species for the region to 186. The increase in number of species by province is as follows: Jujuy, from 65 to 66; and Tucumán, from 64 to 69. The Bermejo River forms a natural barrier between Argentina and Bolivia, but its presence does not imply that these species are isolated in each country. There is a continuous flux of migrants, which facilitates the transport of arthropods with medical and veterinary importance, and/or the causal agents of diseases transmitted by them, between border localities.

It is important to highlight the epidemiological importance of some species recorded in the present report. *Culex maxi* was found naturally infected with the Río Negro virus (VEE virus complex) in the northeast region of Argentina (Pisano et al. 2010). Meanwhile, *Ma. indubitans* was related to WEE virus, and this virus was isolated from specimens identified as *Mansonia* spp. in Santa Fe province, Argentina (Sabattini et al. 1998). Equally important is the presence of *An. nuneztovari* s.l. and *An. neomaculipalpus*, which are considered vectors of *Plasmodium* species in different areas of Bolivia (Navarro 2010), Brazil (Forattini 2002, Galardo et al. 2007), Colombia (Zapata et al. 2007), and Venezuela (Abou Orm et al. 2017). Furthermore, *An. nuneztovari* s.l. comprises a cryptic species complex in northern South America. *Anopheles goeldii* Rozeboom and Gabaldón and *An. dunhami* Causey were resurrected from synonymy with *An. nuneztovari* in the Brazilian Amazon region (Margarete Scarpassa et al. 2016). In Argentina, further investigations about the ecology, behavior, and *Plasmodium* susceptibility within the *An. nuneztovari* complex are needed.

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