J Vector Borne Dis 48, March 2011, pp. 64–66

Occurrence of *Anopheles* (*Anopheles*) *neomaculipalpus* Curry in north-western Argentina

María J. Dantur Juri[1], Marina Stein[2] & María A. Mureb Sallum[3]

[1]*Instituto Superior de Entomología "Dr. Abraham Willink", Facultad de Ciencias Naturales e Instituto Miguel Lillo, Universidad Nacional de Tucumán, Tucumán;* [2]*Departamento de Entomología, Instituto de Medicina Regional, Universidad Nacional del Nordeste, Resistencia, Chaco, Argentina;*[3]*Departamento de Epidemiología, Faculdade de Saúde Pública, Universidade de São Paulo, São Paulo, Brazil.*

Key words *Anopheles* (*Anopheles*) *neomaculipalpus;* epidemiology; north-western Argentina; Occurrence; subtropical mountainous rainforest

Malaria, which is considered as one of the most important tropical diseases, affects millons of people around the world. Its wide geographical distribution in Argentina in the 1940s is now confined only to the extreme north area of the country, where it is difficult to eradicate. Since 2000, official reports of malaria mentioned <300 cases, only 209 cases being reported in 2006[1].

The parasite involved in malaria transmission was *Plasmodium vivax*, but there were also reports of *P. malariae*, *P. falciparum* and mixed infections. *Anopheles* (*Anopheles*) *pseudopunctipennis* Theobald (Diptera: Culicidae, Anophelinae) was reported as malaria vector in north-western Argentina, and this species has been incriminated in the disease transmission until today. However, the constant fluctuations in the climatic conditions could enhance the emergence of another potential malaria vector, as suggestesd by Curto *et al*[2].

In the north-western region of the country, malaria autochtonous cases occur mostly in the rainforest, coinciding with the habitats of many anophelinae species such as *An. pseudopunctipennis, Anopheles* (*Nyssorhynchus*) *strodei* Root*, Anopheles* (*Nyssorhynchus*) *nuneztovari* Gabaldón*, Anopheles* (*Nyssorhynchus*) *rondoni* Neiva and Pinto*, Anopheles* (*Nyssorhynchus*) *rangeli* Gabaldón, Cova-Garcia and López, and *Anopheles* (*Nyssorhynchus*) *argyritarsis* Robineau-Desvoidy. Other species that share the same geographical distribution are included in the Arribalzagia series of *Anopheles* subgenus such as *Anopheles* (*Anopheles*) *fluminensis* Root, *Anopheles* (*Anopheles*) *apicimacula* Dyar and Knab and *Anopheles* (*Anopheles*) *punctimacula* Dyar and Knab. *Anopheles* (*Anopheles*) *neomaculipalpus* Curry, included in the Arribalzagia series, was never found before in the north-western area and its implications in malaria transmission is still unknown.

Anopheles neomaculipalpus is present in the Americas from Mexico to Argentina[3]. The species was described from specimens collected in Panamá, where larvae were taken from cattle footprints exposed to the sunlight in low marshy pastures. In Venezuela, *An. neomaculipalpus* was registered for several departments (Anzoátegui, Apure, Aragua, Barinas, Bolívar, Carabobo, Cojedes, Falcón, Guárico, Lara, Miranda, Monagas, Portuguesa, Sucre, Táchira, Trujillo, Yaracuy, Zulia), being extended its geographical distribution to the Distrito Federal and Mérida States, and to the Amazon region[4]. The biological and ecological aspects of this species were mainly studied in Venezuela by Rubio-Palis[5,6], including information about abundance, hematophagic activities and host preference.

In Argentina, *An. neomaculipalpus* was reported in the north-eastern provinces of Chaco, Corrientes, Formosa, and Santa Fe[7]. During an anopheline survey carried out in different localities of north-western part of the country (Salta province), *Anopheles* (*Anopheles*) and *Anopheles* (*Nyssorhynchus*) adult mosquitoes were collected. A total of 236 adult females were identified as *An. neomaculipalpus* using the identification keys of Wilkerson and Strickman[8] and Forattini[9]. This is the first report of the species for Aguas Blancas (22° 43' S, 64° 22' W; 405 m), El Oculto (23° 06' S, 64° 30' W; 508 m) and San Ramón de la Nueva Orán (23° 08' S; 64° 20' W; 362 m), north-western Argentina. Specimens were collected from 8–10 April 2004 at dusk, with CDC light-traps baited with CO_2. The collection localities are included in the subtropical mountainous rainforest. The sampling sites were bordering the forest, with typical marshy areas where cattle graze. Additionally, in the same areas, specimens of *An. pseudopunctipennis, An. strodei, An. argyritarsis, An. rondoni* and *An. rangeli* were also collecetd.

The subtropical mountainous rainforest include several indigenous tree species such as "orán cedar" (*Cedrela angustifolia*), "palo amarillo" (*Phyllostylon rhamnoides*), "palo blanco" (*Calycophyllum multiflorum*), "afata" (*Cordia tricótoma*) and "lapacho" (*Tabebuia avellanedae*). This native vegetation was partially replaced by corn, sugarcane, beans, bananas, soy, citrus, pumpkin, tomato and cucumber crops. The climate is subtropical with seasonal rain between November and April. From May to October,

fog and low intensity rains are common. The temperature varies strongly throughout the year and during the day. It is possible to distinguish three seasons, a warm and dry spring (September–December), a warm and rainy summer (January–April), and a temperate-cool and humid season that represents the autumn-winter period (May–August)[10]. The rainforest environment (native vegetation and crops) plus the climatic conditions seem to be favouring the species adaptation in the area, that is continuously modified by anthropic activities including deforestation for agriculture, cattle raising and urbanization.

According to Wilkerson and Strickman's[8] and Forattini[9] keys, *An. neomaculipalpus* can be separated from other morphologically similar species by the presence of two large, evident dark spots in the anterior vein (Fig. 1A and B), a few posterolateral pale scales on the abdominal sternum I (Fig. 1C) and hind tarsomere 5 with a dark band in the middle portion (Fig. 1D). The specimens collected in the subtropical mountainous rainforest possess these characteristics that allowed us to identify them as *An. neomaculipalpus*. All the specimens collected were deposited as adult female vouchers with the wings mounted in microscope slides in the collection of Miguel Lillo Foundation (IMLA), Tucumán, Argentina.

About vector competency, Simmons[11] reported to the Panama Canal Zone the experimental infection of *An. neomaculipalpus* with *P. vivax*, which proved that this species was suceptible to the infection. Rubio-Palis *et al*[12] reported that during their studies in Venezuela *An. neomaculipalpus* was not found naturally infected with *Plasmodium* spp. A different situation was reported by Herrera *et al*[13] and Moreno *et al*[3]. The former, using an immunoradiometric assay, found natural infection of *An. neomaculipalpus* with *P. falciparum* parasite in eastern Colombia. Moreno *et al*[3] through a longitudinal study in different localities of Venezuela, found that *An. neomaculipalpus* was positive for natural infection with *P. vivax* CS protein, it having the higher sporozoite rate compared with *Anopheles* (*Nyssorhynchus*) *marajoara* Galvao and Damasceno and being similar to *Anopheles* (*Nyssorhynchus*) *darlingi* Root. According to the vectorial capacity, in western areas of Venezuela, the hematophagic activity of *An. neomaculipalpus* showed that the species tends to be more exophagic than endophagic, with a high percentage of specimens captured close to the dwellings. Besides, it was found that its hematophagic activity was registered during the first hours of the afternoon[5]. Later, Rubio-Palis *et al*[6] reported *An. neomaculipalpus* as a highly anthropophilic mosquito, exhibiting a human-blood index (HBI) of 43% when it was compared with *An. nuneztovari* (HBI ¼ 18.5%), the main malaria vector for the western Venezuela.

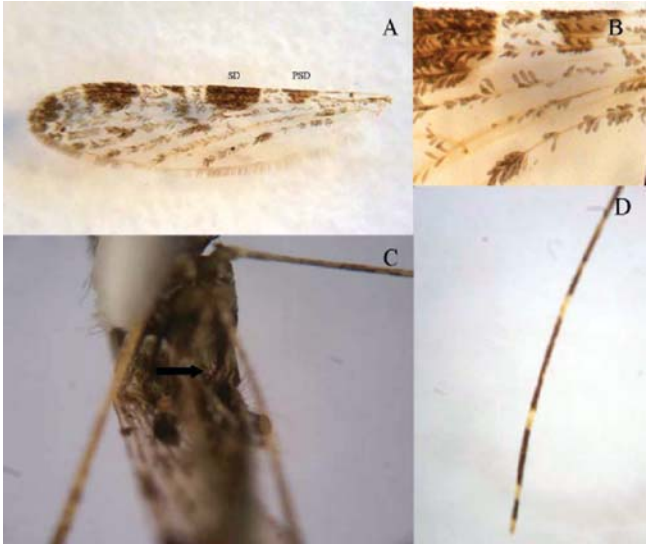

Fig. 1: Adult female of *Anopheles* (*Anopheles*) *neomaculipalpus*. A: wing with two prominent dark spots: presector dark spot (PSD) and sector dark spot (SD) on the anterior veins. B: narrow scales on the proximal area of the M wing vein. C: abdominal sternite I with a few posterolateral pale scales. D: hind tarsomere 5 with a dark band.

These findings are epidemiologically important because little is known about malaria transmisision by this species. *Anopheles neomaculipalpus* could play a role as a secondary vector, it being eventually incriminated in malaria transmission in forest areas recently occupied by humans.

In summary, malaria transmission is still an important public health problem in north-western Argentina. The anophelinae fauna of this region includes species of the *Nyssorhynchus* and *Anopheles* subgenus, which are well-known vectors of malaria. Due to the native vegetation and the climatic conditions, the species seems to be adapted to the subtropical mountainous rainforest environment. However, growing activities related to massive deforestation for wood use and agriculture, urbanization and global climatic changes are continuously modifying the landscape where mosquito adults breed. This situation may have influenced the apparition of *An. neomaculipalpus*, this paper being the first report of the species for the region as well as an important epidemiological finding since *An. neomaculipalpus* could play a role as malaria vector in the north-western Argentina.

ACKNOWLEDGEMENTS

The authors thank Neri Vianconi and Enrique Laci (Coordinación Nacional de Control de Vectores, Ministerio

de Salud de la Nación) for their assistance in the field work. This work was supported by Agencia Nacional de Promoción Científica y Tecnológica (FONCyT); Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET); Consejo de Investigaciones de la Universidad Nacional de Tucumán (CIUNT) and Coordinación Nacional de Control de Vectores (Ministerio de Salud de la Nación). M. J. Dantur Juri is a member of the CONICET in Argentina.

REFERENCES

1. *World Malaria Report 2008.* WHO Library Cataloguing-in-Publication Data. Geneva: World Health Organization 2008; pp. 190.
2. Curto SI, Carbajo AE, Boffi R. Aplicación de sistemas de información geográfica en epidemiología. Caso de estudio: Malaria en la Argentina (1902–2000). *Contribuciones Científicas GÆA Sociedad Argentina de Estudios Geográficos* 2003; p. 239–48.
3. Moreno JE, Rubio-Palis Y, Páez E, Pérez E, Sánchez V, Vaccari E. *Anopheles* (*Anopheles*) *neomaculipalpus*: a new malaria vector in the Amazon basin? *Med Vet Entomol* 2005; *19:* 329–32.
4. Berti J, Mora J, Menares C. Nuevo registro sobre la distribución geográfica de *Anopheles neomaculipalpus* Curry, 1931 (Diptera: Culicidae) en Venezuela. *Bol Entomol Venezolana* 1996; *11:* 1–199.
5. Rubio-Palis Y. Abundancia y actividad hematofágica de *Anopheles rangeli*, *An. strodei* y *An. neomaculipalpus* en el occidente de Venezuela. *Bol Dirección Malariol Saneamiento Ambiental* 1992; *32:* 59–67.
6. Rubio-Palis Y, Curtis CF, González C, Wirtz RA. Host choice of anopheline mosquitoes in a malaria endemic area of western Venezuela. *Med Vet Entomol* 1994; *8:* 275–80.
7. Campos RE, Maciá A. Culicidae. In: Morrone JJ, Coscarón S, editors. *Biodiversidad de artrópodos argentinos. Una aproximación biotaxonómica*. Ediciones Sur, La Plata, Argentina, 1998; p. 291–303.
8. Wilkerson RC, Strickman D. Illustrated key to the female Anophelinae mosquitoes of Central America and Mexico. *J Am Mosq Control Assoc* 1990; *6:* 7–34.
9. Forattini OP. *Culicidologia médica: identificação, biologia, epidemiologia* Vol. 2. São Paulo, Brazil: Editora da Universidade de São Paulo 2002.
10. Brown AD. Las selvas de montaña del noroeste de Argentina: problemas ambientales e importancia de su conservación. In: Brown AD, Grau HR, editors. *Investigación, conservación y desarrollo en las selvas subtropicales de montaña* laboratorio de investigaciones Ecológicas de las Yungas, Universidad Nacional de Tucumán, Tucumán, Argentina 1995; p. 9–18.
11. Simmons JS. *Anopheles* (*Anopheles*) *neomaculipalpus* Curry, experimentally infected with malaria Plasmodia. *Science* 1936; *84:* 202–3.
12. Rubio-Palis Y, Wirtz RA, Curtis CF. Malaria entomological inoculation rates in western Venezuela. *Acta Tropica* 1992; *52:* 167–74.
13. Herrera S, Suárez MF, Sánchez GI, Quiñónez ML, Herrera M. Uso de la técnica inmuno-radiométrica (IRMA) en *Anopheles* de Colombia para la identificación de esporozoítos de *Plasmodium*. *Colombia Médica* 1987; *18:* 2–6.

Correspondence to: María J. Dantur Juri, Instituto Superior de Entomología "Dr. Abraham Willink", Facultad de Ciencias Naturales e Instituto Miguel Lillo, Universidad Nacional de Tucumán, Miguel Lillo 205, CP 4000, Tucumán, Argentina.
E-mail: juliadantur@yahoo.com.ar

Received: 19 October 2010 *Accepted in revised form:* 22 February 2011