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First record of *Aedeomyia squamipennis* (Lynch Arribálzaga, 1878) (Diptera: Culicidae) in the state of Maranhão: epidemiological implications and distribution in Brazil

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Abstract: We record *Aedeomyia squamipennis* from the state of Maranhão, Brazil (municipalities of Bacurituba, Barra do Corda, Cajapió, Governador Nunes Freire, and Santo Amaro do Maranhão). We show that this species is well distributed in the state. The potential in the epidemiology of avian malaria and arboviruses is discussed briefly in connection with its discovery in Santo Amaro do Maranhão, due to the great number of bird species on Lake Santo Amaro. Finally, we present the known distribution of the species in Brazil.

Key words: avian malaria; biomes transition; epidemiology; mosquito; Neotropical Region; South America; vector

The family Culicidae is currently divided into two subfamilies: Anophelinae with 488 formally described species; and Culicinae with 3,067 (Harbach & Kitching 1998; Harbach 2017). Among the 11 tribes of Culicinae, Aedeomyiini is the smallest, with only seven described species in a single genus, *Aedeomyia* Theobald, 1901. *Aedeomyia* has two subgenera: *Aedeomyia* s.s. with six species occurring in the tropics, and the monotypic *Lepiothauma* Enderlein, 1923, recorded in the Afrotropical region only (Tyson 1970; Brunhes et al. 2011).

Aedeomyia is pantropical, with all species occurring in the southern hemisphere. Four species extend their distribution north of the Equator but do not reach the Tropic of Cancer (Belkin 1962; Tyson 1970). This genus is represented in the New World only by *Aedeomyia (Aedeomyia) squamipennis* (Lynch Arribálzaga, 1878: 151), an exclusively Neotropical species whose distribution extends from Argentina to Mexico (Lane 1953). Although Belkin et al. (1970) suggested that *Ad. squamipennis* may represent a species complex, until now no close new taxa have been described in the Neotropics.

Larvae of *Ad. squamipennis* have so far only been found in water sources with aquatic vegetation (Belkin 1962; Gabaldon et al. 1981; Consoli & Lourenço de Oliveira 1994). The adults are considered by many to be nocturnal and ornithophilic (Gabaldon et al. 1977a, 1977b, 1981; Lourenço-de-Oliveira & Silva 1985; Consoli & Lourenço de Oliveira 1994; Naves et al. 1998; Forattini 2002). Not surprisingly, this species has been found naturally infected with avian *Plasmodium* Marchiafava & Celli, 1885 (Gabaldon et al. 1977b, 1985; Gager et al. 2008) as well as Venezuelan Equine Encephalitis virus complex (Mitchell et al. 1985), Gamboa group (Dégallier et al. 1992) and Bunyawera group (Turell et al. 2005) arboviruses. The first two arboviruses are suspected of spending some portion of the intrinsic incubation period in birds (Mitchell et al. 1985; Dégallier et al. 1992).

Aedeomyia squamipennis is well distributed in Brazil, yet prior to this study this species had not been found in Maranhão (Xavier & Mattos 1989a), despite being known to occur in the neighboring Pará and Piauí states (Xavier & Mattos 1975; Xavier et al. 1979).

Maranhão is located in a privileged position with respect to geography, in the transition zone between the two largest Brazilian biomes, the Amazon and the Cerrado, thus forming several different physiognomies (Rebêlo

et al. 2007). The state contains the largest continuous band of Brazilian mangrove (Rebelo-Mochel 2011) and a small portion of Caatinga biome, with a predominance of deciduous and seasonal sub-deciduous vegetation (Velloso et al. 2002). It also contains an extensive floodplain area called 'Baixada Maranhense' formed by flooded terrain, mangroves and sandbanks (Veloso 1964). The latter area is greatly affected by the rainy season, which causes the formation of large lakes that completely alter the local landscape, making it akin to the Brazilian Pantanal. Northeastern Maranhão contains a unique ecosystem called the 'Lençóis Maranhenses', consisting of Restinga vegetation, freshwater lagoons, and lush sandy dunes (Miranda et al. 2012).

According to the literature, prior to this study there were 78 species of mosquitoes recorded in Maranhão state (Vasconcelos et al. 1989; Xavier & Mattos 1989a; Motta & Lourenço-de-Oliveira 1995; Ahid & Lourenço-de-Oliveira 1999; Rebêlo et al. 2007). We present in this manuscript the first record of *Ad. squamipennis* in Maranhão, describing its range in the state and its distribution in Brazil, as did Blanton & Peyton (1957) for Panama and Gabaldon et al. (1981) for Venezuela.

The specimens used in this article are from three different studies. The first is an extensive inventory of phlebotomines conducted under the auspices of the Ministry of Health in the 11 municipalities with the highest rate of leishmaniasis in state. This research lasted two years (May 2012 to April 2014), in which samples were taken monthly and simultaneously in all municipalities studied. The second was the capture of sand flies, carried out in the vicinity of the Lençóis Maranhenses National Park, in villages of Barreirinhas and Santo Amaro do Maranhão, as described by PEREIRA-FILHO et al. (2015). The third is an inventory of sandflies in neighboring municipalities of Bacurituba and Cajapió in June 2016, both in region of Baixada Maranhense. All collections used incandescent, HP type CDC light traps (Pugedo et al. 2005) that were activated during 12 hours (18:00-06:00 h).

All specimens were taken to the Laboratório de Entomologia e Vetores at the Universidade Federal do Maranhão (LEV/UFMA), where insects were screened and identified. The capture methods used were not species-specific, thus in addition to sandflies other insect groups were eventually caught by these traps, including mosquitoes. Vouchers specimens were pinned and deposited in the Coleção de Culicidae da Fiocruz (Fiocruz-CCULI), Rio de Janeiro-RJ, Brasil (Table 1). No samples for DNA were taken from the vouchers.

Aedeomyia squamipennis distribution map was created using the Quantum GIS version 2.16.2 (Figure 1). Data of distribution were derived from extensive review of studies reporting *Ad. squamipennis* in Brazil (Appendix, Table A1). Geographic coordinates were found in literature and internet sources, in some cases this data were approximate, but some localities coordinates were not found. Datum used for geographic coordinates was South American Datum (SAD69).

Identification was carried out by first using the key to Culicidae genera proposed by Consoli & Lourenço de Oliveira (1994), then using the key proposed by Tyson (1970) to identify species within genus *Aedeomyia*, and Brunhes et al. (2011) as a supplementary tool. Furthermore, Dr. Monique Motta of the Laboratório de Mosquitos Transmissores de Hematozoários - Instituto Oswaldo Cruz (LATHEMA-IOC/Fiocruz) confirmed identifications by visual inspection of adults in stereomicroscope.

Aedeomyia squamipennis is the only representative of tribe Aedeomyiini in New World (Figure 2). Differs from all other mosquitoes of this region by following combination of characters: apex of mid and hindfemora with large tufts of outstanding scales (Figure 3); broad scales on torus, clypeus and flagellomere I; all flagellomeres thick and short; and flagellomeres II–XIII nearly equal in length (Figure 4); wings covered with broad yellowish, white and dark scales (Figure 5).

Aedeomyia squamipennis was found in five municipalities of Maranhão (specific localities are noted in parenthesis): Bacurituba (Santa Maria: –2.774784°, –45.723723°), Barra do Corda (Novo Brejo: –5.759478°, –45.3236°), Cajapió (Posto de Seleção: –2.839606°, –44.7244°), Governador Nunes Freire (Portão: –2.070258°, –45.8823°) and Santo Amaro do Maranhão (Riachão: –2.827825°, –43.1273°). Barra do Corda is located in the central region of the state, with a predominance of Cerrado vegetation and mixed forest (equatorial evergreen open forest with Cocal) (IBGE 1984). Governador Nunes Freire lies in the northwestern part of the Amazonian, although with quite deforested areas. Bacurituba and Cajapió are situated in north of state, near to the Rio Mearim mouth, in Baixada Maranhense region. Santo Amaro do Maranhão is located on the northeastern coast near the Lençóis Maranhenses National Park, which contains Restinga vegetation on paleodunes, associated with Cerrado (IBGE 1984).

Data presented in this study indicate that *Ad. squamipennis* is well distributed in the state of Maranhão, occurring in the central, north, northeastern and northwestern portions. With the inclusion of Maranhão now this species

Table 1. Voucher specimens of *Aedeomyia squamipennis* collected in Maranhão state deposited in the Coleção de Culicidae da Fiocruz (Fiocruz-CCULI).

CCULI number	Municipality	Locality	Collection date
3675	Santo Amaro do Maranhão	Riachão	15.XII.2011
3676	Governador Nunes Freire	Portão	09.X.2013
3677	Barra do Corda	Novo Brejo	25.III.2013
4036	Bacurituba	Santa Maria	10.VI.2016
4037	Cajapió	Posto de Seleção	08.VI.2016

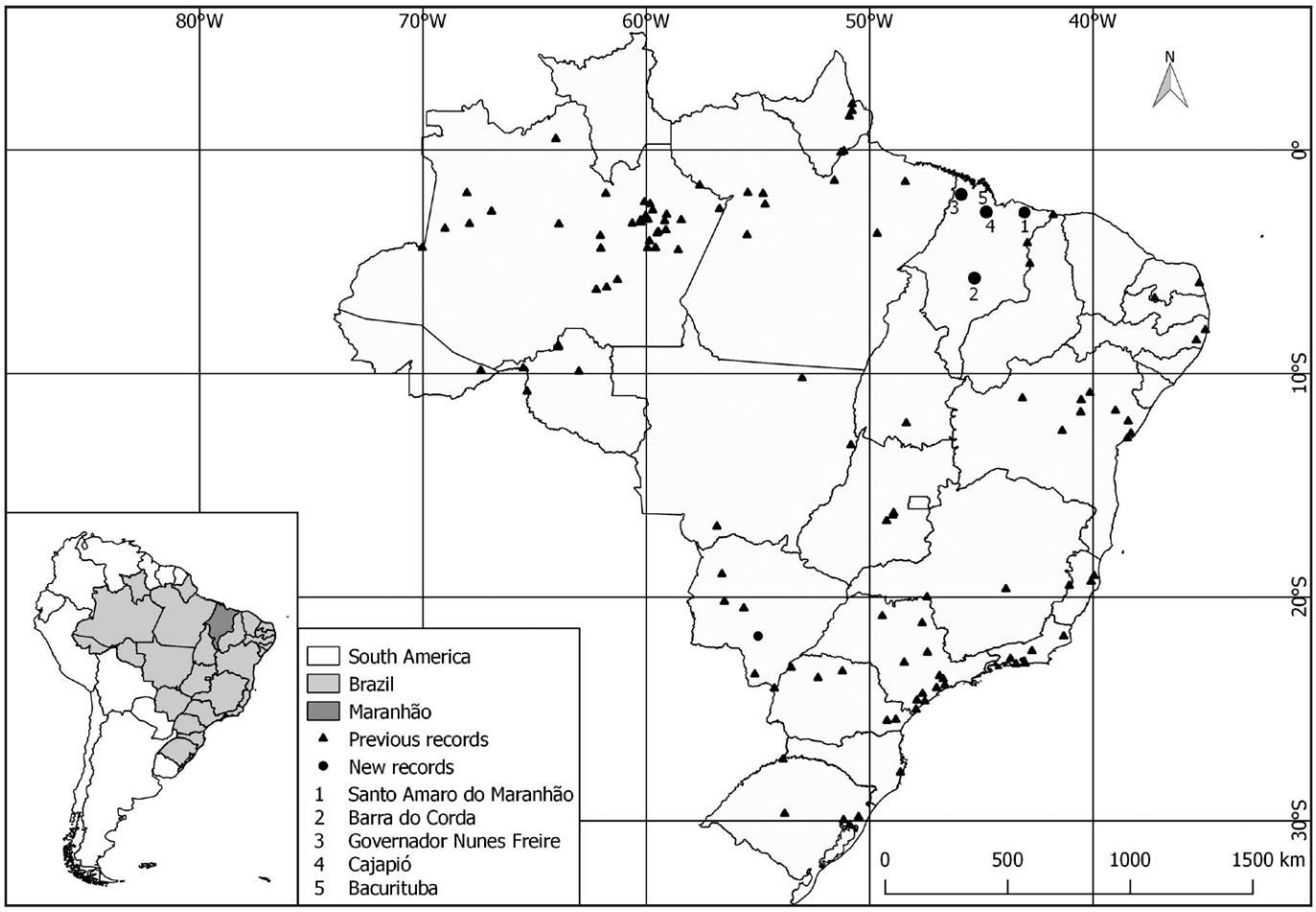

Figure 1. Geographic distribution of *Aedeomyia squamipennis* in Brazil based on literature records and collection data (black triangles), and new records from Maranhão state (black dots), based on present study.

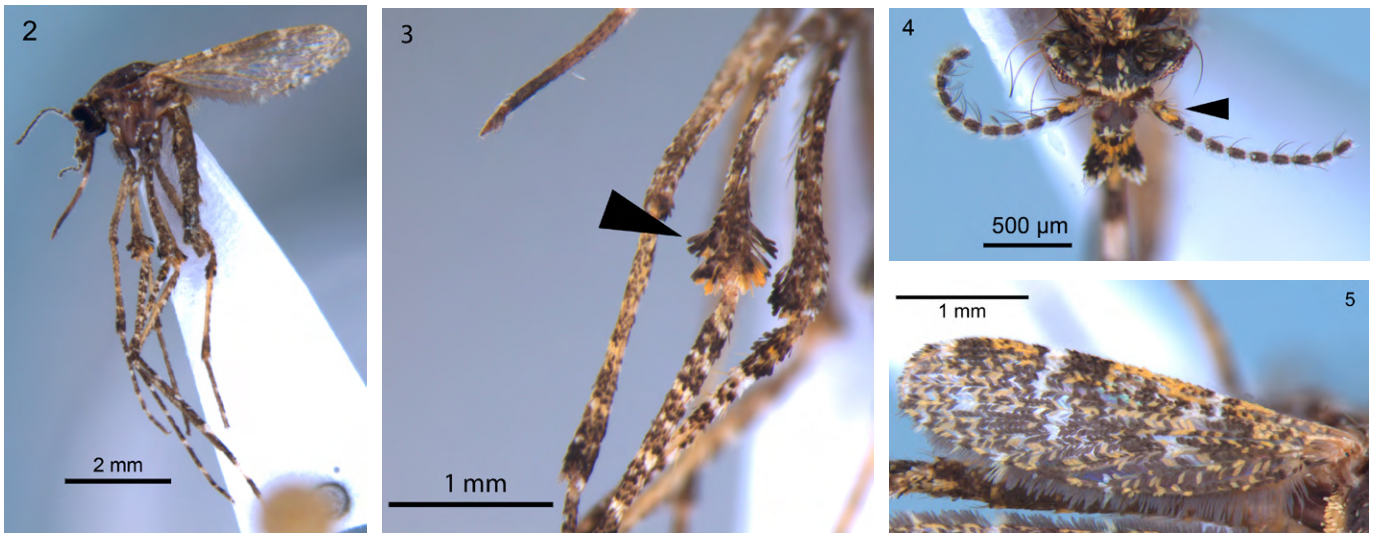

Figura 2–5. Some specimens of *Aedeomyia squamipennis* used in this study. 2. Female habitus of *Ad. squamipennis* (CCULI-4036). 3. Erect scales tufts at apex of the mid and hindfemur (CCULI-4036). 4. Scales covering the clypeus, torus and flagellomere I, all flagellomeres thick and short nearly equal in length (CCULI-4037). 5. Wing scales yellowish, white, and dark (CCULI-4037). Photos by Alexandre Xavier.

has been recorded in 21 federal states. The only states without records of this species are Roraima in the North region, Alagoas, Ceará, Paraíba and Sergipe in the Northeast, the Federal District in the Central-West.

Specimens of *Ad. squamipennis* were collected in trap installed in a henhouse in the Riachão location, Santo Amaro do Maranhão municipality, providing evidence for the ornithophilic and nocturnal behavior (Gabaldon et al. 1977a, 1977b; Lourenço-de-Oliveira & Silva 1985; Consoli & Lourenço de Oliveira 1994; Naves et al. 1998; Forattini 2002). Ornithophilic mosquitoes are often suspected during avian disease outbreaks. For

example, during an avian malaria epidemic in Venezuela, investigations to determine the ornithophilous species (Gabaldon et al. 1977a) revealed *Ad. squamipennis* as a natural vector of avian malaria at that time (Gabaldon et al. 1977b). Gabaldon et al. (1985) suggested that this species is the likely vector *Fallisia (Plasmodioides) neotropicalis* Gabaldon, Ulloa & Zerpa, 1985 in Venezuela, and had previously been considered a vector of *Plasmodium* from subgenera *Giovannolaia* Corradetti, Garnham & Laird, 1963 and *Novyella* Corradetti, Garnham & Laird, 1963 (Gabaldon et al. 1977b). *Aedeomyia squamipennis* was also found infected with *Plasmodium* strain PAN6 in Panama (Gager et al. 2008). In a lengthy study that investigated infection of birds by haemosporidians in the Peruvian Amazon, Svensson-Coelho et al. (2013) found a *Plasmodium* strain similar to that observed for Gager et al. (2008), and thus suspected *Ad. squamipennis* as the vector.

This species has also been implicated in arbovirus cycles, with prior investigators having isolated from adult mosquitoes Gamboa group virus, in which the natural cycle seems to involve birds (Dégallier et al. 1992), as well as Venezuelan Equine Encephalitis (VEE) virus complex (Mitchell et al. 1985). Although birds are not considered important hosts of VEE, Dickerman et al. (1976) showed that some Ciconiiformes can play a role in maintaining enzootic cycles. Such data demonstrate the capacity of *Ad. squamipennis* for contracting various parasites.

It is known that vector susceptibility to a parasite species can vary among populations, a phenomenon that may be explained by a combination of environmental conditions and ecological factors potentially altering vector-pathogen-host interactions (Santiago-Alarcon et al. 2012), in addition to behavioral and ecological variation. Although *Ad. squamipennis* has never been found infected with avian *Plasmodium* in Brazil (Santiago-Alarcon et al. 2012), this record in Santo Amaro do Maranhão indicates some epidemiological potential. The municipality lies on the Santo Amaro Lake, which borders the western edge of the Lençóis Maranhenses National Park. Soares & Rodrigues (2009) observed at least 41 species of birds occupying that lake, including resident and Nearctic migratory shorebirds (i.e., families Caradriidae and Scolopacidae). These two shorebird families are especially abundant in the dry season, which extends from September to November. Data from Soares & Rodrigues (2009) associated the presence of *Ad. squamipennis* in practically the same area as indicative of the potential vulnerability of the region to avian malaria and some arboviruses. The presence of migratory birds in the region may serve as a source of infection, and resident bird as point for dispersion of local parasite populations. Interestingly, of the 14 species of Ciconiiformes found by Gabaldon et al. (1985) to be infected by *F. neotropicalis* in Venezuela, six were later reported on Lake Santo Amaro by Soares & Rodrigues (2009). There have been no ecological studies of mosquito fauna in Santo Amaro do Maranhão (and studies of mosquitoes are generally lacking in other municipalities as well), thus this is the first record of Culicidae species in this municipality.

This new record of *Ad. squamipennis* raises the number of known mosquitoes species in Maranhão to 79. Based on its geographical position in transition zone and the wealth of ecosystems, lack of previous records of *Ad. squamipennis* may be explained by the lack of culicidofauna surveys. This finding indicates the need for entomological surveys in representative areas of the state, in order to better estimate the number of existing mosquito species. Studies that address ecological, behavioral and epidemiological facets of these organisms should also be carried out.

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LITERATURE CITATED

Ahid, S.M.M. & R. Lourenço-de-Oliveira. 1999. Mosquitos vetores potenciais de dirofilariose canina na Região Nordeste do Brasil. Revista de Saúde Pública 33(6): 560–565. doi: 10.1590/S0034-89101999000600007

Alencar, J., E.S. Lorosa, J. dos S. Silva, C.M. Lopes & A.E. Guimarães. 2005. Observações sobre padrões alimentares de mosquitos (Diptera: Culicidae) no Pantanal Mato-Grossense. Neotropical Entomology 34(4): 681–687. doi: 10.1590/S1519-566X2005000400020

Barata, R.A., R.L. Ursine, F.P. Nunes, D.H. Morais & H.S. Araújo. 2012. Synanthropy of mosquitoes and sand flies near the Aimorés hydroelectric power plant, Brazil. Journal of Vector Ecology 37(2): 397–401. doi: 10.1111/j.1948-7134.2012.00243.x

Barbosa, O.C., U. Teodoro, A.L. Lozovei, V. La Salvia Filho, R.P. Spinosa, E.M. de Lima & M.E.M.C. Ferreira. 1993. Nota sobre culicídeos adultos coletados na Região Sul do Brasil. Revista de Saúde Pública 27(3): 214–126. doi: http://doi.org/dv9wzv

Barbosa, M. das G.V., N.F. Fé, A.H.R. Marcião, A.P.T. da Silva, W.M. Monteiro, M.V. de F. Guerra & J.A. de O. Guerra. 2008. Registro de Culicidae de importância epidemiológica na área rural de Manaus, Amazonas. Revista da Sociedade Brasileira de Medica Tropical 41(6): 658–663. doi: http://doi.org/d9szv8

Barghini, A., P.R. Urbinatti & D. Natal. 2004. Atração de mosquitos (Diptera: Culicidae) por lâmpadas incandescentes e fluorescentes. Entomología y Vectores 11(4): 611–622. doi: http://doi.org/bkt3pj

Belkin, J.N. 1962. The Mosquitoes of the South Pacific (*Diptera, Culicidae*) [sic]. Berkeley and Los Angeles: University of California Press. Volume 1. xii + 608 pp.

Belkin, J.N., S.J. Heinemann & W.A. Page. 1970. Mosquito Studies (Diptera, Culicidae). XXI. The Culicidae of Jamaica. Contributions of the American Entomological Institute 6(1): 1–458.

Blanton, F.S. & E.L. Peyton. 1957. Distribution of *Aedeomyia squamipennis* (Diptera, Culicidae) in Panama based on light trap surveys. Mosquito News 17(2): 98–99.

Brunhes, J., P. Boussès & H. da Cunha Ramos. 2011. Les *Aedeomyia* Theobald, 1901, des régions afro-tropicale et malgache (Diptera, Culicidae). Bulletin de la Société Entomologique de France 116(1): 99–128.

Cardoso, J. da C., E. Corseuil & J.M.S. Barata. 2005. Culicinae (Diptera: Culicidae) ocorrentes no Estado do Rio Grande do Sul, Brasil. Revista Brasileira de Entomologia 49(2): 275–287. doi: 10.1590/S0085-56262005000200013

Cerqueira, N.L. 1961. Distribuição geográfica dos mosquitos da Amazônia (Diptera, Culicidae, Culicinae). Revista Brasileira de Entomologia 10: 111–168.

Chagas, E., A. Marques da Cunha, G. de Oliveira Castro, L. Castro Ferreira & C. Romaña. 1937. Leishmaniose Visceral Americana (Nova entidade morbida do homem na America do Sul) Relatório dos trabalhos realisados pela comissão encarregada do estudo da Leishmaniose Visceral Americana em 1936. Memórias do Instituto Oswaldo Cruz 32(3): 321–389 + 45 pls. doi: 10.1590/S0074-02761937000300001

Consoli, R.A.G.B. & R. Lourenço de Oliveira. 1994. Principais mosquitos de importância sanitária no Brasil. Rio de Janeiro: Editora FIOCRUZ. 228 pp. doi: 10.7476/9788575412909

Corradetti, A., P. Garnham & M. Laird. 1963. New classification of the avian malaria parasites. Parassitologia 5(1): 1–4.

Costa, O.R. 1956. Inquérito nosológico entre escolares, realizado em quatro municípios da Paraíba e em tres de Pernambuco. Revista do Serviço Especial de Saúde Pública 8(2): 423–468.

Deane, L.M. & J.A. Ferreira Neto. 1969. Malária em macacos do Estado do Rio Grande do Sul. Observações preliminares. Revista do Instituto de Medicina Tropical de São Paulo 11(5): 299–305. http://www.imt.usp.br/images/pdf/revista/vol11/299-305.pdf

Deane, L.M., J.A. Ferreira Neto, N.L. Cerqueira & F.B. de Almeida. 1968. Studies on monkey malaria in the vicinity of Manaus, state of Amazonas, Brazil. Revista do Instituto de Medicina Tropical de São Paulo 10(6): 335–341. http://www.imt.usp.br/images/pdf/revista/vol10/335-341.pdf

Dégallier, N., A.P.A. Travassos da Rosa, P.F.C. Vasconcelos, J.-P. Hervé, G.C. Sá Filho, J.F.S. Travassos da Rosa, E.S. Travassos da Rosa & S.G. Rodrigues. 1992. Modifications of arbovirus transmission in relation to construction of dams in Brazilian Amazon. Ciência e Cultura 44(2–3): 124–135.

Dibo, M.R., R.M.T. de Menezes, C.P. Ghirardelli, A.L. Mendonça & F. Chiaravalloti Neto. 2011. Presença de culicídeos em um município de porte médio do Estado de São Paulo e risco de ocorrência de Febre do Nilo Ocidental e outras arboviroses. Revista da Sociedade Brasileira de Medicina Tropical 44(4): 496–503. doi: 10.1590/S0037-86822011000400019

Dickerman, R.W., C.M. Bonacorsa & W.F. Scherer. 1976. Viremia in young herons and ibis infected with Venezuelan Encephalitis Virus. American Journal of Epidemiology 104(6): 678–683. http://aje.oxfordjournals.org/content/104/6/678.full.pdf+html

Duret, J.P. & M.P. Barreto. 1956. Notas sôbre culícidas do Estado de São Paulo, Brasil, com descrições de três novas espécies de *Culex* (*Diptera, Culicidae*) [sic]. Revista Brasileira de Entomologia 5: 81–99.

Dutra, A.P., D. Natal, R.M. Tubaki, J.M.S. Barata, R.M.T. Menezes, P.R. Urbinatti & A.I.P. Costa. 1996. Mosquitos (Diptera, Culicidae) da Reserva Estadual de Pedro de Toledo (Juquitiba, SP, Brasil). Revista Brasileira de Entomologia 40(3–4): 375–378.

Enderlein, G. 1923. Zur Kenntnis afrikanischer und orientalischer Culiciden. Wiener Entomologische Zeitung, 40(1–4): 25–29.

Fé, N.F., M. das G.V. Barbosa, F.A.A. Fé, M.V. de F. Guerra & W.D. Alecrim. 2003. Fauna de Culicidae em municípios de zona rural do Estado do Amazonas, com incidências de Febre Amarela. Revista da Sociedade Brasileira de Medicina Tropical 36(3): 343–348. doi: 10.1590/S0037-86822003000300005

Fernandes, G. de O. 2011. Culicídeos vetores em uma Unidade de Conservação da Caatinga na Região do Seridó no Rio Grande do Norte – aspectos da transmissão de doenças. [M.Sc. dissertation]. Natal: Universidade Federal do Rio Grande do Norte. 119 pp. http://repositorio.ufrn.br:8080/jspui/handle/123456789/18217?mode=full

Ferreira-de-Freitas, V., R.M. França, L.C. Bartholomay & C.B. Marcondes. 2017. Contributions to the biodiversity assessment of mosquitoes (Diptera: Culicidae) in the Santa Catarina, Brazil. Journal of Medical Entomology 54(2): 368–376. doi: 10.1093/jme/tjw196

Fiocruz-CCULI. 2016. Coleção de Culicidae. Accessed at http://cculi.fiocruz.br/index, 24 October 2016.

Forattini, O.P. 2002. Culicidologia médica: identificação, biologia, epidemiologia. São Paulo: Editora da Universidade de São Paulo. Volume 2. 864 pp.

Forattini, O.P., E.X. Rabello & M. da D. Cotrim. 1970. Catálogo das Coleções Entomológicas da Faculdade de Saúde Pública da Universidade de São Paulo (1.ª Série) *Culicidae* [sic]. Revista de Saúde Pública 4(Nº especial): 1–100.

Forattini, O.P., E.X. Rabello & M. das D. Cotrim. 1973. Catálogo das Coleções Entomológicas da Faculdade de Saúde Pública da Universidade de São Paulo – (2.ª Série I) – *Culicidae* [sic]. Revista de Saúde Pública 7(4): 453–479. doi: 10.1590/S0034-89101973000400014

Forattini, O.P., A. de C. Gomes, E.A.B. Galati, E.X. Rabello & L.B. Iversson. 1978. Estudos ecológicos sobre mosquitos Culicidae no Sistema Serra do Mar, Brasil. 1 – observações no ambiente extradomiciliar. Revista de Saúde Publica 12(3): 297–325. doi: 10.1590/S0034-89101978000300005

Forattini, O.P., A. de C. Gomes, J.L.F. Santos, E.A.B. Galati, E.X. Rabello & D. Natal. 1981. Observações sobre atividades de mosquitos Culicidae, em mata residual no Vale do Ribeira, S. Paulo, Brasil. Revista de Saúde Pública 15(6): 557–586. doi: 10.1590/S0034-89101981000600001

Forattini, O.P., A. de C. Gomes, D. Natal & J.L.F. Santos. 1986. Observações sobre atividade de mosquitos Culicidae em matas primitivas da planície e perfís epidemiológicos de vários ambientes no Vale do Ribeira, São Paulo, Brasil. Revista de Saúde Pública 20(3): 178–203. doi: 10.1590/S0034-89101986000300002

Gabaldon, A., G. Ulloa, J. Pulido & E. Sutil. 1977a. Especies de la familia Culicidae que presentan ornitofilia en Venezuela. Boletín de la Direccion de Malariología y Saneamiento Ambiental 17(1): 3–8.

Gabaldon, A., G. Ulloa, N. Godoy, E. Marquez & J. Pulido. 1977b. *Aedeomyia squamipennis* (Diptera, Culicidae) vector natural de malaria aviaria en Venezuela. Boletín de la Direccion de Malariología y Saneamiento Ambiental 17(1): 9–13.

Gabaldon, A., G. Ulloa & J. Pulido. 1981. Distribución geográfica, ecología y etología de *Aedeomyia squamipennis*, importante vector natural de malaria aviaria en Venezuela. Boletín de la Direccion de Malariología y Saneamiento Ambiental 21(2): 103–113.

Gabaldon, A., G. Ulloa & N. Zerpa. 1985. *Fallisia (Plasmodioides) neotropicalis* subgen. nov. sp. nov. from Venezuela. Parasitology 90(2): 217–225. doi: 10.1017/S0031182000050927

Gager, A.B., J. del R. Loiaza, D.C. Dearborn & E. Bermingham. 2008. Do mosquitoes filter the access of *Plasmodium* cytochrome *b* lineage to an avian host? Molecular Ecology 17(10): 2552–2561. doi: 10.1111/j.1365-294X.2008.03764.x

Gama, R.A., I.M. da Silva, H.A. de O. Monteiro & A.E. Eiras. 2012. Fauna de Culicidae in rural areas of Porto Velho and the

first record of *Mansonia (Mansonia) flaveola* (Coquillet, 1906), for the State of Rondônia, Brazil. Revista da Sociedade Brasileira de Medicina Tropical 45(1): 125–127. doi: http://doi.org/b4wh

Gomes, A. de C., D. Natal, M.B. de Paula, P.R. Urbinatti, L.F. Mucci & M.D. Bitencourt. 2007. Riqueza e abundância de Culicidae (Diptera) em área impactada, Mato Grosso do Sul, Brasil. Revista de Saúde Pública 41(4): 661–664. doi: 10.1590/S0034-89102007000400023

Guedes, A.S., S.H. Xavier, C.S. Mascarenhas & M.F.L. Ferreira. 1978. Catálogo da Coleção do Laboratório de Entomologia do Centro de Pesquisas René Rachou – Fundação Oswaldo Cruz. II – Gêneros *Aedeomyia* Theobald, 1901, *Coquillettidia* Dyar, 1905, *Mansonia* Blanchard; 1901, e *Orthopodomyia* Theobald, 1904 (Diptera, Culicidae). Ciência e Cultura 30(9): 1111–1116.

Harbach, R.E. 2017. Mosquito Taxonomic Inventory. Accessed at http://mosquito-taxonomic-inventory.info/, 16 March 2017.

Harbach, R.E. & I.J. Kitching. 1998. Phylogeny and classification of Culicidae (Diptera). Systematic Entomology 23(4): 327–370. doi: 10.1046/j.1365-3113.1998.00072.x

Heinemann, S.J. & J.N. Belkin. 1979. Collection records of the Project "Mosquitoes of Middle America" 13. South America: Brazil, (BRA, BRAP, BRB), Ecuador (ECU), Peru (PER), Chile (CH). Mosquito Systematics 11(2): 61–118. http://www.mosquitocatalog.org/files/pdfs/MS11N02P061.pdf

Hutchings, R.S.G., M.A.M. Sallum, R.L.M. Ferreira & R.W. Hutchings. 2005. Mosquitoes of the Jaú National Park and their potential importance in Brazilian Amazonia. Medical and Veterinary Entomology 19(4): 428–441. doi: http://doi.org/fg4xj7

Hutchings, R.S.G., R.W. Hutchings & M.A.M. Sallum. 2010. Culicidae (Diptera, Culicomorpha) from the western Brazilian Amazon: Juami-Japurá Ecological Station. Revista Brasileira de Entomologia 54(4): 687–691. doi: http://doi.org/fq9trg

Hutchings, R.S.G., M.A.M. Sallum & R.W. Hutchings. 2011. Mosquito (Diptera: Culicidae) diversity of a forest-fragment mosaic in the Amazon Rain Forest. Journal of Medical Entomology 48(2): 173–187. doi: 10.1603/ME10061

Hutchings, R.S.G., R.W. Hutchings & M.A.M. Sallum. 2013. Culicidae (Diptera: Culicomorpha) from the central Brazilian Amazon: Nhamundá and Abacaxis Rivers. Zoologia 30(1): 1–14. doi: 10.1590/S1984-46702013000100001

Hutchings, R.S.G., R.W. Hutchings, I.S. Menezes, M. de A. Motta & M.A.M. Sallum. 2016. Mosquitoes (Diptera: Culicidae) from the northwestern Brazilian Amazon: Padauari River. Journal of Medical Entomology 53(6): 1330–1347. doi: 10.1093/jme/tjw101

IBGE (Instituto Brasileiro de Geografia e Estatística). 1984. Atlas do Maranhão. São Luís and Rio de Janeiro: IBGE. 104 pp.

Labarthe, N., M.L. Serrão, Y.F. Melo, S.J. de Oliveira & R. Lourenço-de-Oliveira. 1998. Mosquito frequency and feeding habits in an enzootic canine dirofilariasis area in Niterói, State of Rio de Janeiro, Brazil. Memórias do Instituto Oswaldo Cruz 93(2): 145–154. doi: 10.1590/S0074-02761998000200002

Lane, J. 1939. Catálogo dos mosquitos neotrópicos. Boletim Biológico, Série Monográfica 1: xi + 218 pp.

Lane, J. 1953. Neotropical Culicidae: Tribe *Culicini, Deinocerites, Uranotaenia, Mansonia, Orthopodomyia, Aedeomyia, Aedes, Psorophora, Haemagogus,* tribe *Sabethini, Trichoprosopon, Wyeomyia, Phoniomyia, Limatus* and *Sabethes* [sic]. São Paulo: University of Sao Paulo. Volume 2: 563 pp.

Lopes, J. & A.L. Lozovei. 1995. Ecologia de mosquitos (Diptera: Culicidae) em criadouros naturais e artificiais de área rural do norte do Estado do Paraná, Brasil. I – Coletas ao longo do leito do ribeirão. Revista de Saúde Pública 29(3): 183–191. doi: 10.1590/S0034-89101995000300005

Lourenço de Oliveira, R. 1989. Some observations on the mosquitoes of indian settlements in Xingu National Park, Mato Grosso State, with emphasis on malaria vectors. Revista Brasileira de Biologia 49(2): 393–397.

Lourenço-de-Oliveira, R. & T.F. da Silva. 1985. Alguns aspectos da ecologia de mosquitos (Diptera: Culicidae) de uma área de planície (Granjas Calábria), em Jacarepaguá, Rio de Janeiro. III. Preferência horária das fêmeas para o hematofagismo. Memórias do Instituto Oswaldo Cruz 80(2): 195–201. doi: http://doi.org/ftk2pm

Lutz, A. 1904. Catalogo dos culicideos brasileiros e sul-americanos; pp. 35–50, in: C. Bourroul. Mosquitos do Brasil [Ph.D. thesis]. Salvador: Faculdade de Medicina da Bahia.

Lutz, A. & A. Machado. 1915. Viajem pelo rio S. Francisco e por alguns de seus afluentes entre Pirapora e Joazeiro. Memórias do Instituto Oswaldo Cruz 7(1): 5–50. doi: http://doi.org/cttncv

Lutz, A. & A. Neiva. 1911. Notas dipterolojicas. Contribuições para o conhecimento dos dipteros sanguesugas do noroeste de São Paulo e do Estado de Mato-Grosso. (Com a descrição de duas novas espécies). Memórias do Instituto Oswaldo Cruz 3(2): 295–300. doi: 10.1590/S0074-02761911000200005

Lutz, A. & O. Penna. 1918. Studies on Schistosomatosis, made in the North of Brazil, by commission from the Instituto Oswaldo Cruz. Memórias do Instituto Oswaldo Cruz 10 (1 Translations): 62–73. doi: 10.1590/S0074-02761918000100005

Lynch Arribálzaga, F. 1878. Descripcion de tres nuevos Culicidae de Buenos Aires. El Naturalista Argetino 1: 149–152.

Marchiafava, E. & A. Celli. 1885. Neue Untersuchungen über die Malaria-Infektion. Fortschritte der Medizin 3: 339–354.

Marcondes, C.B., A. Fernandes, U. Paterno, G.A. Müller, L.C. de Pinho & D.V. Struffaldi. 2003. New records of mosquitoes from the southern Brazilian States of Santa Catarina and Rio Grande do Sul, with 18 species new for the States (Diptera: Culicidae). Zootaxa 347: 1–6. http://www.mapress.com/zootaxa/2003/zt00347.pdf

Mattos, S.S. & S.H. Xavier. 1965. Distribuição geográfica dos culicíneos do Brasil (*Diptera*, *Culicidae*) [sic]. I – Estado de Goiás. Revista Brasileira de Malariologia e Doenças Tropicais 17(2–3): 269–291.

Miranda, J.P., J.C.L. Costa & C.F.D. Rocha. 2012. Reptiles from Lençóis Maranhenses National Park, Maranhão, northeastern Brazil. ZooKeys 246: 51–68. doi: 10.3897/zookeys.246.2593

Mitchell, C.J., T.P. Monath, M.S. Sabattini, C.B. Cropp, J.F. Daffner, C.H. Calisher, W.L. Jakob & H.A. Christensen. 1985. Arbovirus investigations in Argentina, 1977–1980 II. Arthropod collection and virus isolations from argentine mosquitoes. The American Journal of Tropical Medicine and Hygiene 34(5): 945–955. http://www.ajtmh.org/content/34/5/945.full.pdf+html

Motta, M.A. & R. Lourenço-de-Oliveira. 1995. *Wyeomyia luteoventralis* Theobald, the type species of the subgenus *Dendromyia* Theobald (Diptera: Culicidae). Memórias do Instituto Oswaldo Cruz 90(3): 375–385. doi: 10.1590/S0074-02761995000300012

Natal D., J.M.S. Barata, C.B.T. Lagos & R.M. Rocha. 1992. Nota sobre culicídeos (Diptera: Culicidae) da bacia do rio Purus, Acre, Amazônia (Brasil). Revista de Saúde Pública 26(2): 129–131. doi: 10.1590/S0034-89101992000200010

Natal, D., P.R. Urbinatti, R. dos S. Malafronte, H.R. Rezende, C. Cerutti Jr. & M.A.M. Sallum. 2007. First record of *Anopheles (Anopheles) costai* Fonseca & Ramos, 1939 in Espírito Santo State, Brazil. Revista do Instituto de Medicina Tropical de São Paulo 49(5): 323–326. doi: 10.1590/S0036-46652007000500009

Naves, H.A.M., M.E.S.D. Carvalho, K.P. Sales & E. Carneiro. 1998. Preferência para diferentes tipos de isca por mosquitos (Diptera: Culicidae) capturados em Goiânia-Goiás. Revista de Patologia Tropical 27(1): 43–52. http://www.revistas.ufg.br/index.php/iptsp/article/view/17195/10367

Pauvolid-Corrêa, A., F.N. Tavares, J. Alencar, J. dos S. Silva, M. Murta, N.M. Serra-Freire, A.O. Pellegrin, H. Gil-Santana,

A.E. Guimarães & E.E. da Silva. 2010. Preliminary investigation of Culicidae species in South Pantanal, Brazil and their potential importance in arbovirus transmission. Revista do Instituto de Medicina Tropical de São Paulo 52(1): 17–23. doi: http://doi.org/c4m32c

Pereira, E. da S., M.I. de M. Sarquis, R.L. Ferreira-Keppler, N. Hamada & Y.B. Alencar. 2009. Filamentous fungi associated with mosquito larvae (Diptera: Culicidae) in municipalities of the Brazilian Amazon. Neotropical Entomology 38(3): 352–359. doi: 10.1590/S1519-566X2009000300009

Pereira-Filho, A.A., M. da C.A. Bandeira, R.S. Fonteles, J.L.P. Moraes, C.R.G. Lopes, M.N. Melo & J.M.M. Rebêlo. 2015. An ecologic study of sand flies (Diptera: Psychodidae) in the vicinity of Lençóis Maranhenses National Park, Maranhão, Brazil. Parasites & Vectors 8: 442. doi: 10.1186/s13071-015-1045-5

Pinto, C., S. Netto & H. Marques. 1940. Mosquitos do Rio Grande do Sul. Arquivos do Departamento Estadual de Saúde do Rio Grande do Sul 1: 14–52.

Pugedo, H., R.A. Barata, J.C. França-Silva, J.C. Silva & E.S. Dias. 2005. HP: um modelo aprimorado de armadilha luminosa de sucção para a captura de pequenos insetos. Revista da Sociedade Brasileira de Medicina Tropical 38(1): 70–72. doi: http://doi.org/chk7hs

Rebêlo, J.M.M., J.L.P. Moraes, G.A. Alves, F.S. Leonardo, R.V. da Rocha, W.A. Mendes, E. Costa, L.E.M.B. Câmara, M.J.A. Silva, Y.N.O. Pereira & J.A.C. Mendonça. 2007. Distribuição das espécies do gênero *Anopheles* (Diptera, Culicidae) no Estado do Maranhão, Brasil. Cadernos de Saúde Pública 23(12): 2959–2971. doi: 10.1590/S0102-311X2007001200017

Rebelo-Mochel, F. 2011. Manguezais amazônicos: status para a conservação e a sustentabilidade na zona costeira maranhense; pp. 93–116, in: M.B. Martins & T. G. de Oliveira (eds.). Amazonia Maranhense: diversidade e conservação. Belém: Museu Paraense Emílio Goeldi. http://ppbio.museu-goeldi.br/sites/default/files/Meu_livro.pdf

Ribeiro, A.F., P.R. Urbinatti, A.M.R. de C. Duarte, M.B. de Paula, D.M. Pereira, L.F. Mucci, A. Fernandes, M.H.S.H. de Mello, M.O. de Mattos Júnior, R.C. de Oliveira, D. Natal & R. dos S. Malafronte. 2012. Mosquitoes in degraded and preserved areas of the Atlantic Forest and potential for vector-borne disease risk in the municipality of São Paulo, Brazil. Journal of Vector Ecology 37(2): 316–324. doi: 10.1111/j.1948-7134.2012.00233.x

Ruas-Neto, A.L., S.M. Silveira & E.R. da C. Colares. 1994. Mosquito control based on larvicides in the State of Rio Grande do Sul, Brazil: choice of the control agent. Cadernos de Saúde Pública 10(2): 222–230. doi: 10.1590/S0102-311X1994000200009

Santiago-Alarcon, D., V. Palinauskas & H.M. Schaefer. 2012. Diptera vectors of avian Haemosporidian parasites: untangling parasite life cycles and their taxonomy. Biological Reviews 87(4): 928–964. doi: 10.1111/j.1469-185X.2012.00234.x

Silva, J. dos S., J.B. Pacheco, J. Alencar & A.E. Guimarães. 2010. Biodiversity and influence of climatic factors on mosquitoes (Diptera: Culicidae) around of the Peixe Angical Hydroeletric scheme in the state of Tocantins, Brazil. Memórias do Instituto Oswaldo Cruz 105(2): 155–162. doi: http://doi.org/dc3h4x

Silva, J. dos S., M.S. Couri, A.P. de L. Giupponi & J. Alencar. 2014. Mosquito fauna of the Guapiaçu Ecological Reserve, Cachoeiras de Macacu, Rio de Janeiro, Brazil, collected under the influence of different color CDC light traps. Journal of Vector Ecology 39(2): 384–394. doi: 10.1111/jvec.12114

Soares, R.K.P. & A.A.F. Rodrigues. 2009. Distribuição espacial e temporal da avifauna aquática no Lago de Santo Amaro, Parque Nacional dos Lençóis Maranhenses, Maranhão, Brasil. Revista Brasileira de Ornitologia 17(3–4): 173–182. http://www4.museu-goeldi.br/revistabrornito/revista/index.php/BJO/article/view/3702

Souto, R.N.P., J.F. Saraiva, R.M. Ferreira & L.M. Barbosa. 2011. Culicideos (Diptera: Culicidae) da Coleção Entomológica do Instituto de Pesquisas Cientificas e Tecnológicas do Amapá. Biota Amazônia 1(2): 60–65. http://periodicos.unifap.br/index.php/biota/article/view/337

Svensson-Coelho, M., J.G. Blake, B.A. Loiselle, A.S. Penrose, P.G. Parker & R.E. Ricklefs. 2013. Diversity, prevalence, and host-specificity of avian *Plasmodium* and *Haemoproteus* in a Western Amazon assemblage. Ornithological Monographs No76: 1–47. doi: 10.1525/om.2013.76.1.1

Teodoro, U., A.L.F. Guilherme, A.L. Lozovei, V. La Salvia Filho, A.A. Sampaio, R.P. Spinosa, M.E.M.C. Ferreira, O.C. Barbosa & E.M. de Lima. 1994. Mosquitos de ambientes peri e extradomiciliares na Região Sul do Brasil. Revista de Saúde Pública 28(2): 107–115. doi: 10.1590/S0034-89101994000200003

Teodoro, U., A.L.F. Guilherme, A.L. Lozovei, V. La Salvia Filho, Y. Fukushigue, R.P. Spinosa, M.E.M.C. Ferreira, O.C. Barbosa & E.M. de Lima. 1995. Culicídeos do lago de Itaipu, no rio Paraná, sul do Brasil. Revista de Saúde Pública 29(1): 6–14. doi: 10.1590/S0034-89101995000100003

Theobald, F.V. 1901. A Monograph of the Culicidae or Mosquitoes. Mainly compiled from Collections received at The British Museum from various parts of the World in connection with the investigation into the cause of Malaria conducted by The Colonial Office and the Royal Society. London: British Museum. Volume 1: xviii + 424 pp.

Tissot, A.C. & M.A.N. da Silva. 2008. Lista das espécies de Culicidae (Diptera) depositadas na Coleção de Entomologia Pe. J. S. Moure. Revista Brasileira de Entomologia 52(2): 263–268. doi: 10.1590/S0085-56262008000200004

Townsend, C.H.T. 1934. Mosquitoes of the Rio Tapajós. Revista de Entomologia 4(4): 486–499.

Travassos, L. & J.F. Teixeira de Freitas. 1943. Relatório da sétima excursão científica do Instituto Oswaldo Cruz, realizada á zona da Estrada de Ferro Noroeste do Brasil, em maio de 1942. Memórias do Instituto Oswaldo Cruz 38(3): 385–412. doi: http://doi.org/bd6qr4

Travassos, L. & J.F. Teixeira de Freitas. 1948. Relatório da excursão do Instituto Oswaldo Cruz ao norte do Estado do Espírito Santo, junto ao Parque de Reserva e Refúgio Soóretama, em fevereiro e março de 1948. Memórias do Instituto Oswaldo Cruz 46(3): 605–631. doi: 10.1590/S0074-02761948000300006

Tubaki, R.M., R.M.T. de Menezes, R.P. Cardoso Junior & E.S. Bergo. 2004. Studies on entomological monitoring: mosquito species frequency in riverine habitats of the Igarapava Dam, Southern Region, Brazil. Revista do Instituto de Medicina Tropical de São Paulo 46(4): 223–229. doi: http://doi.org/fh4q2v

Turell, M.J., M.L. O'Guinn, J.W. Jones, M.R. Sardelis, D.J. Dohm, D.M. Watts, R. Fernandez, A. Travassos da Rosa, H. Guzman, R. Tesh, C.A. Rossi, G.V. Ludwig, J.A. Mangiafico, J. Kondig, L.P. Wasieloski Jr., J. Pecor, M. Zyzak, G. Schoeler, C.N. Mores, C. Calampa, J.S. Lee & T.A. Klein. 2005. Isolation of viruses from mosquitoes (Diptera: Culicidae) collected in the Amazon Basin Region of Peru. Journal of Medical Entomology 42(5): 891–898. doi: 10.1093/jmedent/42.5.891

Tyson, W.H. 1970. Contributions to the Mosquito Fauna of Southeast Asia. VII. Genus *Aedeomyia* Theobald in Southeast Asia. Contributions of the American Entomological Institute 6(2): 1–27.

Vasconcelos, P.F. da C., J.F.S. Travassos da Rosa, S.C. Guerreiro, N. Dégallier, E.S. Travassos da Rosa & A.P. de A. Travassos da Rosa. 1989. Primeiro registro de epidemias causadas pelo Vírus Oropouche nos Estados do Maranhão e Goiás, Brasil. Revista do Instituto de Medicina Tropical de São Paulo 31(4): 271–278. doi: 10.1590/S0036-46651989000400011

Velloso, A.L., E.V.S.B. Sampaio, A.M. Giulietti, M.R.V. Barbosa, A.A.J.F. Castro, L.P. de Queiroz, A. Fernandes, D.C. Oren, L.A. Cestaro, A.J.E. de Carvalho, F.G.C. Pareyn, F.B.R. da Silva, E.E. de Miranda, S. Kell & R.S. Gondin. 2002. Ecorregiões da

Caatinga; pp. 7–34, in: A.L. Velloso, E.E.S.B. Sampaio & F.G.C. Pareyn (eds.). Ecorregiões propostas para o bioma Caatinga. Recife: Associação Plantas do Nordeste, The Nature Conservancy do Brasil.

Veloso, H.P. 1964. Os grandes clímaces do Brasil IV — Considerações gerais sôbre a vegetação da Região Nordeste. Memórias do Instituto Oswaldo Cruz 62: 203–223. doi: http://doi.org/c5bvkq

Xavier, S.H. & S. da S. Mattos. 1975. Geographical distribution of Culicinae in Brazil. III. State of Pará (Diptera, Culicidae). Mosquito Systematics 7(3): 234–268. http://www.mosquitocatalog.org/files/pdfs/MS07N03P234.pdf

Xavier, S.H. & S. da S. Mattos. 1976. Geographical distribution of Culicinae in Brazil – IV. State of Amazonas (Diptera, Culicidae). Mosquito Systematics 8(4): 386–412. http://www.mosquitocatalog.org/files/pdfs/MS08N04P386.pdf

Xavier, S.H. & S. da S. Mattos. 1989a. Lista das espécies e gêneros de culicídeos encontrados nos estados do Brasil. IX. Maranhão (Diptera, Culicidae). Acta Amazonica 19: 295–306. https://acta.inpa.gov.br/fasciculos/19-4/PDF/v19n4a18.pdf

Xavier, S.H. & S. da S. Mattos. 1989b. Lista das espécies e gêneros de cuclicídeos encontrados nos estados do Brasil. VIII. Rondônia (Diptera, Culicidae). Acta Amazonica 19: 285–294. https://acta.inpa.gov.br/fasciculos/19-4/PDF/v19n4a17.pdf

Xavier, S.H., P.V. Calabria, E. Cerqueira & S. da S. Mattos. 1979. Geographical distribution of Culicinae in Brazil. V. State of Piauí (Diptera, Culicidae). Mosquito Systematics 11(1): 1–10. http://www.mosquitocatalog.org/files/pdfs/MS11N01P001.pdf

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APPENDIX

Table A1. Known records of *Aedeomyia squamipennis* in Brazil. Latitude and longitude are show only when georeferenced record could be found, albeit in some cases approximately. New records in the present study are highlighted in bold.

Region	State	Municipality	Locality: *Sublocality*	Latitude	Longitude	Reference
North	AC		Purus River Basin	–9.861008	–67.4109	Natal et al. 1992
North	AP	Amapá		2.044851	–50.7875	Souto et al. 2011
North	AP	Mazagão		1.7452	–50.7894	Souto et al. 2011
North	AP	Pracuúba		–0.116673	–51.2864	Souto et al. 2011
North	AP	Santana	Villa Amazonia	–0.050674	–51.1551	Forattini et al. 1973
North	AP	Tartarugalzinho		1.506173	–50.9092	Souto et al. 2011
North	AM	Autazes		–3.725146	–59.5217	Xavier & Mattos 1976
North	AM	Autazes (as Itacoatiara)	Ambrosio Aires	–3.586098	–59.1261	Xavier & Mattos 1976
North	AM	Autazes (as Itacoatiara)	Capivara Lake (as Capivara)	–3.666507	–59.4665	Xavier & Mattos 1976
North	AM	Autazes (as Borba)	Canarama	–4.079492	–59.8668	Xavier & Mattos 1976
North	AM	Barcelos	Ararinha	0.496930	–64.0533	Hutchings et al. 2016
North	AM	Benjamin Constant (as Fonte Boa)	Javarizinho	–4.375224	–70.0333	Xavier & Mattos 1976
North	AM	Beruri (as Manacapuru)	Pirarara	–4.409548	–62.0383	Xavier & Mattos 1976
North	AM	Borba		–4.391624	–59.5881	Cerqueira 1961
North	AM	Borba	Belém	–4.387882	–59.9484	Xavier & Mattos 1976
North	AM	Borba	Recreio	–4.376506	–59.5927	Xavier & Mattos 1976
North	AM	Coari	Caimbé	–3.317519	–63.9188	Xavier & Mattos 1976
North	AM	Coari	Maquapari			Xavier & Mattos 1976
North	AM	Codájas		–3.839865	–62.061	Cerqueira 1961
North	AM	Fonte Boa	Paraná da Alegria			Xavier & Mattos 1976
North	AM	Humaitá	Bom Futuro	–6.246951	–62.2394	Xavier & Mattos 1976
North	AM	Humaitá	Campo Novo			Xavier & Mattos 1976
North	AM	Iranduba		–3.145614	–60.2574	Fé et al. 2003
North	AM	Iranduba (as Manaus)	Costa do Caldeirão	–3.246759	–60.2434	Xavier & Mattos 1976
North	AM	Itacoatiara		–3.135009	–58.4388	Cerqueira 1961
North	AM	Itacoatiara	Paraná da Eva	–3.180083	–59.1794	Xavier & Mattos 1976
North	AM	Itacoatiara (as Manaus)	AM-010 near km 175 (as Manaus-Itacoatiara Road)	–2.895101	–59.0928	Deane et al. 1968
North	AM	Jupará	Ecological Station Juami-Jupará	–1.927087	–68.0381	Hutchings et al. 2010
North	AM	Jutaí (as Fonte Boa)	Jutaí Mouth	–2.749514	–66.9337	Xavier & Mattos 1976
North	AM	Manacarupu		–3.289421	–60.632	Cerqueira 1961
North	AM	Manaus		–3.118908	–60.0216	Lutz 1904
North	AM	Manaus	Porto Mauá	–3.113576	–59.9275	Deane et al. 1968
North	AM	Manaus	São João Community: *BR-174, km 4*	–2.947889	–60.0287	Barbosa et al. 2008
North	AM	Manaus	Biological Dynamics of Forest Fragments Project: *Dimona Farm*	–2.330691	–60.0824	Hutchings et al. 2011

Continued

Table A1. *Continued.*

Region	State	Municipality	Locality: *Sublocality*	Latitude	Longitude	Reference
North	AM	Manicoré		–5.811544	–61.2915	Cerqueira 1961
North	AM	Manicoré	Boca do Marmelo	–6.144703	–61.781	Xavier & Mattos 1976
North	AM	Manicoré	Costa das Araras			Xavier & Mattos 1976
North	AM	Nhamundá	Nhamundá River: Igarapé da Areia: *Areia*	–1.587074	–57.6161	Hutchings et al. 2013
North	AM	Nhamundá	Abacaxis River: *Paxiuba*	–4.480196	–58.5747	Hutchings et al. 2013
North	AM	Novo Airão	Jaú National Park	–1.951161	–61.8165	Hutchings et al. 2005
North	AM	Parintins		–2.639071	–56.7269	Cerqueira 1961
North	AM	Rio Preta da Eva (as Manaus)	Biological Dynamics of Forest Fragments Project: *Esteio Farm*	–2.418471	–59.832	Hutchings et al. 2011
North	AM	Rio Preto da Eva	Vale Piratininga: *AM–010, km 78*	–2.70001	–59.7167	Pereira et al. 2009
North	AM	Santo Antônio do Içá (as Fonte Boa)	Vargem Grande do Içá	–3.3032	–67.9206	Xavier & Mattos 1976
North	AM	São Paulo de Olivença	Correnteza	–3.517008	–69.0185	Xavier & Mattos 1976
North	PA	Alenquer		–1.95972	–54.7761	Xavier & Mattos 1975
North	PA	Aveiro	Tapajós River: *Bôa Vista (Fordlândia)*	–3.812066	–55.49	Townsend 1934
North	PA	Belém	Utinga State Park (as Utinga Captor de Agua)	–1.427829	–48.4083	Heinemann & Belkin 1979
North	PA	Gurupá	Bacabal	–1.377542	–51.5821	Xavier & Mattos 1975
North	PA	Óbidos		–1.917154	–55.4589	Xavier & Mattos 1975
North	PA	Santarém		–2.440682	–54.6844	Cerqueira 1961
North	PA	Tucuruí	Tucuruí Dam	–3.743103	–49.6649	Dégallier et al. 1992
North	RO	Ariquemes	Ariquemes Zoo	–9.908337	–63.023	Fiocruz-CCULI 2016
North	RO	Guajará–Mirim		–10.8034	–65.3383	Xavier & Mattos 1989b
North	RO	Porto Velho	Mato Grosso	–8.744507	–63.9444	Gama et al. 2012
North	RO	Porto Velho	Abunã River	–9.763419	–65.5152	Pereira et al. 2009
North	RO	Porto Velho	São João	–8.819464	–63.9375	Gama et al. 2012
North	TO	Peixe	Peixe–Angical Hydroeletric reservoir	–12.22365	–48.363	Silva et al. 2010
Northeast	BA	Alagoinhas		–12.13721	–38.4253	Guedes et al. 1978
Northeast	BA	Barra		–11.10302	–43.1643	Lutz & Machado 1915
Northeast	BA	Camaçari		–12.68022	–38.3019	Guedes et al. 1978
Northeast	BA	Jacobina		–11.18908	–40.5312	Forattini et al. 1970
Northeast	BA	Lençóis		–12.56337	–41.383	Guedes et al. 1978
Northeast	BA	Piritiba		–11.72896	–40.5517	Guedes et al. 1978
Northeast	BA	Ponto Novo (as Ponte Nova)		–10.86053	–40.1357	Chagas et al. 1937
Northeast	BA	Salvador (as Pirajá)	Pirajá	–12.8923	–38.4615	Guedes et al. 1978
Northeast	BA	Serrinha		–11.66076	–38.9965	Guedes et al. 1978
Northeast	**MA**	**Bacurituba**	**Santa Maria**	**–2.774784**	**–44.723723**	**Present study**
Northeast	**MA**	**Barra do Corda**	**Novo Brejo**	**–5.759478**	**–45.3236**	**Present study**
Northeast	**MA**	**Cajapió**	**Posto de Seleção**	**–2.839606**	**–44.7244**	**Present study**
Northeast	**MA**	**Governador Nunes Freire**	**Portão**	**–2.070258**	**–45.8823**	**Present study**
Northeast	**MA**	**Santo Amaro do Maranhão**	**Riachão**	**–2.827825**	**–43.1273**	**Present study**
Northeast	PE	Recife	Near Várzea	–8.051983	–34.9688	Lutz & Penna 1918
Northeast	PE	Ribeirão		–8.514625	–35.3737	Costa 1956
Northeast	PI	Miguel Alves	Parnaíba River	–4.168151	–42.9397	Xavier et al. 1979
Northeast	PI	Parnaíba		–2.910322	–41.7881	Chagas et al. 1937
Northeast	PI	Teresina		–5.085562	–42.8279	Chagas et al. 1937
Northeast	RN	Parnamirim (as Natal)	Cajupiranguinha	–5.955868	–35.2416	Forattini et al. 1970
Northeast	RN	Serra Negra do Norte	Seridó Ecological Station	–6.626615	–37.2443	Fernandes 2011
Central-West	GO	Anápolis	Antas Stream (as Ribeirão das Antas)	–16.34092	–48.9663	Mattos & Xavier 1965
Central-West	GO	Anápolis	Olaria Farm (as Olaria)	–16.23419	–48.9279	Mattos & Xavier 1965
Central-West	GO	Goiânia	Naves Farm	–16.59484	–49.2467	Naves et al. 1998
Central-West	MT	Cocalinho	Cristalino River	–13.20231	–50.8373	Forattini et al. 1970
Central-West	MT	Peixoto de Azevedo	Xingu Indigenous Park (as Xingu National Park): *Aldeia Pium*	–10.20429	–53.0263	Lourenço de Oliveira 1989
Central-West	MT	Poconé	MT–060 (Transpantaneira), km 52	–16.84287	–56.8399	Alencar et al. 2005
Central-West	MS	Anastácio	Morro Azul	–20.49151	–55.63753	Forattini et al. 1970
Central-West	MS	Aquidauana	Instituto de Pesquisas do Pantanal (IPPAN)			Fiocruz-CCULI 2016
Central-West	MS	Bataguassu	Santa Cruz Farm	–21.741977	–52.267504	Gomes et al. 2007
Central-West	MS	Corumbá	Embrapa Pantanal: *Nhumirim Ranch*	–18.970509	–56.61784	Pauvolid-Corrêa et al. 2010
Central-West	MS	Miranda	Noroeste do Brasil Railroad, km 136	–20.19805	–56.4997	Lutz & Neiva 1911

Continued

Table A1. *Continued.*

Region	State	Municipality	Locality: *Sublocality*	Latitude	Longitude	Reference
Central-West	MS	Miranda	Near Salobra station	–20.20163	–56.51014	Travassos & Teixeira de Freitas 1943
Southeast	ES	Linhares	Vale do Rio Doce: *Juparanã Lagoon*	–19.30588	–40.08552	Natal et al. 2007
Southeast	ES	Sooretama	Sooretama Biological Reserve	–19.04878	–39.95271	Travassos & Teixeira de Freitas 1948
Southeast	MG	Aimorés	Aimorés Hydroeletric power plant	–19.48336	–41.0647	Barata et al. 2012
Southeast	MG	Lagoa Santa		–19.63945	–43.9007	Guedes et al. 1978
Southeast	MG	Sacramento (as Igarapava–SP)	Grande River	–20.00214	–47.43342	Tubaki et al. 2004
Southeast	RJ	Cachoeiras de Macacu	Reserva Ecológica de Guapiaçu Private Reserve of Natural Heritage	–22.40926	–42.73591	Silva et al. 2014
Southeast	RJ	Campos dos Goytacazes		–21.75373	–41.31307	Guedes et al. 1978
Southeast	RJ	Niterói	Itacoatiara	–22.97253	–43.03674	Labarthe et al. 1998
Southeast	RJ	Rio de Janeira	Jacarepaguá: *Granjas Calábria*	–23.00054	–43.44827	Lourenço-de-Oliveira & Silva 1985
Southeast	RJ	Seropédica	BR–465, between UFRRJ and Seropédica city	–22.75882	–43.6955	Heinemann & Belkin 1979
Southeast	SP		Região de Sorocabana			Lane 1939
Southeast	SP	Botucatu	Porto Martins (as Former Porto Martins station)	–22.92458	–48.45681	Forattini et al. 1970
Southeast	SP	Angatuba		–23.45209	–55.14448	Forattini et al. 1973
Southeast	SP	Barueri		–23.52109	–23.52109	Forattini et al. 1973
Southeast	SP	Cananéia	Folha Larga Farm	–25.02801	–47.92256	Forattini et al. 1986
Southeast	SP	Cordeirópolis		–22.47701	–47.41431	Barghini et al. 2004
Southeast	SP	Iguape	ETEC Eng. Agr. Narciso Medeiros (as Escola Agricola de Iguape)	–24.66257	–47.53388	Forattini et al. 1978
Southeast	SP	Iguape	Sitio Embu			Forattini et al. 1978
Southeast	SP	Juquiá		–24.32314	–47.63279	Forattini et al. 1970
Southeast	SP	Juquitiba	Pedro de Toledo State Reserve	–24.06115	–47.00581	Dutra et al. 1996
Southeast	SP	Pariquera–Açu	Pariquera–Açu Experimental Farm	–24.61479	–47.88404	Forattini et al. 1981
Southeast	SP	Ribeirão Preto	Tamanduá River	–21.15969	–47.65299	Duret & Barreto 1956
Southeast	SP	São José do Rio Preto	Instituto Penal Agrícola	–20.84772	–49.43716	Dibo et al. 2011
Southeast	SP	São Paulo	Santo Amaro	–23.66003	–46.71432	Forattini et al. 1970
Southeast	SP	São Paulo	Capivari–Monos Environmental Protection Area	–23.93831	–46.63535	Ribeiro et al. 2012
South	PR	Curitiba	Iguaçu Regional Park	–25.5245	–49.22462	Tissot & Silva 2008
South	PR	Guaíra	Itaipu Reservoir	–24.07642	–54.2696	Teodoro et al. 1995
South	PR	Londrina	São Domingos Stream	–23.31769	–51.22327	Lopes & Lozovei 1995
South	PR	Morretes	Paraná Environmental Institute II/ IAPAR	–25.48204	–48.82715	Tissot & Silva 2008
South	PR	Querência do Norte	Sonho Real Farm	–23.15178	–53.51785	Teodoro et al. 1994
South	PR	Terra Boa	Palmital Farm	–23.61015	–52.31419	Barbosa et al. 1993
South	RS	Derrubadas (as Tenente Portela)		–27.25876	–53.87938	Ruas-Neto et al. 1994
South	RS	Porto Alegre	Venâncio Aires Street	–29.96761	–51.1708	Pinto et al. 1940
South	RS	Santa Maria		–29.68439	–53.80684	Marcondes et al. 2003
South	RS	Santo Antonio da Patrulha		–29.83155	–50.49946	Cardoso et al. 2005
South	RS	Viamão	Capão da Porteira: *Boa Vista Farm*	–30.18806	–50.8983	Deane et al. 1969
South	SC	Palhoça	Serra do Tabuleiro State Park: *Baixada do Maciambu*	–27.842483	–48.6221	Ferreira-de-Freitas et al. 2017

Legend/States: AC (Acre), AM (Amazonas), AP (Amapá), BA (Bahia), ES (Espírito Santo), GO (Goiás), MA (Maranhão), MG (Minas Gerais), MS (Mato Grosso do Sul), MT (Mato Grosso), PA (Pará), PE (Pernambuco), PI (Piauí), PR (Paraná), RJ (Rio de Janeiro), RN (Rio Grande do Norte), RO (Rondônia), RS (Rio Grande do Sul), SC (Santa Catarina), SP (São Paulo), TO (Tocantins).