

MOSQUITO SPECIES (DIPTERA: CULICIDAE) FROM LOMBOK ISLAND, INDONESIA

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ABSTRACT. Mosquito larvae were collected in different areas on Lombok Island during December 1991 to clarify the mosquito fauna. Approximately 300 larvae and adults belonging to 41 species in 11 genera were mounted and identified during this study. They include 24 new records for the island.

INTRODUCTION

There are few publications dealing with the mosquito fauna of Lombok Island, Indonesia. The most recent intensive study (Lee et al. 1984) recorded 30 species collected in May 1978 and March 1979, with an additional 31 species considered as of probable occurrence based on their geographical distribution in neighboring islands.

Increased interest in the mosquito fauna of Lombok has resulted from the appearance of malaria and the development of tourism on the island, which lies 38 km east of Bali, an area that is free of malaria and famous for sightseeing. Malaria eradication is one of the most important programs for the Lombok government. Epidemics of malaria have occurred sporadically, and since 1990 studies on malaria under the "Large-scale Cooperative Research Project on Tropical Diseases" have been conducted on the island by the Regional Office of Ministry of Health, West Nusa-Tenggara Province in Mataram, School of Medicine of Airlangga University in Sura-

vaya and JSPS (Japan Society for the Promotion of Science). In this connection, the authors visited Lombok Island December 21-28, 1991, to make intensive larval collections throughout the island (Fig. 1).

MATERIALS AND METHODS

Larvae were taken by dipper. A small suction pump was used for collection of tree hole and crab hole mosquitoes. Larval habitats and their salinity (determined by hand refractometer, Atago Co., Ltd.) were recorded. Most of the larvae were reared to the adult stage and in some instances were reared individually to collect the associated fourth-instar larval and pupal exuviae for identification. All emerging adults were mounted for study, and some larvae were preserved in McGregor's solution. Identifications of the common species of *Anopheles*, *Culex*, *Uranotaenia*, and *Aedes* were made using the keys and descriptions by Knight and Laffoon (1946), Knight and Marks (1952), Bonne-Wepster (1954), Bram (1967), Knight (1968), Reinert (1970), Huang (1972, 1977, 1979), Sirivanakarn (1972, 1976, 1977), and Peyton (1977). Voucher specimens will be deposited in the Laboratory of Medical Zoology, University of the Ryukyus.

RESULTS

We collected 41 species, including three unidentified ones, in 11 genera (Table 1).

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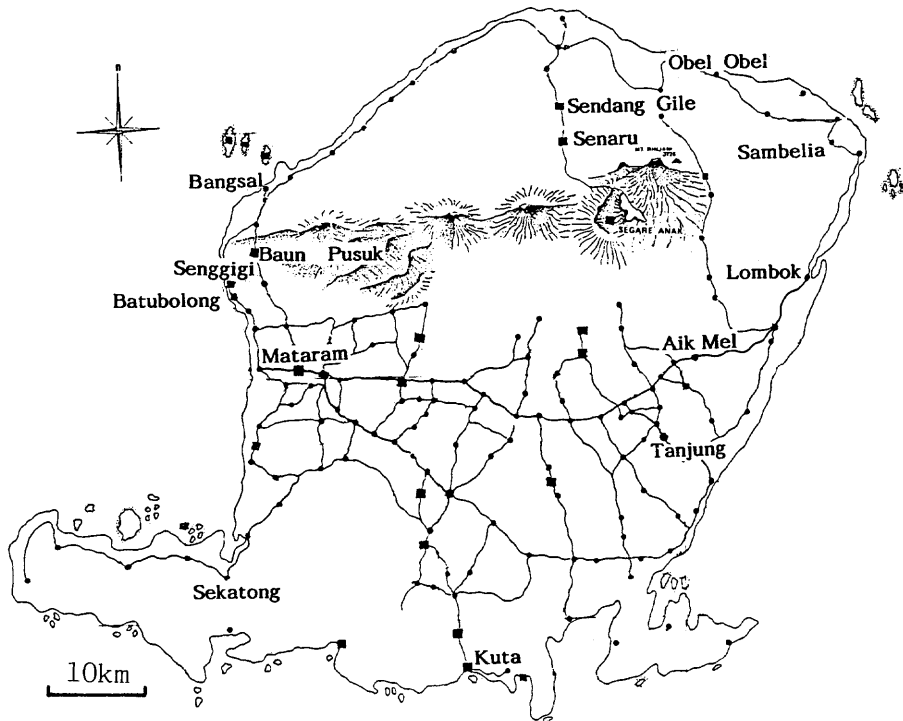


Fig. 1. Lombok Island, Indonesia, showing mosquito collection areas.

Twenty-four species are new to the Lombok fauna: *Anopheles (Cellia) minimus* Theobald, *An. (Cel.) sp.*, *Topomyia (Topomyia) tipuliformis* Leicester, *To. (Top.) sp.*, *Tripteroides (Tripteroides) aranoioides* (Theobald), *Toxorhynchites (Toxorhynchites) splendens* (Wiedemann), *Orthopodomyia anopheloides* (Giles), *Uranotaenia (Pseudoficalbia) obscura* Edwards, *Aedeomyia catasticta* Knab, *Armigeres (Armigeres) malayi* (Theobald), *Ar. (Leicesteria) flavus* (Leicester), *Aedes (Cnecraedes) indonesiae* Mattingly, *Ae. (Stegomyia) albolineatus* (Theobald), *Ae. (Finlaya) notoscriptus* (Skuse), *Ae. (Fin.) saxicola* Edwards, *Ae. (Diceromyia) iyengari* Edwards, *Culex (Culiciomyia) nigropunctatus* Edwards, *Cx. (Cui.) sp.*, *Cx. (Eumelanomyia) brevipalpis* (Giles), *Cx. (Eum.) foliatus* Brug, *Cx. (Lophoceromyia) bandoengensis* Brug, *Cx. (Lop.) bengalensis* Barraud, *Cx. (Lop.) spiculosus* Bram and Rattanarithikul, and *Cx. (Lutzia) fuscanus* Wiedemann.

COMMENTS ON SPECIES

***Anopheles (Ano.) barbirostris* van der Wulp.** Larvae were found commonly in fresh-water ponds, streams, and paddy fields in association with *An. vagus* Doenitz, *An. subpictus* Grassi, *Cx. vishnui* Theobald, and *Cx. tri-taeniorhynchus* Giles. Salinity of a stream in which larvae were collected was 0–1‰.

Anopheles (Ano.) sp. One adult female belonging to the *An. leucosphyrus* group was reared from a larva collected from a rock pool along a stream in the mountain forest, elevation ca. 600 m, Senaru District. The *An. leucosphyrus* group consists of at least six or seven distinct species or subspecies, of which *An. balabacensis* Baisas is considered the most important species for malaria transmission in Kalimantan (Soemarlan and Gandahasada 1990). We provisionally regard the species we collected as belonging to the *An. leucosphyrus* group. The larva was found associated

Table 1. Mosquitoes collected on Lombok Island, Indonesia, 21–28 December, 1991.

Species	Specimens examined and locality
<i>Anopheles barbirostris</i> Van der Wulp	1♀, 21L, Batubolong, Obel Obel
<i>An. leucosphyrus</i> sp. gr.* ¹	1♀, Senaru
<i>An. minimus</i> Theobald*	10♀, 10♂, 10L, Obel Obel
<i>An. subpictus</i> Grassi	7♀, 30L, Krandangan, Telok Kombal, Kuta, Lombok, Aik Mel, Sekatong tengah
<i>An. sundaicus</i> (Rodenwaldt)	5♀, 2L, Telok Kombal, Aik Mel, Kuta
<i>An. vagus</i> Doenitz	13♀, 4L, Batubolong, Krandangan, Aik Mel, Kuta, Obel Obel
<i>Malaya genurostris</i> Leicester	33♀, 38♂, 9L, Aik Mel, Senaru, Obel Obel
<i>Topomyia tipuliformis</i> Leicester*	2♀, 2♂, 1P, 1L, Senaru
<i>To. (Top.)</i> sp.*	1♂, 1P, Senaru
<i>Tripteroides aranoides</i> (Theobald)*	3♀, 4♂, Senaru
<i>Toxorhynchites splendens</i> (Wiedemann)*	3♀, 1♂, Senaru
<i>Orthopodomyia anopheloides</i> (Giles)*	14L, Senaru
<i>Uranotaenia obscura</i> Edwards*	4L, Baun Pusuk
<i>Ur. bicolor</i> Leicester	4L, Senaru
<i>Aedeomyia catasticta</i> Knab*	1L, Aik Mel
<i>Armigeres malayi</i> (Theobald)*	10♀, 26♂, Aik Mel
<i>Ar. subalbatus</i> (Coquillett)	1♂, Senaru
<i>Ar. flavus</i> (Leicester)*	1♀, 7L, Senaru
<i>Aedes albolineatus</i> (Theobald)*	1♀, 2♂, Baun Pusuk
<i>Ae. albopictus</i> (Skuse)	5♀, 2♂, Senaru, Sendang Gile
<i>Ae. annandalei</i> (Theobald)	1♀, 2♂, 1L, Senaru
<i>Ae. indonesiae</i> Mattingly*	5♀, 18♂, 10L, Krandangan, Lombok, Sekatong, Batukijuk, Sambelia, Tanjung Aan
<i>Ae. iyangari</i> Edwards*	1♂, Aik Mel
<i>Ae. notoscriptus</i> (Skuse)*	2♀, Senaru
<i>Ae. poicilius</i> (Theobald)	1♀, 1♂, 2L, Senaru, Baun Pusuk
<i>Ae. saxicola</i> Edwards*	1♂, 8L, Baun Pusuk, Sendang Gile
<i>Ae. vigilax</i> (Skuse)	1♀, 3♂, 18L, Batukijuk
<i>Culex bandoengensis</i> Brug*	8L, Senaru
<i>Cx. bengalensis</i> Barraud*	2L, Senaru
<i>Cx. bitaeniorhynchus</i> Giles	3L, Obel Obel
<i>Cx. brevipalpis</i> (Giles)*	4L, Senaru
<i>Cx. fuscus</i> Wiedemann*	3♀, Lombok, Kuta, Tanjung Aan
<i>Cx. pseudovishnui</i> Colless	13L, Obel Obel
<i>Cx. quinquefasciatus</i> Say	5L, Mataram
<i>Cx. sitiens</i> Wiedemann	35L, Krandangan, Telok Kombal, Lombok, Kuta
<i>Cx. tritaeniorhynchus</i> Giles	5L, Batubolong, Krandangan, Lombok, Obel Obel
<i>Cx. vishnui</i> Theobald	12L, Batubolong, Aik Mel, Obel Obel
<i>Cx. nigropunctatus</i> Edwards*	1L, Obel Obel
<i>Cx. foliatus</i> Brug*	8L, Senaru
<i>Cx. spiculosus</i> Bram and Rattarithikul*	3L, Senaru
<i>Cx. (Culiciomyia)</i> sp.*	18L, Sendang Gile, Senaru, Baun Pusuk

¹ * = new record for Lombok Island, Indonesia.

with *Cx. foliatus*, *Cx. bengalensis*, *Ae. saxicola*, and *Ur. bicolor* Leicester. No member of this group previously has been reported from the island.

***Anopheles (Cel.) minimus*.** Many larvae were taken from slowly moving fresh-water streams and springs with grassy margins in the forest near Obel Obel village, East Lom-

bok, sometimes in association with *An. barbirostris*. This species has been recorded from Java, Bali, Sulawesi, Kalimantan, and Pulau Laut (Soemarlan and Gandahusada 1990) in Indonesia. It is well known as the principal vector of malaria in the Philippines as well as Taiwan and Ryukyu islands. It should therefore be suspected as an important vector

in the Obel Obel area, which is rich in streams and has a history of malaria.

Anopheles (Cel.) subpictus. This is one of the common species of *Anopheles*, inhabiting a wide range of ground pool habitats with 0–29‰ salinity in coastal areas. Many larvae were taken in brackish ground pools, lagoons, fresh-water streams, and irrigation ditches in coastal areas in association with *An. vagus*, *An. sundaicus* (Rodenwaldt), *Cx. sitiens* Wiedemann, *Cx. tritaeniorhynchus*, *Ad. catasticta*, and *Ae. vigilax* (Skuse). *Anopheles subpictus* is considered an important malaria vector in the coastal areas of the island.

Anopheles (Cel.) sundaicus. This species is predominant in areas close to the coast. About 20 larvae were taken in brackish ground water, concrete pools, and lagoons with 0–19‰ salinity. The endemic areas of malaria coincide with the habitats of *An. sundaicus* and *An. subpictus*, which suggests that these two species are the principal vectors of coastal malaria on Lombok Island.

Anopheles (Cel.) vagus. Larvae were found commonly in ponds, paddy fields, and lagoons with a salt concentration of 0–16‰, together with *An. barbirostris* and *An. subpictus*.

Topomyia (Top.) tipuliformis. Four immatures were collected, most from the leaf axils of taro plants (*Callocasia* sp.), at an altitude of ca. 800 m in Senaru. They were always found with *Malaya genurostris* Leicester and sometimes with *Ae. poicilius* (Theobald). Two males and two females with associated larval and pupal exuviae were examined. Identification of this species was made with the description of male genitalia given by Edwards (1922). No species of this genus has been recorded from Lombok previously.

Topomyia (Top.) sp. A single pupa was collected from the leaf axil of taro along a deeply shaded stream in the mountain forest, Senaru (ca. 800 m elevation). One male with associated pupal exuviae was mounted and examined. From the structures of the male genitalia, this species appears to be similar to *To. ankoris* (Klein 1977) from Cambodia and *To. sylvatica* (Lu, Dong and Wang 1986) from

Yunnan, China. There are, however, obvious differences in the shape of the gonostylus, the basal lobe of the claspette, and the ninth tergum.

Tripteroides (Trp.) aranoioides. Larvae were commonly found in bamboo stumps in Senaru. This species has been recorded from Bali.

Toxorhynchites (Tox.) splendens. One male and three females were examined. This species was collected in tree holes and bamboo stumps together with *Cx. brevipalpis*, *Cx. bandoengensis*, *Ae. albopictus* (Skuse), *Ae. annandalei* (Theobald), and *Orthopodomyia anopheloides*.

Orthopodomyia anopheloides. The immatures of this species were common in tree holes at Senaru at an elevation of ca. 800 m. It has been reported previously from Java, Kalimantan, and Sumatra (Zavortink 1971).

Aedeomyia catasticta. One larva was collected in a lagoon in Aik Mel District. It was associated with *An. sundaicus* and *An. subpictus*. Identification was based on the larval description by Tyson (1970). This species is widely distributed throughout the Oriental Region and Australia.

Armigeres (Arm.) malayi. Many larvae were collected in foul water in coconut shells. This species is widely distributed in Southeast Asia and New Guinea. Identification was made with the description of Steffan (1968).

Armigeres (Arm.) subalbatus (Coquillett). This species is widely distributed throughout Southeast Asia. Lee et al. (1984) recorded it as *Ar. obturbans*.

Armigeres (Lei.) flavus. This is apparently a Southeast Asian species, occurring in Malaysia, Indonesia, Thailand, and China. Many larvae were collected from newly cut green bamboo stumps. The larva is large in size and white in color. Identification was made with the description of MacDonald (1960).

Aedes (Can.) indonesiae. The immatures were commonly collected in brackish water (salinity 20‰) in crab holes near the seashore. The descriptions by Mattingly (1958) assisted in the recognition of this species, which is known to occur on Java, Sumatra, and in Thailand. The adults were often collected by sweep net at the entrances of crab holes.

Aedes (Stg.) albolineatus. It is not surprising to find this species on Lombok because it is known to occur throughout Southeast Asia. The immatures were collected in tree holes in Baun Pusuk, together with *Or. anopheloides*, *Cx. brevipalpis*, and *Cx. spiculolus*.

Aedes (Fin.) notoscriptus. A female was reared from a larva collected from a tree hole in the mountain forest (800 m) of Senaru. *Aedes notoscriptus* is a typical Australian species. The population on Java has been treated as a different subspecies, *Ae. notoscriptus montanus* (Bonne-Wepster 1954). Identification was based on the descriptions by Bonne-Wepster (1954) and Dobrotworsky (1965).

Aedes (Dic.) iyengari. Identification was based on the description of the very distinctive female and the illustration of the male genitalia by Reinert (1970). This species was reported previously from nearby Sumba (Bonne-Wepster 1954).

Culex (Cui.) sp. Many larvae belonging to the subgenus *Culiciomyia* were collected from rock pools in Sendang Gile, tree holes in Senaru, and rock pools in Baun Pusuk. They were preserved directly in MacGregor's solution, and no adults were obtained. According to Tsukamoto et al. (1989), the following six species of the subgenus *Culiciomyia* were described from the Oriental Region and China in the adult stage only: *Cx. bahri* (Edwards) from Sri Lanka, *Cx. delfinadoae* Sirivanakarn from the Philippines, *Cx. fuscicinctus* King and Hoogstraal from New Guinea, *Cx. tricuspis* Edwards and *Cx. yaoi* Tung from China, and *Cx. ramakrishnii* Wattal and Kalra from India. The larvae collected by us may be one of these six species with unknown immatures or an undescribed species. Reared adults with associated larval and pupal exuviae will be necessary to determine their identity. The larvae are characterized by the following: siphonal index 3.9–4.2, pecten teeth 4–6, thorax spiculose, seta 5-C with 3–5 branches, 4-P double, 1-X with 2–7 branches, and 4-X with 12–14 branches.

Culex (Lop.) spiculolus. Larvae were collected from tree holes together with *Cx. ban-*

doeensis. Identification was made using Sirivanakarn's (1977) descriptions of the very distinctive, hairy larva.

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