

## NOTES ON THE MOSQUITOES OF NEPAL: III. ADDITIONAL NEW RECORDS IN 1992 (DIPTERA: CULICIDAE)

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**ABSTRACT.** The results of a mosquito survey in the Western Region of Nepal are reported. A genus, *Aedeomyia*, two subgenera, *Aedeomyia* and *Tripteroides*, and 14 species are recorded for the first time. Most of the new records are species in the genus *Aedes* collected at the higher elevations of the Annapurna Range of the Himalaya Mountains.

### INTRODUCTION

The Himalayan country of Nepal is diverse not only with respect to altitude and topography but also in terms of its native biota. Faunistically the country is considered to be a composite of the Palearctic and Oriental biogeographic regions. It is expected that Nepal's mosquito diversity will parallel the country's topographical and biogeographic diversity and that an effective survey of this multifariousness will require considerable time and effort. The current study was, therefore, designed to survey the fauna over a four-year period, each year focusing on a different region. Nepal is divided into five political regions, Eastern, Central, Western, Mid-western, and Farwestern. During 1991, the first year of the study, the Eastern Region was studied, with significant discoveries reported by Darsie et al. (1992). The nation's capital, Kathmandu, is in the Central Region, where many previous collections have been made. Because the mosquito fauna of this region is well known, it was omitted from this project. The 1992 survey was concentrated in the Western Region, primarily in the mountainous areas around Pokhara and the *Terai* west of Butwal town. Working from two base camps, we made a total of 331 field collec-

tions during the period July to October. We are here reporting results of our explorations. Objectives and methods are the same as those given by Darsie et al. (1992).

Our first camp was in Pokhara, Kaski District, at an altitude of 915 m. Although at a relatively low altitude, Pokhara is only 25 km from the summits of the Annapurna Himal, a range that contains three peaks exceeding 7,000 m. Due to its proximity to these high mountains, Pokhara has become one of the most popular tourist centers in Nepal. A logical outgrowth of its location and popularity is the development of a good system of all-weather roads and convenient trekking routes and facilities. Consequently, they afforded us ready access to many districts and mountainous areas. From this base, mosquitoes were sampled throughout the northern part of the Western Region, including sections of Kaski, Parbat, Tanahu, Gorkha, Myagdi, and Mustang districts. The Pokhara camp lasted 38 days, which permitted sufficient time to sample a diversity of mosquito habitats. A visit to the northernmost Mustang District and associated treks into mountainous terrain were especially rewarding, allowing us to sample habitats up to 3,800 m. Further details on the Mustang experience will be the subject of a separate paper.

The second camp was established in the *Terai* 60 km west of Butwal, near the small village of Tikkar in Kapilvastu District. This lowland site at an altitude of 250 m was located in a primary forest adjacent to several small farms and a small permanent stream. Tikkar is composed of three separate communities, each surrounded by rice paddies.

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The village and neighboring terrain, mostly forested, yielded diverse mosquito habitats, including artificial containers, ditches, tree-holes, borrow pits, leaf axils, and crab holes. The one drawback was the paucity of bamboo plantings in the area. Three collectors were dispatched to Tansen, Palpa District, at 1,300 m to survey breeding sites. There they encountered sufficient bamboo to make meaningful collections. Also, nearby Rupandehi and Argakanchi districts were visited. Our Tikkar camp continued for 23 days.

The genus *Aedeomyia* Theobald, subgenera *Aedeomyia* Theobald and *Tripteroides* Giles, and 14 species were recorded from Nepal for the first time. Most of these discoveries belong to the genus *Aedes*, 11 in the subgenus *Finlaya* Theobald and one in subgenus *Aedimorphus* Theobald. The prevalence of *Aedes* among the new records reflected a sample design that focused on habitats frequented by species of this genus. Before the present project began in 1991, 24 species of *Aedes* were known from Nepal (Darsie and Pradhan 1990). In the past two years, an additional 24 species have been added. It is now the genus represented by the largest number of species.

The collection records below show the other species with which the 14 newly recorded taxa were associated. We have no such data on *Ae. pampangensis* (Ludlow) because only adults were collected. The immature stages of all other species were found in association with one to 11 species in seven genera.

Abbreviations for the collectors used in the data below are as follows: GWC—G.W. Courtney, MD—M. Das, SNJ—S.N. Jha, GSN—G.S. Nepal, BBP—B.B. Pradhan, and TS—T. Shrestha. The abbreviations for the genera follow Reinert (1975). The name of the political district is given in uppercase letters.

## NEW COUNTRY RECORDS

### *Aedeomyia (Aedeomyia) catasticta* Knab

KASKI, Pokhara, Begnash Tal (Lake), 6 km E of Pokhara, elevation 677 m, VIII-8-

92, 1♀, reared from pupa; VIII-13-92, 3♀, 2♂, reared from larvae and pupae; VIII-14-92, 10♀, 1♂, reared from larvae, 25♀, 28♂, reared from pupae, BBP, *ex* unused concrete fish ponds with floating decaying plant material, associated with *Anopheles annularis* van der Wulp, *An. subpictus* Grassi, *An. vagus* Doenitz, *Culex pseudovishnui* Colless.

*Aedeomyia catasticta* is widely distributed throughout the Oriental Region, south to Australia and east to the South Pacific Islands (Knight and Stone 1977, Tyson 1970, Barraud 1934, as *Ad. venustipes* (Skuse)). However, the genus *Aedeomyia* Theobald had never been taken in Nepal. The tenacity of B.B. Pradhan was responsible for locating the larval habitat. The breeding site near Begnash Tal was a series of concrete tanks that had been constructed as part of an aquaculture project. The tanks had not yet been employed for fish production, and most were about half full of water containing volunteer aquatic plants. Larvae of *Ad. catasticta* were associated with floating aggregates of gray, decaying aquatic vegetation, mostly confined to the corners of the tanks. This distinctive mosquito was easily recognized using Tyson (1970). The subgenus *Aedeomyia* Theobald is also a new record for Nepal, and Tyson characterizes it in his keys.

### *Aedes (Aedimorphus) pampangensis* (Ludlow)

KAPILVASTU, Gorasinghi, Tikkar Village, elevation 250 m, IX-18-92, 2♀, SNJ, attracted to humans in primary forest.

This species was described by Reinert (1973), who synonymized *Ae. niveoscutellum* Theobald with it. It is apparently confined to low elevations.

### *Aedes (Finlaya) albotaeniatus* (Leicester)

KASKI, Chhomrung, Annapurna Base Camp trail, elevation 2,200 m, VIII-23-92, 1♀, reared from pupa, GWC, *ex* reservoir with clear, fresh water, associated with *Ae. shortii* (Barraud), *Ae. pseudotaeniatus* (Giles).

Although our specimen was collected at 2,200 m, this species is by no means confined

to the higher altitudes. Harrison et al. (1991) gave a meaningful discussion of its distribution, in most of the Oriental Region from India and Nepal eastward, and taxonomic status. Edwards (1922) described a new related species, *Ae. mikiranus* from Assam, India, which was reduced to a variety of *Ae. albotaeniatus* by Barraud (1934) and was synonymized with *Ae. albotaeniatus* by Harrison et al. (1991). The Nepal specimen is the *Ae. mikiranus* form, characterized by a scutum with dark brown scales and indistinct narrow yellow lines rather than a white frontal patch as in the typical form (Barraud 1934).

This species belongs to the *Albotaeniatus* Group as defined by Knight (1948). The group contains 28 species with odd geographic distribution, i.e., 17 species in the Australasian Region, eight on the Indian Subcontinent, and one each in Korea and the Philippines. The nominate species is widely distributed.

#### *Aedes (Finlaya) cacharanus* (Barraud)

KASKI, Pokhara, elevation 915 m, VII-28-92, 1♂, reared from pupa, *ex* bamboo stump, associated with *Ae. albopictus* (Skuse), *Ae. niveoides* Barraud, *Ae. albolateralis* (Theobald), *Ae. prominens* (Barraud), *Armigeres inchoatus* Barraud, *Ar. subalbatus* (Coquillett); Pokhara, Lamachaur, elevation 1,000 m, VII-28-92, 1♂, reared from pupa, *ex* treehole, associated with *Ae. dissimilis*, *Ae. prominens*, *Ar. inchoatus*, *Heizmannia himalayensis* Edwards; VII-29-92, 1♂, reared from larva, *ex* treehole, associated with *Ae. prominens*, *Toxorhynchites splendens* (Wiedemann); VIII-2-92, 2♂, reared from pupae, *ex* bamboo stump, associated with *Ae. albopictus*, *Ae. albolateralis*, *Ae. prominens*, *Ar. inchoatus*; VIII-11-92, 3♂, reared from pupae, 1♀, reared from larva, *ex* treehole, associated with *Ae. albolateralis*, *Ae. dissimilis*, *Ae. prominens*, *Ae. albopictus*, *Ar. subalbatus*, *Orthopodomyia anopheloides* (Giles); Pokhara, Mahendra Gubha (cave), elevation 1,075 m, VIII-4-92, 4♀, 1♂, *ex* bamboo stump, associated with *Ae. albopictus*, *Ae. albolateralis*, *Ae. annandalei* (Theobald); Pokhara, Sarangkot, elevation 1,000 m, VIII-5-92, 1♀, *ex* bamboo stump, associated with *Ae. al-*

*bopictus*, *Ae. albolateralis*, *Ar. subalbatus* (collected by BBP).

Pokhara, Yamdi Khola bridge near Suikhet, elevation 1,200 m, VIII-13-92, 1♀, reared from larva, 1♂, reared from pupa, *ex* treehole, associated with *Ae. albolateralis*, *Ae. gubernatoris* (Giles), *Ae. feegradei* Barraud, *Ae. craggi* (Barraud), VIII-13-92, 1♀, GWC, reared from pupa, *ex* bamboo stump, associated with *Ae. albolateralis*; Kaare, elevation 1,600 m, VIII-13-92, 2♂, reared from pupae, GWC, *ex* treehole, associated with *Ae. albolateralis*, *Ae. cogilli* Edwards, *Ae. deccanus* (Barraud); Lumle, elevation 1,200 m, VIII-13-92, 1♂, reared from larva, 2♂, reared from pupae, BBP, *ex* treehole, associated with *Ae. cogilli* (Barraud), *Ae. albolateralis*; Pokhara, Sarangkot Pakha, elevation 1,000 m, VIII-19-92, 2♀, reared from larvae, 3♂, reared from pupa, BBP, *ex* treehole, associated with *Ae. albolateralis*, *Ar. subalbatus*, *Or. anopheloides*, *Tx. splendens*; Tholomani, elevation 915 m, VIII-25-92, 1♀, 1♂, reared from larvae, 1♀, 1♂, reared from pupae, GSN, *ex* treehole, associated with *Ae. albolateralis*, *Ae. albopictus*.

This species is confined to the northern Indian Subcontinent. It was the most common new record encountered in the environs of the Pokhara Valley. It was never collected in pure culture; it was associated with 11 species of mosquitoes in five genera.

#### *Aedes (Finlaya) cogilli* Edwards

KASKI, Kaare, elevation 1,600 m, VIII-16-92, 2♂, GWC, *ex* treehole, associated with *Ae. deccanus*, *Ae. albolateralis*, *Ae. cacharanus*.

This species apparently is quite rare, originally known from southern India, not reported by Bhat (1975) in his report on a survey of the Indian Himalayas. It is one of several treehole species being recorded in this account.

#### *Aedes (Finlaya) deccanus* (Barraud)

KASKI, Kaare, elevation 1,600 m, VIII-16-92, 2♀, reared from pupae, GWC, *ex* treehole, associated with *Ae. albolateralis*, *Ae.*

*cogilli*, *Ae. cacharanus*; Dhampus, Landruk-Suikhet trail, elevation 1,800 m, 1♀, GWC, reared from pupa, *ex* treehole, associated with *Ae. albolateralis*, *Ae. gubernatoris*, *Ar. subalbatus*, *Hz. himalayensis*.

This species is not known outside the Indian Subcontinent, and only Barraud (1934) reported its occurrence in the western Indian Himalayas.

#### *Aedes (Finlaya) elsiae* (Barraud)

KASKI, Lumle, near Dhote Khola bridge, elevation 1,200 m, VIII-17-92, 1♀, reared from larva, 1♀, reared from pupa, BBP, *ex* rockhole, associated with *Ae. pseudotaeniatatus*, *Ae. macdougalli* Edwards.

This species is closely related to and was found with *Ae. macdougalli* and *Ae. pseudotaeniatatus* in rock pools that we sampled. Unlike *Ae. macdougalli* (see below), it is widely distributed in the Oriental Region (Knight and Stone 1977).

#### *Aedes (Finlaya) feegradei* (Barraud)

KASKI, Kaare, elevation 1,600 m, VIII-13-92, 1♀, reared from pupae, *ex* treehole; VIII-16-92, 1♀, reared from larva, GWC, *ex* treehole, associated with *Ae. albolateralis*, *Ae. cacharanus*, *Ae. gubernatoris*.

This species has a strange distribution pattern. It was originally described from Rangoon, Burma (Barraud 1934), and has also been found in Thailand (Harrison et al. 1991) and Ryukyu Islands (Knight and Stone 1977). However, Tomo and Miyagi (1986) do not list it in the Ryukyu mosquito fauna.

#### *Aedes (Finlaya) harveyi* (Barraud)

KASKI, Pokhara, Arghaun, elevation 791 m, VIII-10-92, 1♂, reared from pupa, BBP, *ex* bamboo stump, associated with *Ae. albopictus*, *Ae. craggi*, *Ar. magnus* (Theobald), *Ar. subalbatus*; Landruk, Modi Khola trail, elevation 1,700 m, VIII-24-92, 1♂, reared from pupa, *ex* banana axil, associated with *Ae. formosensis* Yamada; 1♀ reared from larva, *ex Collocasia* sp. leaf axil, associated with *Ae. formosensis*; 1♂, reared from pupa, GWC,

*ex* bamboo stump, associated with *Ae. albolateralis*, *Ae. gubernatoris*, *Ae. sp.* of Niveus Subgroup, *Ar. subalbatus*; PALPA, Tansen, Basantapur, elevation 1,311 m, IX-11-92, 1♂, reared from larva, TS, *ex Collocasia* sp. leaf axil, associated with *Ae. formosensis*.

This species and *Ae. formosensis* are members of the Chrysolineatus Subgroup and are mainly leaf axil breeders in Nepal, although *Ae. harveyi* was taken on two occasions from bamboo stumps. It is widely distributed in the Indian subcontinent and Sri Lanka eastward to Taiwan and south to Indonesia. We believe that these specimens fit the descriptions of *Ae. harveyi* by Knight (1968) and Barraud (1934) except that the small subspiracular scale patch, mentioned by Knight as absent, is present in our specimens.

#### *Aedes (Finlaya) lophoventralis* (Theobald)

KASKI, Pokhara, Malepatan, elevation 915 m, VII-27-92, 1♀, BBP, attracted to humans; KAPILVASTU, Gorasinghi, Tikkar Village, elevation 250 m, IX-18-92, 1♀, reared from pupa, SNJ, *ex* depression in fallen tree, associated with *Ae. albopictus*; RUPANDEHI, Tunchawa, elevation 250 m, IX-20-92, 1♀, 1♂, reared from larvae, 4♂, reared from pupae, TS, *ex* treehole, no other species present.

This species is one of a group of subgenus *Finlaya* whose adults have erect or semierect scales on the abdominal sterna (and sometimes the terga). Originally thought to be confined to India and Pakistan, it is now known from Nepal, Bangladesh (Ahmed 1987), and Thailand (Harrison et al. 1991).

#### *Aedes (Finlaya) macdougalli* Edwards

KASKI, Lumle near Dhote Khola bridge, elevation 1,200 m, VIII-17-92, 1♀, 1♂, reared from pupae, GWC, *ex* rockhole, associated with *Ae. pseudotaeniatatus*, *Ae. elsiae*.

This species is related to and was found with *Ae. pseudotaeniatatus* and *Ae. elsiae*. Harrison et al. (1991) disavows *Ae. macdougalli*'s presence in Thailand, Malaysia, Indonesia, and China. Such claims are due to misidentifications. They are incorrect, however, in

believing that it is confined to Sri Lanka and south India for we have a good record within the Himalaya Range.

***Aedes (Finlaya) niveoides (Barraud)***

RAMECHHAP, Ramechhap, elevation 1,378 m, IX-4-91, 1♂, TS, *ex* treehole, associated with *Ae. albolateralis*; KASKI, Pokhara, elevation 915 m, VII-28-92, 1♀, reared from pupa, BBP, *ex* bamboo stump, associated with *Ae. albopictus*, *Ae. albolateralis*, *Ae. prominens*, *Ar. inchoatus*, *Ar. subalbatus*.

This species is the third representative of the Niveus Subgroup in Nepal, the others being *Ae. novoniveus* Barraud and *Ae. albolateralis* (Darsie et al. 1992).

***Aedes (Finlaya) shortti (Barraud)***

MUSTANG, Kobang, Kali Gandaki trail, elevation 2,600 m, VIII-5-92, 3♀, 1♂, reared from larvae, 1♂, reared from pupa, *ex* stream pool, associated with *Ae. pseudotaeniatus*; MYAGDI, Ghasa, Kali Gandaki trail, elevation 1,951 m, VIII-6-92, 5♀, 1♂, reared from larvae, 4♀, 5♂, reared from pupae, *ex* seepage, associated with *Ae. pseudotaeniatus*, *Ae. dissimilis*, *Ae. pulchriventer* (Giles), *Cx. pallidothorax* Theobald; KASKI, Banthanti, Ghorapani trail, elevation 2,200 m, VIII-8-92, 1♀, 1♂, reared from larvae, 3♀, 2♂, reared from pupae, *ex* small ground pool, associated with *Ae. pulchriventer*, *Ae. pseudotaeniatus*; Chhomrung, Annapurna Base Camp trail, elevation 2,200 m, VIII-23-92, 3♀, reared from larvae, 1♀, 1♂, reared from pupae, *ex* reservoir pond, associated with *Ae. pseudotaeniatus*, *Ae. albotaeniatus* (collected by GWC).

This is a true high altitude species. The average elevation of its breeding sites in Nepal was 2,237 m and the lowest, 1,951 m. Bhat (1975) collected this species at an average altitude of 2,571 m and a low of 1,140 m in the Indian Himalayas. Harrison et al. (1991) listed it from Thailand.

***Tripteroides (Tripteroides) indicus (Barraud)***

PALPA, Tansen, Sundar Village, elevation 1,300 m, IX-9-92, 1♀, 1♂, reared from larva,

TS, *ex* bamboo stump, associated with *Ae. albopictus*, *Ae. w-albus* (Theobald), *Ar. subalbatus*, *Tx. splendens*.

This is the second species of genus *Tripteroides* and the first in subgenus *Tripteroides* recorded from Nepal (Mattingly 1981). Larvae were aspirated from a bamboo stump at 1,300 m, apparently the highest altitude record for the species, according to Barraud (1934). It was originally described as a subspecies of *Tr. powelli* (Ludlow) but was elevated to specific rank by Thurman (1959). Mattingly (1981) and Baisas and Ubaldo-Pagayon (1952) offer descriptions in part. It is distributed in India, Thailand, Burma, and Indonesia. This species belongs to the Nitidiventer Group as defined by Mattingly (1981).

*Tripteroides aranoides* (Theobald), the first taxon of this genus for Nepal (Darsie et al. 1992), common in the Eastern Region, was absent from the Western Region.

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#### REFERENCES CITED

- Ahmed, T.V. 1987. Checklist of the mosquitoes of Bangladesh. *Mosq. Syst.* 19:187-200.  
Baisas, F.E. and A. Ubaldo-Pagayon. 1952.

- Notes on Philippine mosquitoes XVI. Genus *Tripteroides*. Monogr. Inst. Sci. Tech. Manila, No. 2.
- Barraud, P.J. 1934. Family Culicidae. Tribes Megarhinini and Culicini. The fauna of British India, including Ceylon and Burma. Diptera. Vol. V. Taylor and Francis, London.
- Bhat, H.R. 1975. A survey of haemaphagous arthropods in western Himalayas, Sikkim and hill districts of West Bengal: records of mosquitoes collected from Himalayan region of Uttar Pradesh with ecological notes. Indian J. Med. Res. 63:1583-1608.
- Darsie, R.F., Jr. and S.P. Pradhan. 1990. The mosquitoes of Nepal: their identification, distribution and biology. Mosq. Syst. 22:69-130.
- Darsie, R.F., Jr., S.P. Pradhan and R.G. Vaidya. 1991. Notes on the mosquitoes of Nepal I. New country records and revised *Aedes* keys (Diptera, Culicidae). Mosq. Syst. 23:39-45.
- Darsie, R.F., Jr., S.P. Pradhan and R.G. Vaidya. 1992. Notes on the mosquitoes of Nepal: II. New species records from 1991 collections. Mosq. Syst. 24:23-28.
- Edwards, F.W. 1922. A synopsis of adult Oriental culicine (including megarhine and sabethine) mosquitoes. Part I. Indian J. Med. Res. 10:249-293.
- Harrison, B.A., R. Rattanarithikul, E.L. Peyton and K. Mongkolpanya. 1991. Taxonomic changes, revised occurrence records and notes on the Culicidae of Thailand and neighboring countries. Mosq. Syst. 22:196-227.
- Knight, K.L. 1948. The *Aedes* (*Finlaya*) *albotaeniatus* group of mosquitoes (Diptera: Culicidae). Proc. Entomol. Soc. Wash. 50: 1-8.
- Knight, K.L. 1968. Contributions to the mosquito fauna of Southeast Asia—IV. Species of the subgroup *Chrysolineatus* of group D, genus *Aedes*, subgenus *Finlaya* Theobald. Contrib. Am. Entomol. Inst. (Ann Arbor) 2(5):1-45.
- Knight, K.L. and A. Stone. 1977. A catalog of the mosquitoes of the world (Diptera: Culicidae). Thomas Say Found. 6:1-611.
- Mattingly, P.F. 1981. Medical entomology studies—XIV. The subgenera *Rachionotomyia*, *Tricholeptomyia* and *Tripteroides* (Mabinii Group) of genus *Tripteroides* in the Oriental Region (Diptera: Culicidae). Contrib. Am. Entomol. Inst. (Ann Arbor) 17(5):1-147.
- Reinert, J.F. 1973. Contributions to the mosquito fauna of Southeast Asia.—XVI. Genus *Aedes* Meigen, subgenus *Aedimorphus* Theobald in Southeast Asia. Contrib. Am. Entomol. Inst. (Ann Arbor) 9(5):1-218.
- Reinert, J.F. 1975. Mosquito generic and subgeneric abbreviations (Diptera: Culicidae). Mosq. Syst. 7:105-110.
- Thurman, E.B. 1959. A contribution to a revision of the Culicidae of northern Thailand. Univ. Md. Agr. Exp. Sta. Bull. A-100.
- Tomo, T. and I. Miyagi. 1986. The mosquito fauna of the Ryukyu Archipelago with identification keys, pupal descriptions and notes on biology, medical importance and distribution. Mosq. Syst. 18:1-117.
- Tyson, W.H. 1970. Contributions to the mosquito fauna of Southeast Asia. VII. Genus *Aedeomyia* in Southeast Asia. Contrib. Am. Entomol. Inst. (Ann Arbor) 6(2):1-28.