

A New Synonym and New Species Name in the Southeast
Asian *Anopheles hyrcanus* Complex¹

by

Bruce A. Harrison², John E. Scanlon³ and John A. Reid⁴

ABSTRACT

Evidence is presented that the type of *Anopheles indiensis* Theobald 1901, is lost or non-extant, with no other specimens known; and, that *indiensis* sensu Reid (1953, 1968) does not occur in Madras, India, the type locality of *indiensis* Theobald. Accordingly, *indiensis* Theobald is synonymized under *nigerrimus* Giles 1900, and *nitidus* n. sp., is described for *indiensis* of Reid.

INTRODUCTION

A recent examination of Southeast Asian *Anopheles* type-specimens in the British Museum (Natural History), coupled with recent publications on mosquito collections in India, have prompted the authors to re-examine the status of the name, *Anopheles indiensis* Theobald 1901, and the species currently identified with this name. The study involved a complete review of the literature and an examination of all *indiensis* in the U. S. National Museum (Natural History) (USNM) and the British Museum (Natural History) (BMNH).

DISCUSSION

There has been considerable confusion surrounding the type-specimen of *indiensis*. Theobald (1901a) described *indiensis* as a subspecies of *Anopheles sinensis* Wiedemann, from specimens sent to him by Capt. Cornwall from Madras, India; however, there are no specimens so labeled in the BMNH. Christophers (1924) reported a female in the BMNH under the heading *indiensis*, with no locality label and bearing the label, "*Anopheles annularis* var. *alboanulus* (Type) Theobald." Reid (1953) interpreted this specimen as the type of *indiensis* and presented a review of the history surrounding this

¹This work was supported, in part, by Research Contract No. DA-49-193-MD-2672 from the U. S. Army Medical Research and Development Command, Office of the Surgeon General, Washington, D. C. This paper is contribution number 1221 from the Army Research Program on Malaria.

²Department of Entomology, Walter Reed Army Institute of Research, Washington, D. C. 20012.

³School of Public Health, University of Texas Health Science Center at Houston, P. O. Box 20186, Houston, Texas 77025.

⁴Glenwood, Dorking, Surrey RH5 4BY, England.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 1973		2. REPORT TYPE		3. DATES COVERED 00-00-1973 to 00-00-1973	
4. TITLE AND SUBTITLE A New Synonym and New Species Name in the Southeast Asian Anopheles hyrcanus Complex				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Walter Reed Army Institute of Research, Department of Entomology, Washington, DC, 20012				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT see reprot					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 6	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

female, summing up this review by saying, "There seems no doubt, therefore, that the specimen labelled *alboanulus* is the type of *indiensis* Theo., and I shall follow Christophers (1924) and Yamada (1924) in treating it as such." Our re-examination of this female confirms that it possesses only the above identification label written by Theobald, and no locality label. Therefore, there is no way it can be associated definitely with Theobald's *indiensis*, or even Madras, India. In fact, an examination of this problem using the available facts and recent literature strongly suggests the specimen has no connection with Theobald's *indiensis*. Theobald (1901) accorded *indiensis* and *annularis* Van der Wulp equal status as subspecies of *sinensis* and the descriptions and illustrations reflect this. Theobald (1903) readily admitted that he was in error in 1901 to consider *annularis* (subgenus *Cellia*) as closely related to *sinensis*; however, this does not alter the fact that he made this error of recognition prior to and in 1901. Theobald (1901a) went to some length to describe what he considered *annularis* based on specimens from: Taipang [sic], Perak, Malaya (as "Straits Settlements"), L. Wray, 21.11 and 22. 12. 1899; and Madras, India (D. O'C. Murphy, 99). Based on his discussion of leg variations it is quite obvious he was dealing with at least two currently recognized species. On page 144 under the heading, "Variability of the Subspecies" he wrote as follows, "The large series sent by Mr. Wray, from Taipang, shows considerable variation both in size and markings, one distinct variety being easily separated from them; this I call variety A, in which the bands of the hind tarsi involve both sides of the joint." We believe that the specimen in the BMNH labeled *annularis* var. *alboanulus* is a specimen of Theobald's *annularis* var. A, which he named *alboanulus* for the white bands on the legs. Giles (1904, as *alboannulatus*, not *alboannulus* of Stone et al. 1959) pointed out that this is a manuscript name that Theobald placed on certain specimens in the BMNH. Further, the origin and identity of the specimen labeled *annularis* var. *alboanulus* with the species currently called *indiensis*, is strongly supported by the abundance of *indiensis* in Malaya (Reid 1968) and 7 females in the BMNH identified as *indiensis* by Reid (1953) from Taipang, 1899 (L. Wray), probably the same series of specimens that Theobald's *alboanulus* came from. Therefore, we now feel there is no basis for considering this specimen the type of *indiensis*, although there is no doubt it conforms to *indiensis* sensu Reid (1953, 1968).

Our above contentions are supported by the obvious absence of specimens of the species currently called *indiensis* from central and southern India. Disregarding the specimen labeled *annularis* var. *alboanulus*, there are no other specimens of *indiensis* in the USNM or BMNH from west of Assam (Northeast India). At least 3 other members of the Southeast Asian *hyrcanus* complex have their western-most confirmed records from Assam, which seems to be an area of overlap between the Indian and Southeast Asian faunal subregions. Reid et al. (1962) did not find *indiensis* in specimens from Madras. Further support comes from Reuben (1971a, 1971b), who summarized mosquito collections made in Madras (*indiensis* type locality) between 1958-1963. These collections resulted in the capture of 10,970 specimens of *nigerrimus* Giles 1900 and *peditaeniatus* (Leicester) 1908, but, not a single specimen of *indiensis*. This study involved 13,431 trap nights from bullock and chicken-bait traps and light trap collections, also 6,131 man-hours expended on indoor and outdoor resting collections. Collections on Sri Lanka (Ceylon) by Smithsonian Institution personnel between 1970-1973 also failed to find *indiensis*, although *nigerrimus* and *peditaeniatus* were commonly collected.

It also seems strange that Theobald (1901b) did not acknowledge Capt. Cornwall or his specimens (including the *indiensis* type), in his "List of the collections of mosquitoes received at the British Museum up to the present time,....", when all the other listed contributors were acknowledged. The only reason we can suggest for this, other than oversight, is that Cornwall's specimens were a loan rather than a gift to the BMNH. This contention is supported by Giles (1902) who said, "I have not seen the *indiensis* form, as the single specimen from which it is described by Mr. Theobald was a loan from a private collection,....." There are no references to a Capt. Cornwall or *indiensis* in the Theobald correspondence now in the BMNH (P. F. Mattingly, personal communication).

SYNONYMY

Apparently, the type of *indiensis* is now lost or non-extant, and without a type for comparison we have no way of knowing what species Theobald was describing from Madras. The absence of the species currently called *indiensis* from the Indian subregion west of Assam, presents a problem. Theobald's description, illustration and association of *indiensis* with *sinensis* definitely suggests it is a member of the Southeast Asian *hyrcanus* complex. Current knowledge indicates only two species of this complex, *nigerrimus* and *peditaeniatus*, in Madras. Therefore, *indiensis* (1901) is either a synonym of *nigerrimus* (1900), or *peditaeniatus* (1908) is a synonym of *indiensis*.

Theobald's (1901a) original description of *indiensis* presented only 3 characters: the base of the first submarginal cell being close to the first costal (subcostal) spot; the cross veins separate; and the presence of pale fringe scales at the tip of Cu_2 . Of these, only the last named is now known to have any stability in the Southeast Asian *hyrcanus* complex. Southeast Asian *nigerrimus* frequently have a fringe spot at Cu_2 , while *peditaeniatus* from that subregion only infrequently have this character. An examination of Indian specimens, however, reveals it is uncommon on both of these species (1 of 44 *nigerrimus*: 1 of 52 *peditaeniatus*). Consequently, none of Theobald's characters help to identify this species. This situation leaves us with 3 courses of action. If we consider *indiensis* a nomen dubium because no type or specimens are known and the species cannot be identified by the description, then the name will possibly become lost or forgotten during future work. To synonymize *peditaeniatus* under *indiensis* would cause another major name change, for *peditaeniatus* is one of the most common and widely distributed *Anopheles* in the Orient. However, if we synonymize *indiensis* under *nigerrimus* no other name is changed and *indiensis* remains available in case another species of the *hyrcanus* complex is discovered in Madras. We have chosen the last course of action. The currently recognized synonyms of *nigerrimus* are:

Anopheles (Anopheles) nigerrimus Giles

Anopheles nigerrimus Giles 1900, Handb. Gnats or Mosq., p. 162.

Anopheles sinensis indiensis Theobald 1901, Monogr. Culicidae 1: 145.

(REASSIGNED AS SYNONYM).

Anopheles bentleyi Bentley 1902. Indian Med. Gaz. 37: 15.

Anopheles minutus Theobald 1903, Monogr. Culicidae 3: 91.

Anopheles hyrcanus var. *williamsoni* Baisas and Hu 1936, Philipp. Mon. Bull. Bur. Hlth. 16: 222.

Anopheles venhuisi Bonne-Wepster 1951, Docum. Neerl. Indones. Morb. Trop. 3: 284.

This is not the first time *indiensis* has been considered a synonym of *nigerrimus*. Both *indiensis* and *peditaeniatus* were listed as synonyms of *An. hyrcanus* var. *nigerrimus* by Edwards (1932) and they were usually regarded in this status until Reid (1953) elevated both to full species.

NEW SPECIES

The above evidence shows that the anopheline species in Southeast Asia previously associated with the name *indiensis* has no connection with that name. Consequently, it is now necessary to rename this species. The nomen nudum, *alboannulatus* Giles (1904), published as a Theobald manuscript name, was not accompanied by a sufficient indication (ICZN Code) to become a valid name. The following name for this species was selected because of its bright elegant wing pattern.

Anopheles (Anopheles) nitidus New Species

Anopheles hyrcanus nigerrimus type C of Crawford 1938, *Anopheline Pupae Malaya*, p. 51 (P*); Reid 1953, *Bull. Ent. Res.* 44: 29(=*indiensis*).

Anopheles (Anopheles) indiensis of Reid 1953, *Bull. Ent. Res.* 44: 29 (♂*, ♀*, P*, L*, E*); Bonne-Wepster and Swellengrebel 1953, *Anopheline Mosq. Indo-Australian Region*, p. 244 (A*); Peyton and Scanlon 1966, *Ill. Key Female Anopheles Mosq. Thailand*, p. 5(♀*); Scanlon, Peyton and Gould 1968, *Thai Nat. Sci. Papers, Fauna Ser.* 2: 12; Reid 1968, *Stud. Inst. Med. Res. Malaysia* 31: 98 (♂*, ♀*, P*, L*, E*); Harrison 1972, *Mosq. Syst.* 4: 74; Rattanakrithikul and Harrison (In press), *Ill. Key Anopheles Larvae Thailand*, p. 8 (L*).

DESCRIPTION. This species is easily recognized in the adult stage by scattered pale scales on the basal third of the costa; distinct eye spots on the scutum, a bright sharply defined wing pattern, a patch of dark scales on the humeral cross vein and broad pale bands crossing the joints on the hind tarsal segments. Since all stages have been described by Reid (1953, 1968 as *indiensis*) they are not redescribed here.

TYPE-DATA. The holotype female has been selected from Malayan plesiotypes for *indiensis* that Reid (1953) placed in the BMNH. This female is in excellent condition, has associated immature skins on a slide and has the following label data: (1st label; - "Selangor, 5th m. Klang Rd., 7-11-1950, J. A. Reid"; (2nd label) - "bred in laboratory from known mother", and rearing number "28/9"; and (3rd label) - is Reid's *indiensis* identification label. The male allotype, with associated immature skins on a slide, is also in the BMNH and has the same label data as the holotype, except the rearing number is "28/10." Two male and 5 female paratypes from Selangor, Malaysia, are here designated and deposited in the USNM. One male with genitalia intact, associated immature skins on a slide and rearing number "28/8" is from the same collection as the holotype and allotype. One female with associated immature skins on a slide and rearing number "454/68" is from "Kepong." One male with genitalia intact and collection number "232" is from "Ampang Rd., K. L." Two females with collection number "16984" are from "Sungei Tua." While the 5 paratypes just noted were collected by Reid between 1941 - 1951, the remaining 2 female paratypes have collection number "804" and were collected in "Ulu Langat" in 1967 by personnel from the University of Malaysia.

DISTRIBUTION. Based on specimens examined, *nitidus* occurs in CAMBODIA, INDIA (Assam), INDONESIA (Sumatra), MALAYSIA (West and East), NORTH VIETNAM, SOUTH VIETNAM and THAILAND. Khin-Maung-Kyi (1971) recorded specimens of *indiensis* from BURMA, and based on his brief diagnosis they are probably *nitidus*. Other recent publications referring to *indiensis* in Southeast Asia and referencing Reid's papers, probably refer to *nitidus*.

BIOLOGY. Immatures of *nitidus* apparently require cool quiescent water, emergent and/or floating vegetation and partial shade, requirements which are filled by deep rice fields, swamps, marshes and similar habitats. Adult females are basically zoophilic and there is no evidence that incriminates *nitidus* as a natural vector of human pathogens.

ACKNOWLEDGMENTS

We gratefully acknowledge the assistance of Dr. Peter F. Mattingly, Department of Entomology, British Museum (Natural History), during our search for type-specimens, and Dr. Curtis W. Sabrosky, Systematic Entomology Laboratory (USDA), Smithsonian Institution, for his advice. Special appreciation is also due Mr. E. L. Peyton, Southeast Asia Mosquito Project, and LTC Bruce F. Eldridge, MAJ John F. Reinert and Dr. Ronald A. Ward, Department of Entomology, Walter Reed Army Institute of Research, for critically reviewing the manuscript.

REFERENCES

- Christophers, S. R. 1924. Provisional list and reference catalogue of the Anophelini. Indian Med. Res. Mem. 3: 1-105.
- Edwards, F. W. 1932. Genera Insec. Diptera, Fam. Culicidae. Fasc. 194. Desmet-Verteneuil, Brussels. 258 pp.
- Giles, G. M. 1902. A handbook of the gnats or mosquitoes. John Bale, Sons & Danielsson, Ltd. London. 2nd Ed. 530 pp.
- Giles, G. M. 1904. A revision of the Anophelinae. Supplement I to handbook, 2nd Ed. John Bales, Sons & Danielsson, Ltd. London. 48 pp.
- Khin-Maung-Kyi 1971. The anopheline mosquitoes of Burma. I. Subgenus *Anopheles* Meigen, Series *Anopheles* and *Myzorrhynchus* Edwards. Un. Burma J. Life Sci. (Rangoon) 4: 281-296.
- Reid, J. A. 1953. The *Anopheles hyrcanus* group in South-East Asia (Diptera: Culicidae). Bull. Ent. Res. 44: 5-76.
- Reid, J. A. 1968. Anopheline mosquitoes of Malaya and Borneo. Stud. Inst. Med. Res. Malaysia 31: 1-520.
- Reid, J. A., T. Wilson and A. Ganapathipillai. 1962. Studies on filariasis in Malaya. The mosquito vectors of periodic *Brugia malayi* in North-West Malaya. Ann. Trop. Med. Parasit. 56: 323-336.

- Reuben, R. 1971a. Studies on the mosquitoes of North Arcot District, Madras State, India. Part 1. Seasonal densities. J. Med. Ent. 8: 119-126.
- Reuben, R. 1971b. Studies on the mosquitoes of North Arcot District, Madras State, India. Part 2. Biting cycles and behavior on human and bovine baits at two villages. J. Med. Ent. 8: 127-134.
- Stone, A., K. L. Knight and H. Starcke. 1959. A synoptic catalog of the mosquitoes of the World (Diptera, Culicidae). Thomas Say Found., Ent. Soc. Amer. 6: 1-358.
- Theobald, F. V. 1901a. Monograph of the Culicidae. Brit. Mus. (Nat. Hist.), London. Vol. I, 424 pp.
- Theobald, F. V. 1901b. Monograph of the Culicidae. Brit. Mus. (Nat. Hist.), London. Vol. II, 391 pp.
- Theobald, F. V. 1903. Monograph of the Culicidae. Brit. Mus. (Nat. Hist.), London. Vol. III, 359 pp.
- Yamada, S. 1924. A revision of the adult anopheline mosquitoes of Japan. Part I. Systematic descriptions, their habits and their relations to human diseases together with an account of 3 new species. Sci. Rep. Govt. Inst. Infect. Dis. (Tokyo) 3: 215-241.