

Notes on *Culex (Culex) neovishnui* Lien, 1968 from the Ryukyus and Japan proper (Diptera: Culicidae)*

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Introduction

In 1957, Colless pointed out that the type-specimen of *Culex vishnui* is quite different from any specimens which has been reported as *Culex vishnui* Theobald by many Entomologists in Asia (Borel, 1930; Barraud, 1934; Bonne-Wepster and Brug, 1939; Lee, 1944; Bonne-Wepster, 1954), and he described *Culex pseudovishnui* Colless, 1957, as a new species for the mosquito in question. He suggested, in the same paper, 1957 that the description of *Culex vishnui* La Casse and Yamaguti (1950) appears to refer, in part or whole, to some other form than *C. pseudovishnui*. However, Nakata (1962) suggested that the species name, *C. pseudovishnui* is to be used in part or whole for the mosquito which had been treated as *C. vishnui* in Japan. Since that time,

so called Japanese "*Culex vishnui*" has become to be identified as *C. pseudovishnui* by many Japanese workers (Wada, 1969; Kamimura, 1969; Nishigaki, 1970 etc.).

Recently Lien (1968) described new species, *Culex neovishnui* (Lien, 1968, Trop. Med. 10(4):230) based on the specimens in Formosa and Japan. According to Lien (1968) *neovishnui* is very similar to *pseudovishnui* and has been referred to, in part, as *vishnui* and in part, as *pseudovishnui* by some workers. Although the male or female of *neovishnui* are not easily separable from *pseudovishnui*, the larvae are easily distinguishable morphologically.

According to Lien, the most important differences between *C. neovishnui* and *C.*

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pseudovishnui are as follows: The hairs 4-P are usually bifurcated and the siphonal hairs lateral in position (LH) are usually one pair in the former species instead of 4-P being many branched and LH being usually two pairs in the latter.

However, Lien (1968) examined Japanese larval specimens with only a few one, five in total, which he had collected in nature in Unzen, Nagasaki Prefecture.

So, the present authors attempted to determine whether the mosquito in question found in Japan proper and the Ryukyus is *C. neovishnui*, and examined for the species with 226 larval specimens taken from various localities through the courtesy of many Entomologists. In this paper will be given the results of examinations for morphology and taxonomy of this species.

Materials

Specimens examined*: RYUKYU IS.: 15 larvae, 23 July 1968, Ishigaki-jima; 10 larvae, 11 June 1968, Ishikawa, Okinawa-honto; 14 and 18 larvae got from 2 egg-rafts (Raft A and B), 21 July 1970, Ishikawa, Okinawa-honto by T. Kishimoto. KYUSHU: 3 larvae, 1 Aug. 1967, Tokunoshima by H. Nojima; 1 larva, 12 July 1969, Kagoshima by K. Kushigemati; 9 larvae, 13 Sept. 1966, Uku-jima, Nagasaki; 34 larvae got from an egg-raft (Raft C), 10 Aug. 1968, Uku-jima, Nagasaki; 34 larvae, July 1969, Uki-jime, Nagasaki; 10 larvae got from an egg-raft (Raft D), July 1969, Isahaya, Nagasaki; 6 larvae, 12 July 1966, Kawabira, Nagasaki; 10 larvae, 10 July 1966, Mikawamachi, Nagasaki; 6 larvae, Sept.

1960, Tsushima, Nagasaki by N. Omori; 2 larvae, 20 July 1968, Shimabara, Nagasaki; 20 larvae got from an egg-raft (Raft E), 13 Aug. 1969, Kanbara, Takeda, Oita. SHIKOKU: 15 larvae, 21 July 1969, Tosayamada, Kochi by F. Nakasuji. HONSHU: 5 larvae, 11 Sept. 1969, Osaka by S. Ito; 5 larvae, Sept. 1969, Nagoya by Y. Shyogaki.

Total of 226 4th instar larvae which were collected partly in nature in paddy fields and partly reared from egg-rafts oviposited in the laboratory by the fed females caught in cowsheds were examined under the microscope (10×10 or 10×40). Most of them were mounted by balsum for detailed examinations.

Results and discussion

As stated above, the most important morphological features of *C. neovishnui* are the number of branching of 4-P and pairs of LH, though the present authors also examined for the number of pairs of VH and the number of comb teeth,

and the results will be given as under.

Altogether, the 4th instar larvae of 121 wild-caught and 105 laboratory-reared ones were examined for the branching of 4-P and the pairs of siphonal hairs and the number of comb teeth. The res-

*Specimens without giving the collector's name are taken by the present authors.

Table 1. Number of the 4th instar larvae of *Culex neovishnui* Lien having the indicated average number of branches of 4-P, pairs of LH and VH, and Comb teeth, collected in nature in the Ryukyus and Japan.

Av. No.	RYUKYU ISLANDS								JAPAN PROPER												
	Ishigaki-jima (15 specimens)				Okinawa-honto* (13 specimens)				Kyushu (68 specimens)				Shikoku (15 specimens)				Honshu (10 specimens)				
	4-P	LH	VH	Comb	4-P	LH	VH	Comb	4-P	LH	VH	Comb	4-P	LH	VH	Comb	4-P	LH	VH	Comb	
0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
1.0	—	13	—	—	—	13	—	—	1	66	—	—	—	12	—	—	—	10	—	—	—
1.5	—	2	—	—	2	—	—	—	2	2	—	—	2	2	—	—	—	—	—	—	—
2.0	14	—	—	—	11	—	—	—	63	—	—	1	13	—	—	—	10	—	—	—	—
2.5	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
3.0	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
5.0	—	—	1	—	—	—	1	1	—	—	3	4	—	—	2	—	—	—	—	—	—
5.5	—	—	—	1	—	—	5	1	—	—	10	4	—	—	6	1	—	—	3	1	—
6.0	—	—	11	1	—	—	6	3	—	—	46	7	—	—	7	—	—	—	3	1	—
6.5	—	—	—	3	—	—	1	1	—	—	1	10	—	—	—	6	—	—	2	2	—
7.0	—	—	3	1	—	—	—	2	—	—	8	14	—	—	—	2	—	—	2	1	—
7.5	—	—	—	3	—	—	—	—	—	—	—	7	—	—	—	1	—	—	—	3	—
8.0	—	—	—	4	—	—	—	2	—	—	—	8	—	—	—	1	—	—	—	—	—
8.5	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
9.0	—	—	—	—	—	—	—	—	—	—	—	5	—	—	2	—	—	—	—	1	—
9.5	—	—	—	—	—	—	—	1	—	—	—	3	—	—	—	1	—	—	—	—	—
10.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
10.5	—	—	—	1	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—
11.0	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—
11.5	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
14.5	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Range	2-3	1-2	5-7	5-13	1-2	1	5-7	5-12	1-3	1-2	5-7	4-15	1-2	0-2	5-7	5-13	2	1	5-7	5-10	

*Included the specimens from Tokunosima.

Abbreviation. Av. No.: Average number which was obtained for both sides of each specimen. 4-P: Hair No. 4 on prothorax. LH and VH: Siphonal hairs lateral in position and those ventral in position. Comb: Comb teeth on abdominal segment VIII.

ults of the examinations with the former larvae and the latter are presented in Tables 1 and 2 respectively. From these tables, the number and percentage of the larvae falling into the important features characteristic to *C. neovishnui* are summarized in Table 3. The hairs of 4-P are usually (88.9%) bifurcated, in a few cases (9.7%) are single on one or both sides, and rare cases

(1.3%) are 3-branched on one or both sides. The hairs of LH are most usually (95.1%) are one pair, very rarely (1.3%) are lacking or 0.5 pairs, and rarely (3.5%) are one and a half pairs. Thus, most larvae have 2 branched hairs of 4-P and one pair of the hairs LH, and besides the larvae having 2.5 or 3 branched 4-P are also one pair of LH.

Table 2. Results of the same examinations with the 4th instar larvae reared from wild-caught fed females collected in the Ryukyus and Japan.

Av. No.	RYUKYU ISLANDS								KYUSHU, JAPAN											
	Okinawa-honto Raft A (14 specimens)				Okinawa-honto Raft B (18 specimens)				Nagasaki, Ukujima Raft C (43 specimens)				Nagasaki, Isahaya Raft D (10 specimens)				Takeda, Oita Raft E (20 specimens)			
	4-P	LH	VH	Comb	4-P	LH	VH	Comb	4-P	LH	VH	Comb	4-P	LH	VH	Comb	4-P	LH	VH	Comb
0	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
0.5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
1.0	-	14	-	-	2	14	-	-	-	43	-	-	4	10	-	-	-	20	-	
1.5	-	-	-	-	4	2	-	-	-	-	-	-	4	-	-	-	1	-	-	
2.0	14	-	-	-	12	-	-	-	43	-	-	-	2	-	-	-	-	-	-	
4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
4.5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	
5.0	-	-	-	-	-	-	-	1	-	-	8	1	-	-	-	-	-	-	5	
5.5	-	-	5	-	-	-	1	1	-	-	1	1	-	-	-	-	-	5	3	
6.0	-	-	6	5	-	-	15	2	-	-	27	5	-	-	5	-	-	13	4	
6.5	-	-	3	1	-	-	1	3	-	-	-	4	-	-	4	1	-	2	3	
7.0	-	-	-	3	-	-	-	2	-	-	7	12	-	-	1	-	-	-	3	
7.5	-	-	-	2	-	-	-	2	-	-	-	5	-	-	-	1	-	-	1	
8.0	-	-	-	2	-	-	-	2	-	-	-	4	-	-	-	3	-	-	-	
8.5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-	
9.0	-	-	-	1	-	-	-	2	-	-	-	4	-	-	-	-	-	-	-	
9.5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
10.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
10.5	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	
11.0	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	
11.5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
12.5	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	2	-	-	-	
13.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
Range	2	1	5-7	5-10	1-2	0-2	5-7	5-13	2	1	5-7	5-13	1-2	1	5-7	6-14	1-2	1	5-7	4-8

Abbreviations. See Table 1.

Table 3. Number and percentage of larvae falling in the indicated characteristics.

Av. No. 4-P	Larvae				Av. No. pairs of LH				
	Wild	Reared	Total	%	0	0.5	1	1.5	2
1	1	6	7	3.1	0	0	7	0	0
1.5	6	9	15	6.6	0	1	14	0	0
2	111	90	201	88.9	1	1	191	8	0
2.5	1	0	1	0.4	0	0	1	0	0
3	2	0	2	0.9	0	0	2	0	0
Total	121	105	226	100.0	1	2	215	8	0
%					0.4	0.9	95.1	3.5	0

Remarks: There is no significant difference between the larvae of wild-caught and laboratory-reared ones.

Table 4. Number of the 4th instar larvae of *C. neovishnui* Lien having the indicated average pairs of VH collected in the Ryukyus and Japan.

No. of pairs	Wild-caught larvae	Reared larvae	Total	%
4.5	0	1	1	0.4
5	7	8	15	6.6
5.5	24	12	36	15.9
6	73	66	139	61.5
6.5	4	10	14	6.2
7	13	8	21	9.3
Total	121	105	226	100.0

Table 5. Number of the 4th instar larvae of *C. neovishnui* Lien having indicated average number of comb teeth collected in the Ryukyus and Japan.

Average No. of teeth	Wild-caught larvae	Reared larvae	Total	%
2	1	0	1	0.4
4	0	1	1	0.4
5	5	7	12	5.3
5.5	8	5	13	5.8
6	12	16	28	12.4
6.5	22	12	34	15.0
7	20	20	40	17.7
7.5	14	11	25	11.1
8	15	11	26	11.5
8.5	2	3	5	2.2
9	8	7	15	6.6
9.5	5	1	6	2.7
10	1	1	2	0.9
10.5	4	2	6	2.7
11	2	2	4	1.8
11.5	1	1	2	0.9
12.5	0	4	4	1.8
13	0	1	1	0.4
14.5	1	0	1	0.4
Total	121	105	226	100.0

The average pairs of siphonal hairs ventral in position (VH) are 6 on an average ranging from 4.5 to 7.0 as seen in Table 4. The average number of comb teeth is subjected to a great variation ranging from 2 to 14.5 and commonly ranging from 5 to 9 as shown in Table 5. However, the average pairs of VH and the number of comb teeth are very much overlapping between the ranges shown in Tables 4 and 5 by the present authors, and those of *C. pseudovishnui* shown by Lien, 1968.

As a result, it is apparent that the examined specimens agree very well with the description of *C. neovishnui* Lien, 1968 and not with that of *C. pseudovishnui* Colless, 1957. However, Colless (personal communication, 1967) and Bram (1967) observed that the characteristics of 4-P, LH and are variable to some extent locally in the specimens of *pseudovishnui* collected from Singapore and Thailand and that these variations are probably found throughout the distributional range

of *pseudovishnui*. Therefore, it may be necessary to examine carefully many specimens of *pseudovishnui* and *neovishnui* from various localities in its distributed area, before making clear of the taxonomical relation of the two species, but the present authors wish to identify the mosquito in question as *C. neovishnui* as far as the Japanese and Ryukyu specimens are concerned.

As mentioned before the larva of *neovishnui* is rather readily identified, but the adult is considered very difficult to distinguish from these of *pseudovishnui*. However, the preliminary studies of the male genitalia indicated that the basal process (of Barraud, 1934) in *neovishnui* is weakly developed, whereas in *pseudovishnui* it is well developed externally. The figures are also shown in Fig. 2 of Lien, 1968. This may be of some importance in distinguishing the males of *neovishnui* from *pseudovishnui* as suggested by Lien (personal communication, 1970).

Conclusion

After careful examinations of 226 of full grown larval specimens from Japan and the Ryukyus which have been treated as *Culex vishnui* or *Culex pseudovishnui*,

it seems adequate that the mosquito in question is identified as *Culex neovishnui* Lien, 1968, as far as Japanese and Ryukyu specimens are concerned.

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琉球及び日本本土産の*Culex (Culex) neovishnui* Lien, 1968 について

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摘 要

日本産の所謂シロハシエカ "*Culex vishnui*" は研究者によって *Culex vishnui* Theobald, 1901 あるいわ, *Culex pseudovishnui* Colless, 1957 と呼ばれていたが, 著者等が琉球及び日本本土各地から得た幼虫標本 226 個体につき主要な形態的特長を調べた結果, 最近 Lien (1968) によって記載された *Culex (Culex) neovishnui* Lien, 1968 によく一致するので琉球及び日本本土に関する限りではシロハシエカ *Culex (Culex) neovishnui* Lien, 1968 と呼ぶことが適当であると思われる。