

**The Previously Undetected Presence of *Culex restuans* (Diptera: Culicidae)
in Central America, with Notes on Identification¹**

Daniel Strickman^{2,3} and Richard F. Darsie, Jr.⁴

ABSTRACT. Confirmed identification of *Culex (Culex) restuans* Theobald in Central America is reported for the first time. Larval, male, and female specimens were examined from Guatemala and Honduras with the result that no significant difference could be found between the Central American population and that of the western United States. Larval and female characters are illustrated and described to allow identification of this species in Guatemala.

Recent extensive collecting in Central America by the Centers for Disease Control and by the U.S. Army has expanded material available for taxonomic study and brought to attention a number of new geographic records (Darsie and Hobbs 1982; Darsie 1983, 1984). The subject of this report is the expansion of the known range of *Culex (Culex) restuans* Theobald to Guatemala and Honduras. Previously published records of the species have only extended as far east and south as the state of Campeche in Mexico (Vargas 1956, Díaz Nájera and Vargas 1973).

The preliminary identification of *Cx. restuans* in Guatemala (Torres Campo de Marte, Guatemala City (14°37' N 90°31' W, 1500 m), W. Almengor and V.P. Cowsill, September 2, 1964, larvae in gallon can (collection no. GUA 118) and small ground pool (GUA 119); cited in Heinemann and Belkin 1977) was confirmed by examination of specimens deposited in the U.S. National Museum. Additional Guatemalan specimens were identified in the collection of the junior author (Finca Santa Emilia, near Pochuta, Chimaltenango Province (14°31' N 91°02' W, 960 m), June 25, 1980, larvae in ground pool).

The first recorded collections of *Cx. restuans* in Honduras were made by A.R. Gillogly in 1984 at 4 different sites (deposited in the U.S. National Museum, Walter Reed Biosystematics Unit Accession No. 1076): 1) El Cerron, 5 km northeast of Taulabe, Comayagua Dept. (14°44' N 87°56' W, 1100 m), March 16, small spring widened for domestic water (record no. HONC-12); 2) Tierra Colorada, La Paz Dept. (14°18' N 87°44'

¹Opinions and assertions contained herein are the private views of the authors and are not to be construed as official, nor as reflecting the views of the supporting agencies.

²Department of Entomology, Division of Communicable Diseases and Immunology, Walter Reed Army Institute of Research, Washington, DC 20307-5100.

³Send reprint requests to: Walter Reed Biosystematics Unit, Museum Support Center, Smithsonian Institution, Washington, DC 20560.

⁴The International Center for Public Health Research, University of South Carolina, McClellanville, SC 29458.

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 1988		2. REPORT TYPE		3. DATES COVERED 00-00-1988 to 00-00-1988	
4. TITLE AND SUBTITLE The Previously Undetected Presence of Culex restuans (Diptera: Culicidae) in Central America, with Notes on Identification				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 Biosystematics Unit, Smithsonian Institution, Washington, DC, 20560				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 report					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

W, 1500 m), March 23, small spring-fed pools used for domestic water (HONC-21); 3) Las Moras, La Paz Dept. ($14^{\circ}18' N$ $87^{\circ}47' W$, 1500 m), March 23, shallow pond with cattails (HONC-23); 4) La Enea, 4 km northwest of Zambrano, Francisco Morazan Dept. ($14^{\circ}18' N$ $87^{\circ}25' W$, 1460 m), April 2, small pools in bed of intermittent stream (HONC-30). One additional larval collection was made by the senior author (Marcala, La Paz Dept. ($14^{\circ}9' N$, $87^{\circ}7' W$, 1260 m), September 11, 1986, military foxhole (HONC 230-13, Walter Reed Biosystematics Unit Accession No. 1179)).

Identification of the specimens was based on descriptions and on comparisons with other species of the subgenus in the region. Male genitalia prepared from specimens HONC-30G, GUA 118-11, and GUA 118-27 were similar to the distinctive form of this structure described by Carpenter and La Casse (1955) and by Ross and Horsfall (1965). The description by Bram (1967) does not correspond to the other published descriptions, nor does it correspond to specimens from Virginia examined by Bram. Larvae and adults closely resembled descriptions by Carpenter and La Casse (1955) and by Bohart and Washino (1978). These authors pointed out that, in contrast to specimens from the eastern United States, western populations of *Cx. restuans* have light-colored bands on their hindtarsi.

In order to document salient characters of *Cx. restuans* in Central America, 14 larval specimens available from Guatemala and Honduras (larval exuviae: GUA 118-11, 14; GUA 119-22, 24, 26, 27, 28; HONC-21E, G; HONC-30G, O; whole larvae: 2 from HONC-21; one from HONC-23) were studied and an illustration (Fig. 1) prepared from Honduran specimens (whole larva from HONC-21, HONC-30G larval exuvia). One important character for identification is the position of antennal seta 1-A. The distance from the base of the antenna to the insertion of the seta was a mean 0.44 ($n = 14$, $SD = 0.035$, range = 0.37 - 0.50) of the length of the antenna. Head seta 4-C was most often double and sometimes triple (10 of 26 setae were triple). Another useful and easily observed set of characters is the branching of setae 6 on abdominal segments I - VI, which is invariably double on I and II ($n = 28$ and 27, respectively) and single on III - VI ($n = 27, 23, 22, 23$, and 19, respectively). The shape of the siphon and placement of its setae are also important in identification. The shape of the siphon was consistent among the 14 larvae examined, with the dorsal edge slightly convex basally and slightly concave apically. The ventral edge was either straight or very slightly concave basally and convex apically. The tip of the siphon was always much narrower than the base. The 1-S setae were 4 on a side, with the first 2 always single (for 1a-S, $n = 20$, for 1b-S, $n = 23$), the third seta (1c-S) was usually single (2 of 20 were double), and the fourth seta (1d-S) was usually double (one was single and 2 were triple out of 27 setae).

A number of characters of secondary importance for identification were also examined on the larvae. On the head, seta 5-C had a modal branching of 7, but varied considerably among the 27 setae examined, with one seta with 5 branches, 7 setae with 6 branches, and 7 setae with 8 branches. Among 24 setae 6-C, the modal branch count was 6, with one seta with 4 branches, 4 setae with 5 branches, 5 setae with 7 branches, and 3 setae with 8 branches. The dorsomentum consistently had the form illustrated. Seta (3-P) was double in all but one of the 19 setae examined. Thoracic spiculation was not visible at 200x magnification on all of the larvae. Abdominal seta 1 on segment III was usually double (2 of 15 setae were single); whereas, seta 1 on segments IV, V and VII was always single ($n = 19, 17$, and 25 respectively). The thicker spicules on the posterodorsal portion of the anal segment (X) followed a consistent pattern. Seta 1-X was usually single (5 of 25 were double) and seta 2-X was always single ($n = 26$). The spiracular apodeme usually lacked

teeth at the base of the terminal opening, though sometimes (3 of 14 examined) one or 2 small, blunt projections were present. The mean ratio of the length of the spiracular apodeme to the length of the siphon (dorsal side) was 0.26 (SD = 0.22, range = 0.23 - 0.30). The siphon index (ratio of siphon length to width of the siphon at its base) had a mean value of 4.15 (SD = 0.61, range = 3.75 - 4.81) and the siphon/saddle index (ratio of siphon length to middorsal length of segment X) had a mean value of 4.00 (SD = 0.51, range = 3.45 - 4.31).

Only 5 female adult specimens from Guatemala or Honduras were available for study (GUA 118-14, HONC-21E, 21G, 30O, and 230-13). Important characters for identification are illustrated in Fig. 2. The proboscis band on all of the specimens was weakly developed with light scales restricted to the ventral surface of the proboscis. These scales did not contrast sharply with the dark scales, and were not separated from the dark scales by a sharp border. The pattern of scaling on the scutum was distinctive, with light-colored scales similar in shape and size to the more numerous golden scales covering most of the scutum. Posterior dorsocentral spots were present on all specimens, but whether these are easily lost through damage, as in the case of specimens from the United States, is impossible to determine from the meager number examined from Central America. Experience with other *Culex* of the region would indicate that extensive removal of scales would be necessary to eliminate all of the light-colored scales on the scutum. The hindtarsomeres were banded with light-colored scales. The exact pattern of banding was difficult to see on hindtarsomere 5, with white scales at the apex either very few or entirely absent. Abdominal terga had prominent basal bands of light-colored scales.

Identification of larvae of *Cx. restuans* in Guatemala may be accomplished by modifying the key of Clark-Gil and Darsie (1983). The position of seta 1-A less than half the distance of the length of the antenna from the base separates *Cx. restuans* from all species currently known in Guatemala except *Cx. corniger* Theobald. Examination of the siphon then separates the 2 species. Using the larval key to the subgenus *Culex* (p. 212) and adding a couplet, 1A, the key may be modified as follows:

1. Seta 1-A inserted half or less of the length of the antenna from the base of the antenna1A
 Seta 1-A inserted greater than half the length of the antenna from the base of the antenna.....2
- 1A (1) Siphon index 2.5 or less; 5 or 6 pairs of setae 1-S, each with 2 to 4 branches, the first setae inserted ventrally and the terminal setae inserted laterally and subdorsally *corniger*
 Siphon index between 3.5 and 5.0; 4 pairs of setae 1-S, the first 2 setae always single, the third seta single or double, and the fourth seta double or triple *restuans*

Identification of females in Guatemala should be made using diagnostic characters because the key in Clark-Gil and Darsie (1983) requires modification in a number of areas. The combination of weakly developed proboscis band, well developed banding on abdominal terga, banding of the hindtarsal joints, sparse or absent light-colored scales at the apex of hindtarsomere 5, and scutal ornamentation with light-colored scales are sufficient character states to identify a specimen as *Cx. restuans*. Females of *Cx. corniger* Theobald and *Cx. declarator* Dyar and Knab can resemble *Cx. restuans*, but may be distinguished by the more

strongly developed scutal ornamentation and proboscis band in *Cx. corniger* and by the near lack of scutal ornamentation and less developed hindtarsal banding in *Cx. declarator*.

The distribution of *Cx. restuans* reported here and in Darsie and Ward (1981) suggests possible isolation between the California-Central America populations and those of the rest of the United States and Canada. The presence of hindtarsal banding in the first group and not in the second further supports the possibility that the 2 areas contain separate or diverging species. In the course of this study, we found no other characters dividing *Cx. restuans* into groups, but such characters could have gone undetected because of the limited material available.

We wish to acknowledge Taina Litwak for preparation of the figures.

REFERENCES CITED

- Bohart, R.M. and R.K. Washino. 1978. Mosquitoes of California. Third edition. Div. Agric. Sci., Univ. Calif., Berkeley. viii + 153 pp.
- Bram, R.A. 1967. Classification of *Culex* subgenus *Culex* in the New World (Diptera: Culicidae). Proc. U.S. Nat. Mus. 120 (3557): 122 pp.
- Carpenter, S.J. and W.J. LaCasse. 1955. Mosquitoes of North America (north of Mexico). Univ. Calif. Press, Berkeley. vi + 360 pp. + 127 pl.
- Clark-Gil, S. and R.F. Darsie, Jr. 1983. The mosquitoes of Guatemala. Their identification, distribution and bionomics with keys to adult females and larvae in English and Spanish. Mosq. Syst. 15: 151-284.
- Darsie, R.F., Jr. 1983. The occurrence of *Psorophora cingulata* and *Uranotaenia apicalis* in Guatemala. Mosq. Syst. 15: 28-32.
- Darsie, R.F., Jr. 1984. The presence of *Psorophora cilipes* (Diptera, Culicidae) in Guatemala. Mosq. Syst. 16: 141-143.
- Darsie, R.F., Jr. and J.H. Hobbs. 1982. First report of *Culex chrysonotum* and *Culex spissipes* in Guatemala (Diptera, Culicidae). Mosq. Syst. 14: 73-77.
- Darsie, R.F., Jr. and R.A. Ward. 1981. Identification and geographical distribution of the mosquitoes of North America, north of Mexico. Mosq. Syst. Supplement 1: 1-313.
- Díaz Nájera, A. and L. Vargas. 1973. Mosquitos mexicanos. Distribucion geografica actualizada. Rev. Inv. Salud Publica (Mexico) 33: 111-125.
- Heinemann, S.J. and J.N. Belkin. 1977. Collection records of the project "Mosquitoes of Middle America" 8. Central America: Belize (BH), Guatemala (GUA), El Salvador (SAL), Honduras (HON), Nicaragua (NI, NIC). Mosq. Syst. 9: 403-454.

- Ross, H.H. and W.R. Horsfall. 1965. A synopsis of the mosquitoes of Illinois (Diptera, Culicidae). Ill. Nat. Hist. Surv. Biol. Notes 52, 50 pp.
- Vargas, L. 1956. Especies y distribución de mosquitos mexicanos no anofelinos. Rev. Instit. de Salubr. Enferm. Trop. 16: 19-36.

FIGURES

- Fig. 1. Larva of Central American *Culex restuans*. Abbreviations: A, antenna; C, head; CS, comb scale; Dm, dorsomentum; M, mesothorax, P, prothorax; p, abdominal puncture; PS, pecten spine; S, siphon; T, metathorax; I-X, abdominal segments; 1-15, segmental setae. Scales are 1 mm.
- Fig. 2. Female adult of Central American *Culex restuans*. Views are: Dorsal view of thorax, anterior view of apex of hindfemur and hindtarsus with enlargements of selected portions, lateral view of abdominal tergites, and dorsal view of abdomen. Scales are 1 mm.

Fig. 1

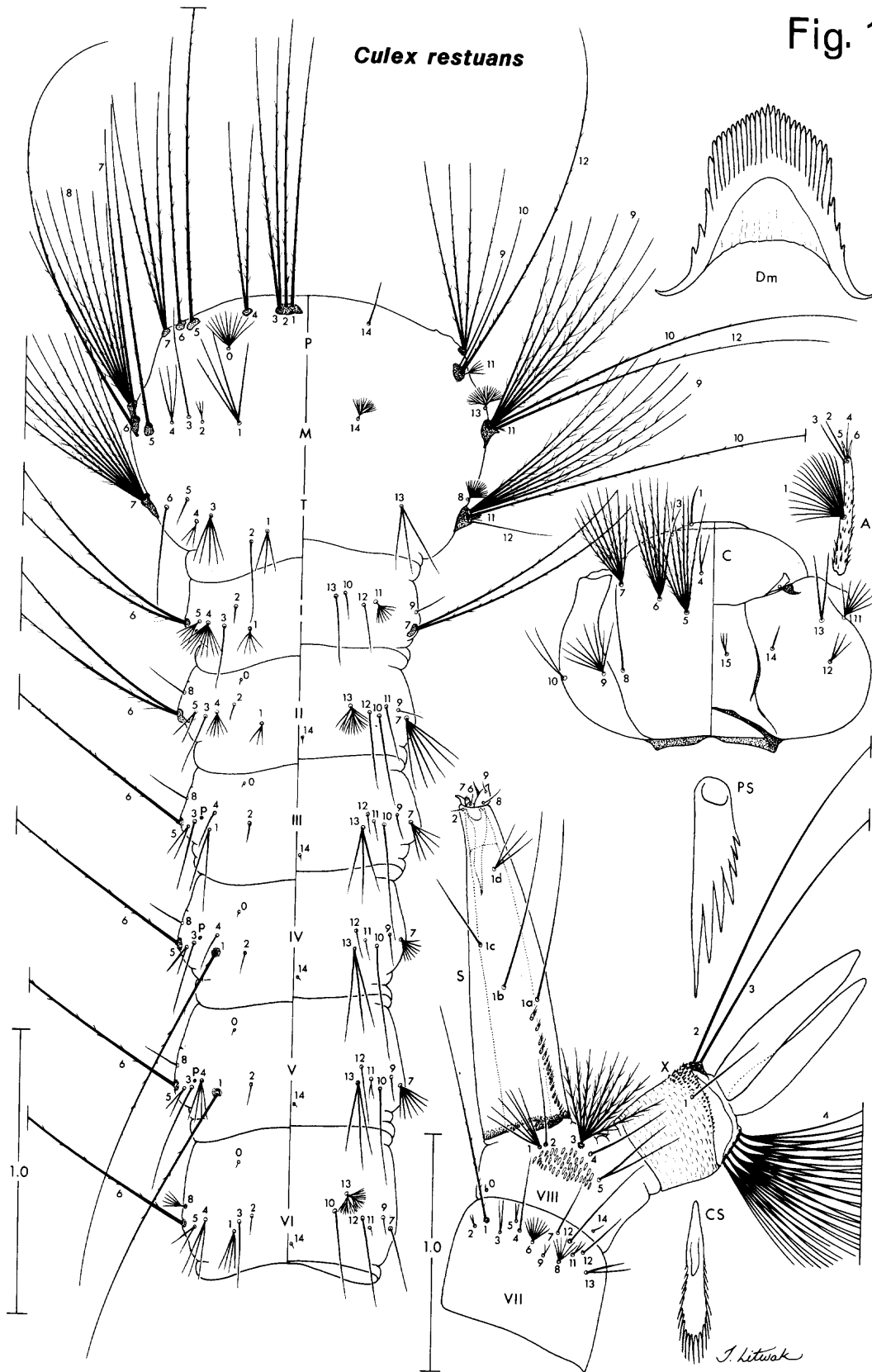


Fig. 2

Culex restuans

