

**RESURRECTION OF THE NAMES *TOXORHYNCHITES MOCTEZUMA*
(DYAR & KNAB) AND *TOXORHYNCHITES HYPOPTES* (KNAB) FROM
SYNONYMY WITH *TOXORHYNCHITES THEOBALDI* (DYAR & KNAB)
(DIPTERA: CULICIDAE)**

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Abstract.—*Toxorhynchites moctezuma* (Dyar and Knab 1906) (**status revised**) and *Toxorhynchites hypoptes* (Knab 1907) (**status revised**) are resurrected from synonymy with *Toxorhynchites theobaldi* (Dyar and Knab 1906). *Toxorhynchites trinidadensis* (Dyar and Knab 1906) is synonymized with *Toxorhynchites moctezuma* (**new synonymy**). Characters are given to distinguish *T. theobaldi*, *T. moctezuma*, and *T. hypoptes*. *Toxorhynchites moctezuma* and *T. hypoptes* are common Middle American species whose larvae are most often found in tree holes, bamboo internodes, fallen nuts or nut husks, and artificial containers.

Key Words: Central America, Middle America, mosquitoes, *Toxorhynchites trinidadensis*

As part of our study of the mosquitoes of Costa Rica, we have examined nearly 250 specimens of *Toxorhynchites* Theobald from that country in the collection of the Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica. We have concluded that five species are represented in this material. However, determining the correct name for each of these species requires the resolution of some long-standing taxonomic or nomenclatural problems within the genus. The purpose of the present paper is to clarify the status of *Toxorhynchites theobaldi* (Dyar and Knab 1906), *Toxorhynchites moctezuma* (Dyar and Knab 1906), *Toxorhynchites trinidadensis* (Dyar and

Knab 1906), and *Toxorhynchites hypoptes* (Knab 1907), names that have been used for common Middle American species with white tarsal markings in males.

Understanding the nomenclature of Middle American species of *Toxorhynchites* with white tarsal markings in males requires a historical review of the pertinent names. The oldest name in this group of species is *Culex ferox* Wiedemann 1828, which was briefly described from an unspecified number of males collected in Brazil. Theobald (1901) transferred *C. ferox* to the genus *Megarhinus* Robineau-Desvoidy and redescribed the species in detail from a male and female from Bogota, Colombia in the collection of the Hope

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Museum, Oxford, England. When Dyar and Knab (1906) reviewed the American species of *Megarhinus*, they concluded that the pair of specimens from Bogota that were the basis of Theobald's redescription of *M. ferox* represented a different, undescribed species, which they named *Megarhinus theobaldi*. Dyar and Knab (1906) also described several other new species with white tarsal markings in males, including *Megarhinus moctezuma* from Central America and *Megarhinus trinidadensis* from Trinidad. Since the name *M. theobaldi* appears earlier in the paper than the descriptions of *M. moctezuma* and *M. trinidadensis*, it has position precedence over them, and this may be the reason Lane (1939) accorded it priority. Knab (1907) described *Megarhinus hypoptes* from a single male collected in Nicaragua. His description included several characters that distinguished the species from others with white tarsal markings in males treated by Dyar and himself in the previous year (Dyar and Knab 1906). Finally, the generic name *Toxorhynchites* Theobald replaced *Megarhinus* Robineau-Desvoidy after it was determined that the latter name was a junior homonym (Stone 1948).

Toxorhynchites moctezuma, *T. trinidadensis*, and *T. hypoptes* were treated as distinct species by Howard et al. (1917), and *T. theobaldi*, *T. moctezuma*, *T. trinidadensis*, and *T. hypoptes* were considered to be separate species by Dyar (1928) and Edwards (1932). However, Lane (1939, 1944, 1953) progressively synonymized more and more names, ultimately placing *T. moctezuma*, *T. trinidadensis*, and *T. hypoptes*, as well as several South American species with white tarsal markings in males, as synonyms of *T. theobaldi*. Lane's (1953) synonymies have been accepted in modern catalogs of mosquitoes (Stone et al. 1959,

Knight and Stone 1977, Walter Reed Biosystematics Unit 2001). However, not all South American entomologists have accepted all of Lane's synonymies (see, for example, Lima et al. 1962), and Steffan (1977) listed *T. theobaldi*, *T. moctezuma*, *T. trinidadensis*, and *T. hypoptes* as valid species in his paper on the type material of *Toxorhynchites*.

Collections of mosquitoes from phytotelmata made for the Mosquitoes of Middle America Project (Belkin et al. 1965) frequently included one of two species of *Toxorhynchites* with white tarsal markings in males. These species could be identified as *T. moctezuma* and *T. hypoptes* with the older literature and were considered to be those species by all personnel of the Mosquitoes of Middle America Project. It was considered very unlikely that either of these species was the same as *T. theobaldi*, which was described from specimens from high elevation (2700 m) in the northern Andes of Colombia (Fig. 1). Zavortink (1969) reported the occurrence of the genus *Toxorhynchites* in the western United States for the first time. He considered the species he collected in Arizona to be the same as one known from Mexico, Guatemala, and Costa Rica, and he stated that the species should possibly be called *T. moctezuma* because the synonymy of *T. moctezuma* with *T. theobaldi* was very questionable. In subsequent years, both *T. moctezuma* and *T. hypoptes* were reported from several countries in Middle America by Heinemann and Belkin (1977a, 1977b, 1977c, 1978a, 1978b, 1978c, 1979) and Heinemann et al. (1980) in a series of papers providing collection records of the Mosquitoes of Middle America Project. However, since each of these papers included a statement that the identifications were preliminary only and did not constitute a change in taxonomic status, other researchers have not known how many

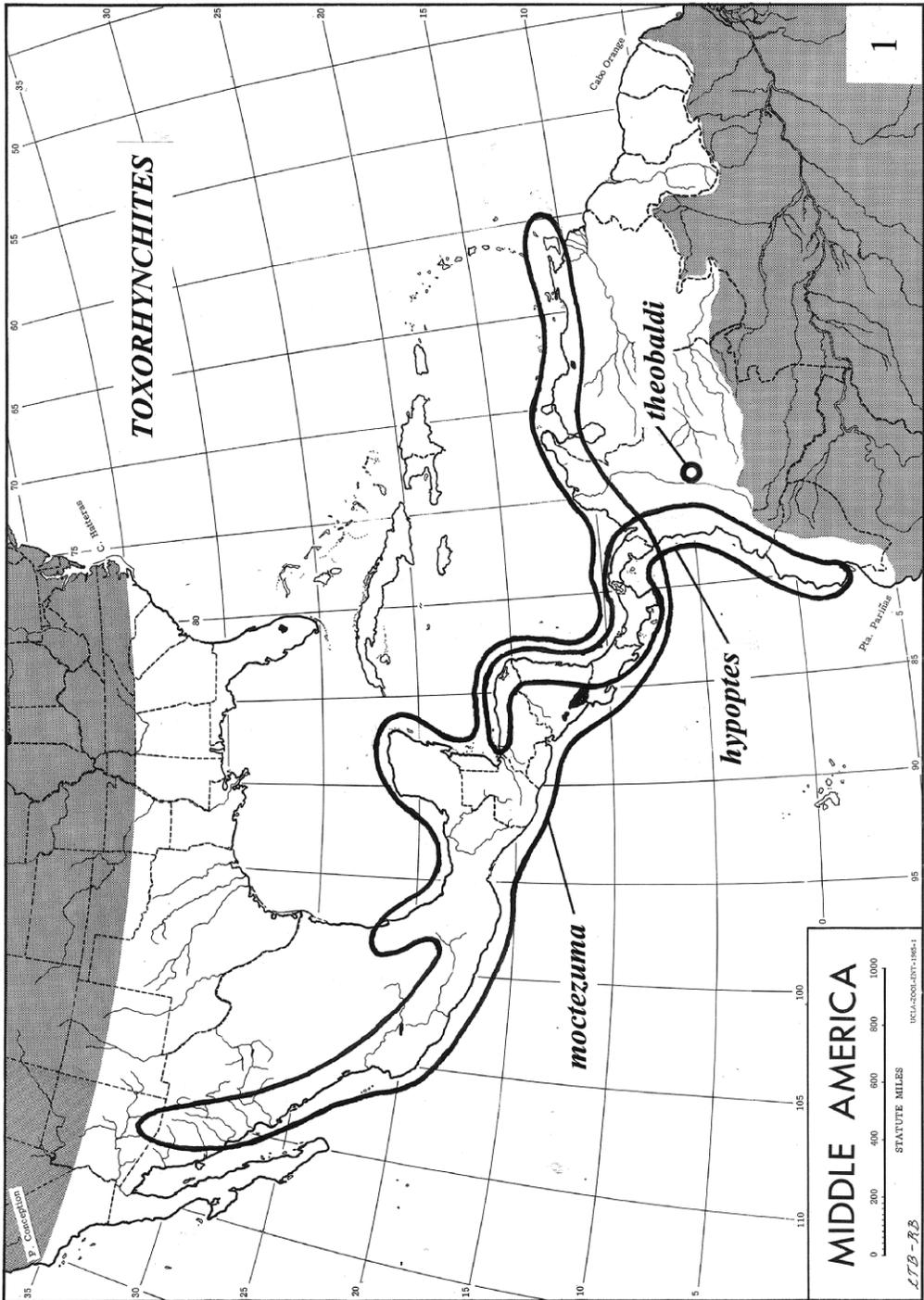


Fig. 1. Map of Middle America showing the type locality of *Toxorhynchites theobaldi* and the distributions of *T. moctezuma* and *T. hypoptes* based on the published collection records of the Mosquitoes of Middle America Project.

Table 1. Distinguishing characteristics of adult *Toxorhynchites moctezuma* and *T. hypoptes*.

<i>T. moctezuma</i>	<i>T. hypoptes</i>
Female with hind tarsomere 4 completely white scaled and hind tarsomere 5 completely dark scaled	Female with both hind tarsomeres 4 and 5 completely white scaled
Male usually with hind tarsomere 4 completely or mostly white scaled and hind tarsomere 5 completely dark scaled	Male with white scales restricted to outer surface of both hind tarsomeres 4 and 5
Pleuron with yellowish-tinged scales on light brown integument	Pleuron with silver scales on dark brown to blackish integument
Top of head with purple or copper scales, upper postpronotum and sides of scutum with pale blue to pale greenish blue scales, and costa and vein R in basal half of wing with purple or purple and blue scales	Top of head with intense blue and sometimes greenish-blue, bronze, gold, or silver scales, upper postpronotum and sides of scutum with bright blue scales, and costa and vein R in basal half of wing with mainly intense blue scales
Eyes of male separated by 3 or 4 facet diameters at their closest point on underside of head	Eyes of male contiguous on midline for some distance on underside of head
Apex of flagellomere 1 of male with erect scales with weak blue, purple, and gold reflections	Apex of flagellomere 1 of male with laterally curved or directed scales that are whitish to bright pale blue

species of *Toxorhynchites* occur in Middle America or what names should be applied to them. Some authors, for example Rubio and Ayesta (1984), have continued to use the name *T. theobaldi*, while others, like Jordan and Hubbard (1991), have used the name *T. moctezuma*. Because of this ongoing confusion about the number of species and their names, we formalize the recognition of *T. moctezuma* and *T. hypoptes* below.

MATERIALS AND METHODS

One-hundred ninety-three adult mosquitoes were examined for this study as follows: 25 *T. hypoptes* in the collection of the Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica (INBC) and 23 in the collection of the Bohart Museum, University of California, Davis (UCDC); 118 *T. moctezuma* in INBC and 26 in UCDC; and the lectotype of *T. theobaldi* in the Hope Entomological Collections, Oxford University Museum of Natural History, Oxford, England.

Adults were examined with a stereoscopic microscope and reflected light at magnifications up to 112.5 diameters. Specimens were identified as *T. hypoptes* or *T. moctezuma* by their distinctive tarsal markings that were described by Knab (1907) and used in the taxonomic keys of Howard et al. (1917) and Dyar (1928). After their identification, specimens of *T. hypoptes* and *T. moctezuma* were compared with each other and with the lectotype of *T. theobaldi* and the additional distinguishing characteristics of these species listed in Tables 1–3 were discerned. Descriptive terminology follows Harbach and Knight (1980).

Genitalia of males were prepared for study and slide-mounted according to the standard procedures for mosquitoes described by Belkin (1962) and were studied with a compound microscope and transmitted light at magnifications up to 400 diameters.

The distributions of *T. hypoptes* and *T. moctezuma* shown in Fig. 1 are based on the published records of the Mos-

Table 2. Distinguishing characteristics of male *Toxorhynchites theobaldi* and *T. hypoptes*.

<i>T. theobaldi</i>	<i>T. hypoptes</i>
Apices of palpomeres 2–4 and sides of abdominal terga II–VII without lilac scales	Apices of palpomeres 2–4 and sides of abdominal terga II–VII with lilac scales
Knee spots absent	Knee spots small, pale blue to lilac
Abdominal tergum V with basal band of gold scales	Abdominal tergum V without basal band of any color

quitoes of Middle America Project (Zavortink 1969; Heinemann and Belkin 1977a, 1977b, 1977c, 1978a, 1978b, 1978c, 1979; Heineman et al. 1980).

RESULTS AND DISCUSSION

As previously stated, we have identified five species of *Toxorhynchites* from Costa Rica in the collection of the Instituto Nacional de Biodiversidad. Among the species with white tarsal markings in males are two obviously different ones that can be identified with the older literature (Knab 1907, Howard et al. 1917, Dyar 1928) as *T. moctezuma* and *T. hypoptes*. Like Heinemann and Belkin (1977a, 1977b, 1977c, 1978a, 1978b, 1978c, 1979), we consider these to be distinct species. Adults of *T. moctezuma* and *T. hypoptes* are readily identified by the characters used by Knab (1907), Howard et al. (1917), and Dyar (1928), as well as other characters that we discovered. The most conspicuous differences between adults of *T.*

moctezuma and *T. hypoptes* are listed in Table 1.

Since both *T. moctezuma* and *T. hypoptes* are placed as synonyms of *T. theobaldi* in current catalogs of mosquitoes (Knight and Stone 1977, Walter Reed Biosystematics Unit 2001), we examined the lectotype male of *M. theobaldi* from Colombia to determine which, if either, of these species should bear this name. We believe we are the first to examine this specimen since it was described by Theobald (1901). Comments by Dyar (1928) and Lane (1953) make it clear that neither of them saw the specimens from Bogota described by Theobald. Belkin (1968) designated the male of *T. theobaldi* as lectotype but stated that he had not studied it. Our examination of the lectotype of *T. theobaldi* shows it to be a species distinct from both *T. moctezuma* and *T. hypoptes*, and both of the latter names are therefore resurrected from synonymy (**status revised**).

Table 3. Distinguishing characteristics of male *Toxorhynchites theobaldi* and *T. moctezuma*.

<i>T. theobaldi</i>	<i>T. moctezuma</i>
Hind tarsomeres 4 and 5 with white scales restricted to outer surface	Hind tarsomere 4 usually completely or mostly white scaled and hind tarsomere 5 usually completely dark scaled
Eyes contiguous on midline for some distance on underside of head	Eyes separated by 3 or 4 facet diameters at their closest point on underside of head
Abdominal tergum V with basal band of gold scales	Abdominal tergum V without basal band of any color
Apices of palpomeres 2–4 and sides of abdominal terga II–VII without lilac scales	Apices of palpomeres 2–4 and sides of abdominal terga II–VII with lilac scales
Apex of flagellomere 1 with laterally curved or directed scales that are whitish to pale blue	Apex of flagellomere 1 with erect scales with weak blue, purple, and gold reflections

Theobald's (1901) diagnosis of *T. theobaldi* (as *M. ferox*) states that the last two hind tarsomeres of the male are white, but the description states that they are white on one side only. The latter statement is accurate, and in this regard *T. theobaldi* is similar to *T. hypoptes*, the males of both species having white scales restricted to the outer surface of hind tarsomeres 4 and 5. Other similarities between males of these species include: (1) eyes that meet in a straight line on the underside of the head, (2) laterally curved or directed scales at the apex of flagellomere 1, and (3) a preponderance of scales with blue reflections on many parts of the body. Characters that distinguish the lectotype male of *T. theobaldi* from males of *T. hypoptes* and *T. moctezuma* are presented in Tables 2 and 3, respectively.

We have not discovered any obvious characters to distinguish the male genitalia of *T. theobaldi*, *T. moctezuma*, and *T. hypoptes*. It is possible that there are subtle differences in proportions of structures and in the length and strength of bristles, but these characters will require careful evaluation through the examination of a large number of specimens.

Toxorhynchites moctezuma extends from southeastern Arizona (Zavortink 1969) south through Mexico (Heinemann and Belkin 1977c) and Central America (Heinemann and Belkin 1977a, 1977b) to Panama (Heinemann and Belkin 1978a), then east through Venezuela (Heinemann and Belkin 1978b) to Trinidad and Tobago (Heinemann et al. 1980) (Fig. 1). The range of variation in tarsal markings of *T. moctezuma* from Costa Rica is broad enough to include *Toxorhynchites trinidadensis*, and we agree with the synonymy of *T. trinidadensis* with *T. moctezuma* suggested by Heinemann et al. (1980) (**new synonymy**). Heinemann and Belkin did not record *T. moctezuma*

from the Guianas (Heinemann and Belkin 1978b) or Brazil (Heinemann and Belkin 1979). *Toxorhynchites hypoptes* extends from Honduras (Heinemann and Belkin 1977b) through Nicaragua (Heinemann and Belkin 1977b) and Costa Rica (Heinemann and Belkin 1977a) to Panama (Heinemann and Belkin 1978a), then south along the Pacific coast of Colombia (Heinemann and Belkin 1978c) and Ecuador (Heinemann and Belkin 1979) (Fig. 1).

The immatures of both *T. moctezuma* and *T. hypoptes* are most often found in natural phytotelm habitats, such as tree holes, bamboo internodes, and fallen nuts or nut husks, and artificial containers. Although the immatures of both species occur in the same kinds of habitats throughout much of Central America, there are no records of them occurring together in the same individual habitat.

A consideration of the nominal species of *Toxorhynchites* from South America synonymized with *T. theobaldi* by Lane (1953) is beyond the scope of the present study. However, none of these taxa are described as having hind tarsal markings like *T. theobaldi*, and we believe future study will show that several distinct South American species have been erroneously synonymized with that species. Until such studies are conducted, the distribution of *T. theobaldi* remains unknown. The species was never collected for the Mosquitoes of Middle America Project, and present knowledge suggests that it does not occur within the ranges of either *T. moctezuma* or *T. hypoptes*.

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