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KEY TO ADULTS OF THE *CULEX* SUBGENERA *MELANOCONION* AND *MOCHLOSTYRAX* OF EASTERN NORTH AMERICA[1]

By **Judy Williams Knight and James S. Haeger**[2]

Abstract: Diagnostic characters were found for distinguishing adults of both sexes of all species of the subgenera *Melanoconion* (6 species) and *Mochlostyrax* (1 species) occurring in eastern North America. Previously, only the males of this group could be identified and then only by genitalia examination. The mesepimeron is distinctive in each species either by the color pattern of the integument or in the type and arrangement of its scales. Other characters employed in the key are the scales and shape of the mesepisternum.

Distribution records of *Melanoconion* and *Mochlostyrax* species are based on the identification of male genitalia. Females of this group have been considered taxonomically inseparable. Recovery of Venezuelan equine encephalitis virus from south Florida *Melanoconion* and/or *Mochlostyrax* (Chamberlain et al. 1964, 1969) has increased the need for female identification in this group.

In the course of identifying fresh and frozen specimens prior to blood meal analysis, several characters which appeared to be species specific for both sexes of these subgenera were noticed. Since specimens in virological work are also fresh or frozen (Chamberlain & Sikes 1954, Sudia et al. 1963), further study was initiated in an attempt to develop a practical key for female identification, as has been reported. Although the key is not designed primarily for use with dried specimens, the same characters, when visible, will also separate museum material. The reliability of the key can be checked by identifying unknown males prior to examining male genitalia.

MATERIALS AND METHODS

Initial examination was carried out using fresh males identified by their genitalia and females reared from identified larvae, all collected from Florida localities (TABLE 1). As the key was developed, it was tested with thousands of wild-caught Florida specimens taken in a wide variety of collecting devices, including New Jersey and CDC light traps, resting boxes, and animal bait traps. Finally, the key was evaluated with dried museum specimens collected from other parts of the geographic ranges (see TABLE 1).

To observe the characters used in the key, it is important to have the mosquitoes properly oriented to the light source. Those species having a pale spot or area on the mesepimeron are best oriented lateral surface up, with legs toward the observer, and the light directed toward the scutum. On the other hand, the fine golden hair-like scales on the mesepimeron of *Culex* (*Mel.*) *iolambdis* are seen clearly only when the specimen is oriented in the opposite direction, with the legs pointed away from the observer, toward the light source. Sometimes these scales are easier to observe by slightly rotating or tilting the specimen. This is also true when viewing the pale tarsal markings of Florida *Culex* (*Mel.*) *opisthopus*.

Measurement of the width to depth ratio of the lower mesepisternum, as illustrated in FIG. 1H, can be made easily with a linear scale measuring eyepiece. The depth measurement is taken by placing the scale on a straight line extension of the mesopleural suture. The width is measured by rotating the scale 90°, so that it forms a right angle with the mesopleural suture. For both measurements, the fixed end of the scale is placed at the point where the lower margin of the mesepimeron meets the mesopleural suture.

Many characters were evaluated in addition to the consistently diagnostic ones used in the key. These included the scales of the alula, tarsal markings, the shape and coloration of the cerci, features

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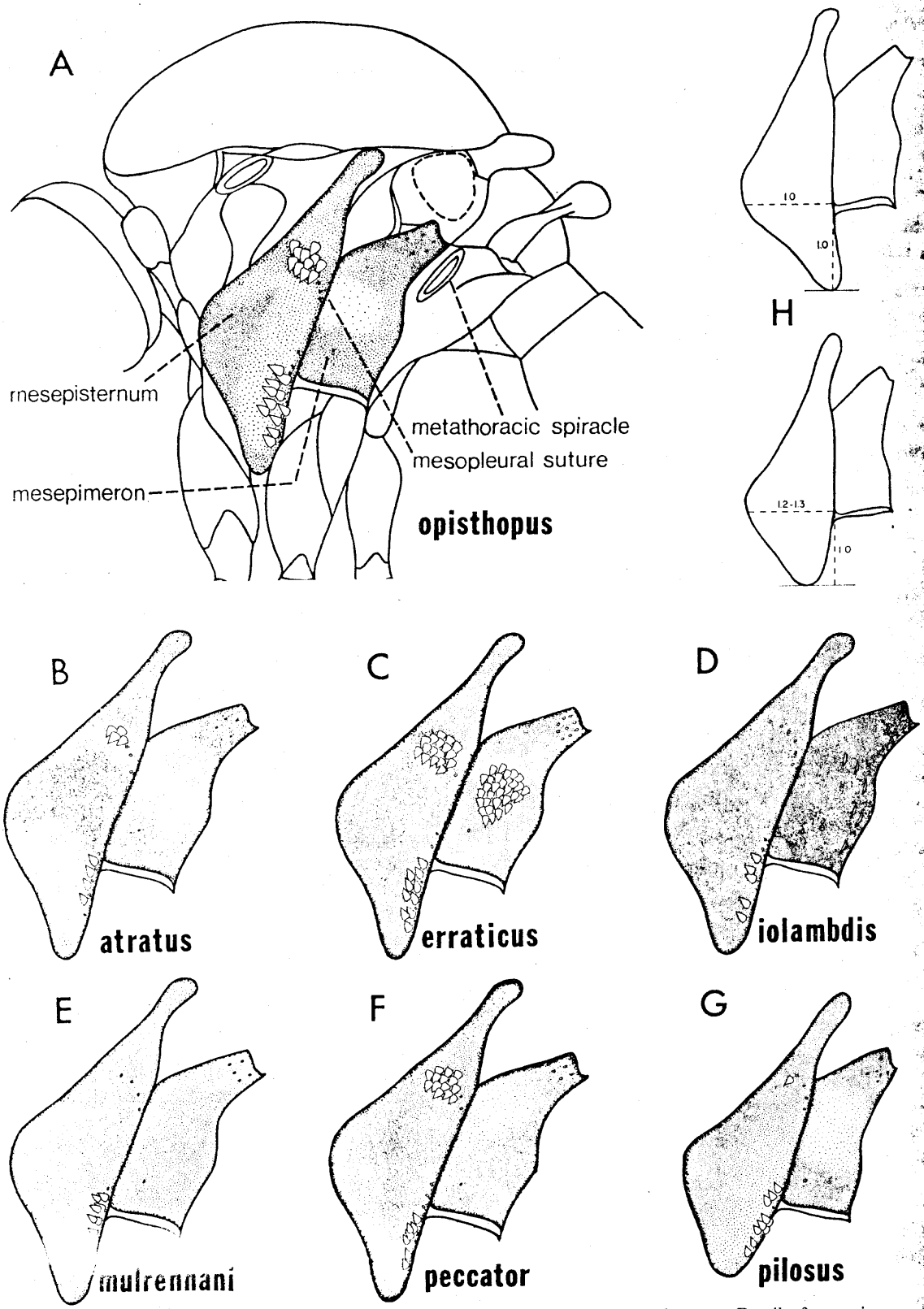

FIG. 1. Lateral aspects of thorax of *Culex* subgenera *Melanoconion* and *Mochlostyrax*. Detail of mesepimeron and mesepisternum for (A) *C.* (*Mel.*) *opisthopus*, (B) *C.* (*Mel.*) *atratus*, (C) *C.* (*Mel.*) *erraticus*, (D) *C.* (*Mel.*) *iolambdis*, (E) *C.* (*Mel.*) *mulrennani*, (F) *C.* (*Mel.*) *peccator*, (G) *C.* (*Moch.*) *pilosus*. (H) Illustration of lower mesepisternum measurement of width to depth, upper drawing for subgenus *Melanoconion* and lower drawing for *C.* (*Mochlostyrax*) *pilosus*.

TABLE 1. Geographical distribution and numbers of specimens examined for key characters. All pinned museum specimens except for Florida* group, which were reared from known larvae.

	Culex (*Melanoconion*)												*Culex* (*Mochlostyrax*)	
	atratus		*erraticus*		*iolambdis*		*mulrennani*		*opisthopus*		*peccator*		*pilosus*	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Florida*	62	19	164	10	70	59	13	13	122	112	56	80	68	34
Florida	43	21	13	90	7	4	7	6	2	1		6	4	
West Indies	12	6	2				1		10				5	1
Central America			4						2				1	
South America			1										3	2
La., Ala., Miss.			6	2							6	2	2	
Ga., N.C., S.C., Ky., Tenn.			5								9	20		
Tex., Okla., Ark.			4								2	2		
Kan., Mo., Ill.			4											
Va., Del., Md.			13											
Totals	117	46	216	102	77	63	21	19	136	113	73	110	83	37

of the scutum, wing length, and several size ratios for various body parts.

KEY TO ADULTS OF THE *Culex* SUBGENERA *Melanoconion* AND *Mochlostyrax* OF EASTERN NORTH AMERICA

1. Mesepimeron with a distinct pale spot, extending from the mesopleural suture toward the posterior margin, pale spot occasionally with a few broad white scales.....2
Mesepimeron without a distinct pale spot as above but may have a large variably-shaped light area, mesepimeron may have scales, either broad and white or fine golden and hair-like.....3
2. Pale spot on mesepimeron broadly connected anteriorly to mesopleural suture, rounded posteriorly (FIG. 1A), without scales; dark area of mesepimeron (below pale spot) not continuing into central area of mesepisternum; tarsi sometimes pale-ringed; known only from southern Florida.....**opisthopus**
Pale spot on mesepimeron variably-shaped (rounded posteroventrally or extending bandlike to posterior margin), less broadly connected to mesopleural suture (FIG. 1B), occasionally with a few (2–9) broad white scales but usually none; dark area of mesepimeron (below pale spot) continuous with dark central area of mesepisternum; tarsi unbanded; known only from Monroe, Dade, Collier, Lee, and Manatee Counties in Florida.....**atratus**
3. Mesepimeron with a large patch of broad white scales or with scattered fine golden hair-like scales, usually along posterior 1/3.....4
Mesepimeron without scales except an occasional single broad white scale.....5
4. Mesepimeron with a large patch of broad white scales (FIG. 1C); similar patches of scales on upper and lower mesepisternum; thoracic integument variably and unevenly colored light to very dark brown; known from eastern and central U. S. .....**erraticus**
Mesepimeron with fine golden hair-like scales, usually along posterior 1/3 but occasionally scattered over entire sclerite (FIG. 1D); lower mesepisternum with a few (2–10) broad gray-white scales; integument (especially of scutum) evenly colored shiny black; known only from coastal areas of southern Florida.....**iolambdis**
5. Mesepimeron with a narrow pale border (FIG. 1E), if light area present, very indistinct; upper mesepisternum without broad white scales; known only from Monroe County, Florida.....**mulrennani**
Mesepimeron without pale border but with a large variably-shaped distinct light area; upper mesepisternum with or without broad white scales.....6
6. Light area on mesepimeron covering the 1/2 adjacent to mesepisternum and dorsal to a diagonal extending from the anteroventral angle of the sclerite toward the metathoracic spiracle (FIG. 1F); upper mesepisternum with a patch of broad white scales (usually more than 5); lower mesepisternum ratio of width to depth 1:1 (FIG. 1H); known from eastern U. S., except extreme southern Florida.....**peccator**
Light area on mesepimeron covering upper 2/3 of sclerite, ventral margin not a diagonal (FIG. 1G); upper mesepisternum never with more than 2–3 broad white scales; lower mesepisternum ratio of width to depth 1.2–1.3:1 (FIG. 1H); known from southeastern U. S. .....**pilosus**

DESCRIPTION OF FEMALES

Culex (**Melanoconion**) **atratus** Theobald

Mesepimeron with variably-shaped pale spot (rounded posteroventrally or extending bandlike to posterior margin) narrowly connected to mesopleural suture, occasionally 1–9 broad white scales on central mesepimeron but usually none, dark area below pale spot continuous with dark central area of mesepisternum; upper mesepisternum with patch of 0–7 broad white scales, lower mesepisternum with patch of 1–4 broad white scales, lower mesepisternum ratio of width to depth 1:1; scutum clothed with bronzy-brown scales and numerous long dark brown setae; wing length 1.97–2.21 mm; all tarsi dark and unbanded.

Culex (**Melanoconion**) **erraticus** (Dyar & Knab)

Mesepimeron with large patch of 4–30 broad white scales centrally located, approximately in area of pale spot of *C.* (*Mel.*) *opisthopus;* upper mesepisternum with patch of 6–32 broad white scales, lower mesepisternum with patch of 1–31 broad white scales, lower mesepisternum ratio of width to depth 1:1; scutum clothed with brown or brown and golden scales and a few long dark brown setae; wing length 2.56–2.80 mm; all tarsi dark and unbanded.

Culex (**Melanoconion**) **iolambdis** Dyar

Mesepimeron with 1–11 fine golden hair-like scales, usually

along posterior 1/3 but occasionally scattered over entire sclerite, occasionally 1–2 broad gray-white scales on central mesepimeron; upper mesepisternum occasionally with 1–2 fine golden hair-like scales, lower mesepisternum with 2–10 broad gray-white scales, lower mesepisternum ratio of width to depth 1:1; scutum clothed with brownish-black to shiny black scales and numerous long dark brown setae; wing length 2.13–2.18 mm; all tarsi dark and unbanded.

Culex (Melanoconion) mulrennani Basham

Mesepimeron with narrow pale border sometimes indistinct, occasionally a single broad white scale on central mesepimeron; upper mesepisternum without scales, lower mesepisternum with 3–14 broad white scales, lower mesepisternum ratio of width to depth 1:1; scutum clothed with golden to brown scales and numerous long dark brown setae; wing length 2.28–2.44 mm; all tarsi dark and unbanded.

Culex (Melanoconion) opisthopus Komp

Mesepimeron with pale spot rounded posteriorly and broadly connected anteriorly to mesopleural suture; upper mesepisternum with a patch of 6–12 broad white scales, lower mesepisternum with a patch of 7–12 broad white scales, lower mesepisternum ratio of width to depth 1:1; scutum clothed with bronzy-brown scales, scattered patches of light golden scales, and numerous long brown setae; wing length 2.44–2.80 mm; hind tarsi with narrow pale bands, both apical and basal, but often absent or obscure particularly in Florida specimens.

Culex (Melanoconion) peccator Dyar & Knab

Mesepimeron with light area covering the 1/2 adjacent to mesepisternum and dorsal to a diagonal extending from the anteroventral angle of sclerite toward the metathoracic spiracle; upper mesepisternum with a patch of 3–15 broad white scales (usually more than 5), lower mesepisternum with a patch of 2–12 broad white scales, lower mesepisternum ratio of width to depth 1:1; scutum clothed with dark brown scales and a few long dark brown setae; wing length 2.29–2.56 mm; all tarsi dark and unbanded.

Culex (Mochlostyrax) pilosus (Dyar & Knab)

Mesepimeron with light area covering upper 2/3 of sclerite, ventral margin not a diagonal; upper mesepisternum occasionally with 1 or 2 broad white scales, lower mesepisternum with a patch of 4–15 broad white scales, lower mesepisternum ratio of width to depth 1.2–1.3:1; scutum clothed with brown to golden scales and a few long dark brown setae; wing length 2.01–2.25 mm; all tarsi dark and unbanded.

DISCUSSION

The scales found on the upper mesepisternum of certain species are easily rubbed off, apparently because of their prominent location, and thus are often useful only in verifying identifications. Although the scale fringe of the alula appeared diagnostic in several species (particularly in *C.* (*Mel.*) *opisthopus*, with slender, pointed, evenly spaced scales and in *C.* (*Mel.*) *peccator*, with broad scales pinnately arranged), this character was not included in the key because it can be seen only at magnification >100 × and the scales are often missing, even on fresh specimens.

Several points concerning each species need mention. They are as follows: (1) The fine golden hair-like scales characteristic of *C.* (*Mel.*) *iolambdis* were found intact on a specimen collected in 1946. (2) The dark continuous band crossing the mesepimeron and mesepisternum of *C.* (*Mel.*) *atratus* was visible on most pinned specimens, even when they were shriveled and up to 70 years old. (3) Specimens of *C.* (*Mel.*) *erraticus*, even those in poor condition, always retained a few scales of the mesepimeral patch. (4) Specimens of *C.* (*Mel.*) *peccator* from throughout the eastern U. S. were easily identified by the diagonally bounded light area of the mesepimeron and the scale patch on the upper mesepisternum. (5) Since few reared and no field-collected adults were available for examination, the characterization of *C.* (*Mel.*) *mulrennani* is subject to refinement. (6) The distinct pale spot characteristic of *C.* (*Mel.*) *opisthopus* was present in all specimens examined, including those from Almirante, Rep. of Panama; Carolina, Puerto Rico; Indian River County, Everglades National Park, and the Keys, Florida; and paratypes of *Culex* (*Mel.*) *cedecei* from Florida. In this key *C.* (*Mel.*) *cedecei* is treated as synonymous with *C.* (*Mel.*) *opisthopus* since its taxonomic status is unresolved [see Mosquito Systematics Newsletter Vol. 1 (2), (3), & (4)]. (7) The cerci of *C.* (*Moch.*) *pilosus* are darkly sclerotized and appear longer than in the *Melanoconion* spp. This adaptation may be related to the fact that eggs of *C.* (*Moch.*) *pilosus* are laid singly rather than in a raft as in most *Culex*. The somewhat different shape and orientation of the thoracic sclerites of *C.* (*Moch.*) *pilosus* may account for the apparently smaller thorax (relative to the abdomen) as compared with the *Melanoconion* spp., even when observed macroscopically. These characters lend support to the exclusion of this species from the subgenus *Melanoconion*.

During this investigation, 4 species were colonized: *C.* (*Mel.*) *opisthopus*, *C.* (*Mel.*) *erraticus*, *C.* (*Mel.*) *peccator*, and *C.* (*Mel.*) *atratus*. Some laboratory matings were obtained with *C.* (*Mel.*) *mulrennani*, but none with *C.* (*Mel.*) *iolambdis* or *C.* (*Moch.*) *pilosus*. New records for Indian River County, Florida were established for *C.* (*Mel.*) *iolambdis*, *C.* (*Mel.*) *peccator*, and *C.* (*Mel.*) *opisthopus* during this study.

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STUDIES ON AUTOGENY IN NATURAL POPULATIONS OF *CULEX PIPIENS*

II. Seasonal abundance of autogenous and anautogenous populations[1]

By **Andrew Spielman**[2]

Abstract: Autogenous mosquitoes were most numerous in breeding sites that were enclosed, while anautogenous mosquitoes were most numerous in more open bodies of water. Anautogenous populations increased more rapidly than did autogenous populations. This was attributed to differences in fecundity and in rate of development. Anautogenous populations declined in numbers in mid-summer. This followed an apparent decline in blood feeding and may have been due either to changes in daily light cycles or to scarcity of vertebrate hosts. An autogenous population bred continuously throughout the winter in a sheltered site. Mosquitoes with large fat bodies were captured at the end of the summer season and these were presumably diapausing anautogenous females. Avian hosts supplied most of the blood meals taken by mosquitoes in this study.

Two morphologically similar populations of *Culex pipiens* coexist in north-temperate urban regions. The females of 1 population are uniformly autogenous, developing eggs without nutritional stimulus, while those of the other are anautogenous and require a meal of blood before laying eggs. In addition, anautogenous females are capable of hibernation, fly extensively before mating (Roubaud 1933), and in the presence of suitable hosts, produce more eggs than do autogenous females (Christophers 1961). Although these populations are sympatric, they apparently remain reproductively isolated in nature (Spielman 1964a).

The environmental factors that influence the relative abundance of the 2 forms in nature have not been evaluated. Accordingly, the objective of the present study was to define the seasonal distribution in 1 locality of autogenous and anautogenous populations.

Description of the Study Area

The study area was located in an urban portion of Boston, Massachusetts. That site designated as the "tunnel" (FIG. 1) has been described in an earlier report (Spielman 1964a). In addition, 3 permanent collections of water were studied. The "air shaft" site was located immediately adjacent to the tunnel. It represented the lower portion of a shaft that ventilated the tunnel and contained rotting basswood leaves in less than 400 liters of water. At 6 m above water level, the mouth of the shaft was closed by a coarse iron grille with 2.5-cm interstices and was surrounded by sparse vegetation. Another breeding source, the "catch basin" site, was 7.6 m from the air shaft. It contained approximately 2400 liters of water that drained from the street through a narrow slit in the curb. The slit was generally blocked by debris and its underground extension was tortuous. Various kinds of trash were present among the basswood leaves which formed the bulk of the pollutant in this site. A third breeding site, the "pit," was located below ground level some 1000 m from the tunnel site. It contained approximately 1100 liters of water and was choked with rotting scraps of lumber. Twelve additional breeding sites were discovered outside of this immediate area and were studied sporadically. They included catch-basins, ponds, ditches and flooded portions of buildings.

Adult mosquitoes were collected in 1 additional

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