ILLUSTRATED KEY TO THE FEMALE ANOPHELINE MOSQUITOES OF CENTRAL AMERICA AND MEXICO

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ILLUSTRATED BY TAINA R. LITWAK

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ABSTRACT. An illustrated key to the female anopheline mosquitoes of Central America from western Panama to the southern border of the United States is presented with a taxonomic summary and distribution table. Thirty-nine species and one subspecies are treated: Chagasia (1), Anopheles (Anoph eles) (25 and one subspecies), An. (Kerteszia) (2), An. (Lophodomyia) (1), An. (Nyssorhynchus) (9) and An. (Stethomyia) (1).

INTRODUCTION

Malaria continues to be a major health problem in Central America. In recent years the number of cases in the region has risen rather than declined (Bruce-Chwatt 1985). The key presented here was developed because available keys to the Central American anopheline mosquitoes (Komp 1941, 1942; Simmons and Aitken 1942; Russell et al. 1943; Lane 1953; Vargas and Martinez Palacios 1956; Forattini 1962; Stojanovich et al. 1966; Vargas 1975; Clark-Gil and Darsie 1983) are useful only in limited geographical areas, are not current or not effective.

We hope to disprove G. B. Fairchild (personal communication, 1989) who claimed that, “Keys are made by people who don’t need them for those that can’t use them.” His message should be partially heeded nonetheless. One should not assume definitive determinations in every case based on the few characters a key provides. To make accurate identifications mosquito taxonomists often must use keys, detailed descriptions of all life stages, and even make comparisons with type specimens. In addition, specimen condition frequently influences the reliability of determinations. Unrubbed, undamaged specimens should be used for identifications whenever possible because color and/or position of scales and other vestiture is relied upon extensively in the key. Researchers and public health workers are therefore encouraged to confirm their identifications by sending samples to specialists when possible. It is also important that voucher specimens be deposited in appropriate museums so that it will be possible to verify identifications.

The morphological characters used here are based on original observations and previous usage in the literature. Especially helpful were: Faran (1980), Albimanus Section of subgenus Nyssorhynchus; Linthicum (1988), Argyritarsis Section of subgenus Nyssorhynchus; Zavortink (1970), treehole Anopheles; Zavortink (1973), subgenus Kerteszia; and Floore et al. (1976), Crucians Subgroup of subgenus Anopheles. The usefulness of wing spot characters has been enhanced by the recent redefinition of wing spot nomenclature (Wilkerson and Peyton 1990).

There are a few noteworthy changes from previous publications on the anophelines of the region. Two species were recently retrieved from synonymy: Anopheles (Ano.) malefactor Dyar and Knab, from synonymy with An. (Ano') punctimacula Dyar and Knab (Wilkerson 1990b), and An. (Ano.) chiriquiensis Komp, from synonymy with An. (Ano.) parapunctipennis Martini (Wilkerson 1990a). Bruce Harrison (personal communication, 1989) provided characters to separate An. (Ano.) intermedius (Peryassu) from the closely related An. (Ano.) apificmaculata Dyar and Knab. As a result, we determined that An. (Ano.) intermedius does not occur in Central America. Other notes are indicated in the key by superscript letters, e.g., “wing with mixed brown and yellowish-white scales”, and are presented in an “Explanation of Notes” section.

We do not intend for this key be used for eastern Panama because the mosquito fauna of the area is not well-known (E. L. Peyton, personal communication 1989). It is possible that northern South American species such as An. (Nys.) benarrochi Gabaldon, Cova Garcia and Lopez, An. (Nys.) braziliensis (Chagas), An. (Ano.) maculipes (Theobald), An. (Ker.) lepidotus Zavortink and/or An. (Ker.) homunculus Komp could be encountered in eastern Panama.
## Table 1. Central American and Mexican anopheline mosquitoes: taxonomic index, primary basis for key characters and primary taxonomic references.

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### Table 1. continued

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Two northern South American species known from eastern Panama are *An. (Ano.) mediopunctatus* (Theobald) (Stojanovich et al. 1966) and *An. (Nys.) nuneztovari* Gabaldon (Faran 1980). Refer to Ward (1982) for an introduction to Central American mosquito taxonomic literature. Bionomics and disease transmission are not reviewed here, but the following species are considered to be vectors of malarial parasites in Central America (White 1982). These include 4 primary vectors, *An. (Nys.) albimanus* Wiedemann, *An. (Nys.) argyriras* Robineau-Desvoidy, *An. (Nys.) aquasalis* Curry, *An. (Nys.) darlingi* Root, and 3 secondary vectors, *An. (Nys.) marajoara* Galvao and Damasceno, *An. (Ano.) aztecus* Hoffmann, and *An. (Ano.) punctimacula* (?also *An. (Ano.) malefactor*). Other species should not be overlooked, however, especially on a local basis.

Harbach and Knight (1980, 1982) are followed for morphological terms and abbreviations with the exception that Roman numerals denoting abdominal segments follow the abbreviations for tergum and sternum instead of the other way around, e.g., S-II, not II-S, for sternum II. To assist the user in becoming familiar with mosquito terminology, morphological features are written out followed by their abbreviations, e.g., radius-four-plus-five ($R_4S_5$).

Specimens were examined at 10–80× magnification with blue-filtered tungsten light. "Pure" white was established as a reference for determining other colors according to the method of Peyton and Ramalingam (1988). This was ac-
Table 2. Distribution of anopheline mosquitoes in Central America and Mexico.

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CG = Clark-Gil and Darsie (1983); F = Faran (1980); K = Komp 1942; K and S = Knight and Stone (1977); L = Linthicum (1988); MV = M. Vargas (1975); S and A = Simmons and Atiken (1942); V = Vargas and Martinez Palacios (1956); X = examined; Z = Zavortink (1970); Za = Zavortink (1973).

The scales of the halter in species of the Arriba- 
lagia Series of the subgenus Anopheles.

Table 1 is a taxonomic index to the anophe- 
lines of Central America and Mexico. It lists the 
primary specimens used for determining key 
characters and also lists salient taxonomic lit-

The examination was accomplished by using 60x or higher magnification to position the light source(s) so that a white surface appeared as white as possible. Among the species treated here, the whitest structures found were hindtarsomeres 2 and 3 in species of the subgenus Nyssorhynchus and
It is worth noting the definitions of 4 of the pale wing spots used in the key (Wilkerson and Peyton 1990). The sector pale (SP) spot is “the group of pale scales occurring on the costa, subcosta and/or radius associated with or just distad of the sc-r crossvein.” The accessory sector pale (ASP) spot is “the group of pale scales associated with crossvein r1-r5 on vein R, sometimes also on veins Sc and C, usually separated by a dark spot from the sector pale but sometimes fused with the sector pale.” The preapical pale (PP) spot refers to the “pale scales on the costa and radius-one proximal to the end of R1,

Fig. 1. Female anopheline mosquito, lateral view. Ap: antepronotum; C-I: forecoxa; C-II: midcoxa; C-III: hindcoxa; Fe-I: forefemur; Fe-II: midfemur; Fe-III: hindfemur; Hl: halter; La: labellum; Mks: mesepisternum; Mm: mesepimeron; MPlp: maxillary palp, segments 1–5; Mpn: mesopostnotum; MS: mesothoracic spiracle; Mts: metepisternum; P: proboscis; Pa: paratergite; PA: postspiracular area; Ppn: postpronotum; Ps: proepisternum; S-I-VIII: sterna I-VIII; Scu: scutum; Stm: scutellum; Ta-III,4: hindtarsomeres 1–5; Te-I-VIII: terga I-VIII; Ti-III: hindtibia; Tr-I: foretrochanter; Tr-II: midtrochanter; Tr-III: hindtrochanter.
between the preapical dark and apical dark. Scales on the costa at the end of R1.

The apical pale (AP) spot is "the area of pale

Fig. 2. Wing of a female Anopheles mosquito; veins and crossveins. C: costa; Cu: cubitus; h: humeral crossvein; M: media; M1: media-one; M2+3: media-one-plus-two; M3+4: media-three-plus-four; mcu: mediocubital crossvein; R: radius; R1: radius-one; r1-r5: radial crossvein; R2: radius-two; R3+4: radius-two-plus-three; R5: radius-three; R4+5: radius-four-plus-five; R6: radial sector; Sc: subcosta; sc-r: subcostal crossvein; IA: Anal.

Abbreviations for Figs. 3–6: AD: apical dark spot; AP: apical pale spot; APD: accessory preapical dark spot; ASD: accessory sector dark spot; ASP: accessory sector pale spot; BD: basal dark spot; BP: basal pale spot; h: humeral crossvein; HD: humeral dark spot; HP: humeral pale spot; PD: preapical dark spot; PHD: prehumeral dark spot; PHP: prehumeral pale spot; POSCD: postsubcostal dark spot; POSCP: postsubcostal pale spot; PP: preapical pale spot; PRSCD: presubcostal dark spot; PRSCP: presubcostal pale spot; PSD: presector dark spot; PSP: presector pale spot; r1-r5: radial crossvein; SBD: subbasal dark spot (humeral dark spot plus presector dark spot); sc-r: subcostal crossvein; SCA: subcostal area; SCD: subcostal dark spot; SCP: subcostal pale spot; SD: sector dark spot; SP: sector pale spot.

Fig. 3. Wing of Anopheles (Anopheles) apicimacula.
Fig. 4. Wing of *Anopheles (Nyssorhynchus) oswaldoi*.

Fig. 5. Wing of *Anopheles (Kerteszia) neivai*.

Fig. 6. Wing of *Anopheles (Anopheles) hectoris*. 
KEY TO THE FEMALE ANOPHELINES OF CENTRAL AMERICA AND MEXICO

1. Scutellum (Stm) slightly trilobed, with setae confined to lobes (Fig. 7); postpronotal (Ppn) setae and scales present (Fig. 8); wing with mixed brown and yellowish-white scales*, not forming a well-defined pattern of spots ........................................... Chagasia bathana

Scutellum (Stm) evenly rounded, bearing a continuous line of setae (Fig. 9); postpronotal (Ppn) setae and scales absent (Fig. 10); wing scales either unicolorous or with 1 or more distinct pale spots ........................................... 2

2(1). Hindfemur (Fe-III) with a distinct apical patch of dark erect scales (Fig. 11) ........................................... Anopheles (Lophopodomyia) squamifemur

Hindfemur (Fe-III) without a distinct apical patch of dark erect scales (Fig. 12) ........................................... 3

3(2). Femora (Fe) and tibiae (Ti) unicolorous or variously marked, speckles, if present, small, dark or not abundant (Figs. 13 and 14); costa (C) with a single small to large pale spot (subcostal pale, SCP) in the vicinity of the junction with subcosta (Sc) (Figs. 16 and 17) or costa (C) wholly dark-scaled in the area of the subcostal junction (Sc); sector pale spot (SP), if present, not interrupted by a dark spot (ASD) (Figs. 16 and 17) ........................................... 4

Femora (Fe) and tibiae (Ti) with abundant large pale speckles (Fig. 15); costa (C) with a small to large dark spot (subcostal dark, SCD) at junction with subcosta (Sc) (Figs. 18 and 19), the dark spot bordered on each side by one or more pre- and postsubcostal pale and dark spots (PRSCP, PRSCD, POSCP, POSCD) (Fig. 3); sector pale spot (SP) interrupted by a dark spot (accessory sector dark) (ASD) (Figs. 18 and 19) ........................................... Anopheles (Anopheles) (in part), Arribalzagia Series? 7

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*Note: *The asterisk (*) indicates a feature that is not always present and may vary among individuals of the same species. The feature is highlighted to draw attention to its variability. The specific description here is illustrative and not exhaustive of all possible variations. Additional details and context would typically be provided in a scientific publication or field guide.
Scutum (Scu) with a single narrow, sometimes faint, middorsal silvery pollinose stripe (Fig. 20); head without scales except for sparse erect scales on the vertex (V) (Fig. 23); small species with unicolorous dark legs and wings ........................................ Anopheles (Stethomyia) kompi

Scutum (Scu) unicolorous or variously marked, but not as above (Figs. 21, 22, 25); head with numerous erect scales on vertex (V) and occiput (Occ) (Fig. 24) ........................................... 5
5(4). Hindtarsomeres ($Ta$-$III_{1-5}$) with conspicuous apical pale bands, or some hindtarsomeres with conspicuous apical pale bands and others entirely pale (Figs. 26 and 27); pale spotting on costa (C) well-developed, usually with 8 pale spots present including: basal (BP), prehumeral (PHP), humeral (HP), presector (PSP), sector (SP), accessory sector (ASP), subcostal (SCP) and preapical (PP) (Fig. 29).............................6

Hindtarsomeres ($Ta$-$III_{1-5}$) mostly dark, without conspicuous bands, at most with small basal patches or very narrow bands of pale scales on some tarsomeres (Fig. 28); pale spotting on costa (C) absent or less developed, 1-5 pale spots may be present including some combination of the following: basal pale (BP), prehumeral pale (PHP), humeral pale (HP), sector pale (SP), subcostal pale (SCP), preapical (PP), apical pale (AP) (Fig. 30).....Anopheles (Anopheles) (in part) 12

Fig. 26. An. (Ker.) neivai

Fig. 27. An. (Nys.) oswaldoi

Fig. 28. An. (Ano.) hectoris

Fig. 30. An. (Ano.) chiriquiensis

6(5). Scutum (Scu) with 4 longitudinal dark stripes (Fig. 31); hindtarsomeres ($Ta$-$III_{1-5}$) with conspicuous apical pale bands (Fig. 32); accessory sector pale (ASP) spot near middle of costa (C), nearly equidistant between sector pale (SP) and subcostal pale (SCP) spots (Fig. 35)........................................Anopheles (Kerteszia) 29

Scutum (Scu) otherwise (Fig. 33); hindtarsomeres 3 and 4 ($Ta$-$III_{3-4}$) entirely white (Fig. 34); accessory sector pale (ASP) spot about 0.4 from wing base, conspicuously closer to sector pale (SP) than to subcostal pale (SCP) spot (Fig. 36)..................Anopheles (Nyssorhynchus) 30

Fig. 31. An. (Ker.) neivai

Fig. 33. An. (Nys.) albimanus

Fig. 32. Ta-$III_{5}$

Fig. 34. An. (Nys.) oswaldoi
7(3). Scutum (Scu) and scutellum (Stm) without distinct dark pollinose spots (Fig. 37); wing predominantly dark-scaled; radius-four-plus-five (R_{4+5}) usually predominantly dark-scaled (Fig. 39) .... 8
Scutum (Scu) and scutellum (Stm) with 3 distinct dark pollinose spots accentuated by silvery pollinosity, 2 lateral spots anterior to wing bases and median spot on prescutellar area (PrA) continuous onto scutellum (Stm) (Fig. 38); wing predominantly pale-scaled; radius-four-plus-five (R_{4+5}) usually predominantly pale-scaled (Fig. 40) .......................................................... 9
87. Abdominal terga without posterolateral scale-tufts (Fig. 41); abdominal sterna with sparse scales (Fig. 42) ............................................................ *vestitipennis*

Abdominal terga with posterolateral scale-tufts (Fig. 43); abdominal sterna with numerous pale and dark scales (Fig. 44) ........................................ *gabaldoni*

97. Scales on median portion of cubitus (Cu) dark, appressed to vein and smaller than scales on adjoining veins (Fig. 45); anterior wing veins with 4 primary dark spots (best seen with little or no magnification), apical dark (AD) spot as distinct as presector dark (PSD), sector dark (SD) and preapical dark (PD) spots (Fig. 45) ........................................... *apicimacula*

Scales on cubitus (Cu) not as above, mostly pale or a mixture of pale and dark, usually not appressed to vein and usually about same size as scales of adjoining veins (Fig. 46); anterior wing veins with 3 or 4 primary dark spots, apical dark (AD) spot may be indistinct (Fig. 46) ........................... 10
10(9). Preapical dark (PD) spot small, 0.06-0.12 length of wing (mean 0.09) (Fig. 47); sternum I (S-I) usually with a few posterolateral pale scales (Fig. 48); hindtarsomere 5 (Ta-III) with a dark band (Fig. 49) ............................................................................. neomaculipalpus

Preapical dark (PD) spot larger, 0.11-0.23 length of wing (mean 0.17) (Fig. 50); sternum I (S-I) bare (Fig. 51); hindtarsomere 5 (Ta-III) with or without a dark band (Fig. 52) ..........................11

11(10). Mesepimeron (Mm) without scales (Fig. 54); pale wing scales mostly yellow except for distinctly contrasting white scales on either side of presector dark (PSD), sector dark (SD) and preapical dark (PD) spots (Fig. 53); hindtarsomere 5 (Ta-III) usually with a dark band or spot (Fig. 55) ............................................................................. punctimacula

Mesepimeron (Mm) usually with several pale upper mesepimeral scales (UMSc)(Fig. 57); pale wing scales a mixture of pale yellow and white (Fig. 58) hindtarsomere 5 (Ta-III) pale (Fig. 56) ............................................................................. malefactor²
12(5). Wing entirely dark-scaled (including fringe at apex) (Figs. 59 and 60) ........................................ 13
Wing with one or more pale spots (wing may be entirely dark-scaled except for a pale spot restricted to fringe at apex) (Figs. 61 and 62) ......................................................... 17

Fig. 59. An. (Ano.) quadrimaculatus
13(12). Wing scales uniformly dark, without patches of denser and/or darker scales at crossveins and furcations (Fig. 60); maxillary palpus and legs entirely dark-scaled. \textit{judithae}

Wing scales darker and/or more dense at crossveins and furcations, forming faint dark spots (often better seen without magnification) (Fig. 59); maxillary palpus entirely dark-scaled or with pale scales at articulations and apex of palpmere 5; legs entirely dark or with pale scales at articulations. \textit{14}

14(13). Scales and setae of interocular space (IS), and usually pale scales of vertex (V), golden yellow (Fig. 63); scales on apices of femora (Fe) and tibiae (Ti) not noticeably contrasting with other scaling of legs (Fig. 66). \textit{aztecs}

Scales and setae of interocular space (IS), and pale scales of vertex (V) white or yellowish white (Figs. 64 and 65); apices of femora (Fe) and tibiae (Ti) white-scaled, noticeably contrasting with dark brown scaling of legs (Fig. 67) \textit{15}
15(14). Maxillary palpus (MPlp) with pale scales at articulations of palpomeres 2–3, 3–4, 4–5 and at apex of 5 (Fig. 68) ................................................. \textit{walkeri}

Maxillary palpus (MPlp) uniformly dark-scaled (Fig. 69) ................................................. 16

16(15). Wing scales narrow, short and sparse, wing membrane readily visible on apical 0.5 of wing (Fig. 70) (northwestern Mexico) ................................................. \textit{freeborni}*

Wing scales broader, longer and more numerous, little of wing membrane visible on apical 0.5 of wing (Fig. 71) (eastern Mexico) ................................................. Quadrimaculatus Complex

17(12). Hindtibia (Ti-III) with a conspicuous broad apical white band (Fig. 72); apex of hindfemur (Fe-III) with a few pale scales; costa (C) dark-scaled except for a distinct preapical pale (PP) spot on costa (C) and radius-one (R₁) (Fig. 73) ................................................. \textit{eiseni}

Hindtibia (Ti-III) either dark-scaled apically, with a narrow apical white band or with a conspicuous apical white patch; hindfemur (Fe-III) variable; costa (C) variable ................................................. 18
18(17). Hindfemur (Fe-III) with a broad apical white band (Fig. 74); wing dark-scaled except for apical pale (AP) spot on costa (C) and radius-one (R₁), or on wing fringe (WF) at and posterior to radius-one (R₁) (Figs. 76-78) .................................................. 19

Hindfemur (Fe-III) either dark, with a narrow apical white band or with a few apical pale scales (Fig. 75); wing variable .................................................. 22

19(18). Apices of costa (C) and radius-one (R₁) (including fringe) pale-scaled (Fig. 77); small pale fringe spots (PFS) present at ends of media-one (M₁), media-two (M₂) and media-three-plus-four (M₃+₄); denser patches of scales form dark spots at furcations, at crossveins and at base of wing (Fig. 77) .................................................. 18

Apices of costa (C) and radius-one (R₁) dark-scaled, pale scales confined to fringe from radius-one (R₁) to radius-four-plus-five (R₄+₅) or media-one (M₁) (Fig. 78); pale fringe spots (PFS) not present at ends of media-one (M₁), media-two (M₂) and media-three-plus-four (M₃+₄); denser patches of wing scales not present (Fig. 78) .................................................. 20

Fig. 74. \textit{An. (Ano.) xelajuensis}

Fig. 75. \textit{An. (Ano.) hectoris}

Fig. 76. \textit{An. (Ano.) fausti}

Fig. 77. \textit{An. (Ano.) xelajuensis}

Fig. 78. \textit{An. (Ano.) powderi}
20(19). Maxillary palpus (MPlp) entirely dark-scaled (Fig. 79); wing profusely scaled; scales in middle of anal vein (1A) spread widely from vein (Fig. 82) .............................................. powderi

Maxillary palpus (MPlp) with pale scales at articulations and apex (Fig. 80); wing moderately scaled; scales in middle of anal vein (1A) appressed or slightly spreading from vein (Fig. 81) .............................................. fausti

21(20). Apices of fore- (Fe-I) and midfemora (Fe-II) with a few white scales (Fig. 83) .............................................. fausti

Apices of fore- (Fe-I) and midfemora (Fe-II) dark-scaled (Fig. 84) .............................................. arboricola

22(18). Costa (C) with an apical pale (AP) spot only (Fig. 85) .............................................. 23

Costa (C) with at least apical pale (AP) and subcostal pale (SCP) spots (Fig. 86) .............................................. 24
23(22). Cubitus (Cu) usually pale-scaled to mediocubital crossvein (mcu) (Fig. 87)  
Cubitus (Cu) usually dark-scaled to mediocubital crossvein (mcu) (Fig. 88) 
_________________________ bradleyi  
_________________________ crucians

24(22). Base of costa (C) dark-scaled, without prehumeral pale (PHP) or humeral pale (HP) spots (Fig. 89)  
Base of costa (C) with humeral pale (HP) and/or prehumeral pale (PHP) spots (Figs. 90 and 91)  
_________________________ 25  
_________________________ 27

Fig. 85. An. (Ano.) bradleyi

Fig. 86. An. (Ano.) hectoris

Fig. 87. An. (Ano.) bradleyi

Fig. 88. An. (Ano.) crucians

Fig. 89. An. (Ano.) pseudopunctipennis

Fig. 90. An. (Ano.) hectoris

Fig. 91. An. (Ano.) parapunctipennis
25(24). Cubitus (Cu) dark-scaled (Fig. 92); radius (R) and radius-one (R₁) dark except at subcostal (SCP) and apical (AP) pale spots (Fig. 92); no sector pale (SP) spot at radial crossvein (r₁ – r₂) (Fig. 92); maxillary palpus (MPlp) entirely dark-scaled (Fig. 94).............. punctipennis

Cubitus (Cu) predominantly pale-scaled with dark spots at each end (Fig. 93); radius (R) and radius-one (R₁) pale except at presector (PSD), sector (SD) and subapical dark (SAD = PD + AD) spots (Fig. 93); with sector pale (SP) spot at radial crossvein (r₁ – r₂) (Fig. 93); maxillary palpus (MPlp) pale-scaled at articulations (Fig. 95). .......................... 26

Fig. 92.  
*An. (Ano.) punctipennis*

Fig. 93.  
*An. (Ano.) pseudopunctipennis*

26(25). Palpomere 5 (MPlp₅) pale-scaled (Fig. 96); media (M) predominantly pale-scaled (Fig. 93) .............. pseudopunctipennis

Palpomere 5 (MPlp₅) pale basally, dark apically (Fig. 97); media (M) predominantly dark-scaled (Fig. 98) ............. franciscanus

Fig. 94.  
*An. (Ano.) punctipennis*

Fig. 95.  
*An. (Ano.) pseudopunctipennis*

Fig. 96.  
*An. (Ano.) pseudopunctipennis*

Fig. 97.  
*An. (Ano.) franciscanus*
Fig. 98.
*An. (Ano.) franciscanus*

Entire broad middorsal silvery pollinose stripe of scutum (Scu) overlain by slender white fusiform scales (Fig. 100); sector pale (SP) spot present on radius (R) but not on costa (C) (Fig. 99); pale scales of wing, thorax and proboscis white

**hectoris**

Only extreme anterior margin of broad middorsal silvery pollinose stripe of scutum (Scu) with slender white fusiform scales (Fig. 102); sector pale (SP) spot either absent or present on both costa (C) and radius (R) (Figs. 101 and 103); pale scales of wing, thorax and proboscis yellowish white...
28(27). Sector pale (SP) spot absent (Fig. 104); maxillary palpus (MPlp) mostly dark with pale scales at apex of palpomere 3 (MPlp3) and at base and apex of palpomeres 4 and 5 (MPlp4, MPlp5) (Fig. 106); capitellum (Ca) of halter dark brown (Fig. 108) .............................................. \textit{parapunctipennis} and \textit{parapunctipennis guatemalensis} \textsuperscript{h}

Sector pale (SP) spot present on costa (C) and radius (R) (Fig. 105); maxillary palpus (MPlp) with more extensive pale scaling, with pale scales at the apex of palpomere 2 (MPlp2), base of 3 (MPlp3), most of 4 (MPlp4), except for a dark median band and, palpomere 5 (MPlp5) pale, sometimes with a dark median band (Fig. 107); capitellum (Ca) of halter mostly yellowish (Fig. 109) .......................... \textit{chiriquiensis}

29(6). Terga and sterna II-VII without obvious scales (Fig. 110); basal 0.3-0.5 of hindtarsomere 2 (Ta-III2) dark, remainder pale (Fig. 112) ................................................................. \textit{neivai}

Terga and sterna II-VII with numerous scales (Fig. 111); basal 0.8-0.9 of hindtarsomere 2 (Ta-III2) dark, apex pale (Fig. 113) ................................................................. \textit{pholidotus}

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{fig104.png}
\caption{Fig. 104. \textit{An. (Ano.) parapunctipennis}}
\end{figure}

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{fig105.png}
\caption{Fig. 105. \textit{An. (Ano.) chiriquiensis}}
\end{figure}

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{fig106.png}
\caption{Fig. 106. \textit{An. (Ano.) parapunctipennis}}
\end{figure}

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{fig107.png}
\caption{Fig. 107. \textit{An. (Ano.) chiriquiensis}}
\end{figure}

\begin{figure}[h!]
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\includegraphics[width=\textwidth]{fig108.png}
\caption{Fig. 108. \textit{An. (Ano.) parapunctipennis}}
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\begin{figure}[h!]
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\includegraphics[width=\textwidth]{fig109.png}
\caption{Fig. 109. \textit{An. (Ano.) chiriquiensis}}
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\includegraphics[width=\textwidth]{fig110.png}
\caption{Fig. 110. \textit{An. (Ker.) neivai}}
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\includegraphics[width=\textwidth]{fig111.png}
\caption{Fig. 111. \textit{An. (Ker.) pholidotus}}
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\includegraphics[width=\textwidth]{fig112.png}
\caption{Fig. 112. \textit{An. (Ker.) neivai}}
\end{figure}

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{fig113.png}
\caption{Fig. 113. \textit{An. (Ker.) pholidotus}}
\end{figure}
30(6). Hindtarsomere 5 (Ta-III) with a basal dark band (Fig. 114) .......... Albimanus Section ... 31
Hindtarsomere 5 (Ta-III) entirely white (Fig. 115) ................. Argyritarsis Section ... 35

Fig. 114. An. (Nys.) albimanus

Fig. 115. An. (Nys.) darlingi

31(30). Tergum II (Te-II) without dark posterolateral scale-tufts (Fig. 116); palpomere 4 (MP1p₄) with dark or yellow to golden-brown scales on mediolateral surface, scales never white or cream-colored (Fig. 118); foretarsomere 5 (Ta-I₅) usually all dark albianus
Tergum II (Te-II) with dark posterolateral scale-tufts (Fig. 117); palpomere 4 (MP1p₄) with at least some white or cream-colored scales on mediolateral surface (Fig. 119); foretarsomere 5 (Ta-I₅) variable ........................................ 32

Fig. 116. Te-II

Fig. 117. Te-II

Fig. 118. MP1p₄

Fig. 119. MP1p₄

An. (Nys.) albimanus

An. (Nys.) oswaldoi

32(31). Hindtarsomere 2 (Ta-III₂) with basal dark band less than 0.25 length of tarsomere (Fig. 120) ........ oswaldoi
Hindtarsomere 2 (Ta-III₂) with basal dark band greater than 0.3 length of tarsomere (Fig. 121) ....... 33

< 0.25

Fig. 120. An. (Nys.) oswaldoi

> 0.3

Fig. 121. An. (Nys.) strodei
33(32). Humeral pale (HP) spot small, 0.5–1.3 times length of prehumeral dark (PHD) (Fig. 122); middle of mesepimeron (Mm) usually with a patch of pale anterior mesepimeral scales (AMSc) (Fig. 124); hindtarsomere 2 with basal dark band 0.4–0.7 length of segment ................. triannulatus

Humeral pale (HP) spot large, greater than 1.3 times length of prehumeral dark (PHD) spot (Fig. 123); middle of mesepimeron (Mm) without a patch of pale scales (Fig. 125); hindtarsomere 2 with basal dark band 0.3–0.6 length of segment ................. 34

34(33). Pale scales on wing and coxae usually white or nearly so ................. strodei and anomalophyllus
Pale scales on wing and coxae yellowish, not white .......................... aequalis

35(30). Humeral pale (HP) spot short, 0.25–0.33 times length of prehumeral dark (PHD) spot (Fig. 126); mesepimeron (Mm) without a patch of pale upper mesepimeral scales (UMSc) (as in Fig. 129); mesepimeron (Mm) usually with a patch of pale anterior mesepimeral scales (AMSc) (Fig. 128); dark caudolateral scale-tufts present on tergum II (Te-II) (Fig. 128); anterior pale wing scales yellow ................................... darlingi

Humeral pale (HP) spot long, not less than 1.25 times length of prehumeral dark (PHD) spot (Fig. 127); mesepimeron (Mm) usually with a patch of upper mesepimeral pale scales (UMSc) (Fig. 129); mesepimeron (Mm) without a patch of anterior pale scales (AMSc) (as in Fig. 128); dark caudolateral scale-tufts absent on tergum II (Te-II) (Fig. 129); anterior pale wing scales white ................. 36
Sternum I (S-I) with submedian rows of white scales (Fig. 130); basal dark band of hindtarsomere 2 (Ta-III₂) usually 0.5–0.7 (range 0.3–0.8) length of tarsomere (Fig. 132) .................. marajoara
Sternum I (S-I) without scales (Fig. 131); basal dark band of hindtarsomere 2 (Ta-III₂) less than 0.4 length of tarsomere (Fig. 133) .......................... argyritarsis
EXPLANATION OF NOTES

a Unless otherwise noted the colors given refer to scale color.
b Some specimens of An. (Ano.) vestitipennis lack pre-subcostal pale (PRSCP) spots. In these specimens the "isolated" dark spot is continuous with the sector dark (SD) spot and therefore not present. This should not cause confusion since the character of speckled legs is constant and postsubcostal pale (POSCP) spot(s) will still be present.
c Dust-like or powdery appearance of the cuticula. This term describes what is normally seen with a dissecting microscope, but are actually "microtrichiumlike spicules comprising the tomentum which covers the cuticula (except the wing membrane)" (Harbach and Knight 1980).

Anopheles veruslani Vargas (1979a, b) from Quir-
tana Roo, Mexico, will key out here. The identity of this species cannot be determined with certainty. Since An. malefactor is known only from Panama and Colombia it is likely that An. veruslani will prove to be distinct and identifiable when more material becomes available.
It is possible that the species called An. freeborni in northern Mexico is actually a very similar species, An. hermsi, recently described from southern California by Barr and Gugpavanti (1988).

These 2 taxa are treated by Wilkerson (1990a). Though they are morphologically similar, their status remains unchanged until more material becomes available. Females of An. parapunctipennis guatemalensis are distinguishable from the nominotypical subspecies by the absence of pale scales on vein R1 at the subcostal pale (SCP) spot.

Anopheles veruslani (Vargas 1979a, b) from Quin-
tana Roo, Mexico, will key out here. The identity of this species cannot be determined with certainty. Since An. malefactor is known only from Panama and Colombia it is likely that An. veruslani will prove to be distinct and identifiable when more material becomes available.
It is possible that the species called An. freeborni in northern Mexico is actually a very similar species, An. hermsi, recently described from southern California by Barr and Gugpavanti (1988).

Recent evidence (Narang et al. 1989; Kaiser et al. 1988a, b; Lanzaro et al. 1988) documents at least 4 species in the Quadrimaculatus Complex in the U.S. The morphology of these taxa has not been studied, and it is uncertain which form(s) occur in Mexico.
See Floore et al. (1976). Anopheles bradleyi and An. crucians can only be identified reliably in the immature stage. The character given in the key is about 75% reliable for adult females (B. A. Harrison, personal communication).

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ison, E. L. Peyton and R. A. Ward, Department of Entomology, Walter Reed Army Institute of Research, for their many helpful comments during the preparation of this manuscript.

APPENDIX

Essential label information is listed for the specimens used to produce the illustrations. Spec-
cies names are given in alphabetical order. Ex-
cept where noted, all specimens are in the Na-
tional Museum of Natural History, Museum Support Center, Smithsonian Institution, Wash-
ington, DC.

Anopheles (Nys.) albimanus, Honduras, HONC 66-110, Acc. 1179, Strickman; An. (Ano.) opicimacula, Mexico, Chiapas, MX 141-
3, Acc. 1250; An. (Ano.) arboricola, Panama, El Volcan, VI-30-43, T. H. G. Aitken, 690203-4; An. (Nys.) argyritarsis, Panama, Gorgas Mem. Lab., '63, PA 460-104; An. (Ano.) aztecus, (2), Mexico, MX 17 and MX 19; Ch. bathanus, (2), British Honduras, 1967, BH 429; An. (Ano.) bradleyi, Cocoa FL, Lt 11 (?) March 48, Halsten; An. (Ano.) chiriquiensis, Panama, Chiriqui, PN 94-104, 10 Oct. 85, Peyton and Strickman; An. (Ano.) crucians, Honduras, 1986, HONC 25-10, Strickman, Acc. 1179; An. (Nys.) darlingi, (2), Los Amates, Guatemala, Feb 18-28, 05, Jas. S. Hine; An. (Ano.) eiseni, Honduras, 1986, HONC 217-13, Strickman, Acc. 1179; An. (Ano.) fausti, (In Instituto de Salubridad y Enfermedades Tropicales, Mexico City, Mexico) paratype, Col. M. Macias, IV-1942, Tlapexhuocan, S.L.P.; An. (Ano.) franciscanus, (2) New Mexico, Artesia, July 3, 1948, Beadle and New Mexico, Tucumari, June 25, 48, Beadle; An. (Ano.) freeborni, California, Saratoga Springs, Death Valley, 1-11-55, Belkin, Lot/sub 153; An. (Ano.) gabaldoni, (In Liverpool School of Tropical Medicine) British Honduras, Bertram, 1845 on 18-12-67, Hum-
type, 10,500 p. /Anoph Chiriquiensis, ?Chquis; An. (Ker.) pholidotus, allotype, Panama, Bocas de Toro Prov., Caldera, Chi quota Trail, 31-X-55, Orguela; An. (Ano.) powderi, Panama, Cerro Punta, Chiiriqui, (6000 ft), V-26-46, Galindo; An. (Ano.) pseudopunctipennis, Honduras, HONC 113-14, Strickman, Acc. 1179; An. (Ano.) punctimacla, (3), Panama, PA 1175-8, 58, PA 1175-64 and PAX 49; An. (Ano.) punctipennis, Mexico, Monterrey, N.L., X-1945, Col. M. Macias; An. (Ano.) quadrimaculatus, Mexico, Tampico, March 10-1921, J.A. Le Prince; An. (Lph.) squamifemur, Panama, PA 94-2, 65/66, Gorgas Mem Lab; An. (Nys.) strodei, Panama, Juan Diaz, 12/7/36, MEP Acc. No. 596; An. (Nys.)
REFERENCES CITED


