THE MOSQUITOES OF PENNSYLVANIA

Identification of Adult Females and Fourth Instar Larvae, Geographical Distribution, Biology and Public Health Importance

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Contributions of the authors:
RFD was primarily responsible for the taxonomic keys and MLH was primarily responsible for the biological sketches.

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TABLE OF CONTENTS

Acknowledgements……………………………………………………..…………..i
Introduction…………………………………………………….……………..1
Systematic index of the mosquitoes of Pennsylvania……………………….…………..4
Morphology of the adult female……………………………………………………7
Basic structures…………………………………………………….……7
Head…………………………………………………………………….7
Thorax……………………………………………………..……..8
Abdomen………………………………………………………………10
Plates 1-4………………………………………………………………12
Abbreviations used in keys to adult females………………………………………...18
Keys to the adult female mosquitoes………………………………………………..20
Genera…………………………………………………………………20
Anopheles…………………………………………………………...…27
Aedes and *Ochlerotatus*…………………………………………………..31
Psorophora……………………………………………………………..53
Culex……………………………………………………………………...56
Culiseta………………………………………………………………...60
Orthopodomyia………………………………………………………...63
Morphology of the fourth instar larva………………………………………………64
Vestiture………………………………………………………………..64
Head……………………………………………………………………65
Thorax…………………………………………………………………66
Abdomen………………………………………………………………66
Plates 6-9………………………………………………………………69
Abbreviations used in the keys to the fourth instar larvae…………………….…74
Keys to the fourth instar larvae……………………………………………………...75
Genera………………………………………………………………….....75
Anopheles………………………………………………………….....…82
Aedes and *Ochlerotatus*…..………………………………………………..88
Psorophora……………………………………………………………110
Culex……………………………………………………………………...113
Culiseta………………………………………………………………116
Orthopodomyia………………………………………………………120
Biological sketches…………………………………………………………...121
Aedes…………………………………………………………………123
Anopheles……………………………………………………………127
Coquillettidia…………………………………………………………134
Culex…………………………………………………………………135
Culiseta………………………………………………………………141
Ochlerotatus…………………………………………………………146
Orthopodomyia……………………………………………………....175
Psorophora……………………………………………………………..177
Toxorhynchites………………………………………………………182
Uranotaenia…………………………………………………………183
Wyeomyia……………………………………………………………184
Bibliography……………………………………………………………...… 185

INTRODUCTION

For people living in and visiting the state of Pennsylvania, mosquitoes (Diptera: Culicidae) can have adverse effects on their health and welfare. Not only are they pestiferous irritants, but they are also potential transmitters of human disease agents such as eastern equine encephalomyelitis, St. Louis encephalitis, and West Nile viruses. Proper species-level identification of mosquitoes is essential for their effective control. Related to their recognition is their biology, which provides additional clues to their control.

Previous publications provided identification keys to all known species in North America (Carpenter and LaCasse 1955, Darsie and Ward 1981, Darsie and Ward 2005). Stojanovich (1961) furnished a useful key to the common species in Northeastern North America. Prior keys to Pennsylvania species were produced by Rutschky et al. (1958) and later by Wills and Beaudoin (1965).

A checklist of the mosquito fauna of Pennsylvania was published by Hutchinson et al. (2008) reporting 62 species in 11 genera and 21 subgenera which included new state records and updated nomenclature (see page 4). The work presented here represents a more thorough treatment of the mosquitoes of Pennsylvania by incorporating illustrated keys to the adult females and fourth instar larvae with attending morphology of these stages, and details of their biology, disease potential and distribution in the state.

Using the keys

The keys are adapted from Darsie and Ward (2005). A thorough knowledge of the morphology of the adult female and fourth instar larva is a prerequisite to successfully employing the keys since they are entirely based on morphology. The descriptions of the morphology should be studied prior to using the keys. An additional aid is Taxonomists' Glossary of Mosquito Anatomy by Harbach and Knight (1980).

The keys are organized by numbered "couplets" which consist of two opposing statements. To identify a specimen read the two descriptions in the first couplet. The half of the couplet which characterizes the specimen being examined has either a name of a genus or species OR a number on the right-hand margin. If there is a name, the identification is completed. If, on the other hand, a number applies to the specimen under study, proceed to the couplet bearing that number. If the genus has only one species in the Pennsylvania fauna (*Coquillettidia, Toxorhynchites, Uranotaenia, Wyeomyia*) it is identified by using the generic key.

Taxonomic notes:

There exists an ongoing debate regarding the taxonomic status of several groups of mosquito species worldwide and the names of many Pennsylvania species have been affected by recently proposed taxonomic revisions. The subgenus *Ochlerotatus* was elevated to generic rank and all but four of the Pennsylvania species in the genus *Aedes* were placed in the genus *Ochlerotatus* by Reinert (2000). In 2004, another revision called for two of the remaining Pennsylvania *Aedes* species to be renamed. *Aedes aegypti* was renamed *Stegomyia aegypti* and *Aedes albopictus* was renamed *Stegomyia albopicta* (Reinert et al. 2004). Then in 2006, two Pennsylvania species that were placed in *Ochlerotatus* in 2000 once again received new names. *Ochlerotatus atropalpus* was renamed *Georgecraigius atropalpus* and *Ochlerotatus japonicus* was renamed *Hulecoeteomyia japonica* (Reinert et al. 2006). Not all systematists agree with the proposed changes. For this publication, we have elected to use the names that are currently most commonly used in the published literature. Specifically, we recognize *Ochlerotatus* as a genus, but not *Stegomyia, Georgecraigius or Hulecoeteomyia* until this issue has been resolved in the literature.

BIOLOGICAL SKETCHES

Data provided in the biological sketches are the result of a statewide mosquito survey initiated to detect the presence of West Nile virus and other mosquito-borne diseases. This work includes the results of 7 years of collection and testing data from 2001-2007. Any references to specimen totals for collections or virus testing were from this survey unless specifically indicated in the text. In the interest of readability and conservation of space, references were not specifically cited within the text, but can be found at the end of this document.

Larval Habitat:

Habitat data were obtained from over 50,000 larval collections and from published literature.

Host Preferences:

Host preference data were obtained from published literature.

Virus Testing Results:

All mosquito specimens in this section were tested at least for West Nile virus. Some of those specimens were also screened for either Eastern Equine Encephalomialitis (EEE) or La Crosse encephalitis (LAC). Emphasis for EEE or LAC testing was placed on species that are known enzootic and/or bridge vectors for the respective virus.

The MIR is the minimum infection rate calculated by dividing the number of positive pools by the number of specimens tested and multiplying by 1,000. A pool is defined as a sample of mosquitoes of the same species grouped together in one vial for testing purposes. The MIR represents the minimum number of positive specimens per 1,000 mosquitoes tested and offers some measure of comparison among species. Analysis of MIR's is most useful over short time frames (such as weekly) to identify the intensity of infection in a particular area. As a rule, MIR's should not be calculated over long time frames such as an entire season. However, it was more practical to include season-long MIR's for this publication to provide the reader with a crude idea of which species were most important in the enzootic and epizootic cycles of each virus.

For those species in which at least one positive pool was detected, we provided the trapping methods that were used to collect the tested mosquitoes. This reveals much information about the physiological state of the mosquitoes at the time of testing. Most specimens from gravid traps had presumably already completed one gonotrophic cycle, indicating that they had already taken at least one blood meal. A disproportionately high number of specimens from CO_2-baited traps were likely seeking their first blood meal and had less of an opportunity to become infected. The reader should take this factor into consideration when attempting to evaluate the importance of each species in the virus cycles of WNV, EEE, and LAC when comparing MIR's.

Distribution Maps:

The distribution maps are represented by data points for specific coordinates where a species was collected. The data points were not weighted; therefore a site that yielded a single specimen will have the same size data point as will a site that yielded large numbers of specimens. In some cases, the distribution of a species will appear uniform on the map when, in reality, the species is extremely concentrated among only a few localities. In such cases (e.g. *Culex salinarius*), additional clarification was provided in the Comments section for that species. Collection efforts were concentrated on species that are believed to be important transmitters of disease. Therefore, some species, particularly univoltine species, may be more common and widely distributed than the maps indicate. Specimens that appeared to be outside of their expected ranges were investigated by MLH to attempt to eliminate the possibility of identification or data entry errors. Records that appeared to be erroneous were excluded. Data for both larvae and adults were used to create the maps.

SYSTEMATIC INDEX OF THE MOSQUITOES OF PENNSYLVANIA
(11 genera, 21 subgenera, 62 species)

ANOPHELES Meigen

Subg. *Anopheles* Meigen

barberi Coquillett

crucians Wiedemann

earlei Vargas

perplexens Ludlow

punctipennis (Say)

quadrimaculatus Say sl

walkeri Theobald

AEDES Meigen

Subg. *Aedes* Meigen

cinereus Meigen

Subg, *Aedimorphus* Theobald

vexans (Meigen)

Subg. *Stegomyia* Theobald

aegypti (Linnaeus)

albopictus (Skuse)

OCHLEROTATUS Lynch Arribalzaga

Subg. *Finlaya* Theobald

japonicus japonicus (Theobald)

Subg. *Ochlerotatus* Lynch Arribalzaga

abserratus (Felt & Young)

atlanticus (Dyar &Knab)

atropalpus (Coquillett)

aurifer (Coquillett)

canadensis canadensis (Theobald)

cantator (Coquillett)

communis (De Geer)

decticus (Howard, Dyar & Knab)

diantaeus (Howard, Dyar & Knab)

dorsalis (Meigen)

dupreei (Coquillett)

excrucians (Walker)

fitchii (Felt & Young)

grossbecki (Dyar & Knab)

infirmatus (Dyar & Knab)

intrudens (Dyar)

mitchellae (Dyar)

punctor (Kirby)

sollicitans (Walker)

sticticus (Meigen)

stimulans (Walker)

taeniorhynchus (Wiedemann)

thibaulti (Dyar & Knab)

tormentor (Dyar & Knab)

trivittatus (Coquillett)

Subg. *Protomacleaya* Theobald

hendersoni (Cockerell)

triseriatus (Say)

Subg. *Rusticoides* Shevchenko & Prudkina

provocans (Walker)

*PSOROPHOR*A Robineau-Desvoidy

Subg. *Grabhamia* Theobald

columbiae (Dyar &Knab)

Subg. *Janthinosoma* Lynch Arribalzaga

ferox (von Humboldt)

horrida Dyar & Knab

Subg. *Psorophora* Robineau-Desvoidy

ciliata (Fabricius)

howardii Coquillett

CULEX Linnaeus

Subg. *Culex* Linnaeus

pipiens Linnaeus

restuans Theobald

salinarius Coquillett

tarsalis Coquillett

Subg. *Melanoconion* Theobald

erraticus (Dyar & Knab)

Subg. *Neoculex* Dyar

territans Walker

CULISETA Felt

Subg. *Climacura* Howard, Dyar & Knab

melanura (Coquillett)

Subg. *Culicella* Felt

minnesotae Barr

morsitans Theobald

Subg. *Culiseta* Felt

impatiens (Walker)

inornata (Williston)

COQUILLETTIDIA Dyar

Subg. *Coquillettidia* Dyar

perturbans (Walker)

ORTHOPODOMYIA Theobald

alba Baker

signifera (Coquillett)

WYEOMYIA Theobald

Subg, *Wyeomyia* Theobald

smithii (Coquillett)

URANOTAENIA Lynch Arribalzaga

Subg. *Uranotaenia* Lynch Arribalzaga

sapphirina (Osten Sacken)

TOXORHYNCHITES Theobald

Subg. *Lynchiella* Lahille

rutilus septentrionalis (Dyar & Knab)

MORPHOLOGY OF THE ADULT FEMALE

The morphological descriptions below deal mostly with the structures used in the keys. For a more detailed account of mosquito anatomy, consult Harbach and Knight (1980) and Darsie and Ward (2005).

BASIC STRUCTURES

The body of the adult female is composed of chitinous plates, called *sclerites*, separated by lines known as *sutures*, or by membranes of various sizes. These structures comprise the *integument*, or outer covering of the body; those important in identification of the female will be discussed below.

Since *scales* are common on adult females and constitute one of the principal structures of recognition, they must be distinguished from *setae*. Setae (hairs, hair tufts, bristles and spiniforms) are usually round in cross section, tapering from base to apex, and arising from a relatively large cup-like socket, called an alveolus (pl. alveoli).

Scales, on the other hand, are flat in cross section, widening from base to apex, with longitudinal ridges attached to minute alveoli on the integument. They occur in three basic shapes, broad and flat, narrow and curved, and erect and apically forked. The scales on the fringe of the wing are fusiform.

The color of scales varies from black and brown, shades of yellow, such as dingy yellow in *Cx. salinarius*, to white and silvery. The white color can be brownish white, as in *Cs. minnesotae*, to grayish white. The colors tend to fade over time in pinned adult specimens, so in the keys herein, pale is used to mean shades of white, and dark to mean black or brown. It is important to adjust the microscope lighting to observe the true color of scales.

The body of the adult female is divided into three principal regions, head, thorax and abdomen, Plate 1.

HEAD

The structure of the head is shown in Plates 1 and 2C. It is usually ovoid and a large portion is occupied by the *compound eyes* (CE). The eyes are composed of circular morphological units called *corneal facets* (CoF). The *antennae* arise between the eyes. The sclerite ventral to their bases is the small, convex *clypeus* (Clp). Dorsal is a sclerite between and above the antennae and eyes, the *frons* (Fr), above which is the dorsum of the head, made up of the *vertex* (V) anteriorly and the *occiput* (Occ) posteriorly. Since there is no suture between them, it is customary to refer to the while dorsum simply as the occiput. The anterior border along the dorsal edge of the compound eye is known as the *ocular line* (OL).

The head bears the following five appendages: two antennae, two maxillary palpi and the proboscis. The base of the *antenna* consists of two small segments of which the second, the *pedicel*, a cup-shaped segment, has some useful characters. From the pedicel arises the *flagellum*, having 13 or 14 *flagellomeres*, or antennal segments, each bearing a whorl of setae. A pair of *maxillary palpi*, simply called palpi (sing. palpus) are located ventrolateral to the clypeus, each composed of five *palpomeres*, or palpal segments: however, in some females the basal palpomere is small or rudimentary so that the palpi appear 4-segmented. The proboscis extends forward from the anteroventral base of the head. Normally only the outer scaled covering of the proboscis, known as the *labium* (Lb) and the two terminal lobes, the *labella* (La) (sing. labellum), are visible. Inside the labium in most species are thin stylets for piercing the host's skin.

THORAX

The thorax (Plates 3, 4), the body region between the head and abdomen is divided into three segments; *prothorax*, *mesothorax* and *metathorax*. Each bears a pair of legs; in addition, the mesothorax has a pair of functional wings, and the metathorax has a pair of knobbed *halteres*. The dipterous mesothorax is typically greatly enlarged to accommodate the flight muscles associated with the functional wings. The pro- and metathorax are correspondingly reduced in size.

In dorsal view (Plates 3A, B) proceeding from anterior to posterior, the *antepronota* (Ap), part of the prothorax, are found laterally just posterior to the head. In *Wyeomyia* they are enlarged and approach each other middorsally. Next is the *scutum* (Scu), the largest sclerite of the mosquito body and rather spheroid. Anterolateral depressions in the sphere are known as the *scutal fossae* (SF) and the slightly depressed, usually unscaled area posteromedially is the prescutellar area (PrA). The scutum has setae arranged in three, somewhat irregular, longitudinal rows in the middle third. The central one is composed of the *acrostichal setae* (AcS), and the rows on either side are *dorsocentral setae* (DS). In addition there is a group in front of and superior to the wing root, the *supraalar setae* (SaS). In some species the color of the supraalar setae is diagnostic. Those anterolateral setae occurring around and in the scutal fossa are the *scutal fossal setae* (SFS) (Plates 3B, 4A). In some species the scutal setae are quite numerous and long (e.g. *An. barberi*), while in most species they are shorter and fewer. In the *Culex* subgenus *Melanoconion*, the acrostichal setae are absent.

The patterns made by the scutal scales are employed extensively in culicine mosquito identification, particularly in the genus *Ochlerotatus*. One difficulty commonly encountered is rubbed specimens in which the scutum is devoid of scales and setae. When such specimens are examined under high magnification of a stereoscopic microscope the color of some few scales still attached may give a clue about the pattern of the species. Likewise the presence of alveoli, as tiny dark circles, will indicate the prior location of setae.

Posterior to the scutum is a narrow transverse sclerite, the *scutellum* (Stm). In the genus *Anopheles* it is arcuate and bears an even row of setae, the *scutellar setae* (MSS, LSS). In the culicine species the scutellum is trilobed, with a separate group of setae on each lobe.

The shiny, dome-shaped structure posterior to the scutellum is the *mesopostnotum* (Mpm). In most species it is bare, but in genus *Wyeomyia* a group of setae occurs near its attachment to abdominal segment I and is known as the *mesopostnotal setae* (MpnS). Lateral to the mesoposnotum are knobbed structures, the halteres, the structures that assist with balance during flight. Usually they are dark-scaled, but are pale in one Pennsylvania species (*An. walkeri*).

The three thoracic segments are also represented by the structures of the thoracic pleuron, the lateral area of the thorax (Plate 4A). The prothoracic elements consist of a vertical, strap-like sclerite, the *proepisternum* (Ps), bearing the upper *proepisternal setae*

(PeSU). The last prothroacic sclerite, the *postpronotum* (Ppn) is found posterior to the antepronotum and lateral to the scutum at the level of the scutal fossa. It bears scales, that sometimes form a distinctive pattern, and a number of *postpronotal setae* (PpS) usually confined to the posterior margin.

The mesothoracic pleuron has important sclerites. Just posterior to the postpronotum is an opening in the integument, the *mesothoracic spiracle* (MS), an opening to the respiratory system. It is surrounded by a large sclerite, the *anterior mesanepisternum* (Amas), which is divided into four areas: (1) The *prespiracular area* (PsA), a small triangle dorsoanterior to the spiracle. It adjoins the posterior border of the postpronotum and sometimes bears setae, the *prespiracular setae* (PsS), e.g., genus *Culiseta*. (2) The *postspiracular area* (PA), a rather large space posterior to the spiracle with or without setae and scales; when present these are the postspiracular setae (PS) and *postspiracular scales* (PoSc). (3) The *hypostigmal area* (HyA), immediately ventral to the spiracle and at times with *hypostigmal scales* (HySc). (4) The *subspiracular area* (SA), a depression ventral to the hypostigmal area, adjoining the mesokatepisternum ventral to it, with or without subspiracular scales (SSc).

The largest of the mesopleural sclerites, the *mesokatepisternum* (Mks) is rather pear-shaped, bulging ventroanteriorly. It is united with a narrow dorsal linear line, the *posterior mesanepisternum* (Pmas), containing the *prealar area* (Pa) with its *prealar knob* (PK) that bears a group of setae, the *prealar setae* (PaS). The mesokatepisternum has two groups of setae, the *upper* (MkSU) and the *lower* (MkSL) *mesokatepisternal setae*. The *mesokatepisternal scales* (MkSU) are sometimes arranged in distinct patterns, i.e., a large patch may or may not reach the anterior angle. Between the forecoxa and the ventroanterior border of the mesokatepisternum there is a membrane, the *postprocoxal membrane* (PM). In some species of *Ochlerotatus* it bears a small patch of scales, the *postprocoxal scales* (PSc).

The rectangular sclerite just posterior to the mesokatepisternum and ventral to the wing root is the mesepimeron (Mm). It bears a group of setae at the dorsoposterior corner, the upper *mesepimeral setae* (MeSU). Sometimes another several setae, the lower mesepimeral setae (MeSL), usually not more than 1-6 setae in a single row, occur along the anteroventral border.

Just ventral to the mesepimeron is the smallest mesopleural sclerite, the mesomeron (MsM). It is triangular and situated between the mid- and hindcoxae. The relation of the base of the mesomeron to the base of the hindcoxa is a generic character. Usually the base of the hindcoxa is distinctly ventral to the base of the mesomeron, but in *Wyeomyia* females, the base of the hindcoxa is about even with the base of the mesomeron.

The metathoracic pleuron is much reduced and only the *metameron* (Mem) needs to be mentioned here. It is a small structure located posterior to the mesomeron and dorsal to the hindcoxa. At times it bears scales, the *metameral scales* (MeSc).

Appendages of the thorax. **Wings**. The two functional *wings* (W) of adult mosquitoes are attached to the mesothorax, Plate 3. Each is composed of a network of longitudinal thickenings called *veins*. Between the veins are stretched membranes known as *cells*. The veins are clothed with scales dorsally and ventrally. The apical and ventral margins of the wing are bordered by long fusiform scales, the *wing fringe* (FS).

The veins and cells have names, as shown in Plate 3C, which follow the Comstock-Needham system. There are six major longitudinal veins: costa (C), subcosta (Sc), radius (R), media (M), cubitus (Cu) and anal (A). If veins are traced from base to apex, several have one or more subdivisions. For example, the radius has a basal vein R, with primary branches R_1 and R_s apically. The latter further divides into R_{2+3} and R_{4+5}. The R_{2+3} separates into veins R_2 and R_3, apically. There are several crossveins, short connectors between major veins.

The cells likewise have names, per Plate 3C, letters in italics. Each cell derives its name from the vein just anterior to it. An important one is cell R_2 as it is shortened in the genus *Uranotaenia*. In the key its length is compared to the length of vein R_{2+3}.

The *wing scales* provide many useful characters. They can be broad and spatulate, triangular-shaped or narrow and filiform. Many species have the wing scales entirely dark, or sometimes they have varying numbers of pale scales from a small patch at the base of the costa to generally mixed pale and dark scales, to mostly pale scales.

Furthermore, there are wings with unicolorous spots produced by dense clusters of scales along some veins. The costa, subcosta and radial veins in some anophelines possess spots of pale scales that bear names (Wilkerson and Peyton 1990). The area of pale scales at or near the apex of the wing is called the *apical pale spot* and the *subcostal pale spot* is found where the subcostal vein joins the costal vein. Although they are called "spots" they are really patches of pale scales sometimes extending to several veins. Most wings do not have prominent setae, but in genus *Culiseta* a row occurs ventrally near the base of the subcosta.

Legs. There are three pairs of legs, one attached to each thoracic segment. The leg consists of five main parts: coax (C), trochanter (Tr), femur (Fe), tibia (Ti) and tarsus (Ta) (Plate 2D). The tarsus is composed of five segments known as *tarsomeres*. The fifth tarsomere bears two *unguis* (U) also called claws (Cl), which in most species have a secondary element, the *tooth*. The shape of the claws is at times diagnostic. Since they are tiny, they can best be studied under a stereoscopic microscope by shining the light on the stage below the specimen and viewing the claw by indirect light. In *Orthopodomyia*, tarsomere 4 (Ta_4) is unusually small in the fore- and midtarsi.

Scale patterns on the various segments of the legs are extensively employed as key characters. The femora may have subapical pale rings or apical pale rings, known as *knee spots* (KS). The tibiae sometimes have a longitudinal line of pale scales or a subapical pale band. The tarsomeres, especially on the hindleg, may have basal pale bands which are narrow or broad, or with both basal and apical bands, creating the effect of a very wide band, or with tarsomeres 5, 4 and part of 3 all pale-scaled.

ABDOMEN

The abdomen is composed of 10 segments of which the first seven are quite similar in external structure, Plate 4B. The three terminal segments are specialized for reproduction and excretion. It is customary to refer to the abdominal segments by Roman numerals, e.g. abdominal segment III, and they are referred to in the keys by just the Roman numeral.

Each of the seven segments has a dorsal sclerite, the *tergum* (Te), and a ventral sclerite, the *sternum* (S). Laterally they are connected by an expandable, elastic membrane, the *pleural membrane* (PMe). A similar *intersegmental membrane* (IM) separates the terga dorsally and the sterna ventrally. These membranes permit the abdomen to expand during blood feeding and when the female becomes gravid.

Segments VIII-X are shortened and modified. In some genera these segments are telescoped inside the terminal segments, making the apex of the abdomen appear bluntly rounded. In others, part of these segments protrude posteriorly, giving the abdomen a rather pointed appearance. Also in those with blunt abdomens, segment VII is almost the same width as VI, but for the pointed abdomens VII is decidedly narrower than VI. Abdominal segment VIII usually has a larger sternum than tergum. Posterior to tergum VIII can be seen two elongated lobes, the *cerci* (Ce) (sing. circus). These structures are ling, straight and visible in the genera with pointed abdomens, but shorter, usually curved medially, and not so visible in the genera with blunt abdomens.

No attempt will be made to describe the female genitalia since they are not included in the keys. For an account of the female genitalia consult Reinert (1974).

The anopheline abdomens are largely devoid of scales, although they bear a number of tergal and sternal setae. In the other genera both setae and scales are present on the abdomen. Their patterns of dark and pale scales are very important in identification. In some females pale scales are located basally on the terga, i.e., on the part of the segment nearest the base of the abdomen where it joins the thorax; or sometimes on the apical part nearest to the distal end of the abdomen. Likewise the scales on the sterna may have distinctive patterns.

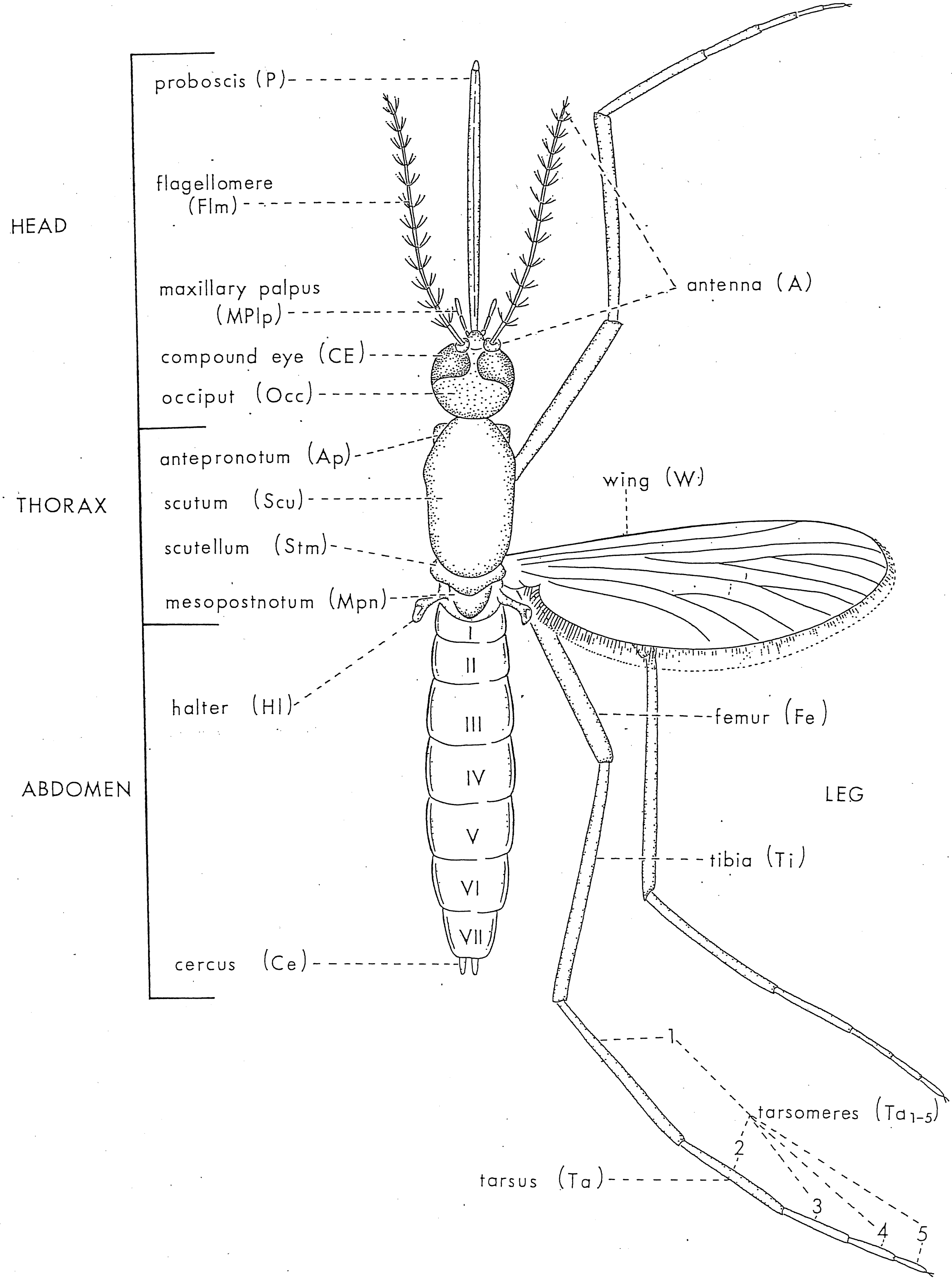


Plate 1. Diagram of adult female mosquito.

ABBREVIATIONS OF ADULT FEMALE MORPHOLOGY IN PLATES

A - antenna
C - coxa
CE - compound eye
Cl - claw
Clp - clypeus
CoF - corneal facet
Fe - femur
Fl - flagellum
Flm - flagellomere
Fr - frons
IS - interocular space
La - labellum

Plate 2

Lb - labium
MPlp - maxillary palpus
Occ - occiput
OL - ocular line
P - proboscis
Pe - pedicel
Plp - palpomere
Sc - scape
Ta - tarsus
Ta_{1-5} - tarsomere
Ti - tibia
Tr - trochanter
V - vertex

Illustrations A and B

AcS - acrostichal setae
Ap - antepronotum
ApS - antepronotal setae
C-I - forecoxa
Cv - cervix
DS - dorsocentral setae
LSS - lateral scutellar setae
Mpn - mesopostnotum
MSS - median scutellar setae
Mtn - metanotum

Plate 3

PeSU - upper proepisternal setae
Ppn - postpronotum
PpS - postpronotal setae
PrA - prescutellar area
Ps - proepisternum
SaS - supraalar setae
Scu - scutum
SF - scutal fossa
SFS - scutal fossal setae
Stm - scutellum
W - wing

Illustration C (Wing)

A - anal vein
A - anal cell
C - costal vein
C - Costal cell
Cu - cubital vein
Cu_1 - anterior branch of cubital vein
Cu_1 - cubital cell
Cu_2 - posterior branch of cubital vein
Cu_2 - $cubital_2$ cell
FS - fringe scales
h - humeral crossvein
M - medial vein
M - medial cell
M_{1+2} - anterior branch of medial vein
M_2 - $medial_2$ cell
M_{3+4} - posterior branch of medial vein
M_4 - $medial_4$ cell
m-cu - mediocubital crossvein
R - radial vein
R - radial cell
R_1 - anteriormost branch of radial vein
R_1 - $radial_1$ cell
R_s - radial sector vein
R_2 - anterior branch of radial sector vein

R_2 - radial$_2$ cell

R_{2+3} - connector vein (stem) of radial sector vein

R_3 - median branch of radial sector vein

R_3 - radial$_3$ cell

R_{4+5} - posterior branch of radial sector vein

R_5 - radial$_5$ cell

r-m - radiomedial crossvein

Sc - subcostal vein

Sc - subcostal cell

Plate 4

Ab-I - abdominal segment I

AMas - anterior mesanepisternum

Ap - antepronotum

ApS - antepronotal setae

C-I - forecoxa

C-II - midcoxa

C-III - hindcoxa

Ce - cercus

Cv - cervix

DS - dorsocentral setae

H- head

Hl - halter

HyA - hypostigmal area

LSS - lateral scutellar setae

Mam - mesanepimeron

Mem - metameron

MeSL - lower mesanepimeral setae

MeSU - upper mesanepimeral setae

Mks - mesokatepisternum

MkSL - lower mesokatepisternal setae

MkSU - upper mesokatepisternal setae

Mpn - mesopostnotum

MS - mesothoracic spiracle

Msm - mesomeron

MSS - medial scutellar setae

Mtm - metepimeron

Mtn - metanotum

Mtpn - metapostnotum

Mts - metepisternum

MtS - metathoracic spiracle

PA - postspiracular area

PaS - prealar setae

PeSU - upper proepisternal setae

PGL - postgenital lobe

PM - postprocoxal membrane

PMas - posterior mesanepisternum

Ppn - postpronotum

PpS - postpronotal setae

Ps - proepisternum

PS - postspiracular setae

PsS - prespiracular setae

PsA - prespiracular area

S - sternum of abdomen

SA - subspiracular area

SaS - supraalar setae

Scu - scutum

SF- scutal fossa

SFS - scutal fossal setae

Stm - scutellum

Te - tergum of abdomen

W - wing

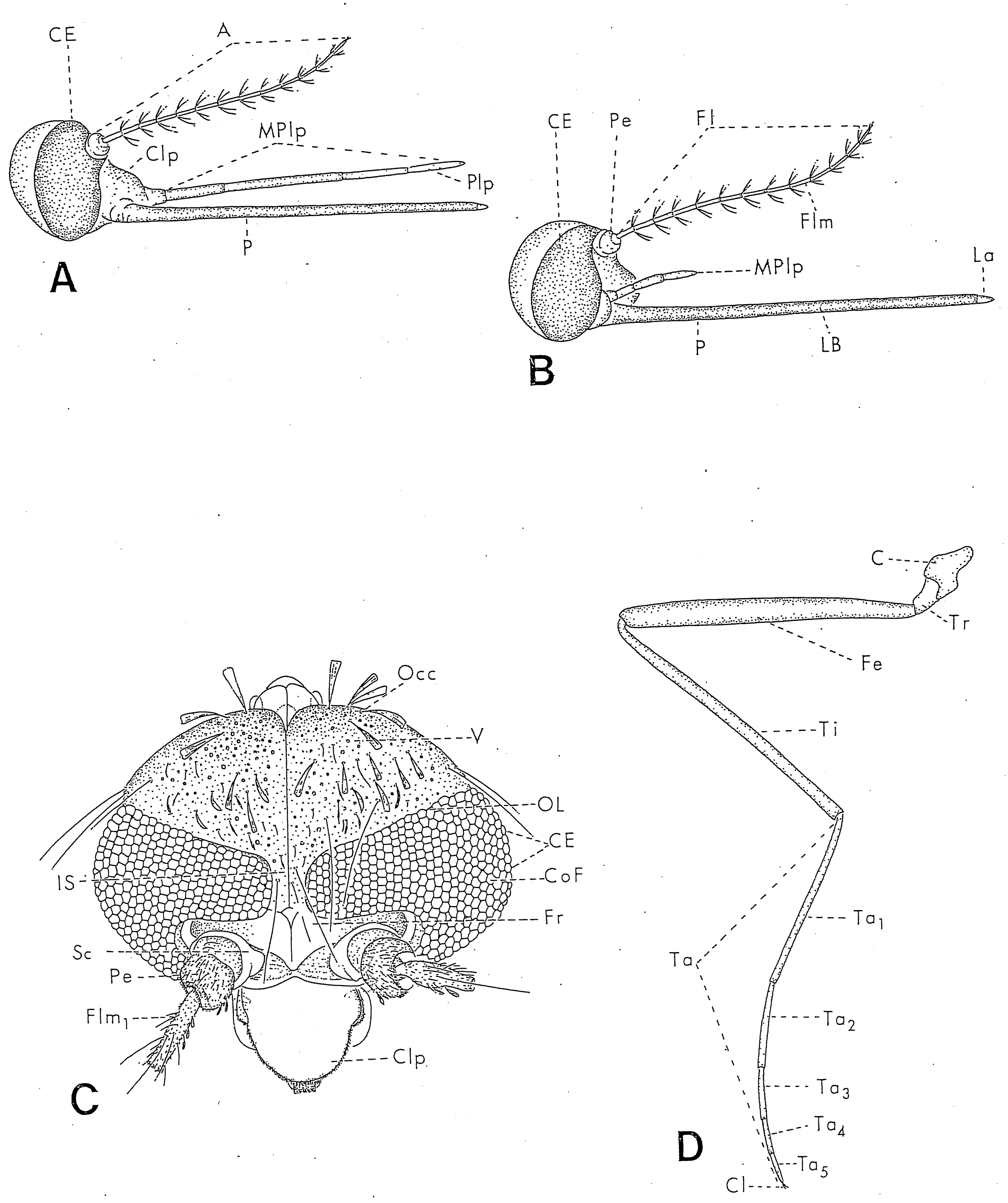


Plate 2. Head and leg of adult female mosquito. A. Lateral view of anopheline head; B. Lateral view of culicine head; C. dorsal view of culicine head; D. lateral view of leg.

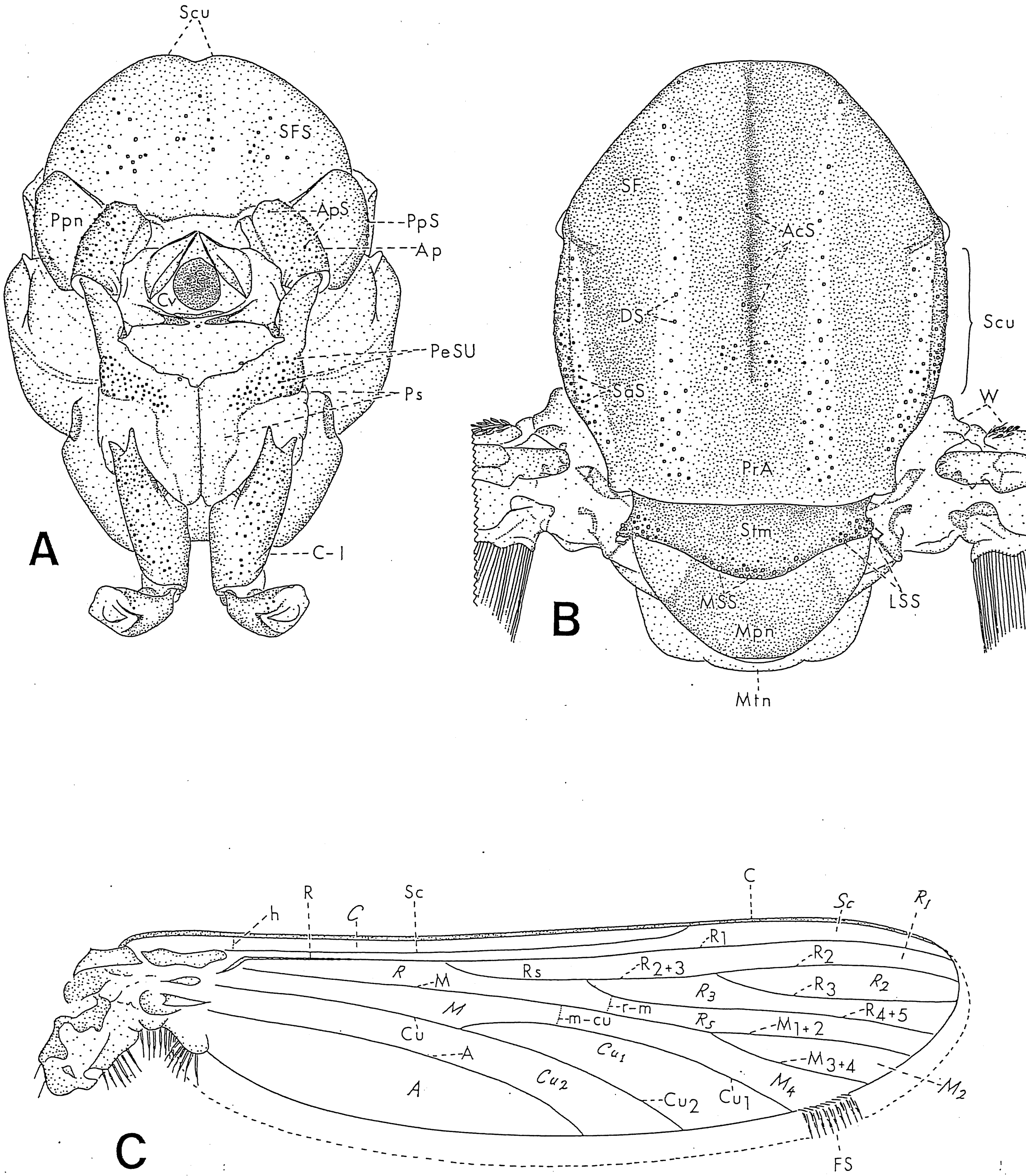
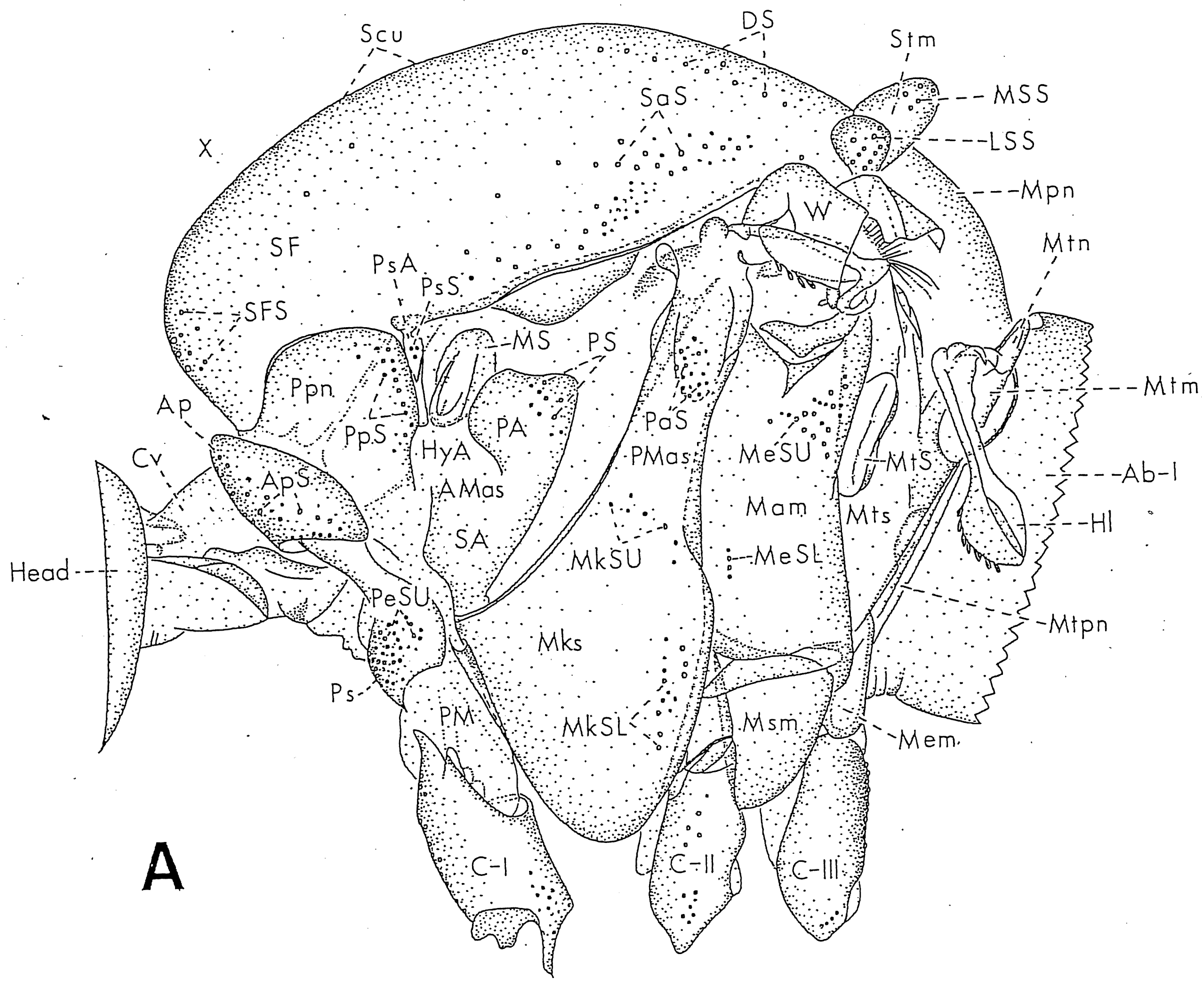
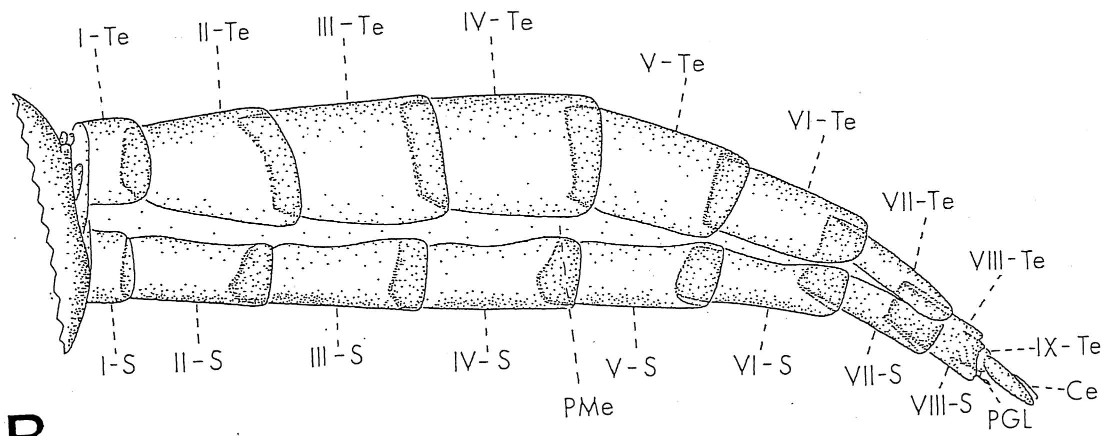


Plate 3. Thorax and wing of adult female mosquito. A. Anterior view of thorax; B. Dorsal view of thorax; C. Dorsal view of wing: longitudinal veins designated by gothic letters, cells by italics.



A



B

Plate 4. Thorax and abdomen of adult female mosquito. A. Lateral view of thorax; B. Lateral view of abdomen.

Abbreviations used in the key to adult females

A – anal vein of wing

AcS – acrostichal setae

Ant – antenna

AP – apical spot of wing

C – costal vein of wing

C-I – forecoxa

C-III – hindcoxa

Cu_2 – cubitus vein of wing

Fe-III – hindfemur

HyA – hypostigmal area

HySc – hypostigmal setae

ISe – interocular area

Mem – metameron

MeSL – lower mesepimeral seta

MkSL – lower mesokatepisternal setae

Mks - mesokatepisternum

Mm – mesepimeron

MPlp – maxillary palpus

Mpn - mesopostnotum

Msm – mesomeron

MSS – median scutellar setae

Occ – occiput

P – proboscis

PA – postspiracular area

Pe – pedicel of antenna

PM – postprocoxal membrane

PsA – prespiracular area

PS – postspiracular setae

PSc – postprocoxal scales

PsS – prespiracular setae

R_2 – radial vein$_2$ of wing

R_{2+3} – radial vein $_{2+3}$ of wing

R_{4+5} – radial vein $_{4+5}$ of wing

SA – subspiracular area

SaS – supraalar setae

Sc – subcostal vein of wing

Scu – scutum

ScP – subcostal spot of wing

SF – scutal fossa

SSc – subspiracular setae

Ta_{1-5} – tarsal segments 1-5

Ti-III - hindtibia

KEYS TO THE ADULT FEMALE MOSQUITOES OF PENNSYLVANIA

KEY TO GENERA

1. Proboscis long and strongly recurved (Fig. 1); posterior border of wing distinctly emarginate at apex of Cu_2 (Fig. 2) .... *Toxorhynchites rutilus septentrionalis*

   Proboscis not so long and only slightly recurved, if at all (Fig. 3); wing border rounded of slightly emarginate at apex of Cu_2 (Fig. 4) 2

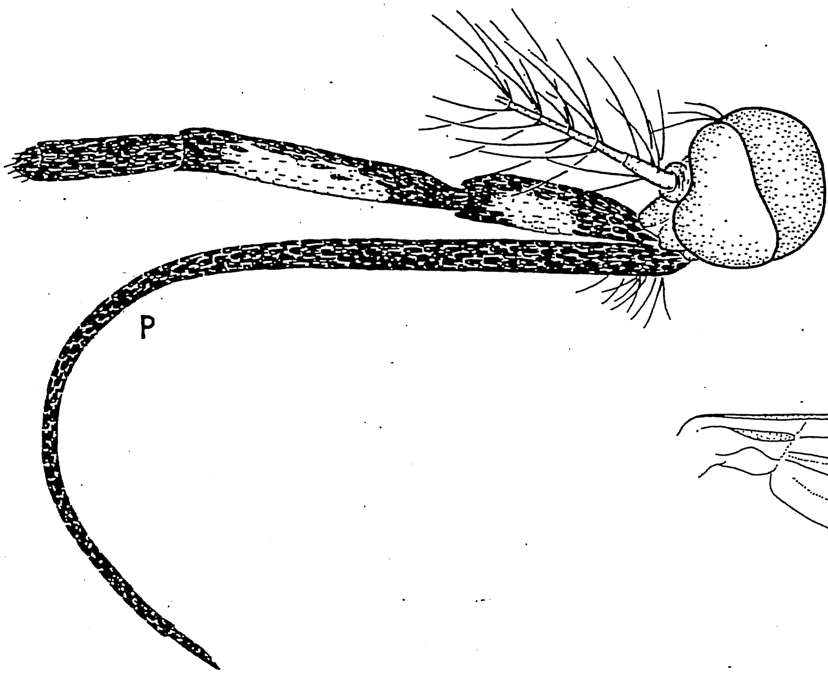


Fig. 1. Lateral view of head – *Tx. r. septentrionalis*

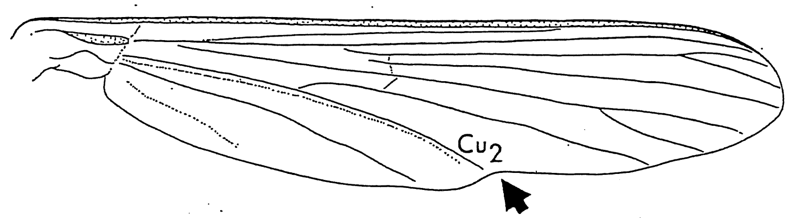


Fig. 2. Dorsal view of wing – *Tx. r. septentrionalis*

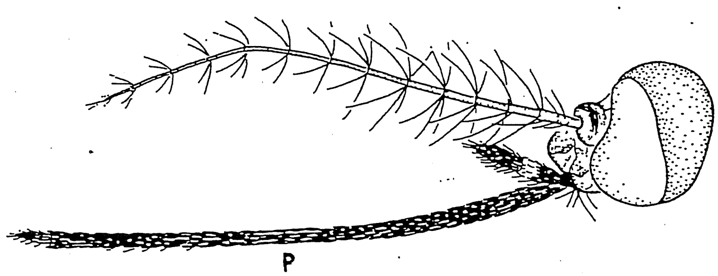


Fig. 3. Lateral view of head – *Ae. vexans*

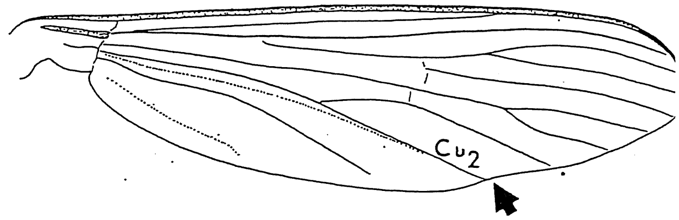


Fig. 4. Dorsal view of wing – *Ae. vexans*

2(1). Scutellum evenly rounded, with setae more or less evenly distributed (Fig. 5); maxillary palpi about as long as proboscis (Fig. 6) . . . . *Anopheles*

Scutellum trilobed, with setae in 3 distinct groups (Fig. 7); maxillary palpi shorter than proboscis (Fig. 8) 3

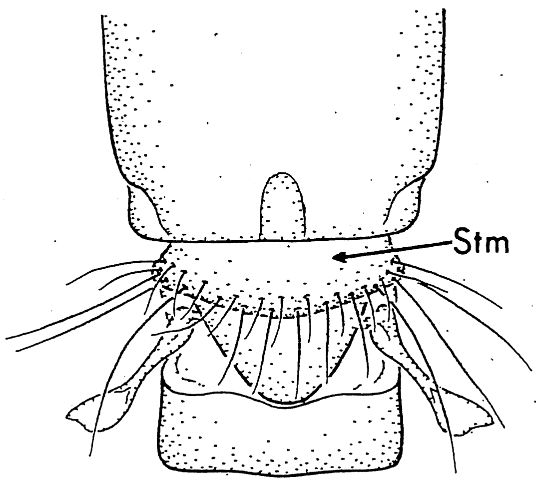


Fig. 5. Posterior dorsal view of thorax – *An. quadrimaculatus*

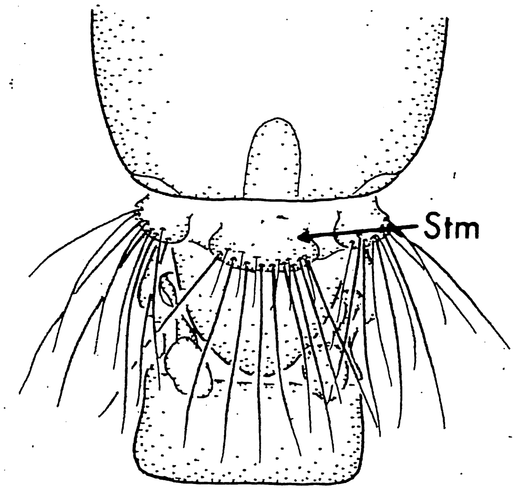


Fig. 7. Posterior dorsal view of thorax – *Ae. vexans*

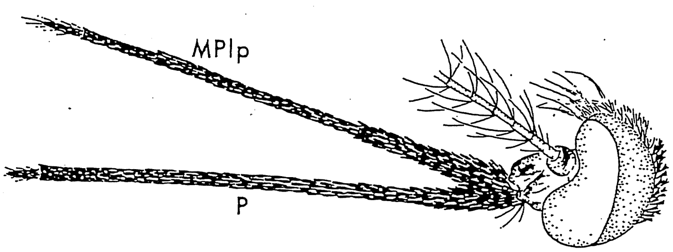


Fig. 6. Lateral view of head – *An. quadrimaculatus*

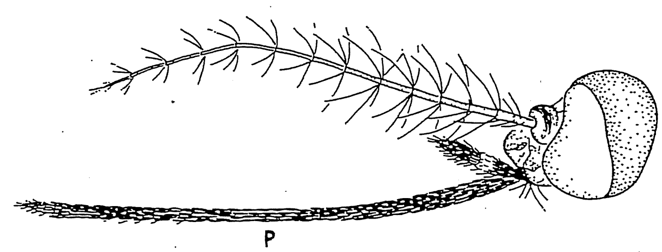


Fig. 8. Lateral view of head – *Ae. vexans*

3(2). Mesopostnotum with setae (Fig. 9); base of hindcoxa in line with base of mesomeron or slightly dorsad (Fig. 10) . . . . *Wyeomyia smithii*

Mesopostnotum without setae (Fig. 11); base of hindcoxa distinctly ventral to base of mesomeron (Fig. 12) 4

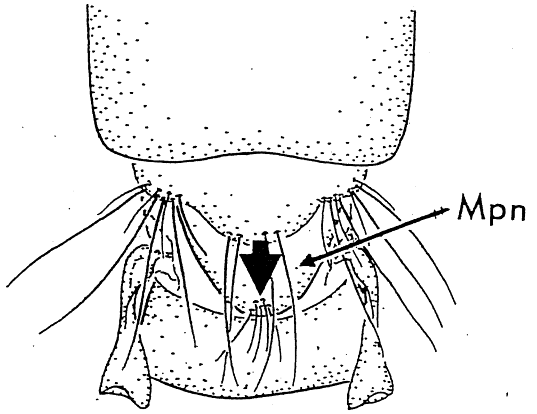


Fig. 9. Posterior dorsal view of thorax – *Wy. smithii*

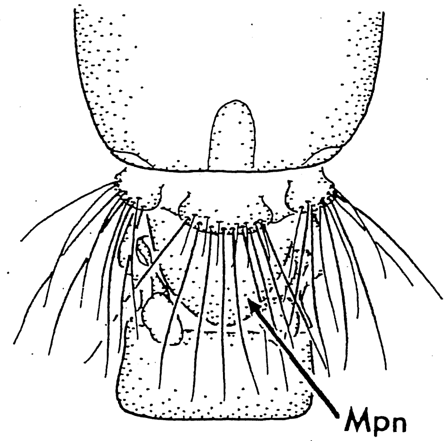


Fig. 11. Posterior dorsal view of thorax – *Ae. vexans*

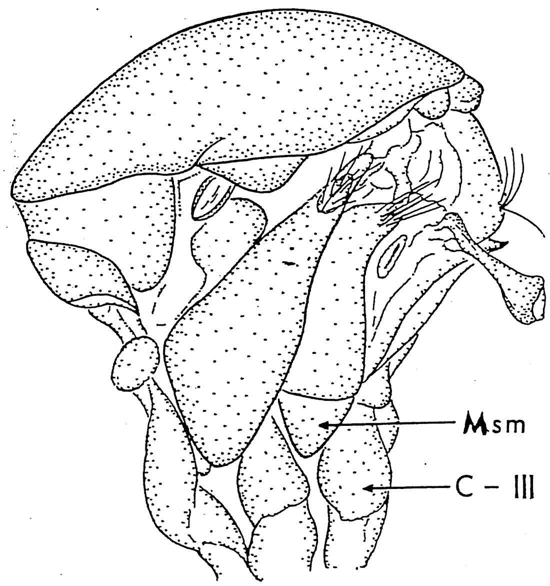


Fig. 10. Lateral view of thorax – *Wy. smithii*

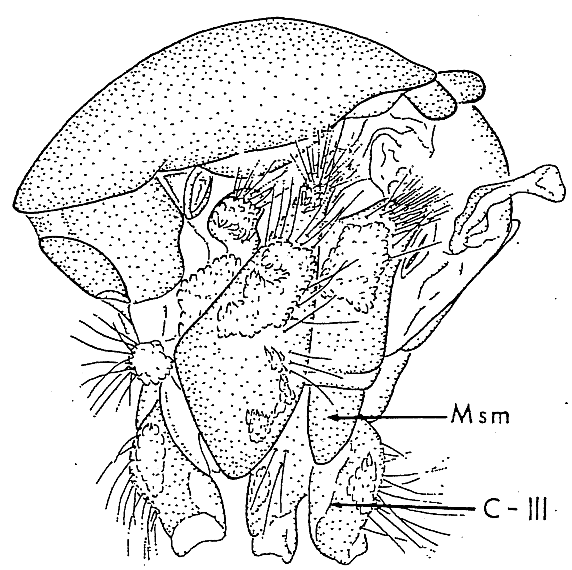


Fig. 12. Lateral view of thorax – *Ae. vexans*

4(3). Wing cell R_2 shorter than vein R_{2+3} (Fig. 13); thorax with lines of iridescent blue scales (Fig. 14) .... *Uranotaenia sapphirina*

Wing cell R_2 at least as long as vein R_{2+3} (Fig. 15); iridescent blue scales absent on thorax (Fig. 16) 5

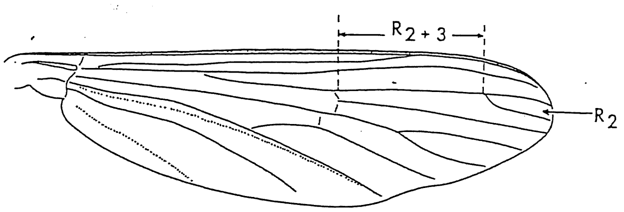


Fig. 13. Dorsal view of wing – *Ur. sapphirina*

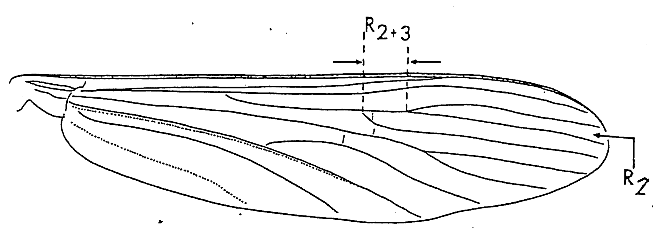


Fig. 15. Dorsal view of wing – *Cx. pipiens*

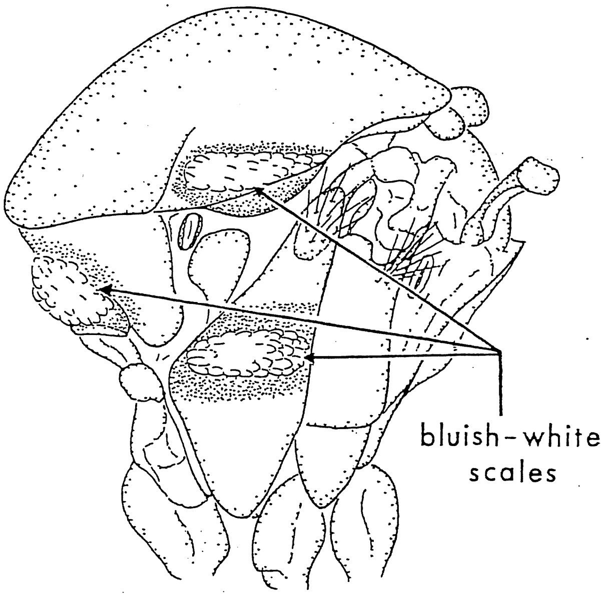


Fig. 14. Lateral view of thorax – *Ur. sapphirina*

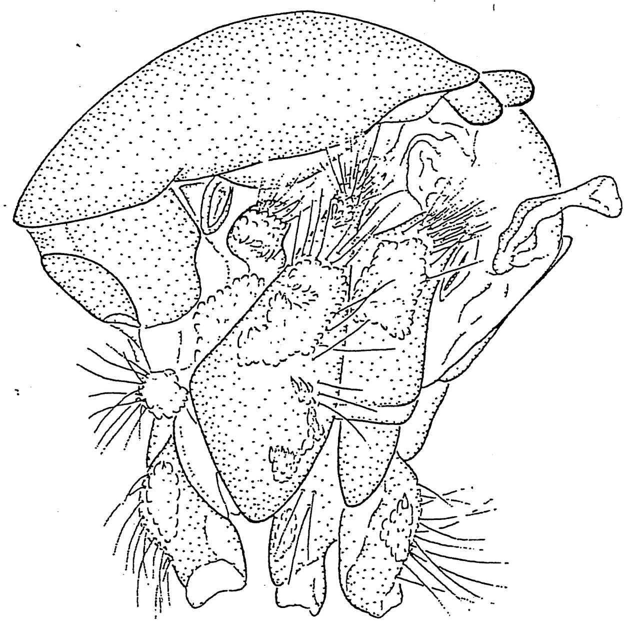


Fig. 16. Lateral view of thorax – *Ae. vexans*

5(4). Postspiracular setae present (Fig. 17) 6

Postspiracular setae absent (Fig. 18) 7

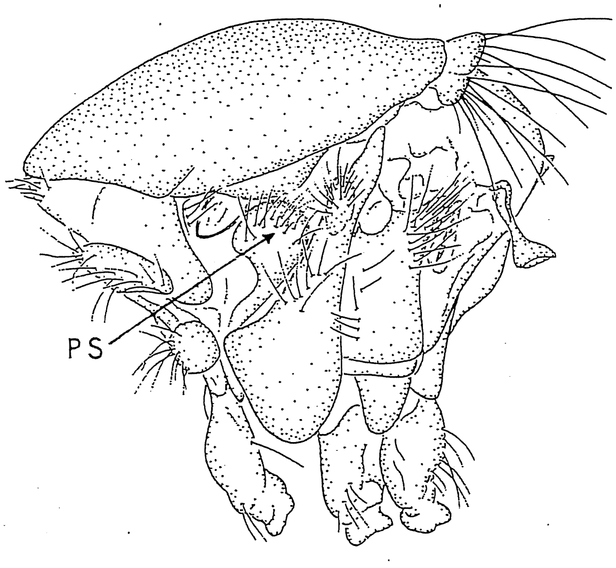


Fig. 17. Lateral view of thorax – *Ps. ciliata*

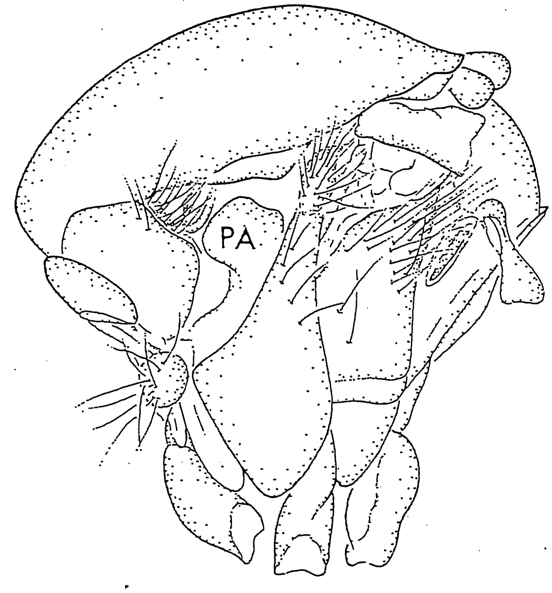


Fig. 18. Lateral view of thorax – *Cs. inornata*

6(5). Prespiracular setae present (Fig. 19); pale transverse bands or lateral patches apical on abdominal terga (Fig. 20) .... *Psorophora*

Prespiracular setae absent (Fig. 21); pale transverse bands or lateral patches basal on abdominal terga (Fig. 22) .... *Aedes* *Ochlerotatus*

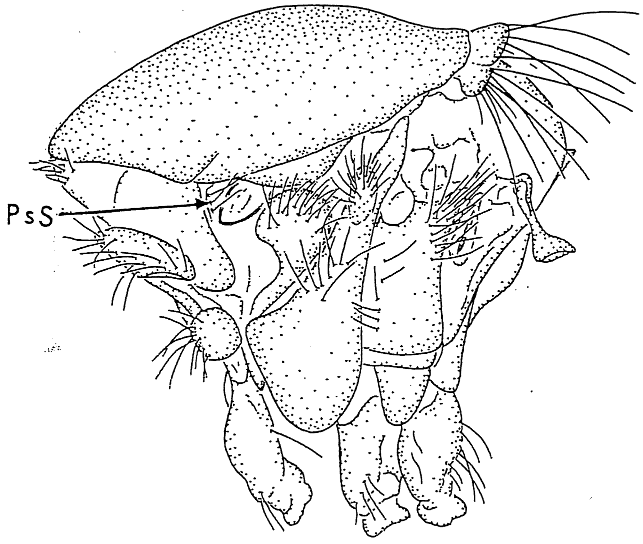


Fig. 19. Lateral view of thorax – *Ps. ciliata*

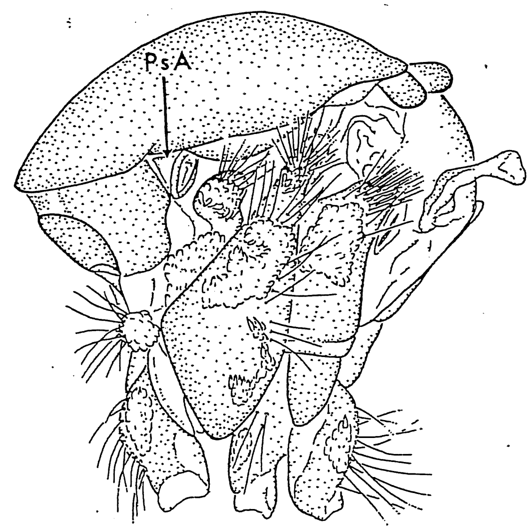


Fig. 21. Lateral view of thorax – *Ae. vexans*

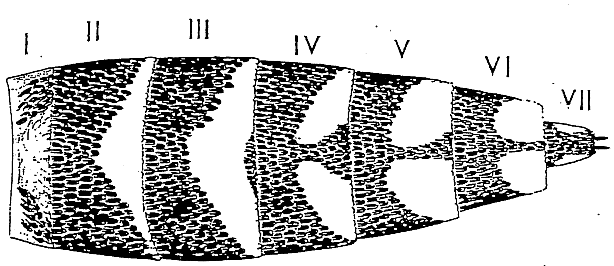


Fig. 20. Dorsal view of abdomen – *Ps. cyanescens*

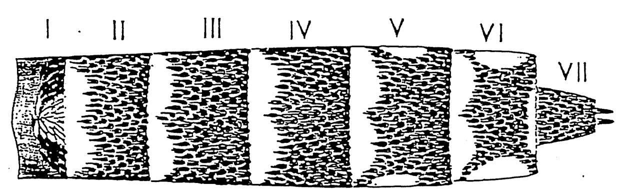


Fig. 22. Dorsal view of abdomen – *Ae. vexans*

7(5). Prespiracular setae present (Fig. 23); base of wing vein Sc with row of setae ventrally (Fig. 24) .... *Culiseta*

Prespiracular setae and vein Sc setae absent (Figs. 25, 26) 8

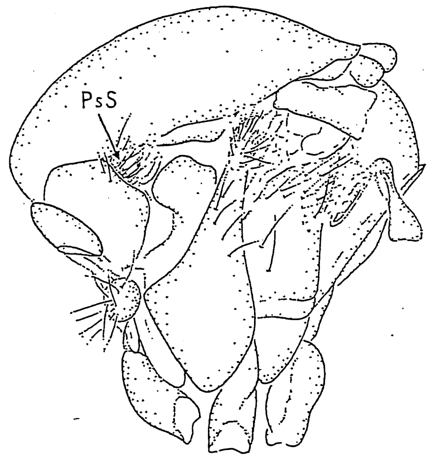


Fig. 23. Lateral view of thorax – *Cs. inornata*

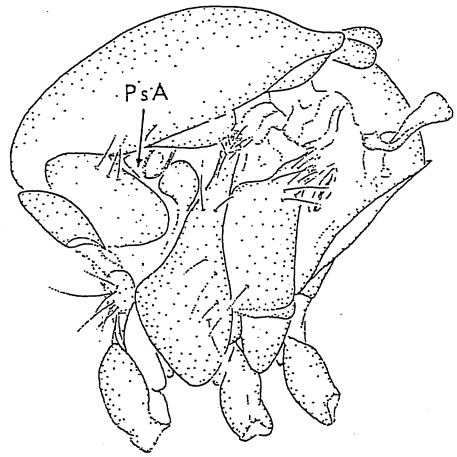


Fig. 25. Lateral view of thorax – *Cx. pipiens*

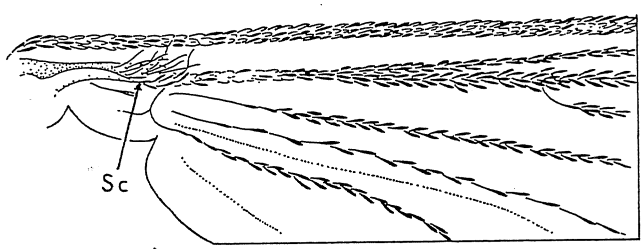


Fig. 24. Ventral view of basal half of wing – *Cs. inornata*

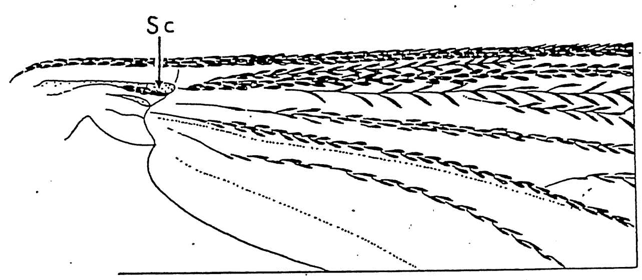


Fig. 26. Ventral view of basal half of wing – *Cx. pipiens*

8(7). Scutum with narrow lines of pale scales (Fig. 27); tarsomere 1 of fore- and midlegs longer than tarsomeres 2-5 combined, tarsomere 4 very short, about as long as wide (Fig. 28) . . . . *Orthopodomyia*

Scutum without narrow lines of pale scales (Fig. 29); tarsomere 1 of fore- and midlegs shorter than tarsomeres 2-5 combined, tarsomere 4 much longer than wide (Fig. 30) 9

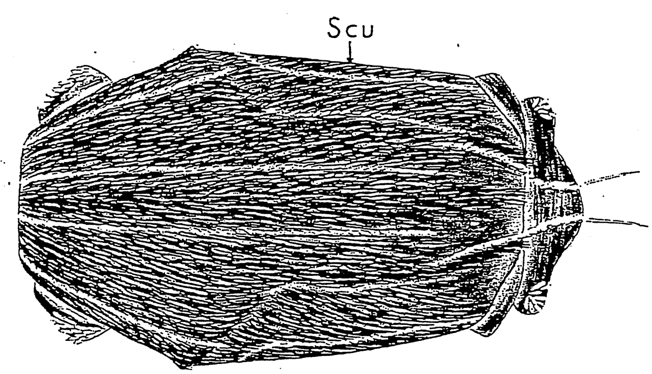


Fig. 27. Dorsal view of thorax – *Or. signifera*

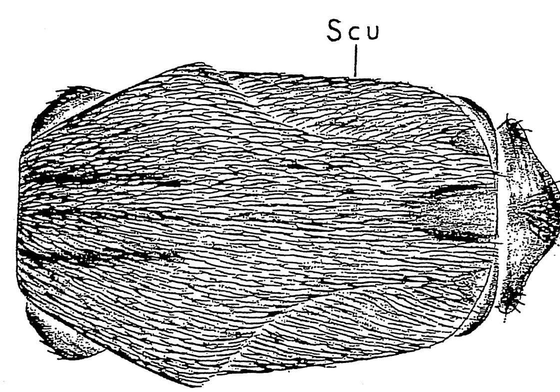


Fig. 29. Dorsal view of thorax – *Cx. pipiens*

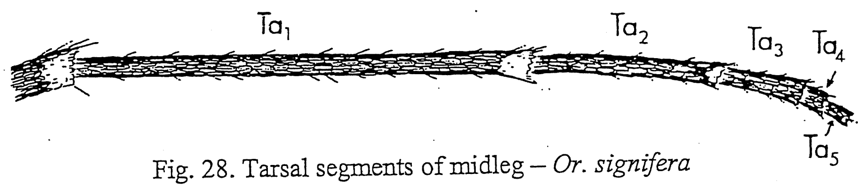


Fig. 28. Tarsal segments of midleg – *Or. signifera*

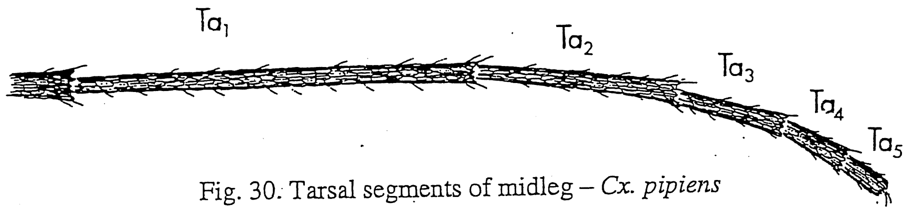


Fig. 30. Tarsal segments of midleg – *Cx. pipiens*

9(8). Most scales on dorsal surface of wing very broad (Fig.31); hindtibia with subapical pale-scaled ring (Fig. 32) . . . *Coquillettidia perturbans*

Scales on dorsal surface of wing long, narrow, at least on veins R_s and M (Fig. 33); hindtibia without subapical pale-scaled ring (Fig. 34) . . . . *Culex*

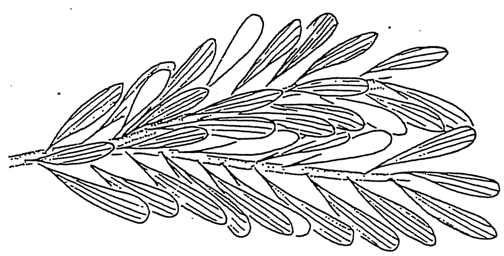


Fig. 31. Dorsal view of wing scales – *Cq. perturbans*

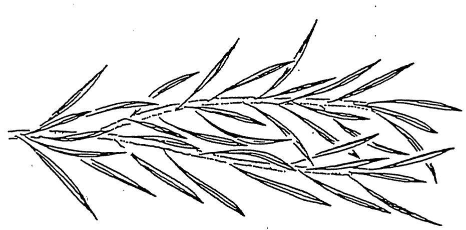


Fig. 33. Dorsal view of wing scales – *Cx. pipiens*

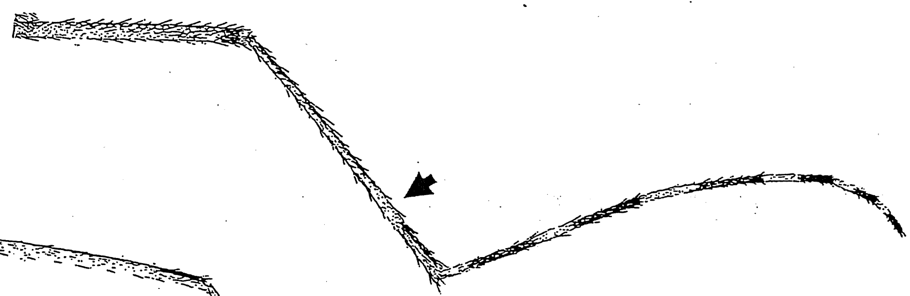


Fig. 32. Segments of hindleg – *Cq. perturbans*

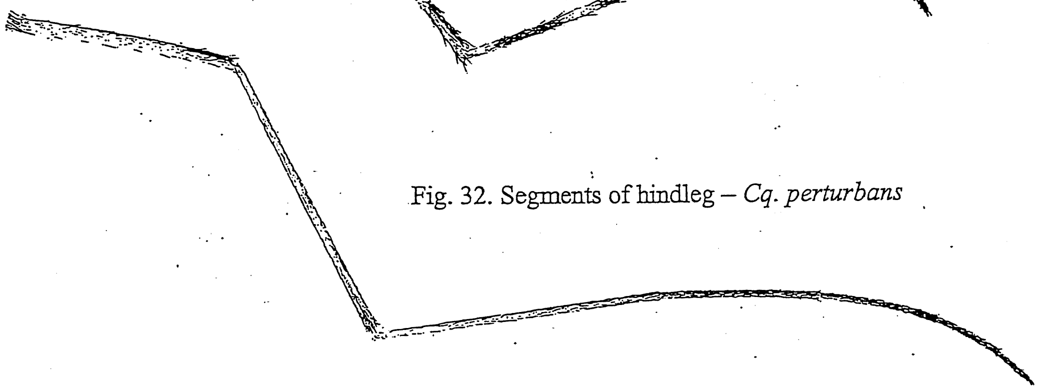


Fig. 34. Segments of hindleg - *Cx. restuans*

KEY TO GENUS ANOPHELES

1. Wing with pale-scaled spots (Fig. 35) 2

   Wing dark-scaled (Fig. 36) 4

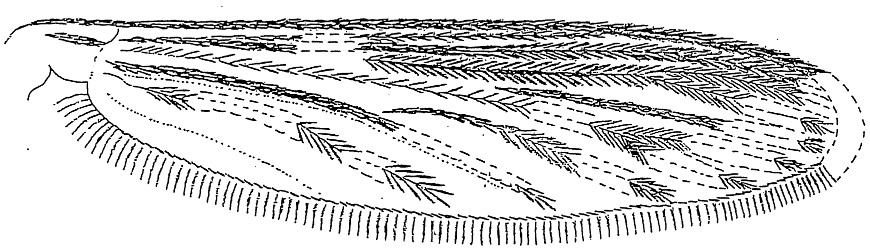


Fig.35. Dorsal view of wing – *An. crucians*

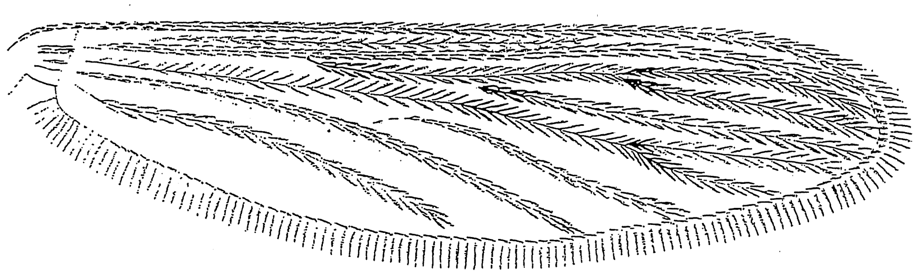


Fig. 36. Dorsal view of wing – *An. quadrimaculatus*

2(1). Wing vein C with apical pale spot, otherwise dark-scaled; vein A with 3 dark spots (Fig. 37) . . . . *crucians*

Wing vein C with apical and subcostal pale spots; vein A with 1 or 2 dark spots (Fig. 38) 3

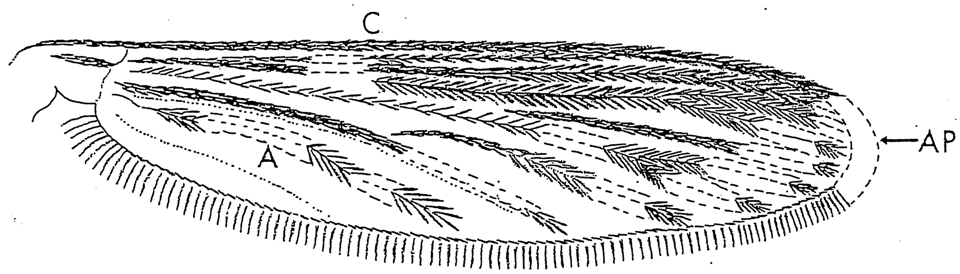


Fig. 37. Dorsal view of wing – *An. crucians*

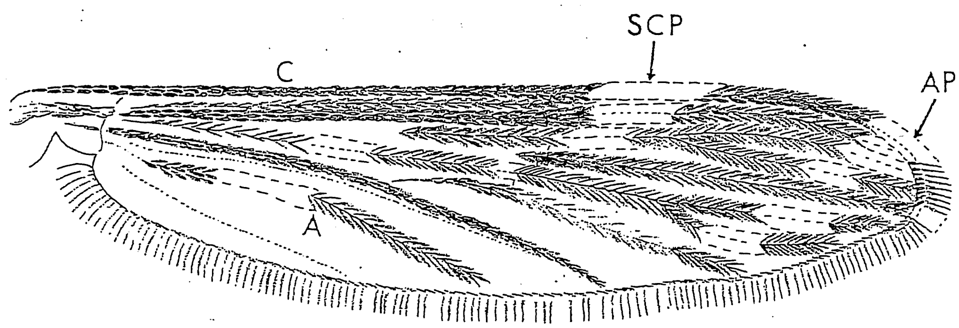


Fig. 38. Dorsal view of wing – *An. punctipennis*

3(2). Subcostal pale spot 0.5 or more length of preapical dark spot (Fig. 39) . . . . *punctipennis*

Subapical pale spot much reduced, usually less that 0.3 length of preapical dark spot (Fig. 40) . . . . *perplexens*

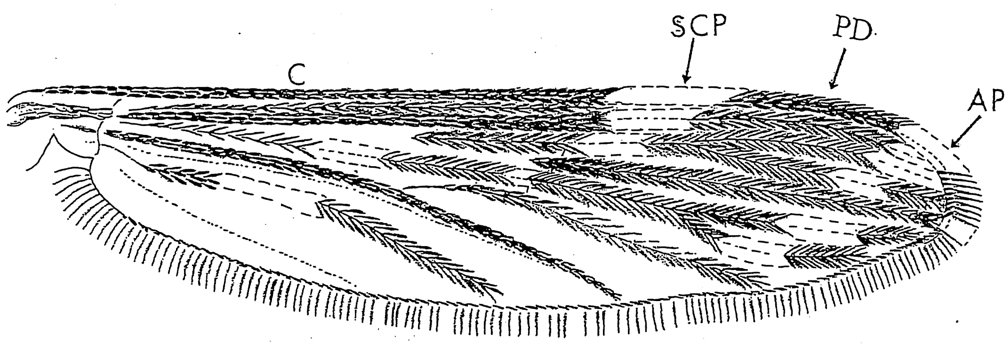


Fig. 39. Dorsal view of wing – *An. punctipennis*

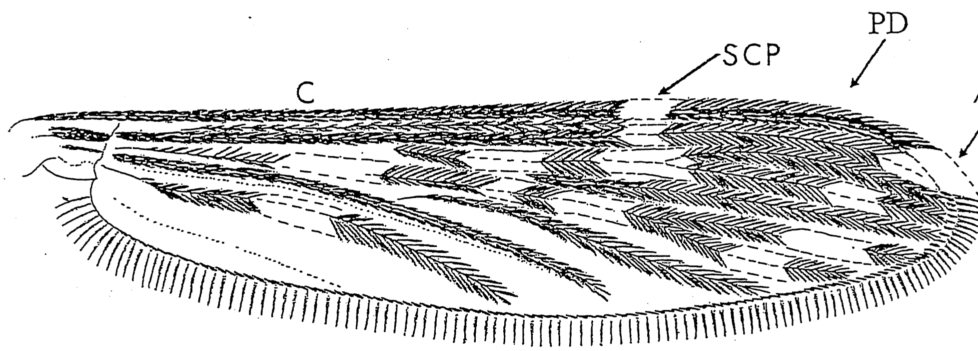


Fig. 40. Dorsal view of wing – *An. perplexens*

4(1). Wing with silvery or coppery apical fringe spot (Fig. 41) .... *earlei*

Wing with apical fringe spot dark-scaled (Fig. 42) 5

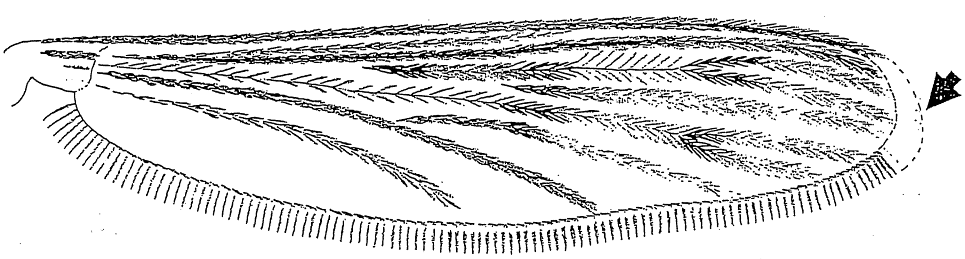


Fig. 41. Dorsal view of wing – *An. earlei*

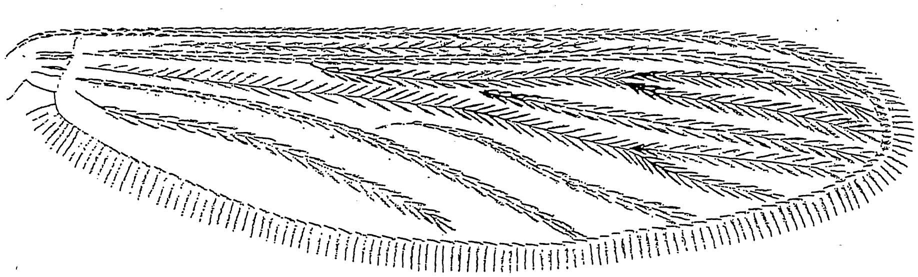


Fig. 42. Dorsal view of wing – *An. quadrimaculatus*

5(4). Wing unspotted (Fig. 43); scutal setae about 0.5 width of scutum (Fig. 44); small species, wing length about 3.0 mm . . . . *barberi*

Wing spots of dark scales more or less distinct (Fig. 45); scutal setae mostly shorter than 0.5 width of scutum (Fig. 46); medium to large species, wing length 4.0 mm or more 6

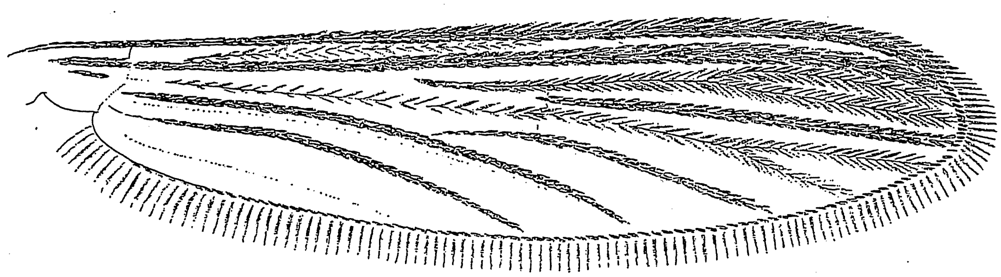


Fig. 43. Dorsal view of wing – *An. barberi*

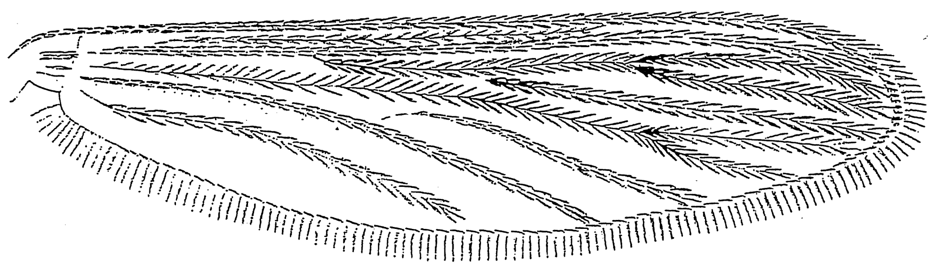


Fig. 45. Dorsal view of wing – *An. quadrimaculatus*

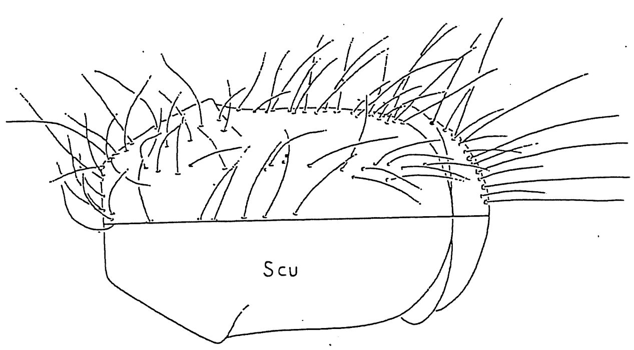


Fig. 44. Dorsal view of thorax – *An. barberi*

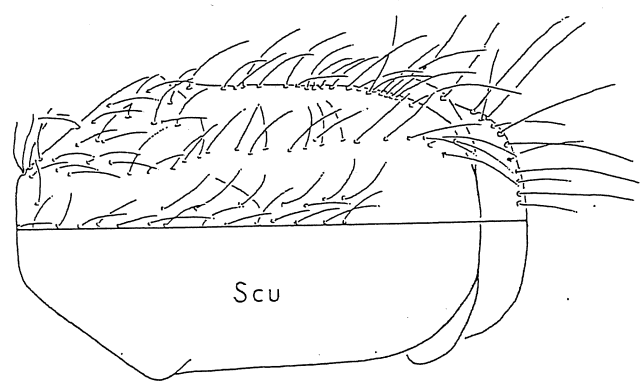


Fig. 46. Dorsal view of thorax – *An. quadrimaculatus*

6(5). Palpi with dark scales; frontal tuft with some pale setae (Fig. 47); capitellum of halter entirely dark-scaled (Fig. 48) .... *quadrimaculatus* sl

Palpomeres 1-3 with apical pale rings; frontal tuft entirely dark-scaled (Fig. 49); capitellum of halter usually pale-scaled (Fig. 50) .... *walkeri*

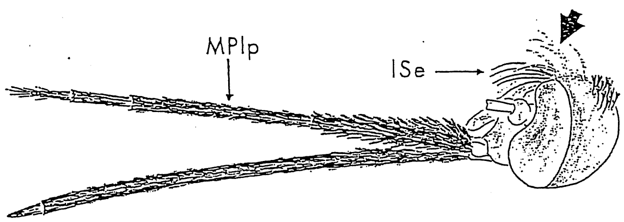


Fig. 47. Lateral view of head – *An. quadrimaculatus*

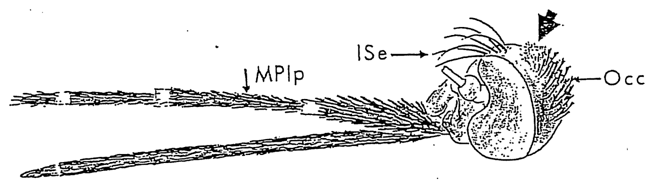


Fig. 49. Lateral view of head – *An. walkeri*

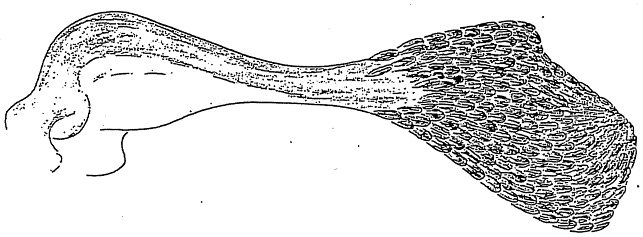


Fig. 48. Halter enlarged – *An. quadrimaculatus*

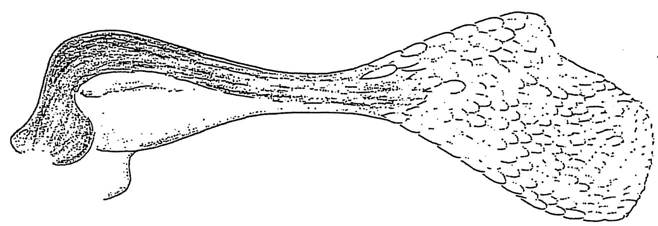


Fig. 50. Halter enlarged – *An. walkeri*

KEY TO GENERA AEDES (Ae) AND OCHLEROTATUS (Oc)

1. Hindtarsomeres with pale bands (Fig. 51) 2

Hidtarsomeres entirely dark-scaled (Fig. 52) 16

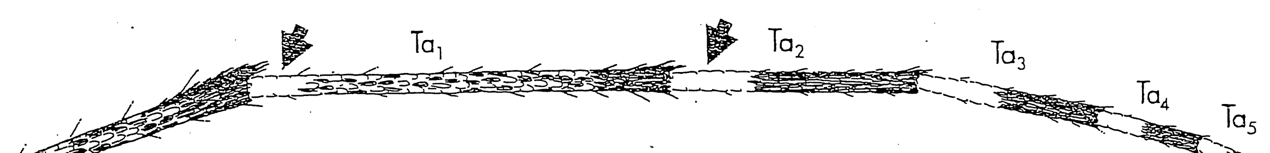


Fig. 51, Hindleg – *Oc. excrucians*

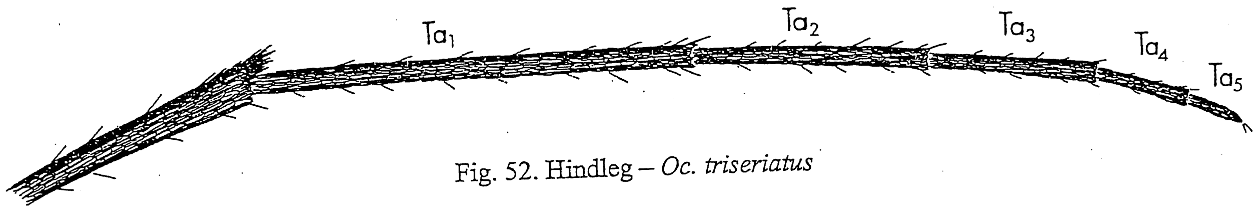


Fig. 52. Hindleg – *Oc. triseriatus*

2(1). Hindtarsomeres with pale bands on basal part of tarsomere only (Fig. 53) 3

Hindtarsomeres with pale bands both basally and apically at least on some tarsomeres (Fig. 54) 14

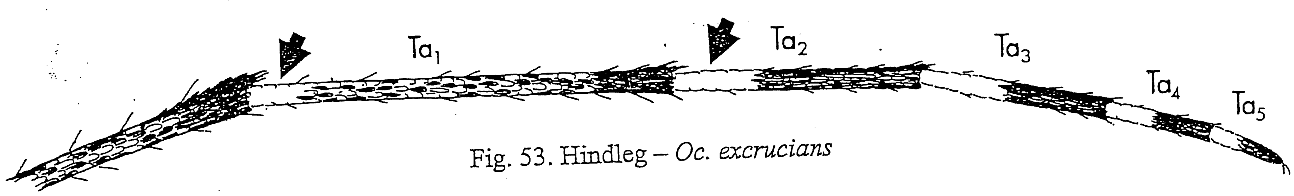


Fig. 53. Hindleg – *Oc. excrucians*

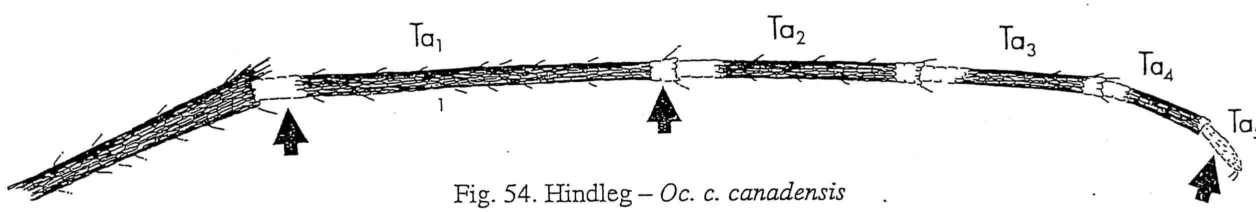


Fig. 54. Hindleg – *Oc. c. canadensis*

3(2). Proboscis with definite pale-scaled band near middle (Fig. 55) 4

Proboscis lacking definite pale-scaled band near middle (Fig. 56) 6

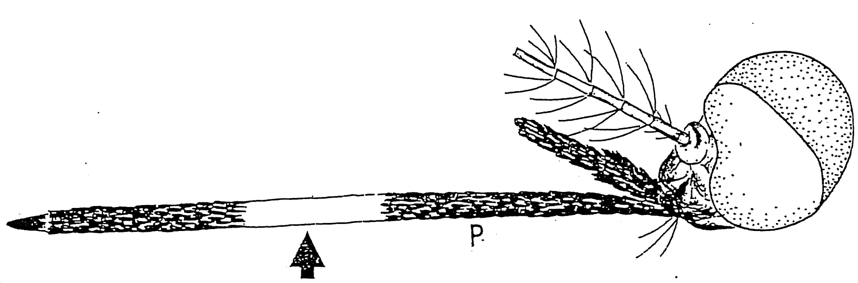


Fig. 55. Lateral view of head – *Oc. sollicitans*

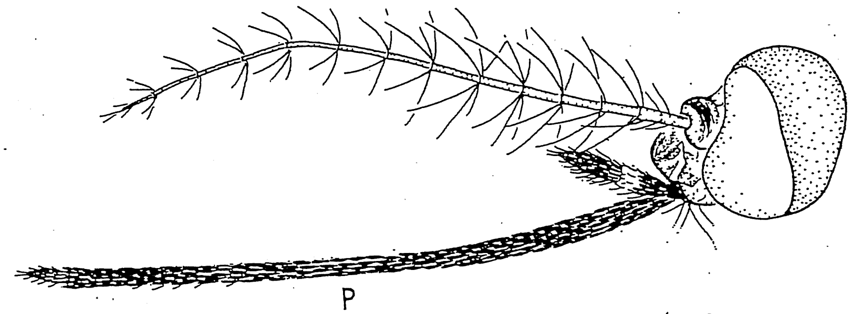


Fig. 56. Lateral view of head – *Ae. vexans*

4(3). Abdominal terga with transverse basal pale bands, but lacking median longitudinal stripe of pale scales (Fig. 57); wing dark-scaled (Fig. 58) .... *Oc. taeniorhynchites*

Abdominal terga with pale-scaled median longitudinal stripe or row of disconnected spots (Fig. 59); wing scales either all dark or intermixed dark and pale (Fig. 60) 5

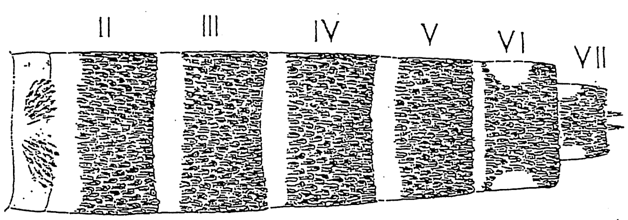


Fig. 57. Dorsal view of abdomen – *Oc. taeniorhynchus*

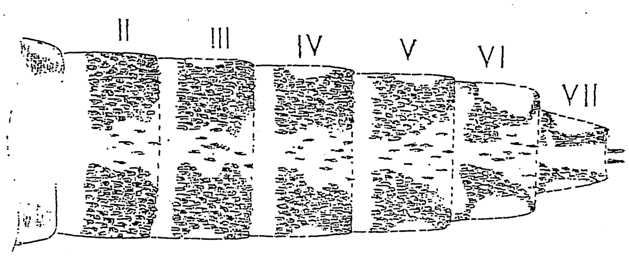


Fig. 59. Dorsal view of abdomen – *Oc. sollicitans*

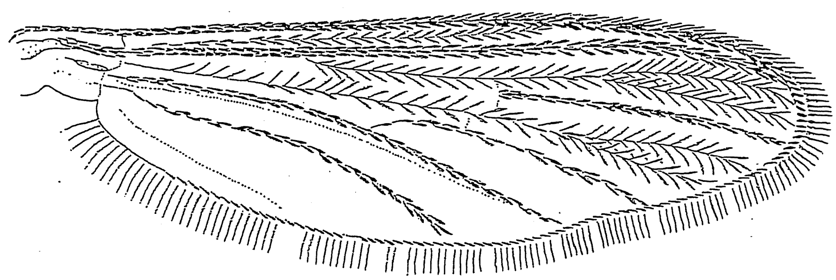


Fig. 58. Dorsal view of wing – *Oc. taeniorhynchus*

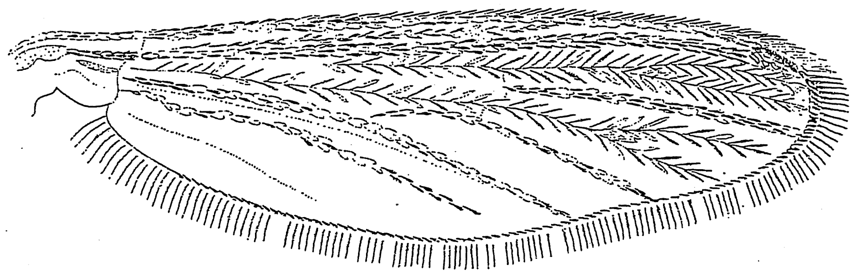


Fig. 60. Dorsal view of wing – *Oc. sollicitans*

5(4).. Wing with scales all dark (Fig. 61); hypostigmal scales absent (Fig. 62) .... *Oc. mitchellae*

Wing with dark and pale scales intermixed (Fig. 63); hypostigmal scales present (Fig. 64) .... *Oc. sollicitans*

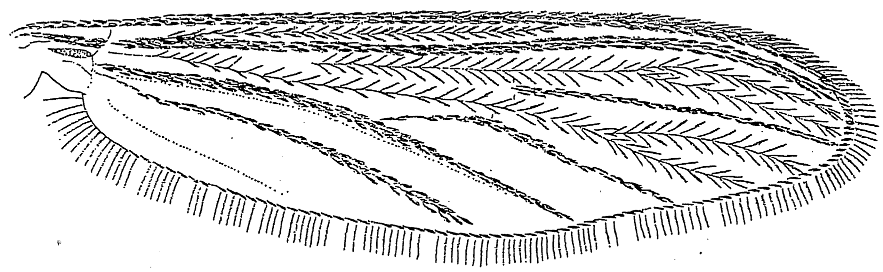


Fig. 61. Dorsal view of wing – *Oc. mitchellae*

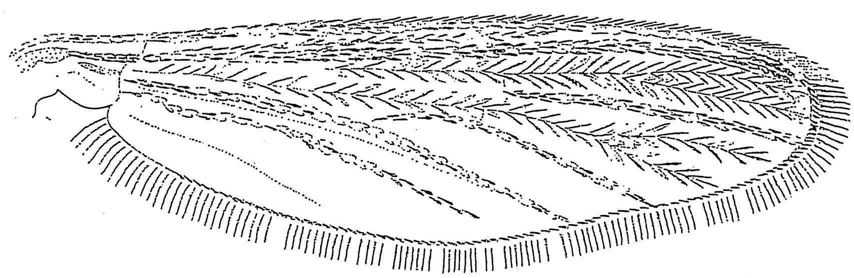


Fig. 63. Dorsal view of wing – *Oc. sollicitans*

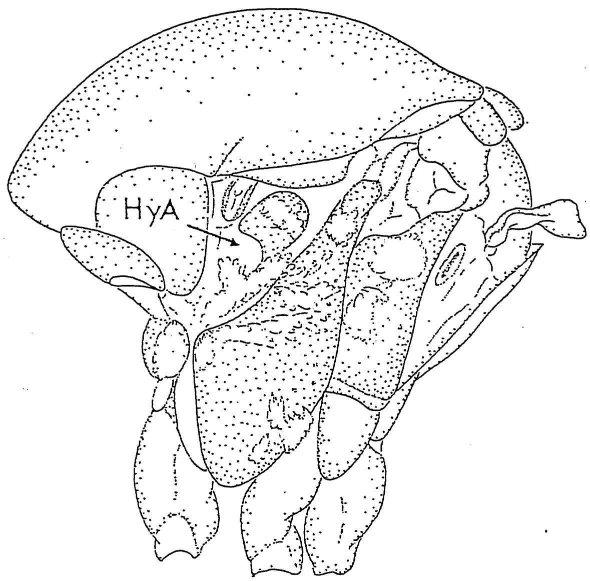


Fig. 62. Lateral view of thorax – *Oc. mitchellae*

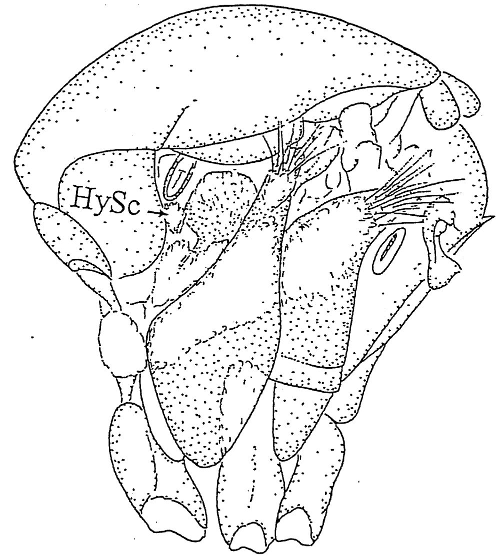


Fig. 64. Lateral view of thorax – *Oc. sollicitans*

6(3) Basal pale bands of hindtarsomeres narrow, 0.2 or less length of each tarsomere (Fig. 65) 7

Basal pale bands of hindtarsomeres broad, that on tarsomere 2 more than 0.3 of its length (Fig. 66) 8

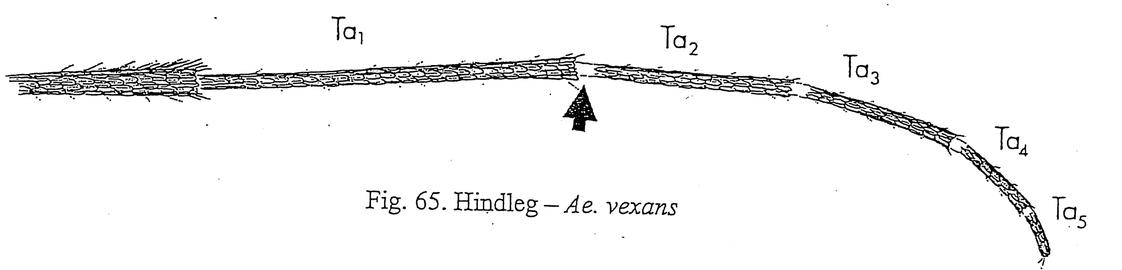


Fig. 65. Hindleg – *Ae. vexans*

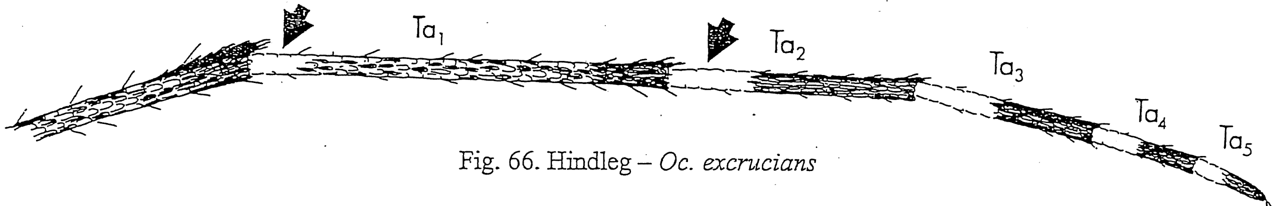


Fig. 66. Hindleg – *Oc. excrucians*

7(6). Basal pale bands on abdominal terga II-VI with 2 posterior lobes, tergum VII mostly dark-scaled (Fig. 67); lower mesepimeral seta absent (Fig. 68) . . . . *Ae. vexans*

Basal pale bands on terga II-VI not bilobed nor clearly defined, tergum VII mostly pale-scaled (Fig. 69); lower mesepimeral seta present (Fig. 70) . . . . *Oc. cantator*

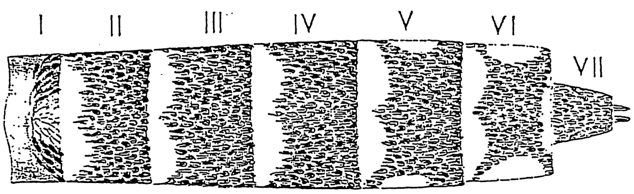


Fig. 67. Dorsal view of abdomen – *Ae. vexans*

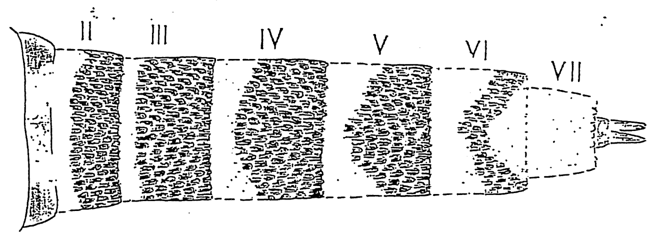


Fig. 69. Dorsal view of abdomen – *Oc. cantator*

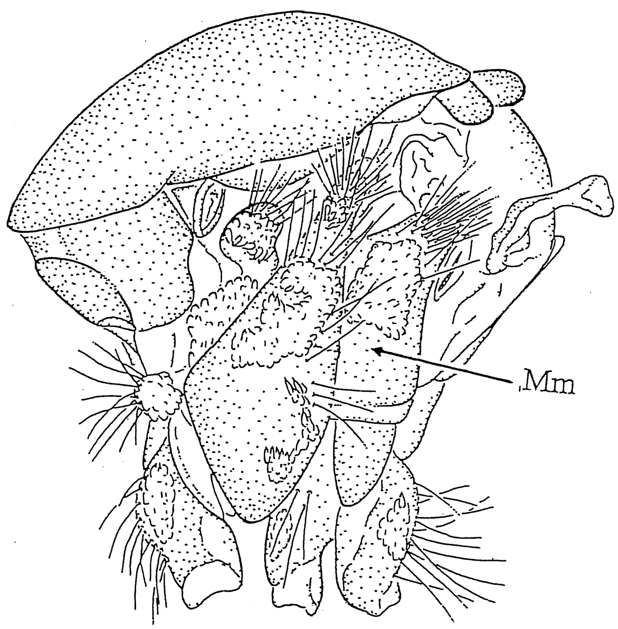


Fig. 68. Lateral view of thorax – *Ae. vexans*

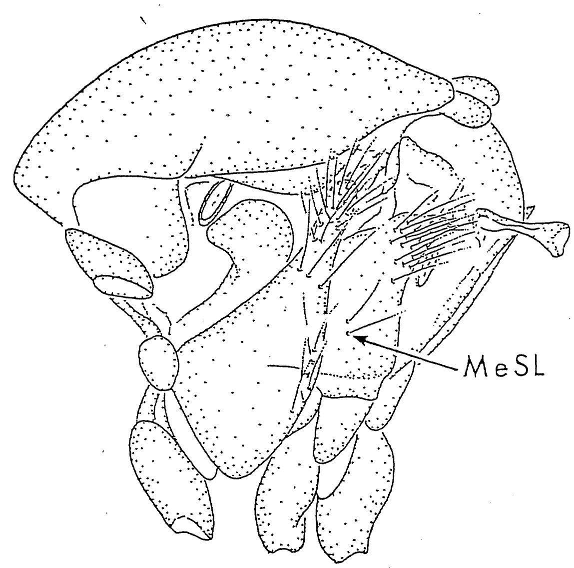


Fig. 70. Lateral view of thorax – *Oc. cantator*

8(6). Wing with broad, triangular-shaped, dark and pale scales rather evenly mixed dorsally (Fig. 71) . . . . *Oc. grossbecki*

At least some of wing scales narrow, with dark and pale scales usually unevenly distributed (Fig. 72) 9

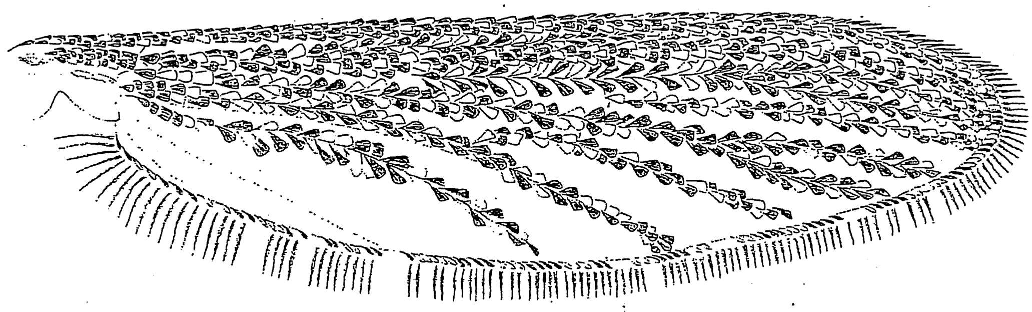


Fig. 71. Dorsal view of wing – *Oc. grossbecki*

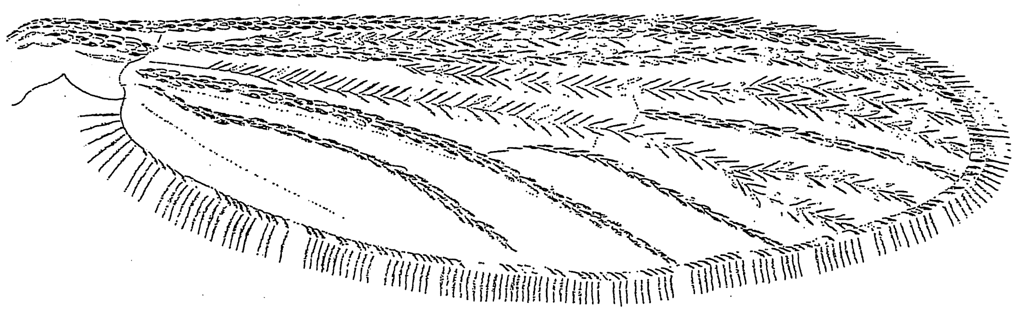


Fig. 72. Dorsal view of wing – *Oc. stimulans*

9(8). Scutum with median, narrow stripe of pale scales (Fig. 73) .... *Ae. albopictus*

Scutum with other pattern of pale scales (Fig. 74) 10

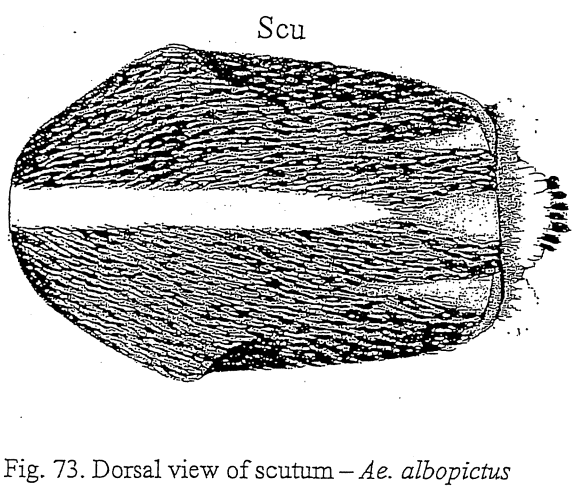


Fig. 73. Dorsal view of scutum – *Ae. albopictus*

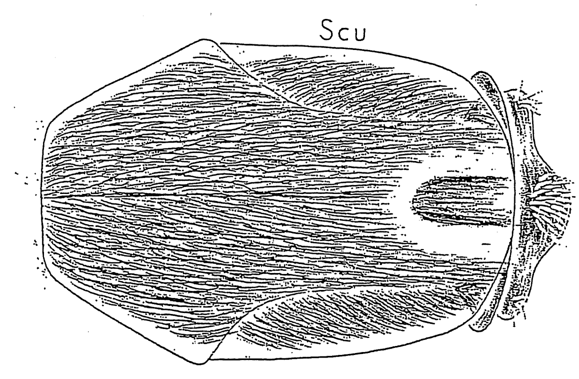


Fig.. 74. Dorsal view of scutum – *Oc. c. canadensis*

10(9). Scutum with lyre- or modified lyre-shaped marking of silvery or golden scales on dark-scaled background (Fig. 75) 11

Scutum without lyre-shaped marking (Fig. 76) 12

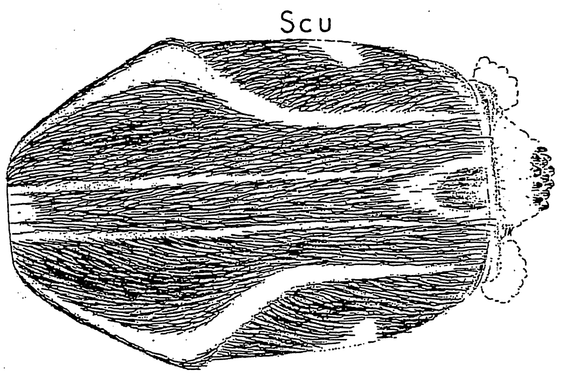


Fig. 75. Dorsal view of scutum – *Ae. aegypti*

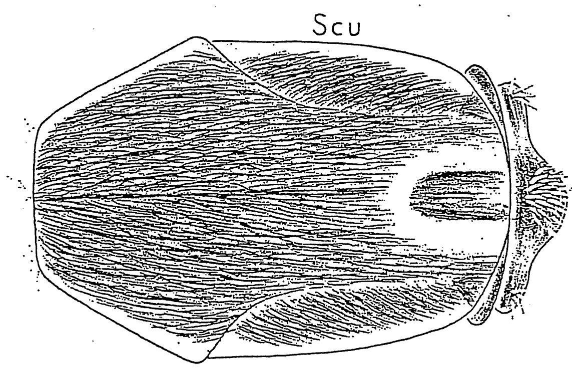


Fig. 76. Dorsal view of acutum – *Oc. c. canadensis*

11(10). Scutum with median longitudinal stripe of golden scales (Fig. 77); abdominal terga III-VII without basal transverse pale bands (Fig. 78); hindtarsomere 5 dark-scaled (Fig. 79) ..... *Oc. japonicus*

Scutum without median longitudinal stripe (Fig. 80); abdominal terga with basal transverse pale bands (Fig. 81); hindtarsomere 5 pale-scaled (Fig. 82) .... *Ae. aegypti*

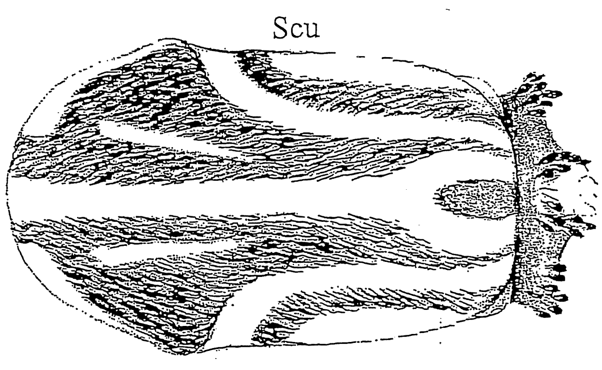


Fig. 77. Dorsal view of scutum – *Oc. j. japonicus*

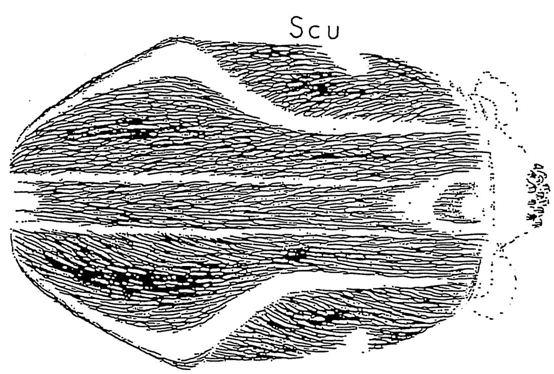


Fig. 80. Dorsal view of scutum – *Ae. aegypti*

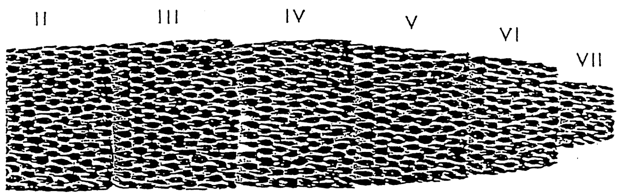


Fig. 78. Dorsal view of abdomen – *Oc. j. japonicus*

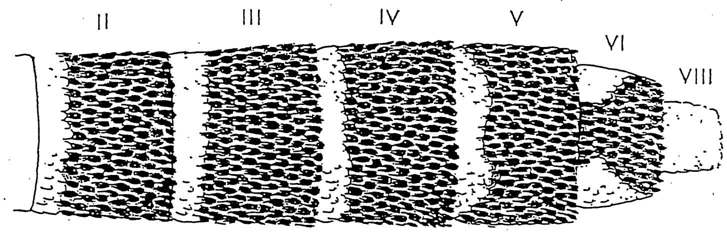
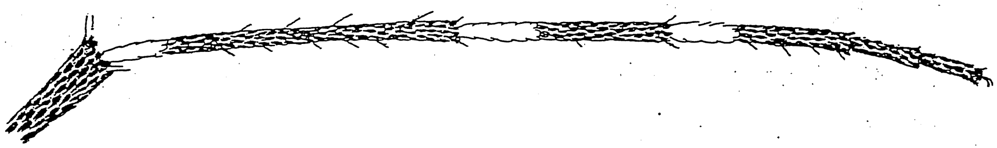


Fig. 81. Dorsal view of abdomen – *Ae. aegypti*



Fig,. 79. Hindtarsomeres – *Oc. j. japonicus*

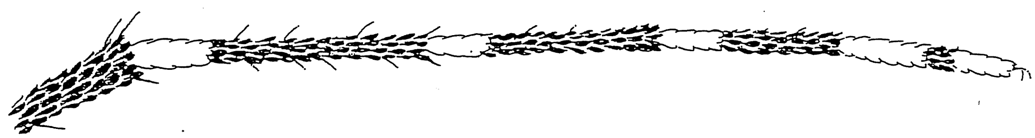


Fig. 82. Hindtarsomeres – *Ae. aegypti*

12(10). Foreclaw sharply bent and subparallel to long tooth (Fig. 83) .... *Oc. excrucians*
Foreclaw not sharply bent nor nearly parallel to shorter tooth (Fig. 84) 13

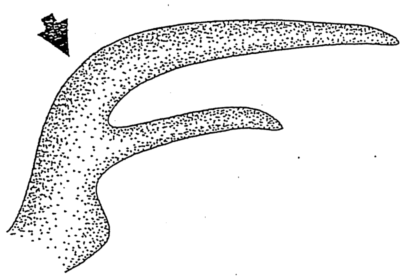


Fig. 83. Foreclaw – *Oc. excrucians*

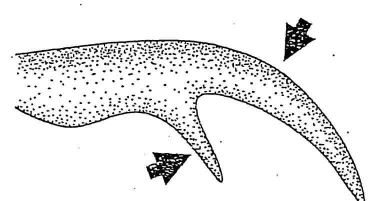


Fig. 84. Foreclaw – *Oc. fitchii*

13(12). Scales on antennal pedicel numerous, mostly pale (Fig. 85); scutum with medium to dark brown, longitudinal stripe (Fig. 86) . . . . *Oc. fitchii*

Scales on antennal pedicel few, mostly dark (Fig. 87); scutum with reddish brown scales medially, sometimes with stripe of light scales (Fig. 88) . . . . *Oc. stimulans*

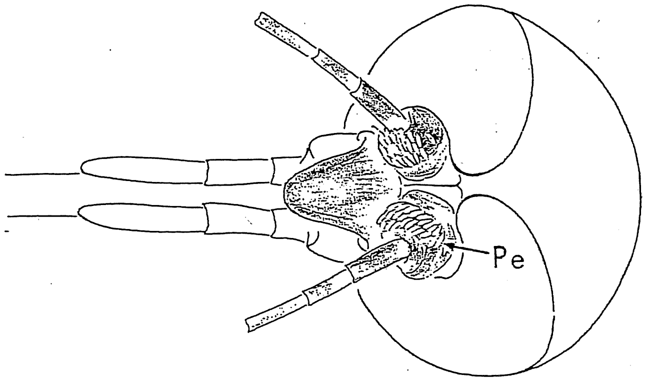


Fig. 85. Anterior view of head – *Oc. fitchii*

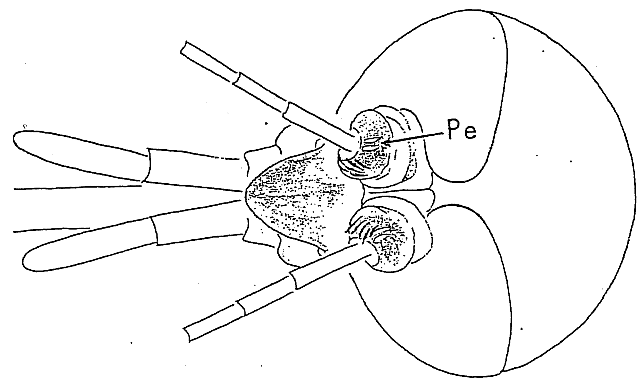


Fig. 87. Anterior view of head – *Oc. stimulans*

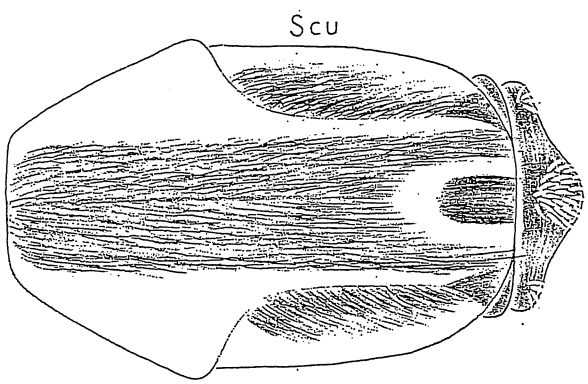


Fig. 86. Dorsal view of scurum – *Oc. fitchii*

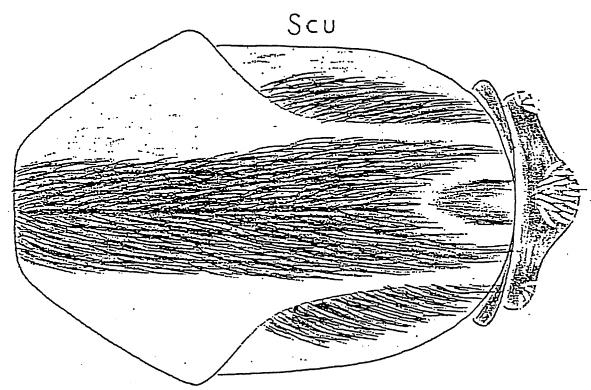


Fig. 88. Dorsal view of scutum – *Oc. stimulans*

14(2). Wings with dark and pale scales intermixed, mostly pale-scaled (Fig. 89); postprocoxal scale patch present (Fig. 90) . . . . *Oc. dorsalis*

Wings entirely dark-scaled or some pale scales on anterior veins (Fig. 91); postprocoxal scale patch absent (Fig. 92) 15

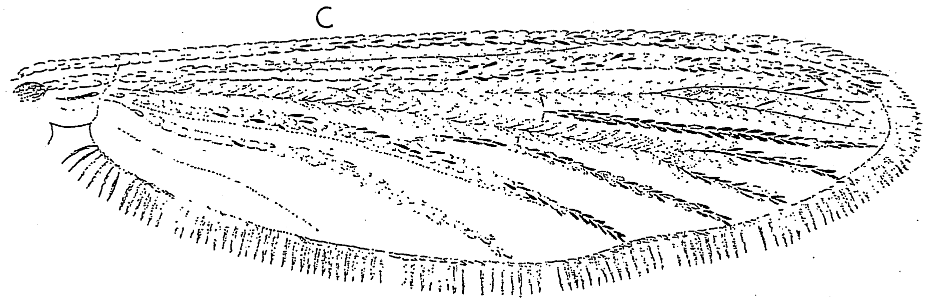


Fig. 89. Dorsal view of wing – *Oc. dorsalis*

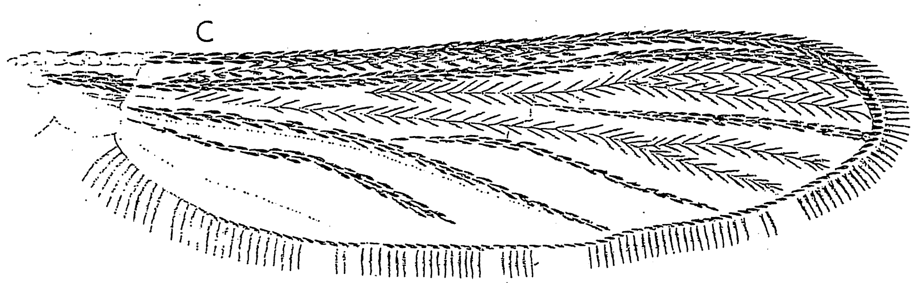


Fig. 91. Dorsal view of wing – *Oc. atropalpus*

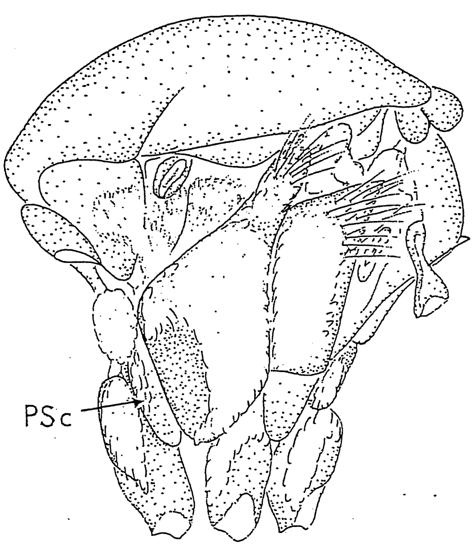


Fig. 90. Lateral view of thorax – *Oc. dorsalis*

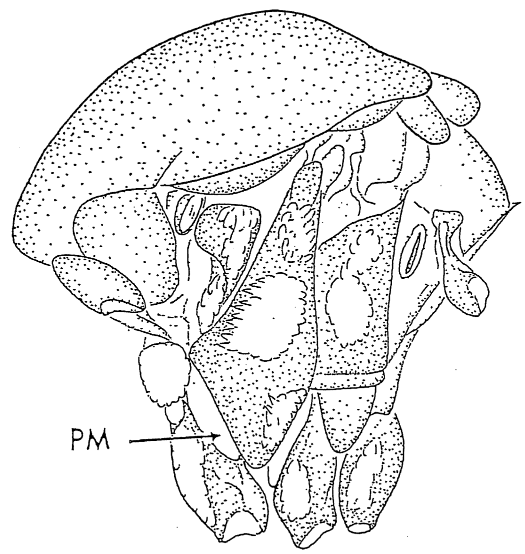


Fig. 92. Lateral view of thorax – *Oc. atropalpus*

15(14). Wing with prominent patch of pale scales on base of vein C (Fig. 93); scutum with broad dark brown median longitudinal stripe (Fig. 94) . . . . *Oc. atropalpus*

Wing **entirely** dark-scaled (Fig. 95); scutum without median dark stripe, usually rather evenly golden-brown scales (Fig. 96) . . . . *Oc. canadensis canadensis*

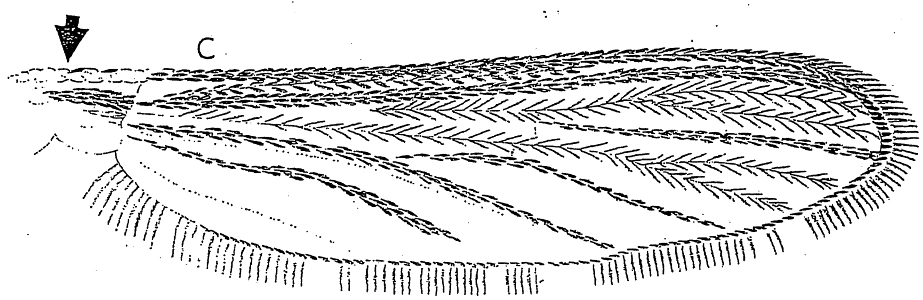


Fig. 93. Dorsal view of wing – *Oc. atropalpus*

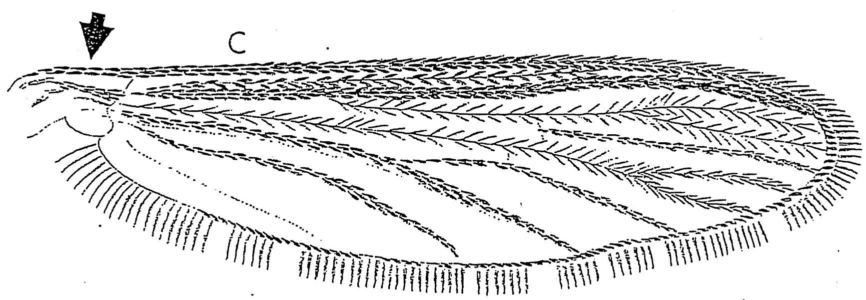


Fig. 95. Dorsal view of wing – *Oc. c. canadensis*

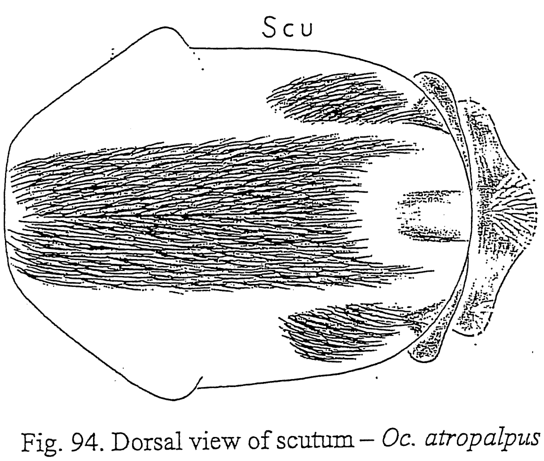


Fig. 94. Dorsal view of scutum – *Oc. atropalpus*

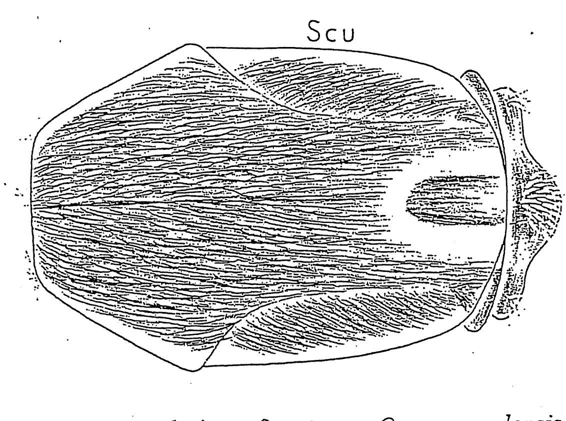


Fig. 96. Dorsal view of scutum – *Oc. c. canadensis*

16(1). Scutum with silvery white scales only laterally (Fig. 97) 17

Scutum with other pattern, not only silvery white laterally (Fig. 98) 18

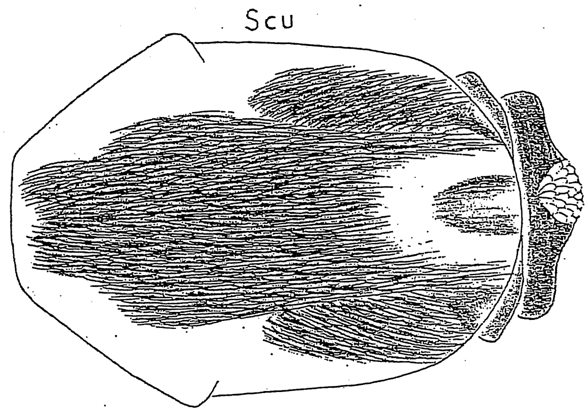


Fig. 97. Dorsal view of scutum – *Oc. triseriatus*

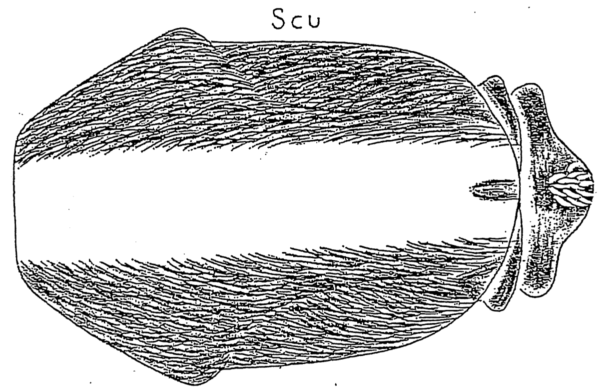


Fig. 98. Dorsal view of scurum – *Oc. atlanticus*

17(16). Silvery scales of scutal fossa usually restricted to lateral and posterior portions (Fig. 99); fore- and midclaws evenly curved, tooth less than 0.3 length of claw (Fig. 100) . . . . . *Oc. triseriatus*

Silvery scales usually covering entire scutal fossa (Fig. 101); claw of fore- and midlegs abruptly curving, tooth 0.3-0.5 length of claw (Fig. 102) . . . . *Oc. hendersoni*

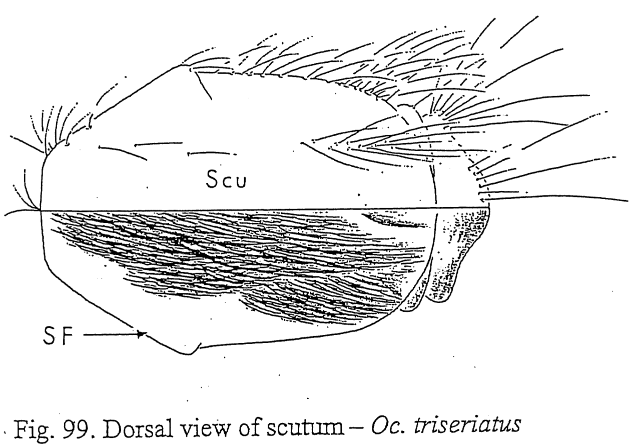


Fig. 99. Dorsal view of scutum – *Oc. triseriatus*

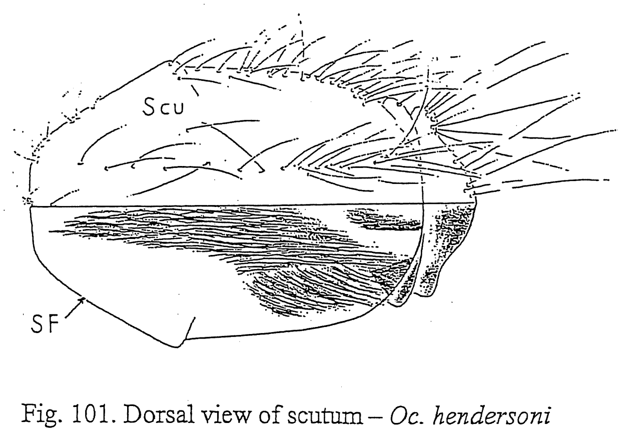


Fig. 101. Dorsal view of scutum – *Oc. hendersoni*

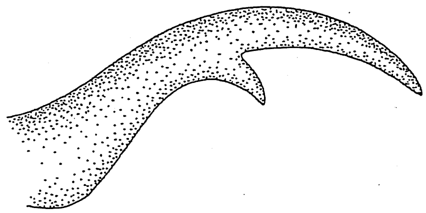


Fig. 100. Foreclaw – *Oc. triseriatus*

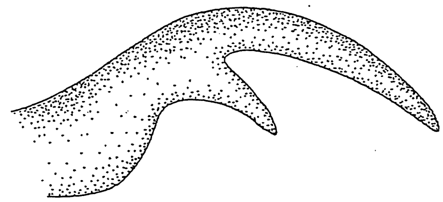


Fig. 102. Foreclaw – Oc. hendersoni

18(16). Scutum with pair of submedian pale-scaled stripes, separated by dark stripe of about same width (Fig. 103) . . . . *Oc. trivittatus*

Scutum without pair of submedian pale-scaled stripes (Fig. 104). 19

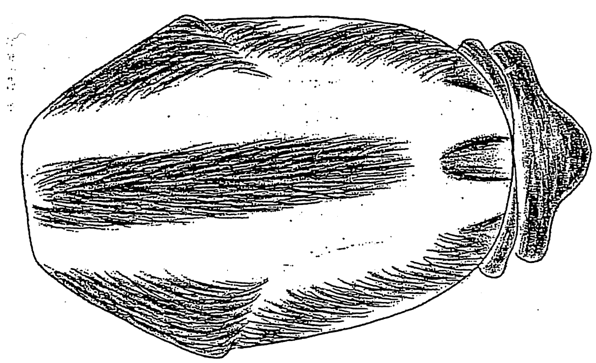


Fig. 103. Dorsal view of scutum – *Oc. trivittatus*

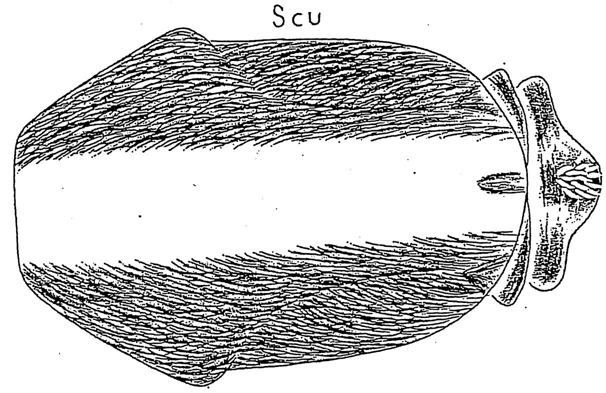


Fig. 104. Dorsal view of scutum – *Oc. atlanticus*

19(18). Scutum with anteromedian patch of white scales extending to middle or a little beyond, much broader than lateral dark-scaled areas (Fig. 105) . . . . *Oc. infirmatus*

Scutum without anteromedian patch of white scales (Fig. 106) 20

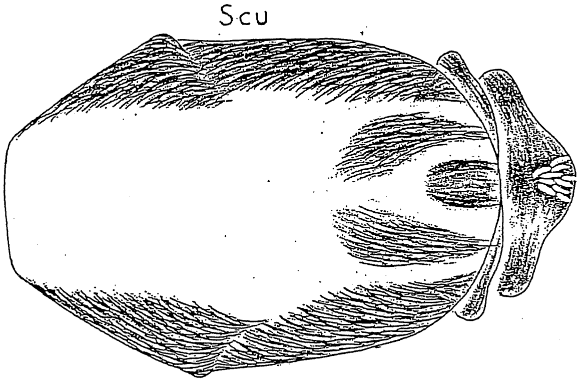


Fig. 105. Dorsal view of scutum – *Oc. infirmatus*

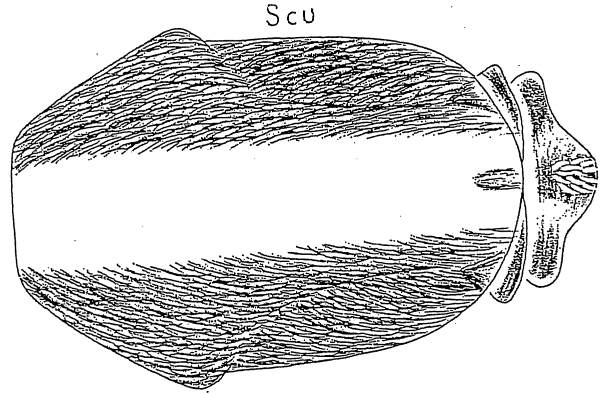


Fig. 106. Dorsal view of scutum – *Oc. atlanticus*

20(19). Scutum with median longitudinal stripe of silvery scales extending full length, usually narrower than lateral dark-scaled areas (Fig. 107) 21

Scutum without median longitudinal full length stripe of white scales (Fig. 108) 22

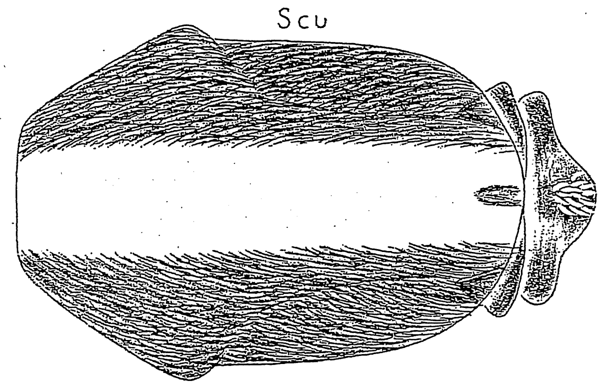


Fig. 107. Dorsal view of scutum – *Oc. atlanticus*

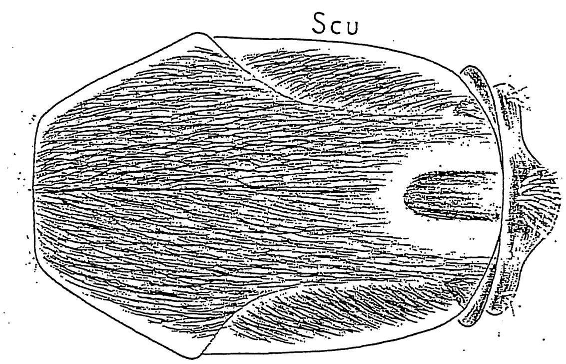


Fig. 108. Dorsal view of scutum – *Oc. c. canadensis*

21(20). Occiput with few or no dark-scales laterally (Fig. 109) small species, wing length about 2.5 mm . . . . *Oc. dupreei*

Occiput with prominent spots of dark, appressed scales laterally (Fig. 110), medium-sized species, wing length 3.0-4.0 mm . . . . *Oc. atlanticus*
Oc. tormentor

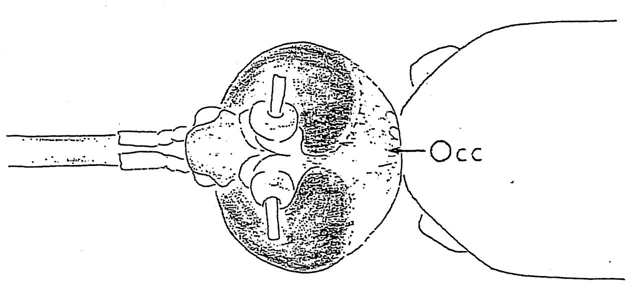


Fig. 109. Dorsal, view of head – *Oc. dupreei*

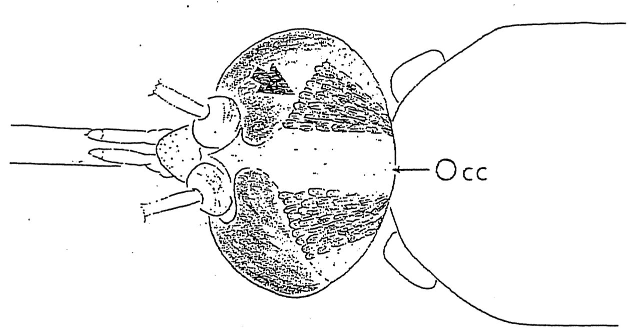


Fig. 110. Dorsal view of head – *Oc. atlanticus*

22(20). Hypostigmal area with scales (Fig. 111) 23

Hypostigmal area without scales (Fig. 112) 24

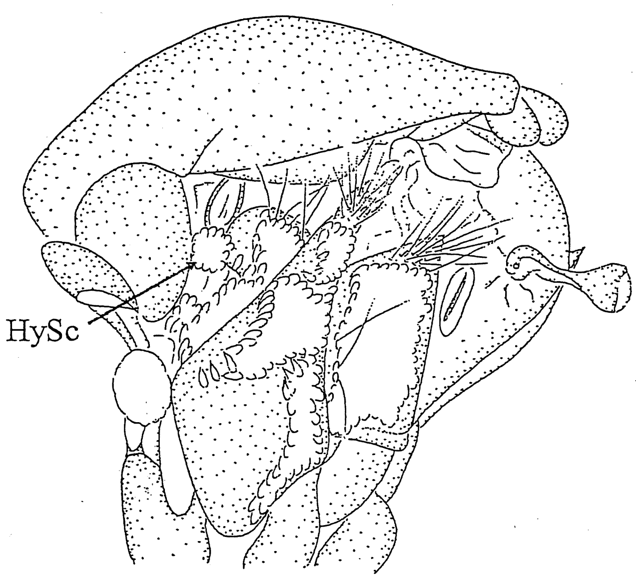


Fig. 111. Lateral view of thorax – *Oc. pullatus*

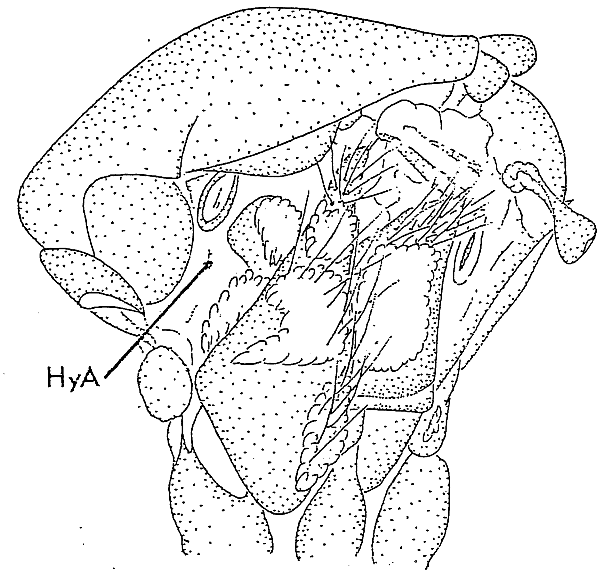


Fig. 112. Lateral view of thorax – *Oc. diantaeus*

23(20). Postprocoxal scale patch absent (Fig. 113); palpi usually with some pale scales (Fig. 114) .... (in part) *Oc. intrudens*

Postprocoxal scale patch present (Fig. 115); palpi entirely dark-scaled (Fig. 116) .... *Oc. provocans*

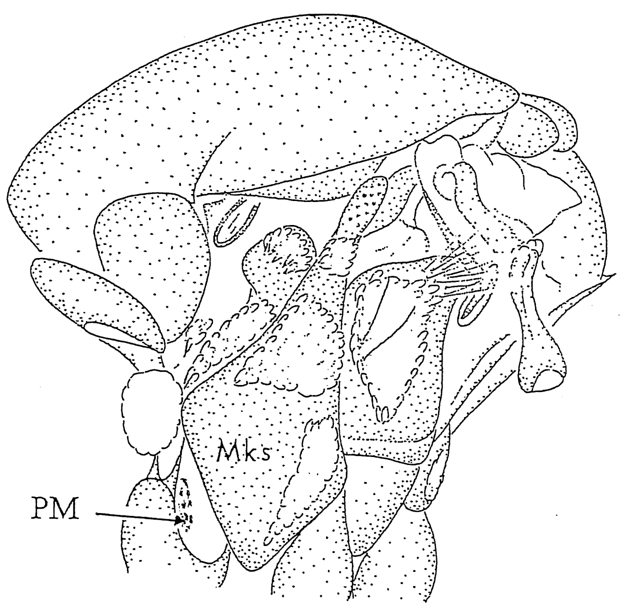


Fig. 113. Lateral view of thorax – *Oc. intrudens*

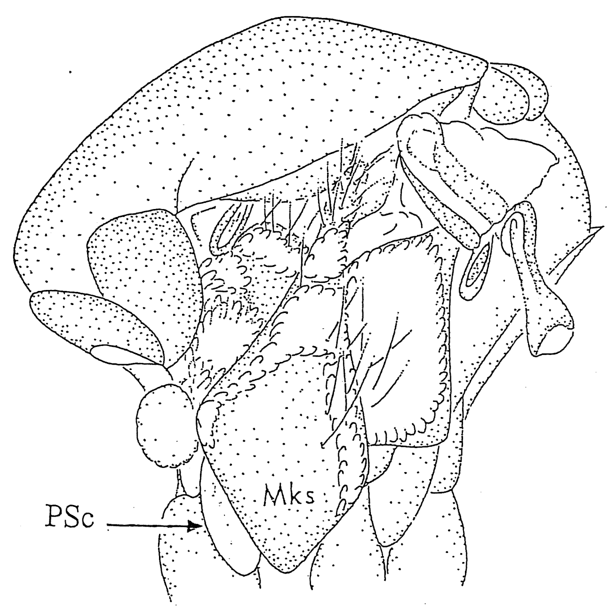


Fig. 115. Lateral view of thorax – *Oc. provocans*

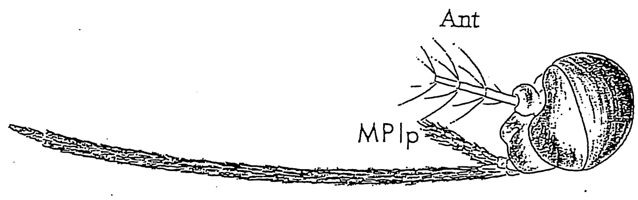


Fig. 114. Lateral view of head – *Oc. intrudens*

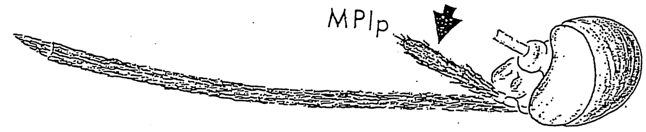


Fig. 116. Lateral view of head – *Oc. provocans*

24(22). Abdominal terga without basal transverse pale bands on I-VII, if present, on fewer than 0.5 of terga (Fig. 117) 25

Abdominal terga usually with basal transverse pale bands on I-VII, at least on more than 0.5 of terga (Fig. 118) 28

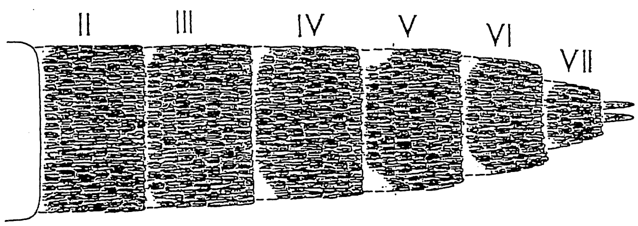


Fig. 117. Dorsal view of abdomen – *Oc. diantaeus*

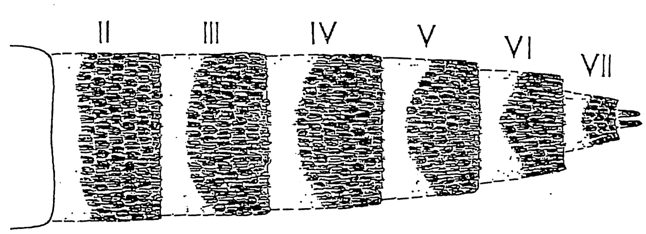


Fig. 118. Dorsal view of abdomen – *Oc. intrudens*

25(24). Abdominal sterna entirely pale-scaled (Fig. 119); forecoxa with at least some brown scales (Fig. 120) . . . . *Oc. aurifer*

At least some abdominal sterna with dark scales apically (Fig. 121); forecoxa entirely pale-scaled (Fig. 122) 26

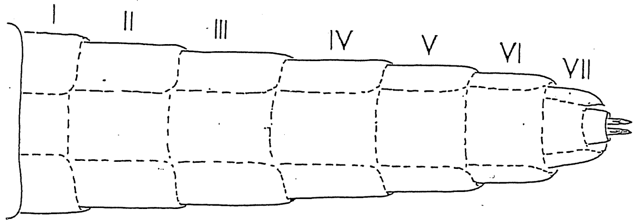


Fig. 119. Ventral view of abdomen – *Oc. aurifer*

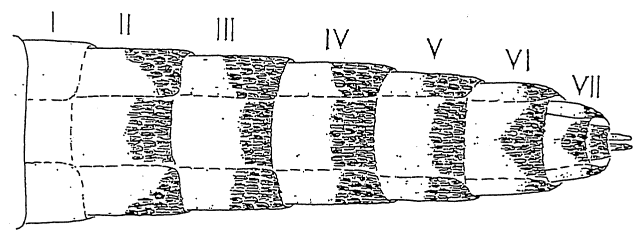


Fig. 121. Ventral view of abdomen – *Oc. thibaulti*

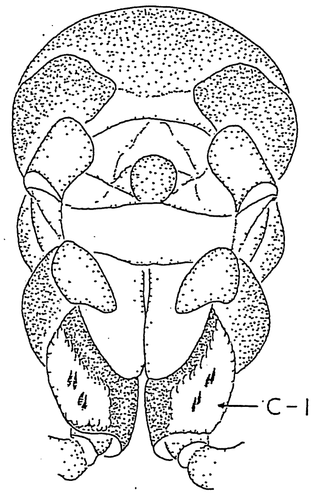


Fig. 120. Anterior view of thorax – *Oc. aurifer*

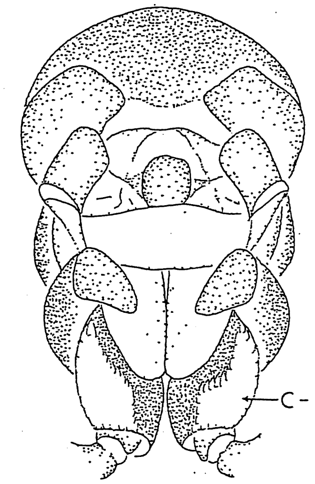


Fig. 122. Anterior view of thorax – *Oc. thibaulti*

26(25). Scutum with broad median longitudinal stripe of dark scales, broadening abruptly just posterior to scutal angle (Fig. 123) .... *Oc. thibaulti*

Scutum with 2 narrow brown-scaled stripes, sometimes fused if so not distinctly broader posteriorly (Fig. 124) 27

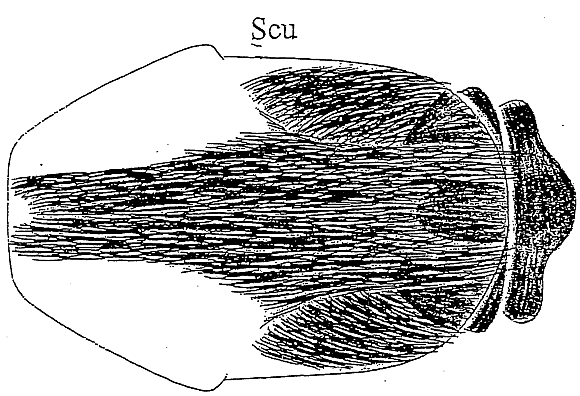


Fig. 123. Dorsal view of scutum – *Oc. thibaulti*

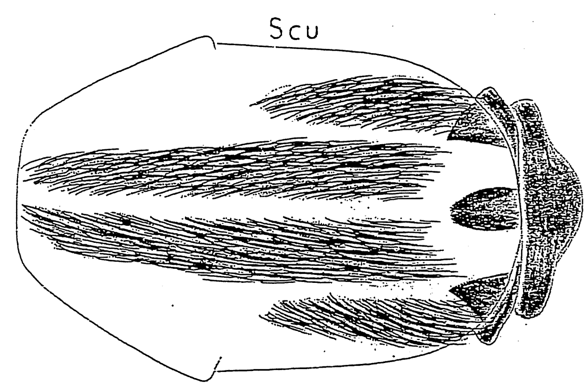


Fig. 124. Dorsal view of scutum – *Oc. decticus*

27(26). Mesokatepisternum with fewer than 10 setae, usually 5,6 (Fig. 125); occiput with submedian spots of dark scales (Fig. 126); metameron bare (Fig. 125) . . . . *Oc. decticus*

Mesokatepisternum with 10-20 setae (Fig. 127); submedian spots on occiput lacking (Fig. 128); metameron with small scale-patch (Fig. 127) . . . . *Oc. diantaeus*

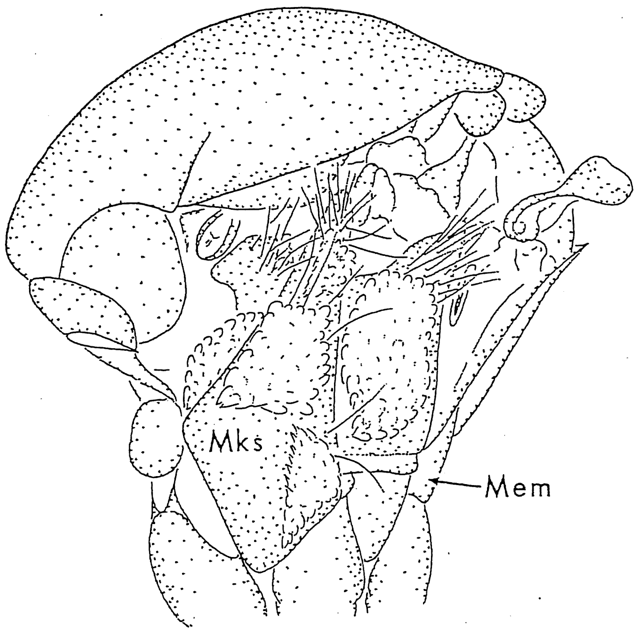


Fig. 125. Lateral view of thorax – *Oc. decticus*

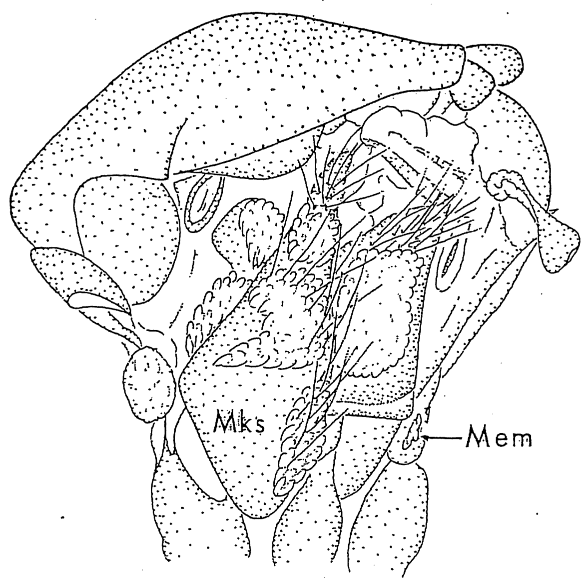


Fig. 127. Lateral view of thorax – *Oc. diantaeus*

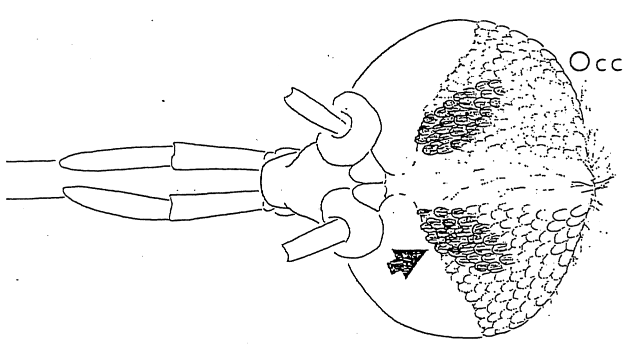


Fig. 126. Dorsal view of head – *Oc. decticus*

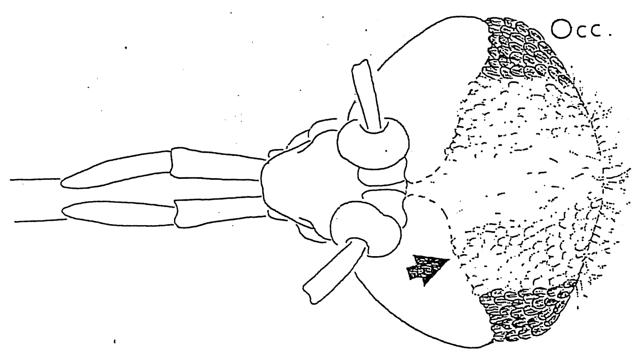


Fig. 128. Dorsal view of head – *Oc. diantaeus*

28(24). Postprocoxal scale patch absent (Fig. 129) 29

Postprocoxal scale patch present (Fig. 130) .... *Oc. abserratus*
Oc. punctor

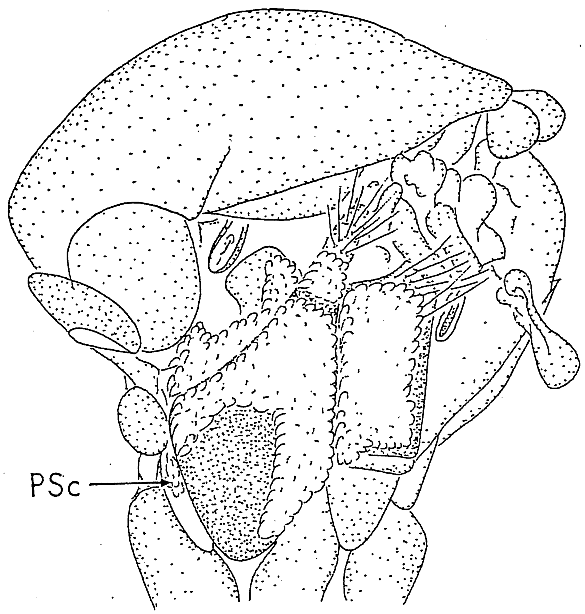


Fig. 130. Lateral view of thorax – *Oc. punctor*

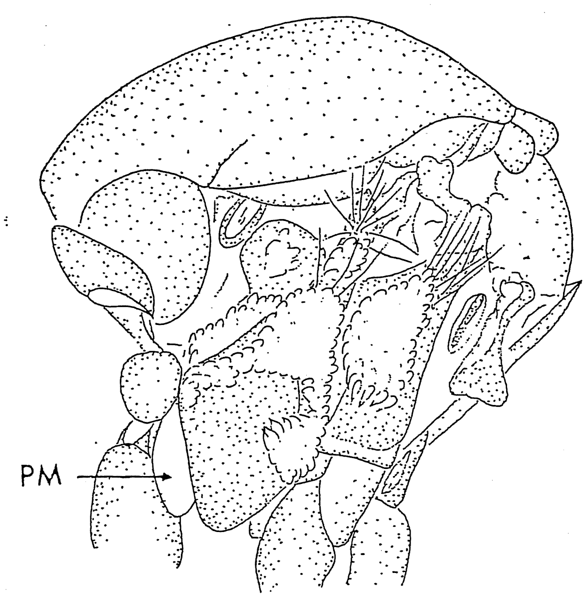


Fig. 129. Lateral view of thorax – *Oc. sticticus*

29(28). Scutum with unicolorous scales (Fig. 131); mesokatepisternum with scales usually not extending to anterior angle (Fig. 132) 30

Scutum with dark median longitudinal stripe (Fig. 133); mesokatepisternum with scales extending to anterior angle (Fig. 134) 31

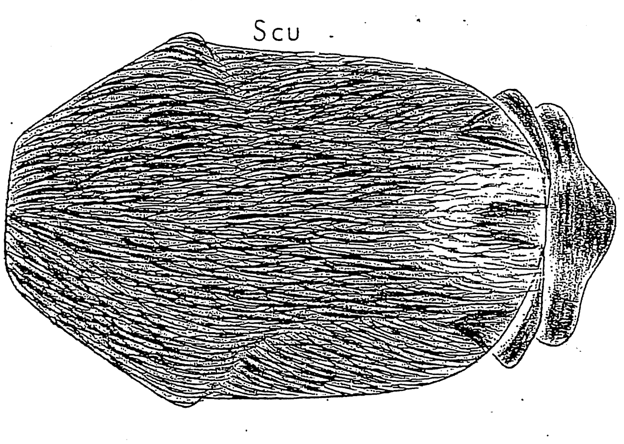


Fig. 131. Dorsal view of scutum – *Oc. intrudens*

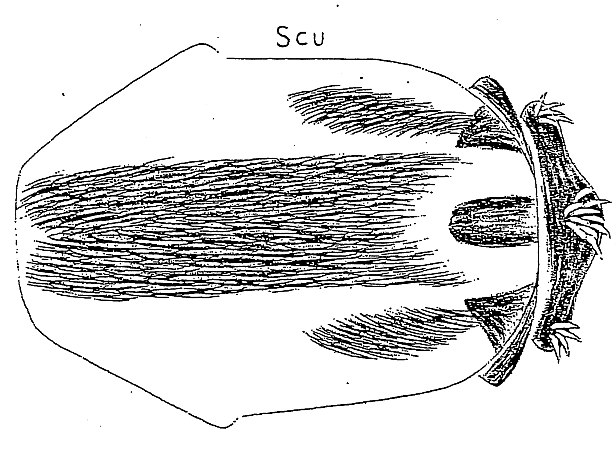


Fig. 133. Dorsal view of scutum – *Oc. sticticus*

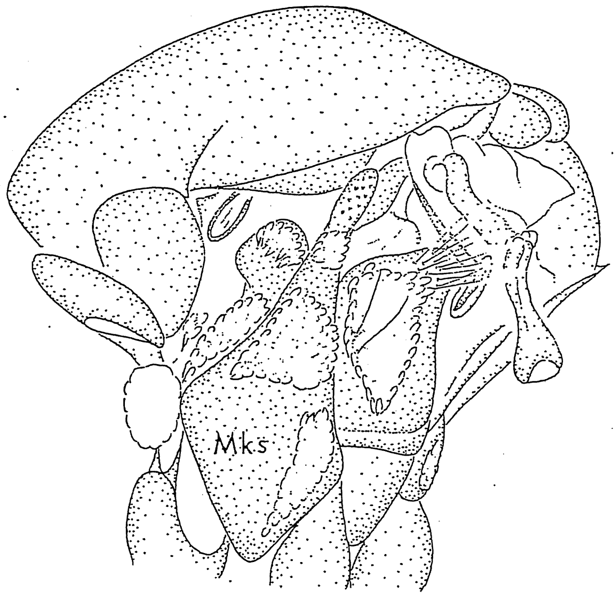


Fig. 132. Lateral view of thorax – *Oc. intrudens*

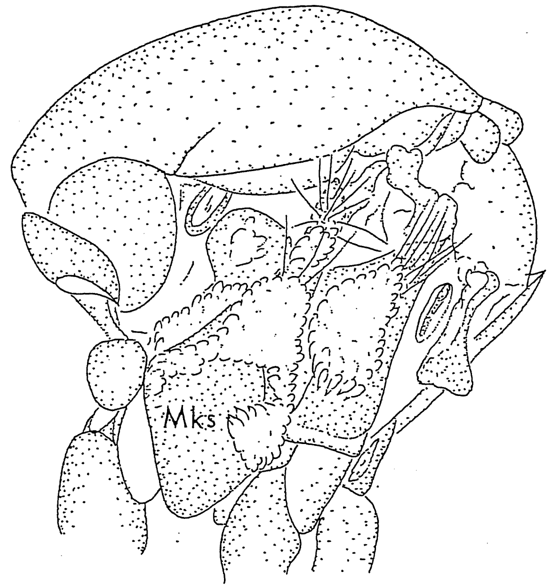


Fig. 134. Lateral view of thorax – *Oc. sticticus*

30(29). Forecoxa with patch of brown scales (Fig. 135); subspiracular area bare (Fig. 136) .... *Ae. cinereus*

Forecoxa with pale scales, or with few dark scales only (Fig. 137); subspiracular area with scales (Fig. 138) .... (in part) *Oc. intrudens*

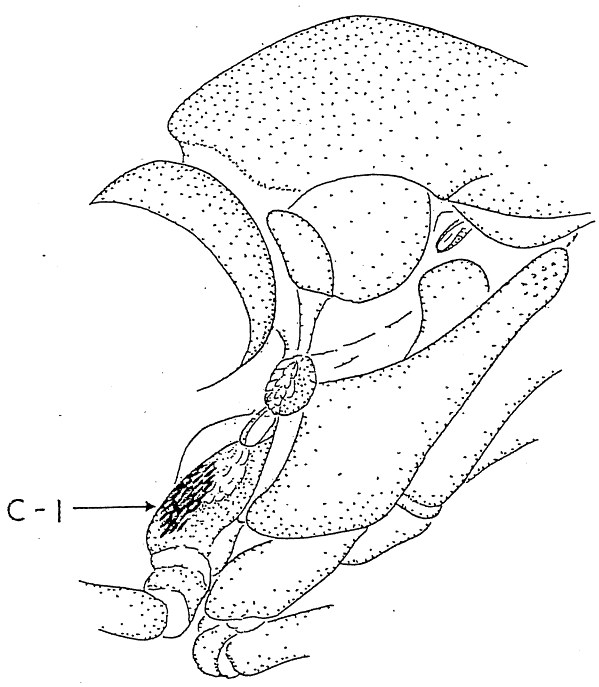


Fig. 135. Anterior view of thorax – *Ae. cinereus*

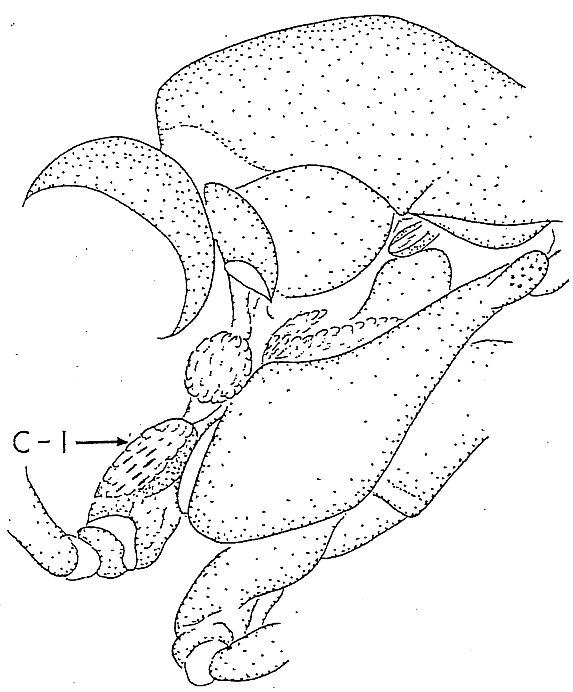


Fig. 137. Anterior view of thorax – *Oc. intrudens*

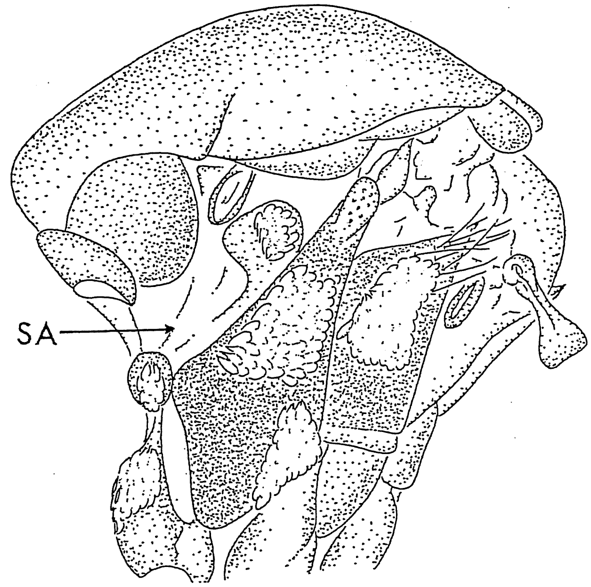


Fig. 136. Lateral view of thorax – *Ae. cinereus*

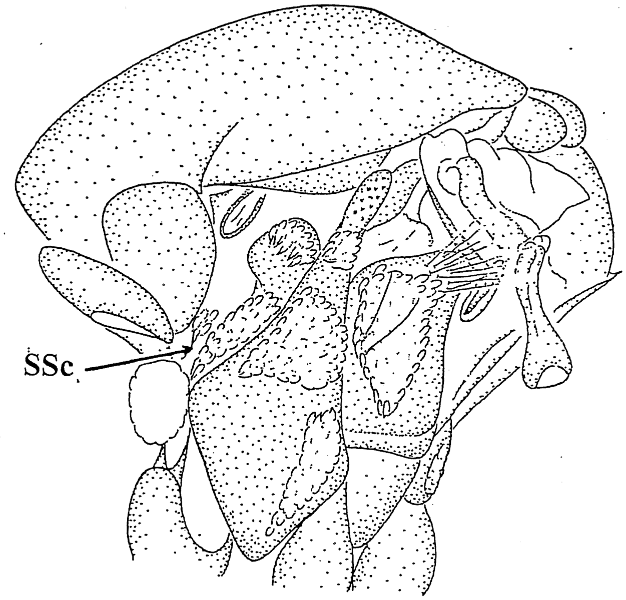


Fig. 138. Lateral view of thorax – *Oc. intrudens*

31(29). Scutellar and supraalar setae yellowish (Fig. 139); lower mesepimeral seta usually absent and ventral 0.25 of sclerite devoid of scales (Fig. 140) .... *Oc. sticticus*

Scutellar and supraalar setae brown or black (Fig. 141); lower mesepimeral seta present and ventral 0.25 of sclerite scaled (Fig. 142) .... *Oc. communis*

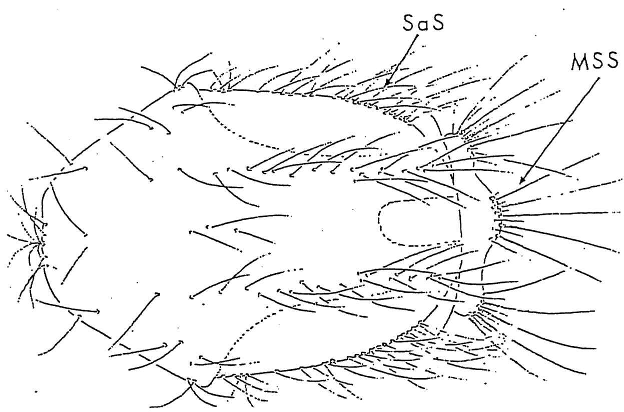


Fig. 139. Dorsal view of scutum – *Oc. sticticus*

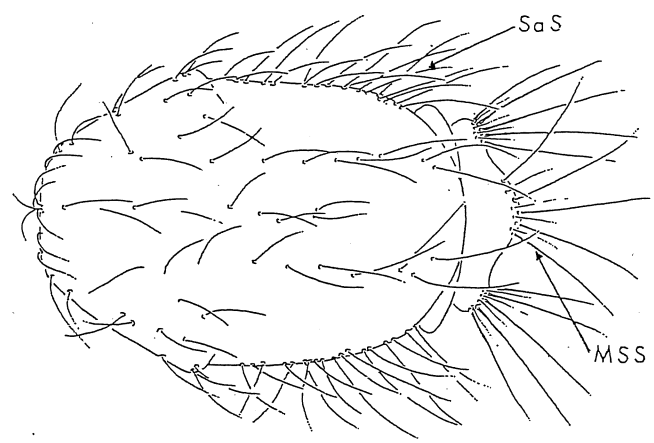


Fig. 141. Dorsal view of scutum – *Oc. communis*

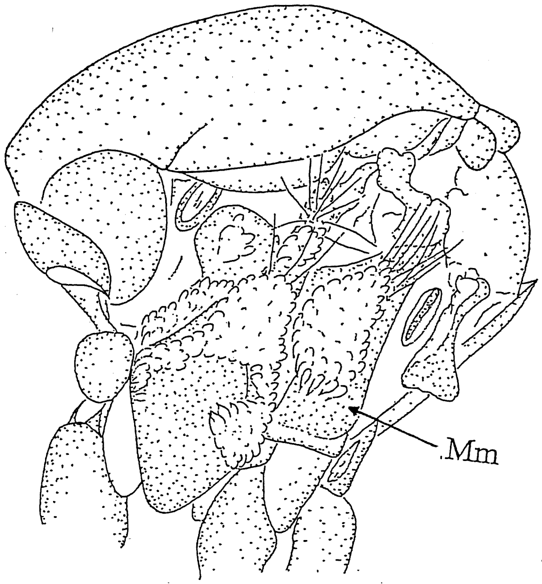


Fig. 140. Lateral view of thorax – *Oc. sticticus*

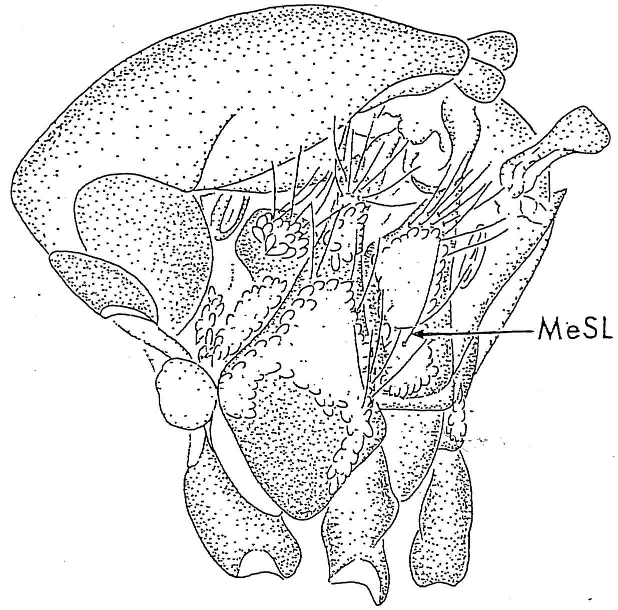


Fig. 142. Lateral view of thorax – *Oc. communis*

KEY TO GENUS PSOROPHORA

1. Wing with dark and pale scales on all veins (Fig. 143); femora with narrow subapical bands of pale scales (Fig. 144) (Subgenus *Grabhamia*) . . . . *columbiae*

   Wing scales entirely dark, or with only a few pale scales on veins C and Sc (Fig. 145); femora without subapical pale bands (Fig. 146) 2

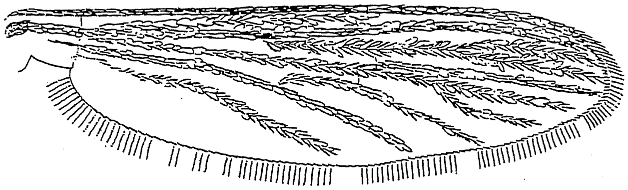


Fig. 143. Dorsal view of wing – *Ps. columbiae*

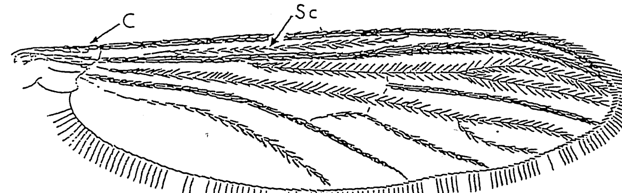


Fig. 145. Dorsal view of wing – *Ps. cilata*

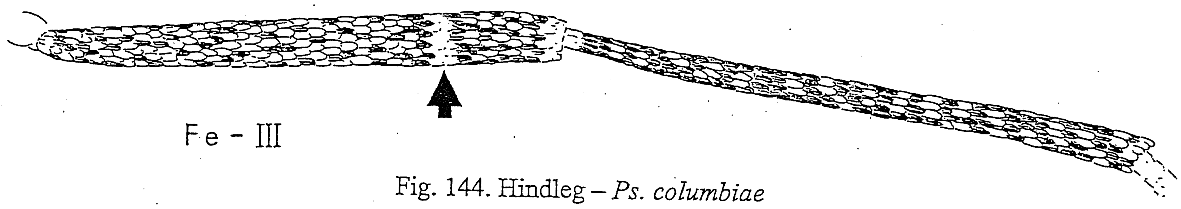


Fig. 144. Hindleg – *Ps. columbiae*

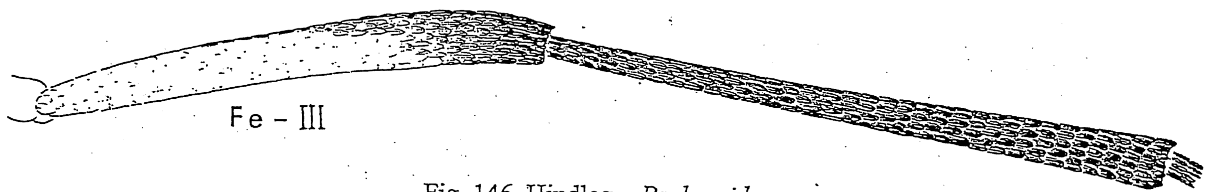


Fig. 146. Hindleg – *Ps. horrida*

2(1). Apices of hindfemur and tibia with long, erect scales, shaggy , hindtarsomere 5 partly dark-scaled (Fig. 147) (Subgenus *Psorophora*) 3

Apices of hindfemur and tibia without erect scales, sometimes suberect scales present, hindtarsomere 4,5 entirely pale-scaled (Fig. 148) (Subgenus *Janthinosoma*) 4

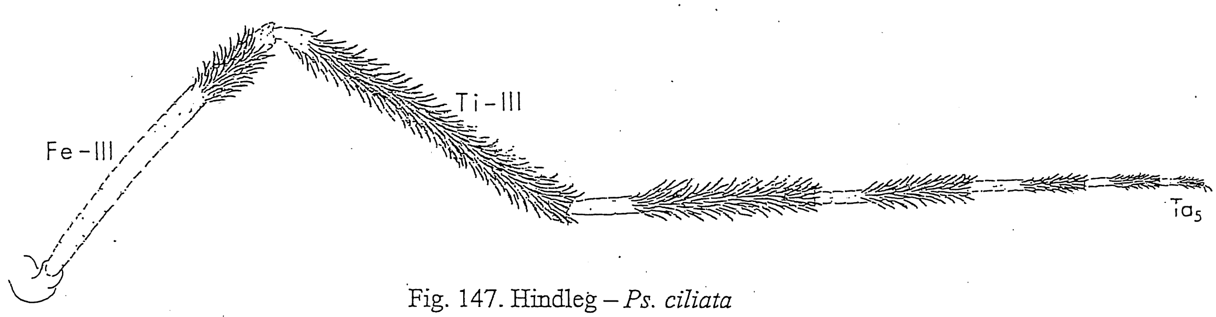


Fig. 147. Hindleg – *Ps. ciliata*

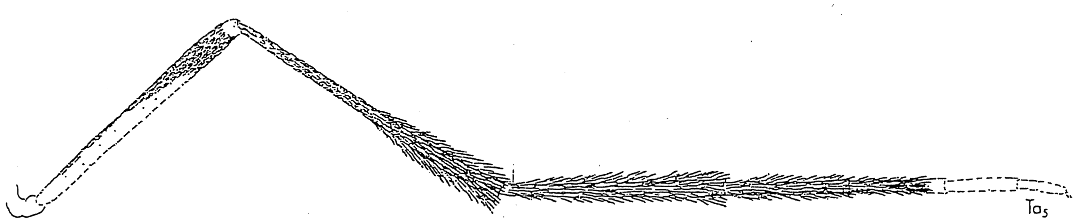


Fig. 148. Hindleg – *Ps. ferox*

3(2). Scutum with narrow, median, longitudinal stripe of golden scales (Fig. 149) proboscis mostly yellow-scaled (Fig. 150) . . . . *ciliata*

Scutum with median, longitudinal stripe of dark brown scales (Fig. 151); proboscis dark-scaled (Fig. 152) . . . . *howardii*

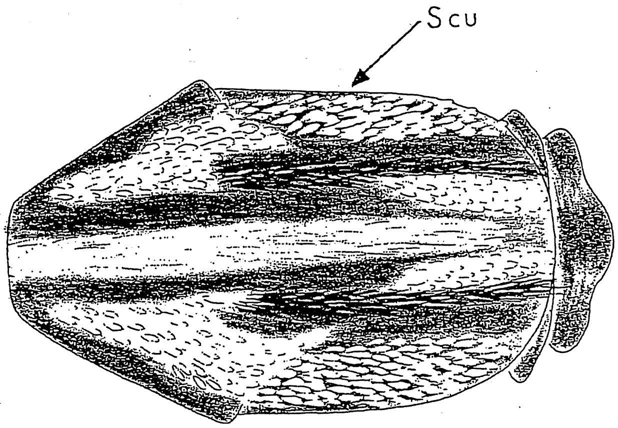


Fig. 149. Dorsal view of scutum – *Ps. ciliata*

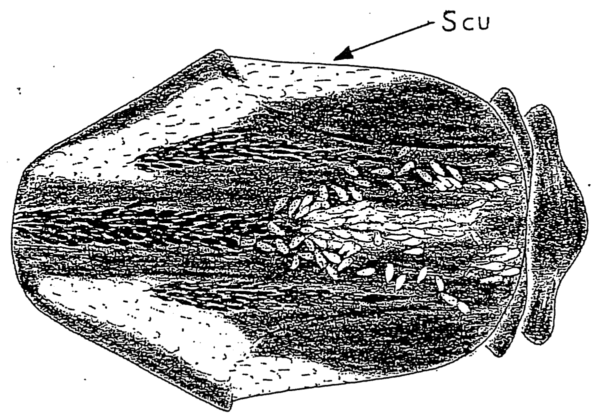


Fig. 151. Dorsal view of scutum – *Ps. howardii*

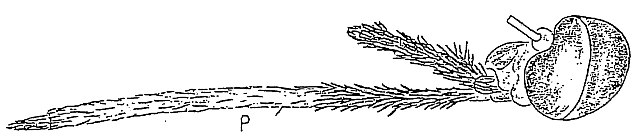


Fig. 150. Lateral view of head and proboscis – *Ps. ciliata*

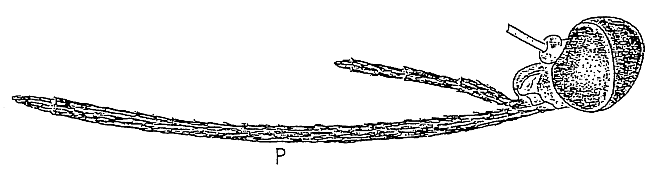


Fig. 152. Lateral view of head and proboscis – *Ps. howardii*

4(2). Scutum with dark brown and golden scales in no definite pattern (Fig. 153); abdominal tergum I with purplish scales medially (Fig. 154) . . . . *ferox*

Scutum with broad median longitudinal stripe of dark scales: whitish scales laterally (Fig. 155); abdominal tergum I with pale scales medially (Fig. 156) . . . . *horrida*

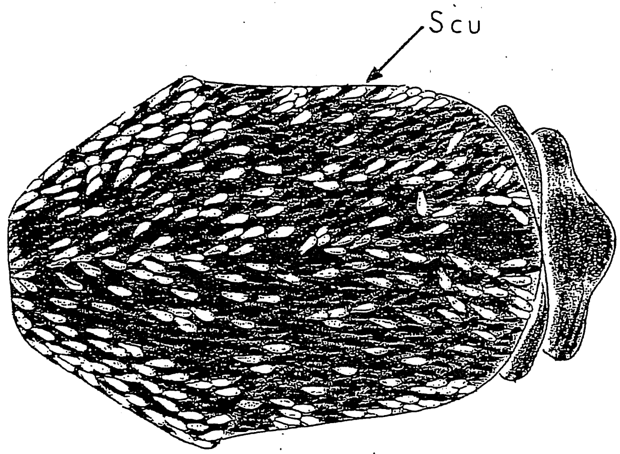


Fig. 153. Dorsal view of scutum – *Ps. ferox*

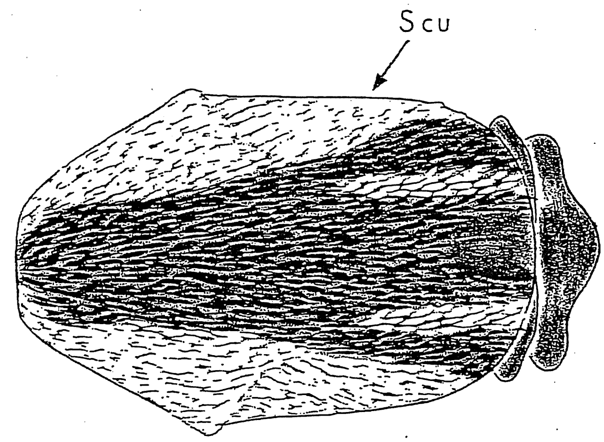


Fig. 155. Dorsal view of scutum – *Ps. horrida*

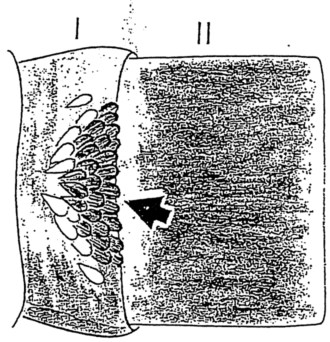


Fig. 154. Dorsal view of abdominal terga I-II – *Ps. ferox*

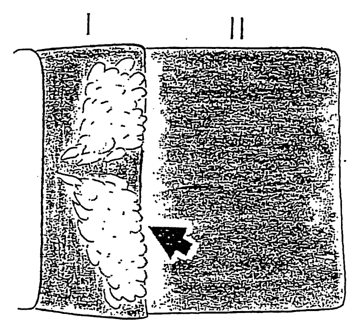


Fig. 156. Dorsal view of abdominal terga I-II – *Ps. horrida*

KEY TO GENUS CULEX

1. Scutum without middorsal acrostichal setae (Fig. 157); occiput with broad, appressed scales (Fig. 158) (Subgenus *Melanoconion*) . . . . *erraticus*

   Scutum with middorsal acrostichal setae (Fig. 159); occiput with narrow, appressed scales (Fig. 160) 2

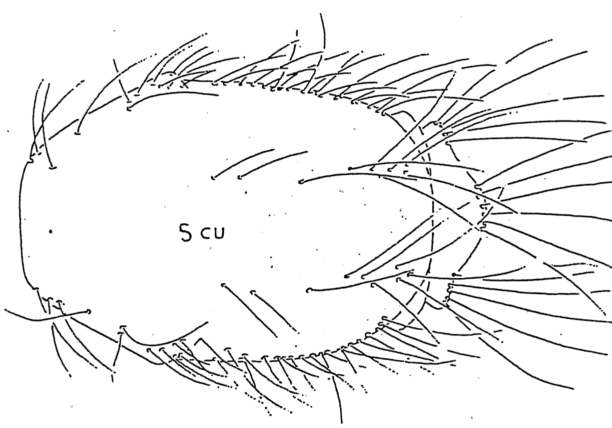


Fig. 157. Dorsal view of scutum – *Cx.erraticus*

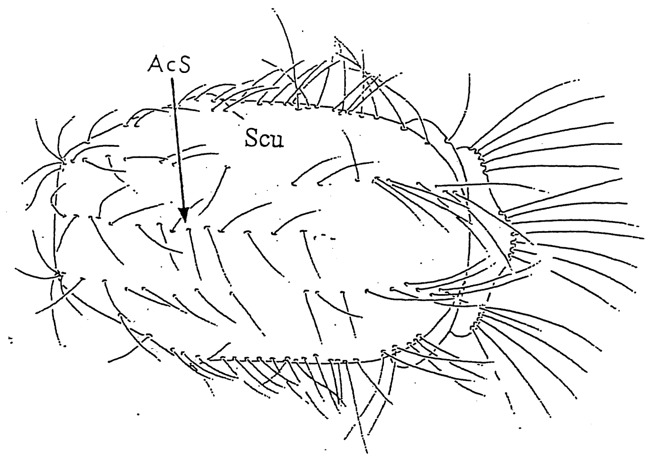


Fig. 159. Dorsal view of scutum – *Cx. pipiens*

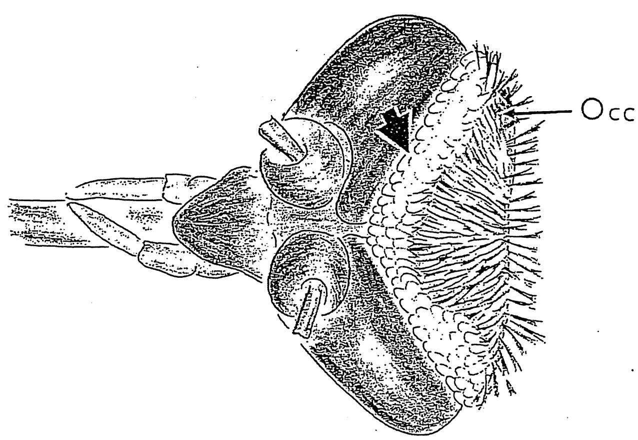


Fig. 158. Dorsal view of head – *Cx. erraticus*.

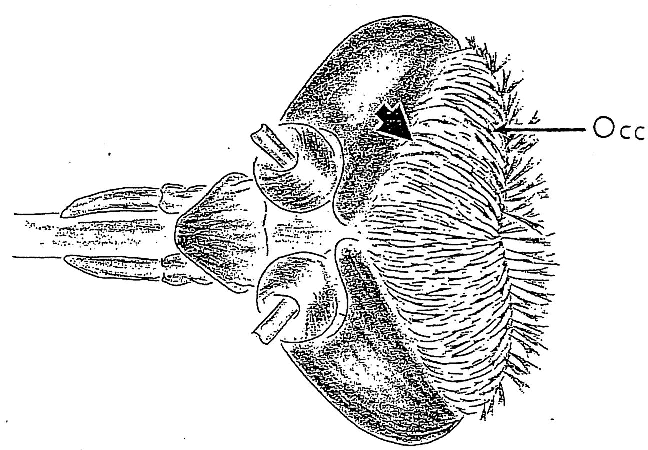


Fig. 160. Dorsal view of head – *Cx.pipiens*

2(1). Abdominal terga with bands or lateral patches of pale scales along apical border (Fig. 161) (Subgenus *Neoculex*) . . . . *territans*

Abdominal terga with bands or lateral patches of pale scales along basal border (Fig. 162) (Subgenus *Culex*) 3

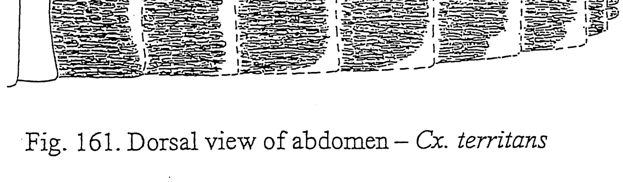


Fig. 161. Dorsal view of abdomen – *Cx. territans*

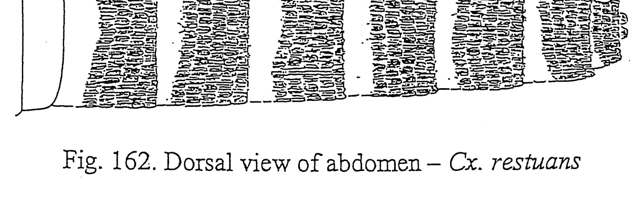


Fig. 162. Dorsal view of abdomen – *Cx. restuans*

3(2). Proboscis with distinct, complete ring of pale scales (Fig. 163); hindtarsomeres with basal and apical bands of pale scales (Fig. 164) .... *tarsalis*

Proboscis without complete distinct ring of pale scales (Fig. 165); hindtarsomeres entirely dark-scaled (Fig. 166) 4

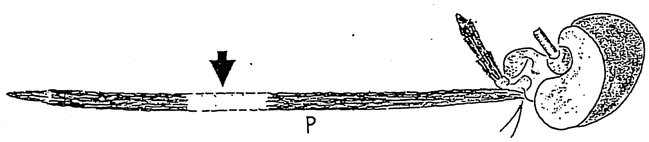


Fig. 163. Lateral view of head – *Cx. tarsalis*

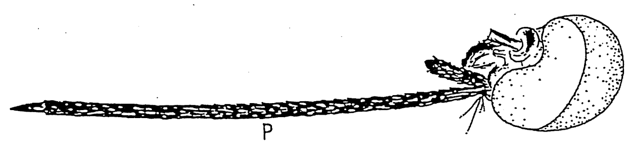


Fig. 165. Lateral view of head - *Cx. pipiens*

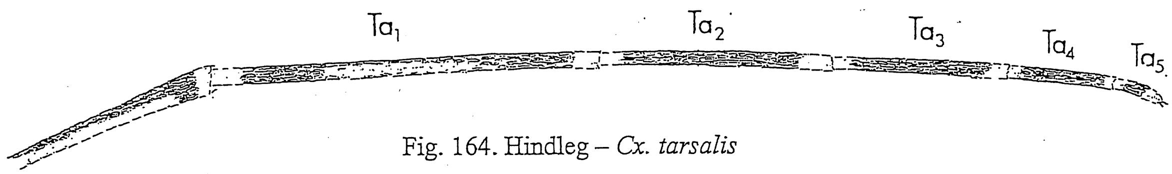


Fig. 164. Hindleg – *Cx. tarsalis*

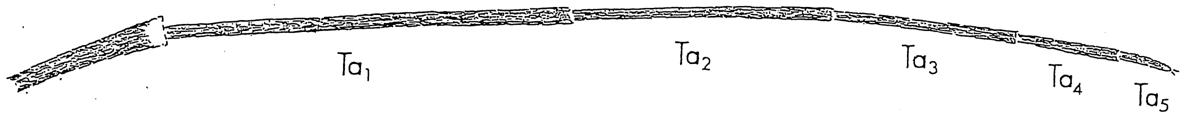


Fig. 166. Hindleg – *Cx. restuans*

4(3). Abdominal terga unbanded or with narrow basal dingy yellow bands sometimes blended with similar scales on apex of previous tergum, tergum VII covered mostly by dingy yellow scales (Fig. 167)........................ *salinarius*

Abdominal terga with conspicuous bands of pale scales, tergum VII mostly with dark scales (Fig. 168) 5

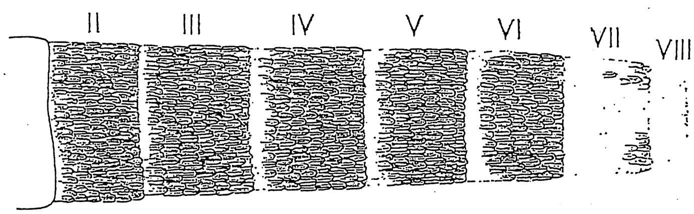


Fig. 167. Dorsal view of abdomen – *Cx. salinarius*

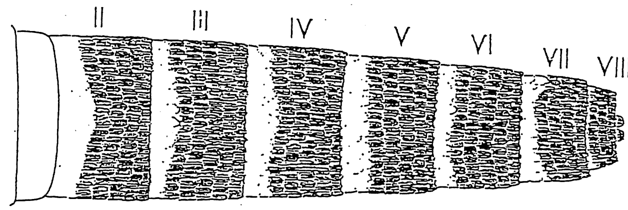


Fig. 168. Dorsal view of abdomen – *Cx. restuans*

5(4). Basal pale bands on abdominal terga rounded posteriorly with marked sublateral constrictions, narrowly joined to large lateral pale patches (Fig. 169); scutum without pale-scaled spots (Fig. 170) . . . . *pipiens*

Basal pale bands on abdominal terga more or less straight posteriorly, broadly joined to small lateral pale patches with only slight sublateral constriction, if at all (Fig. 171); scutum with or without pale-scaled submedian spots near middle (Fig. 172) . . . . *restuans*

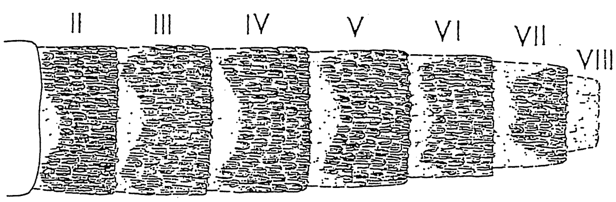


Fig. 169. Dorsal view of abdomen – *Cx. pipiens*

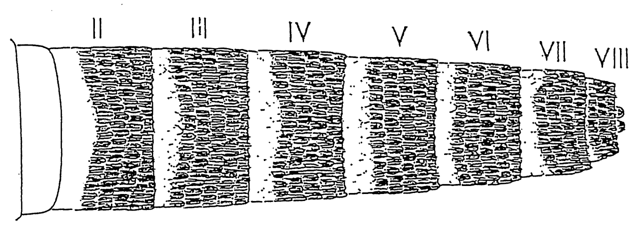


Fig. 171. Dorsal view of abdomen – *Cx. restuans*

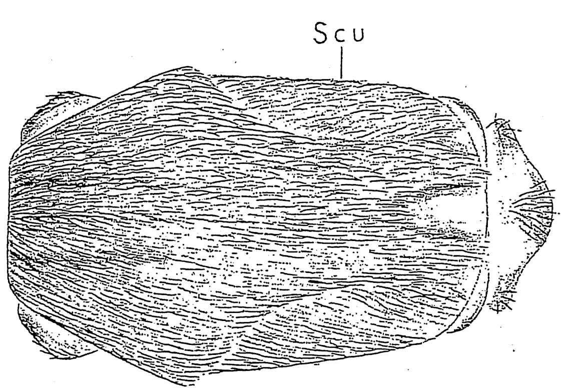


Fig. 170. Dorsal view of scutum – *Cx. pipiens*

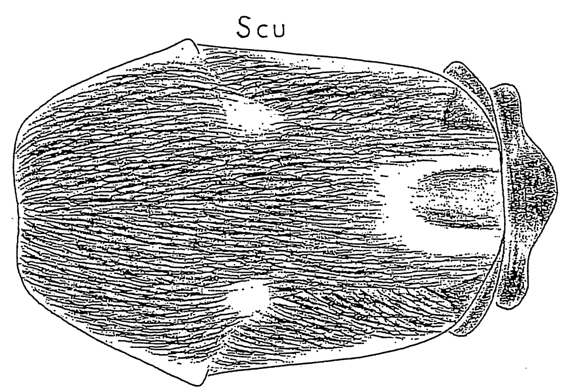


Fig. 172. Dorsal view of scutum – *Cx. restuans*

KEY TO GENUS CULISETA

1. Abdominal terga without basal pale bands (Fig. 173) (Subgenus *Climacura*) . . . . (in part) *melanura*

   Abdominal terga with more or less distinct basal pale bands (Fig. 174) 2

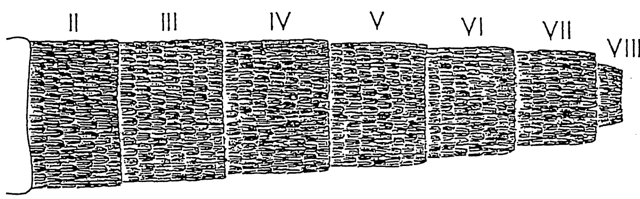


Fig. 173. Dorsal view of abdomen – *Cs. melanura*

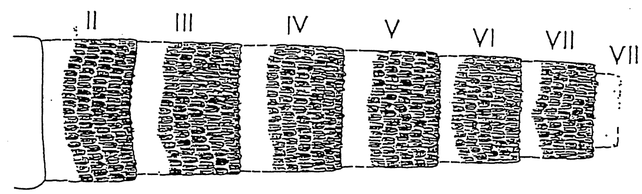


Fig. 174. Dorsal view of abdomen – *Cs. morsitans*

2(1). Hindtarsomeres with pale-scaled bands at least on some tarsomeres (Fig. 175) (Subgenus *Culicella*) 3

   Hindtarsomeres without pale bands (Fig. 176) (Subgenus *Culiseta*) 4

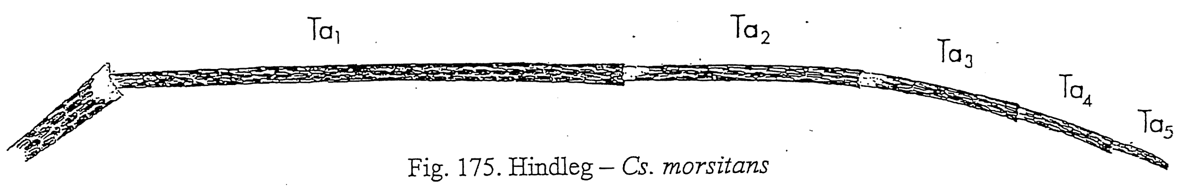


Fig. 175. Hindleg – *Cs. morsitans*

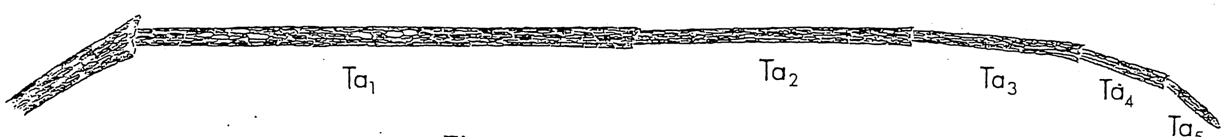


Fig. 176. Hindleg – *Cs. impatiens*

3(2). Abdominal terga with pale bands on apices as well as bases, pale scales with brownish tinge, not white (Fig. 177) . . . . *minnesotae*

   Abdominal terga with pale bands on bases only, pale scales whitish (Fig. 178) . . . . *morsitans*

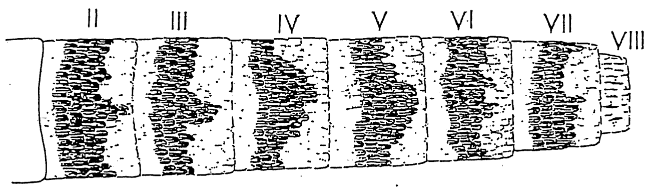


Fig. 177. Dorsal view of abdomen – *Cs. minnesotae*

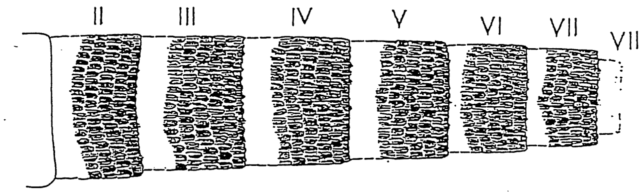


Fig. 178. Dorsal view of abdomen – *Cs. morsitans*

4(2). Wing with dark and pale scales intermixed on anterior veins (Fig. 179); hindtarsomeres 1,2 with dark and pale scales (Fig. 180) . . . . *inornata*

Wing and hindtarsomeres 1,2 dark-scaled (Figs. 181, 182) 5

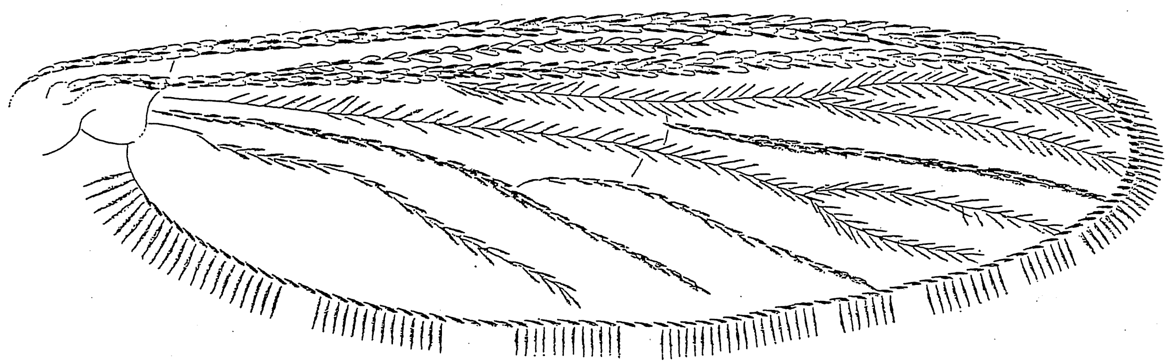


Fig. 179. Dorsal view of wing – *Cs. inornata*

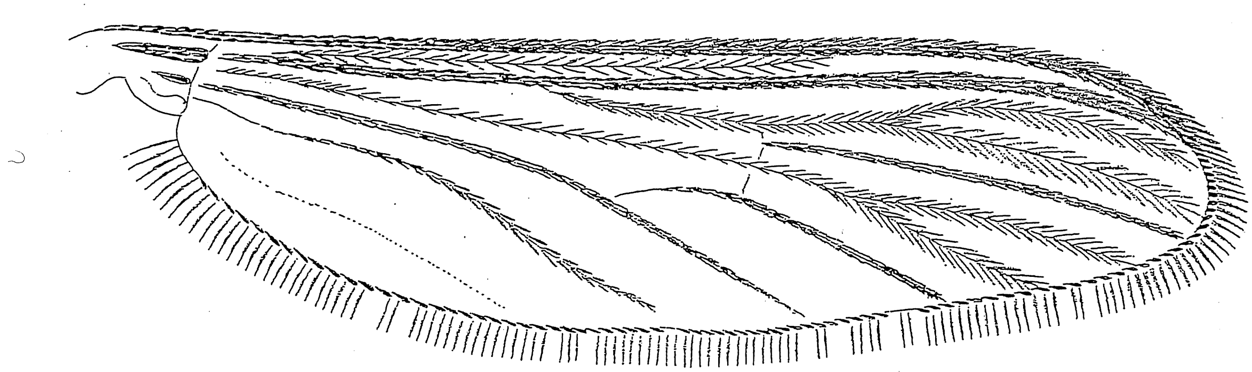


Fig. 181 – Dorsal view of wing – *Cs. impatiens*

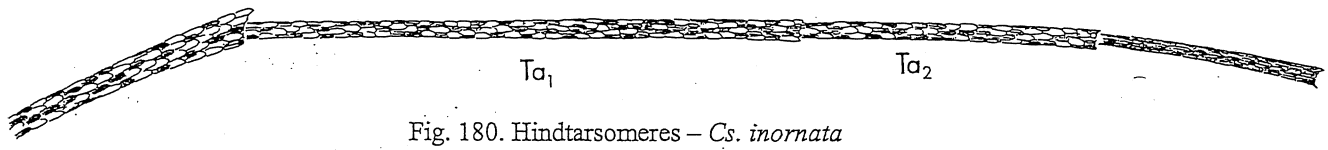


Fig. 180. Hindtarsomeres – *Cs. inornata*

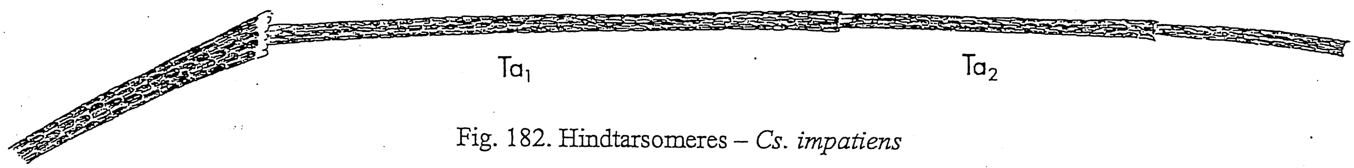


Fig. 182. Hindtarsomeres – *Cs. impatiens*

5(4). Points of origin of crossveins rm and m_{3+4} separated by more than length of either crossvein (Fig. 183); abdomen entirely dark-scaled or with faint yellowish-white bands dorsally (Fig. 184) .... (in part) *melanura*

Points of origin of crossveins rm and m_{3+4} separated by less than length of either crossvein (Fig. 185); abdomen with prominent basal pale bands dorsally (Fig. 186) .... *impatiens*

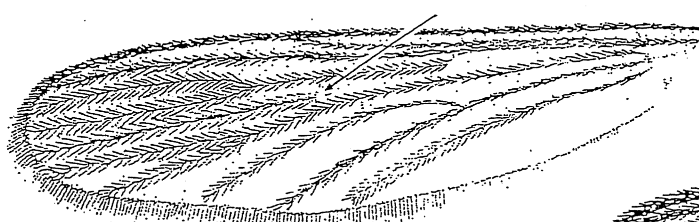


Fig. 183. Dorsal view of wing – *Cs. melanura*

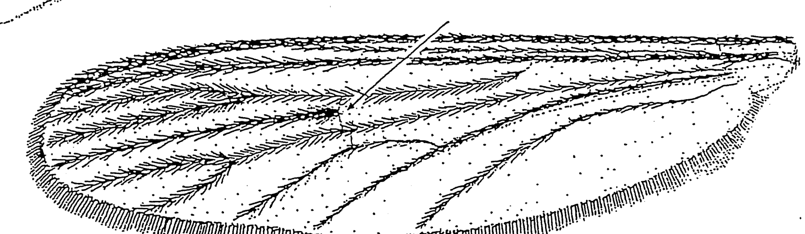


Fig. 185. Dorsal view of wing – *Cs. impatiens*

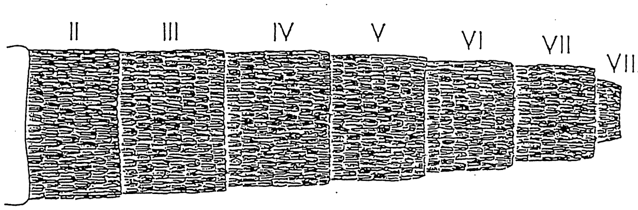


Fig. 184. Dorsal view of abdomen – *Cs. melanura*


Fig. 186. Dorsal view of abdomen – *Cs. impatiens*

KEY TO GENUS ORTHOPODOMYIA

Lower mesokatepisternal setae 4 or more (Fig. 187); base of wing vein R_{4+5} usually with patch of pale scales (Fig. 188) .... *signifera*

Lower mesokatepisternal setare 0-2 (Fig. 189); base of wing vein R_{4+5} usually dark-scaled (Fig. 190) .... *alba*

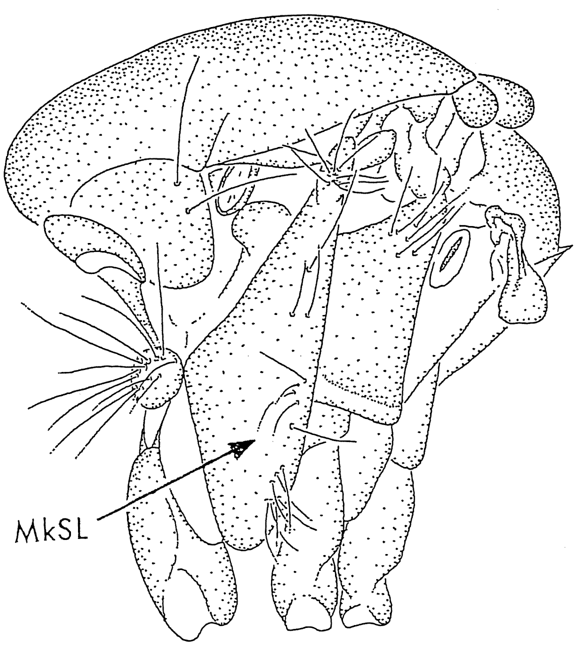


Fig. 187. Lateral view of thorax – *Or. signifera*

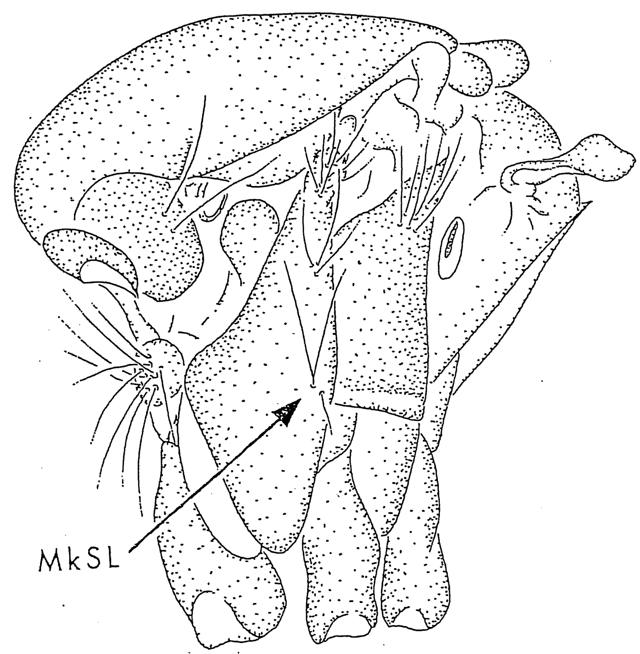


Fig. 189. Lateral view of thorax – *Or. alba*

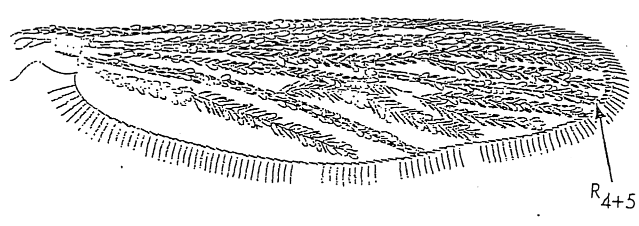


Fig. 188. Dorsal view of wing – *Or. signifera*

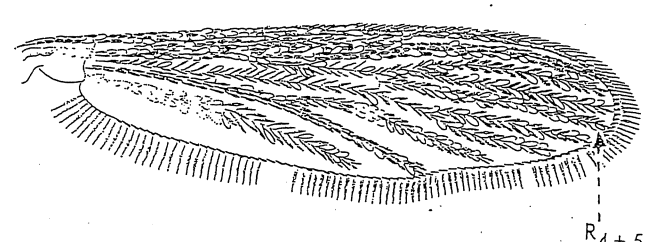


Fig. 190. Dorsal view of wing – *Or. alba*

MORPHOLOGY OF THE FOURTH INSTAR MOSQUITO LARVA

The fourth instar larval body, contrary to the adult, is largely composed of soft, membranous tissue, but with some parts consisting of hardened, sclerotized plates. This allows fro the characteristic swimming movements and doubling of the body when cleaning the lateral palatal brushes. The body is divided into the head, thorax and abdomen (Plate 6). The head capsule is completely sclerotized while the thorax and abdomen are largely membranous. The larval body is adorned by some 190 pairs of setae (Plates 6, 7). The study of the arrangements and nomenclature of setae is known as chaetotaxy. These, along with various kinds of spicules are known collectively as the vestiture, i.e., protusions from the cuticle of the integument (Harbach and Knight 1980) and are thus defined as cuticular projections. The organization and nomenclature of these structures is very important in larval identification. A complete treatment of the vestiture in general and the chaetotaxy in particular may be found in Harbach and Knight (1980).

VESTITURE

The two main components of the larval vestiture are spicules and setae (synonyms: hairs, hair tufts, bristles). In larvae whose thorax and/or abdomen is covered by a pubescence, the tiny spicules are called *aculeae*, and the cuticle is *aculeate*. Without this pile the surface is smooth or *glabrous*. Where parts of a structure bear thorn-like spicules, varying from tiny to very coarse, they are termed *aciculae* and the state is called *aciculate*. The lateral aspect of abdominal segment VIII and also the siphon in many kinds of mosquito larvae bear specialized projections (Plates 6, 7). Laterally on abdominal segment VIII the structures are *comb scales* (CS) and they usually bear along their projecting, posterior border a fringe of subequal spinules, or a median large spine and lateral smaller spinules. Those on the siphon are the pecten spines (PS), consisting of a comb-like row of spines. Each may bear one or more lateral denticles on one, or less frequently, on both margins. In subgenus *Psorophora*, the pecten spines extend apically into long filaments. In anopheline larvae there is a *pecten plate* (PP) on abdominal segment VIII possessing large and small spines posteriorly.

Setae are distinguished from spicules by the presence of a basal alveolus from which the seta arises. Setae may be attached to the sclerotized structures, such as the head, siphon and saddle, or directly to the membranous integument of the larval body. Single setae may be aciculate, barbed, brush-tipped, foliform, lanceolate, simple, spiniform or spinluate. The forms of branched setae are shown on Plate 8. Two of them need special mention. Specialized setae characteristic of the genus *Anopheles* have flattened, moveable branches radiating from a short, stout stem and are named *palmate*. These branches are known as leaflets which can have smooth or serrate margins. The flat surface of the leaflets is the *blade* and it may have a terminal *filament*. The other is *seta 4-X,* a group of setal tufts, known as the *ventral brush* (VB). In most mosquito larvae it is composed of a row of fanlike setae, some or all of which are usually attached to a heavily sclerotized network of bars called the *grid* (G). It consists of a number of *transverse grid bars* (TGB) connected to *lateral grid bars* (LGB) (Plate 9A). Those setal tufts attached to the grid are called *cratal setae* and those attached to the segment anterior to the grid are the *precratal setae*. The following abbreviations will be used in the larval keys (Plates 6, 7) and must be learned. In the keys that follow only numbers and letters or Roman numerals will be used in naming setae.

A = antenna	III = abdominal segment III
C = head	IV = abdominal segment IV
P = prothorax	V = abdominal segment V
M = mesothorax	VI = abdominal segment VI
T = metathorax	VII = abdominal segment VII
I = abdominal segment I	VIII = abdominal segment VIII
II = abdominal segment II	X = abdominal segment X
	S = siphon

HEAD

The head is composed of a sclerotized capsule, bearing the mouthparts and antennae anteriorly and the occipital foramen posteriorly, the opening of the cranium to which the cervix is attached. The shape of the head is distinctive in some mosquito larvae. Most have an ovate head, wider than long with the greatest width at the level of the eyes. In the genus *Uranotaenia*, larval heads are rather thin, longer than wide, while in the predatory larvae, heads are quadrate-shaped, e.g., *Ps. ciliata*.

The large sclerite forming the dorsal aspect of the head is the *dorsal apotome* (Dap). The mouthparts will not be discussed here. For their description and function, consult Gardner et al. (1973) and Harbach and Knight (1980). Dorsolateral to the mouthparts, of which the mandibles and maxillae are most obvious externally, is a lobe, the *lateral palatal plate* (LPP) bearing a brush, the *lateral palatal brush* (LPB), previously called the mouth brush. Usually the brush is made up of many filaments, sometimes comb-tipped, but in the predatory larvae, they consist of a few stout prehensile spicules or rods.

Setae of the head. On the head are 16 pairs of setae, of which seta 2-C to 9-C are used in identification. The letter “C” is used to indicate that the seta is located on the head.

The position of the setae in relation to one another is used in identification. In anopheline larvae the two setae 2-C may be so close together that they are separated by less than the diameter of one of their alveoli, or they are separated by more than the width of one alveolus.

In several species the setae of the head are very course, that is, their diameters are about equal from the base to near the apex, while in most larvae the setae of the head are attenuated, gradually tapering apically. Usually seta 4-C is a small, weak seta, but in species of subgenus *Protomacleaya* it is well developed and multibranched.

In many instances the size of a seta or relative size in comparison to another, the number of branches, the manner of branching (Plate 8) and the presence of aciculae are all used as diagnostic characters. Setae 5, 6-C in *Uranotaenia* are unique, very stout, spinulate spiniforms.

Antenna. The antenna is a cylindrical, sensory appendage attached anterolaterally to the head. It bears six setae, 1-A to 6-A. In the genus *Coquillettidia* the antenna has an additional segment distal to the point of attachment of setae 2, 3-A, called the *flagellum* (Fl). In most species of genus *Culex* the antenna is markedly constricted in the distal

0.33, beyond the attachment of seta 1-A. The antennal length is significant; in most species it is shorter than the head, but in some it is as long as or longer than the head. The surface of the antenna is usually beset with spicules but may vary from none, to a few small spicules, to many coarse spicules. The location of seta 1-A is diagnostic for some larvae. It may be near the middle, or may be in the basal 0.3 or the distal 0.3, depending on the species. The number and size of the branches of 1-A are also used.

THORAX

The thorax is an ovate unit of the body, somewhat wider than the head in well-nourished fourth instars. As in the adult, it consists of 3 segments, pro-, meso-, and metathorax. They are distinguished by 3 distinct rows of setae, 0-P to 14-P on the prothorax, 1-M to 14-M on the mesothorax, and 1-T to 13-T on the metathorax. The integument is either glabrous or aceuleate. Larvae with the latter are easily detected under a compound microscope. Check the edges of the thorax on the vertical surface where debris, often found covering the body of mature larvae, does not accumulate.

Of the 42 pairs of setae available on the thorax, only 10 are used in the larval keys. The number of branches in seta 1, 3-P and the size of seta 1-M are important key characters.

ABDOMEN

The larval abdomen consists of 10 segments, each designated by the appropriate Roman numeral. The first 7 segments are very similar, segment I bearing 12 setae and II through VII, 15 setae each. Segments VIII-X are functionally specialized and morphologically different from the others. Segment IX does not exist as a distinct unit, but is incorporated into VIII and X and is not in the keys.

Some larvae of *Orthopodomyia* have a well-developed tergal plate (TP) present on VIII and sometimes on VII and larvae of *Uranotaenia* and most *Psorophora* have sclerites laterally on VIII, known as *comb plates* (CP) to which the comb scales are attached. *Toxorhynchites* larvae have numerous *setal support plates* (SSP) on thoracic and abdominal segments and a larger one laterally on VIII.

Segments I-VII. Although there are 86 pairs of setae on abdominal segments I-VII, only 13 different setae are used as key characters. Seta 1 is a palmate seta on some abdominal terga in anopheline larvae. The fully developed palmate seta usually has 10 or more leaflets and when in its normal position spreads at least 150 degrees. Seta 6, usually prominent, is found laterally on each segment and is best developed on I, II. Seta 0 is usually a tiny, single seta in anopheline larvae, but in *An. crucians* it is well developed with 4 or more branches.

Segment VIII. Mosquito larvae are metapneustic, that is, the only functional orifices of the respiratory system, the *spiracular openings* (SOp), are located on abdominal segment VIII. These openings are surrounded by the *spriacular apparatus* (Sap). In anopheline larvae these structures are sessile, while in culicines they are borne on the apex of a sclerotized tube, the *siphon* (S). There are only 5 setae on segments, 1-VIII to 5-VIII. Laterally on all larvae, except those in the genus *Toxorhynchites*, there occur *comb scales* (CS). They may be arranged in a single row, double row or an irregular patch. There may be as few as 5 or as many as 60. The total number, within ranges, is diagnostic and is used throughout the keys. The character of the middle spine compared to the size of the subapical spinules is occasionally utilized.

Spiracular apparatus. The spiracular apparatus is a 5-lobed valve that closes around the spiracular openings during submersion of the larva to protect the respiratory tracheae from inundation. The 5 lobes are the *anterior spiracular lobe* (ASL), the two *anterolateral spiracular lobes* (LSL) and the two *posterolateral spiracular lobes* (PSL). They are moveable, flap-like lobes and bear a total of 11 pairs of setae, 3-S to 13-S. Genus *Coquillettidia* has the spiracular apparatus highly modified for piercing the roots of aquatic plants to find a source of oxygen. It is in the form of an attenuated tube bearing hook-like teeth at the apex, *inner* and *outer spiracular teeth* (IST, OST), and an anterior serrated plate, known as the *saw* (SAW). This modified apparatus possesses 4 visible pairs of setae, 1, 2, 6 and 8-S

Siphon. The siphon (S) in culicine mosquito larvae is one of the most useful structures in identification. The length divided by the basal width is expressed as the *siphonal index*. In the species treated here the index varies from 1.8 to 7.0. Attached to the base of the siphon is a small lateral sclerite, the *siphon acus* (SA). In some species it is absent while in others it is detached from the base and is "floating" in its membrane.

Pecten. In four Pennsylvania genera, *Coquillettidia*, *Orthopodomyia*, *Toxorhynchites* and *Wyeomyia*, the pecten is absent. In most larvae the *pecten spines* form a comb-like row of spine-like spicules ventrolaterally on the siphon. Each spine has a varying number of denticles on its basal margin. A common variant is the distal-most spines being widely spaced from the others, termed "detached apically." The number of spines differs from as few as 3 to as many as 20.

Siphon setae. In many mosquito larvae the siphon has two pairs of setae, 1-S and 2-S, however, when several are present, the basal-most is named 1a-S, then in sequence 1b-S, 1c-S, 1d-S, etc. proceeding distally. Seta 2-S is small and located dorsal preapically. A trait of *Culex* larvae is the presence of 3 or more setae on the siphon and in many cases the penultimate seta is dorsally out of line. *Culiseta* larvae have as their principal distinguishing feature a pair of subbasal, ventrolateral setae. Furthermore, species of the subgenus *Culiseta* bear a row of short spicules just distal to the pecten. The location, size and number of branches of the setae are employed in the keys.

Segment X. This highly modified abdominal segment, commonly called the anal segment, is the most posterior. It possesses a large sclerite, the *saddle* (Sa), which partially or entirely encircles the segment, and usually 2 pairs of anal papillae, the homeostatic cylindrical organs attached terminally to the segment, and 4 pairs of setae, 1-X to 4-X.

Saddle. Larvae of Aedes, most Ochlerotatus and Wyeomyia posses a saddle which does not completely encircle segment X. It is often necessary to determine the extent to which the saddle encircles the segment. Some are small and do not exceed even 0.5 the distance to the midventral line. On the other hand, some larvae have very long, though incomplete saddles, almost reaching the midventral line. Since it is a principal key character it must be determined. At times it is extremely difficult to gauge the exact size especially in larvae that have been mounted in Canada balsam for many years because of the clearing action of the mountant. Very fine focusing by a compound microscope with 200-400X magnification will help.

Anal paplillae. Most mosquito larvae have 4 anal papillae (APP), however, *Wy. smithii* has only 2. It is customary to express the length of the anal papiallae as a ratio to the dorsal length of the saddle, known as the *anal papilla-saddle index*, computed by dividing the length of the dorsal papillae by the dorsal length of the saddle. *Oc. dupreei* larvae are unique for having very long anal papillae with an index of 8.0. Other Pennsylvania larvae have an index of less than 5.0. At the other extreme, those larvae that live in brackish water have very small anal papillae.

Setae of segment X. The length of seta 1-X, the saddle seta, is a key character. It is compared to the saddle length. Seta 4-X, the ventral brush, is composed of a variable number of paired and unpaired, fanlike setae. The most anterior seta is designated 4a-X, proceeding posteriorly, 4b-X, 4c-X, 4d-X, etc. This group of setae ac as a rudder during swimming. Seta 4-X is particularly well developed in larvae of genus *Psorophora*, in which numerous precratal setae extend anteriorly to more than 0.5 the length of the segment. The position of seta 4-X is important in larvae of *Ochlerotatus* having complete saddles. Seta 4-X is always posterior to the saddle. In *Wyeomyia* 4-X is a single pair of long or short, ventrolateral setae.

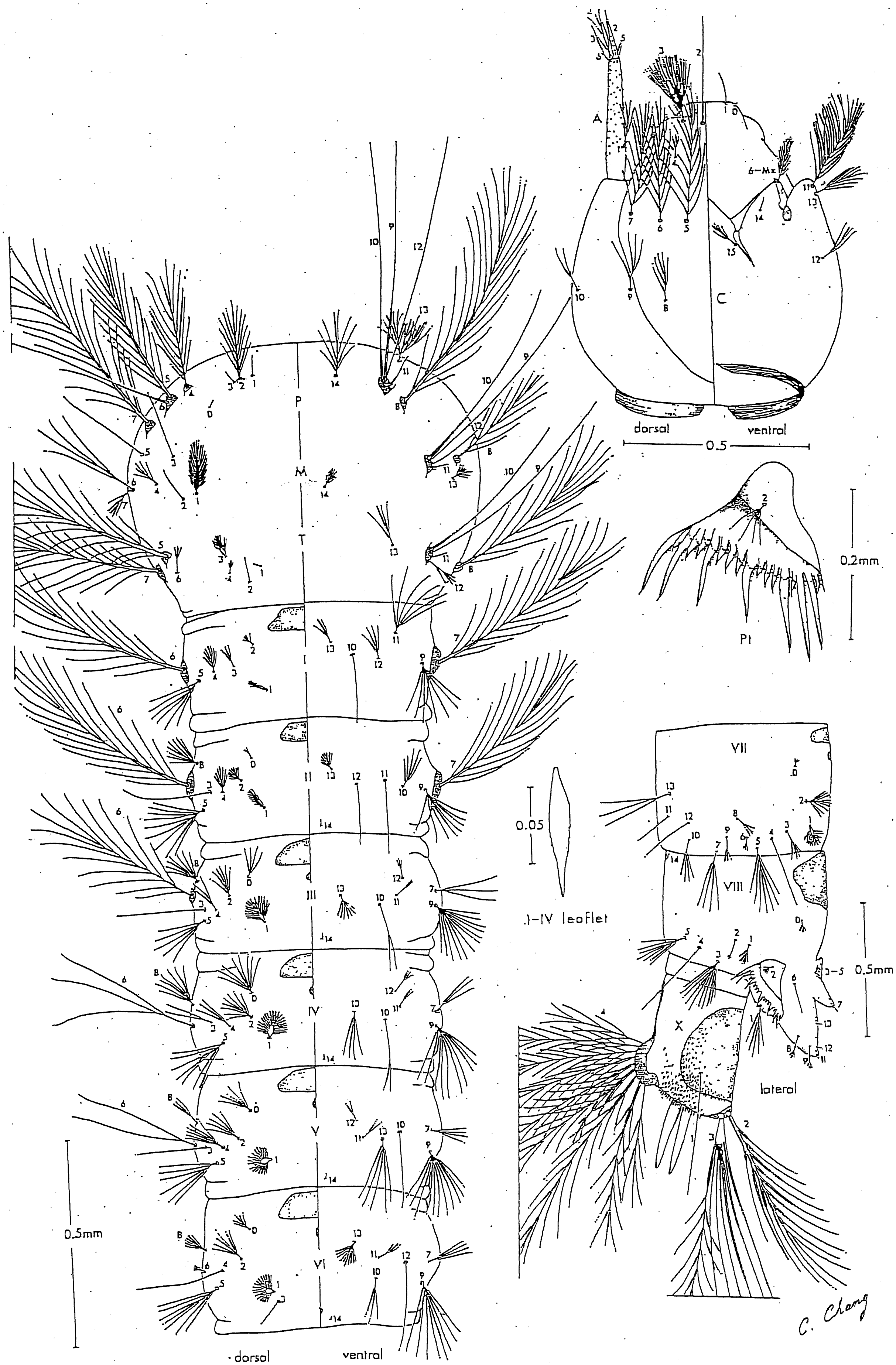


Plate 6. Fourth stage anopheline larva; dorsal left, ventral right.

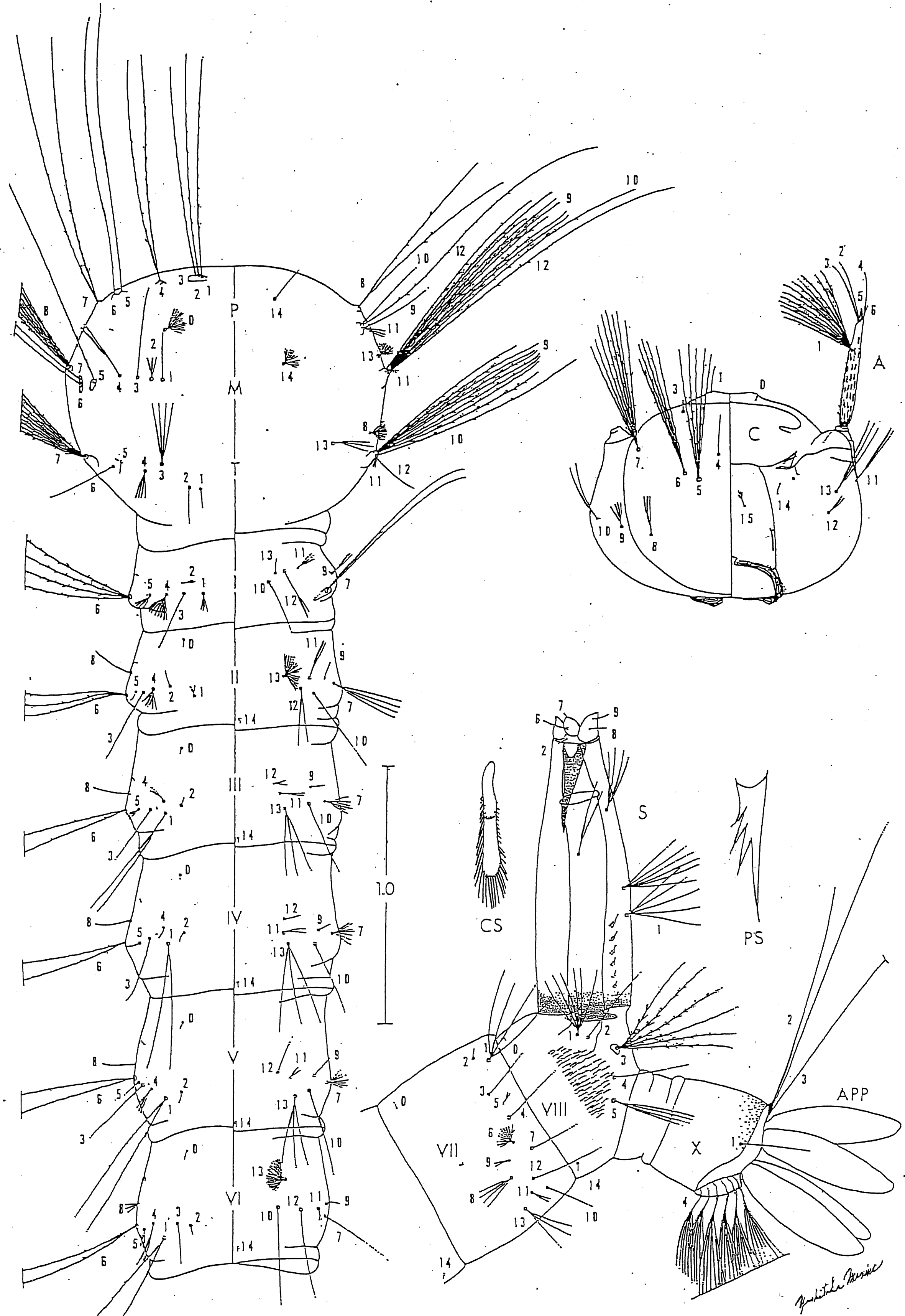


Plate 7.. Fourth stage culicine larva; dorsal left, ventral right.

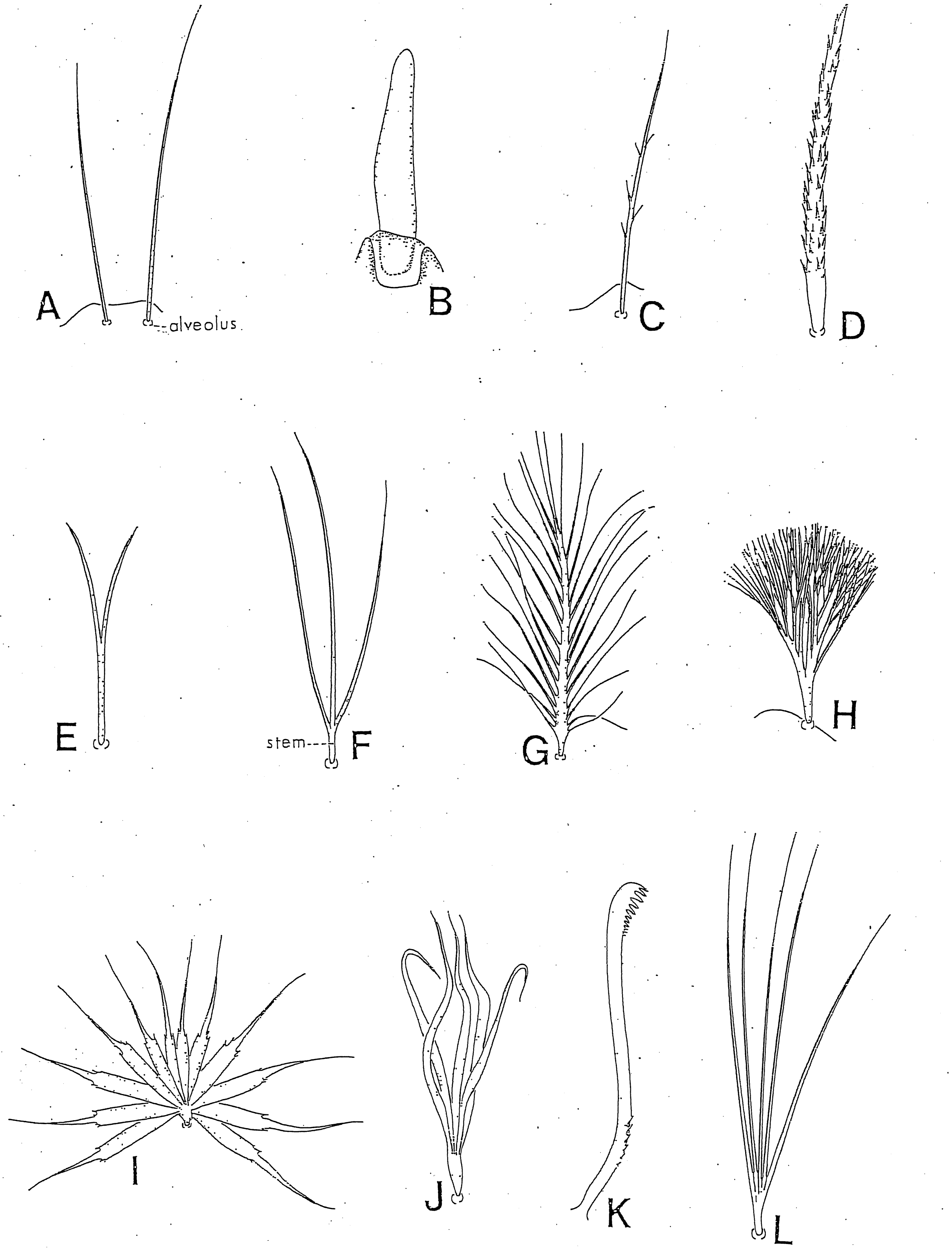


Plate 8. Examples of kinds of setae found in mosquito larvae. A. Unbranched smooth setae; B. Spiniform seta; C. Unbranched aciculate seta; D. Spinulate spiniform seta; E. Forked seta; F. Branched seta; G. Plumose seta; H. Dendritic seta; I. Palmate seta, fully developed; J. Palmate seta, 0.5 developed; K. Comb-tipped filament; L. Fanlike seta of ventral brush.

ABBREVIATIONS IN PLATE 9

APP - anal papilla
ASL - anterior spiracular lobe
ASLP - anterior spiracular lobe plate
C - comb
CS - comb scales
G - grid
IST - inner spiracular teeth
LGB - lateral grid bar
LSL - anterolateral spiracular lobe
LSLP - anterolateral spiracular lobe plate
MdP - median plate
OST - outer spiracular teeth
PP - pecten plate
PS - pecten spines
PSL - posterolateral spiracular lobe
PSLP - posterolateral spiracular lobe plate
PSP - posterior spiracular plate
Pt - pecten
S - siphon
Sa - saddle
SA - siphon acus
SaA - saddle acus
SAd- spiracular apodeme
SAp- spiracular apparatus
SAW - saw
SOp - spiracular opening
TGB - transverse grid bar
VII - abdominal segment VII
VIII - abdominal segment VIII
X - abdominal segment X (anal segment)
2-S - seta 2 of siphon

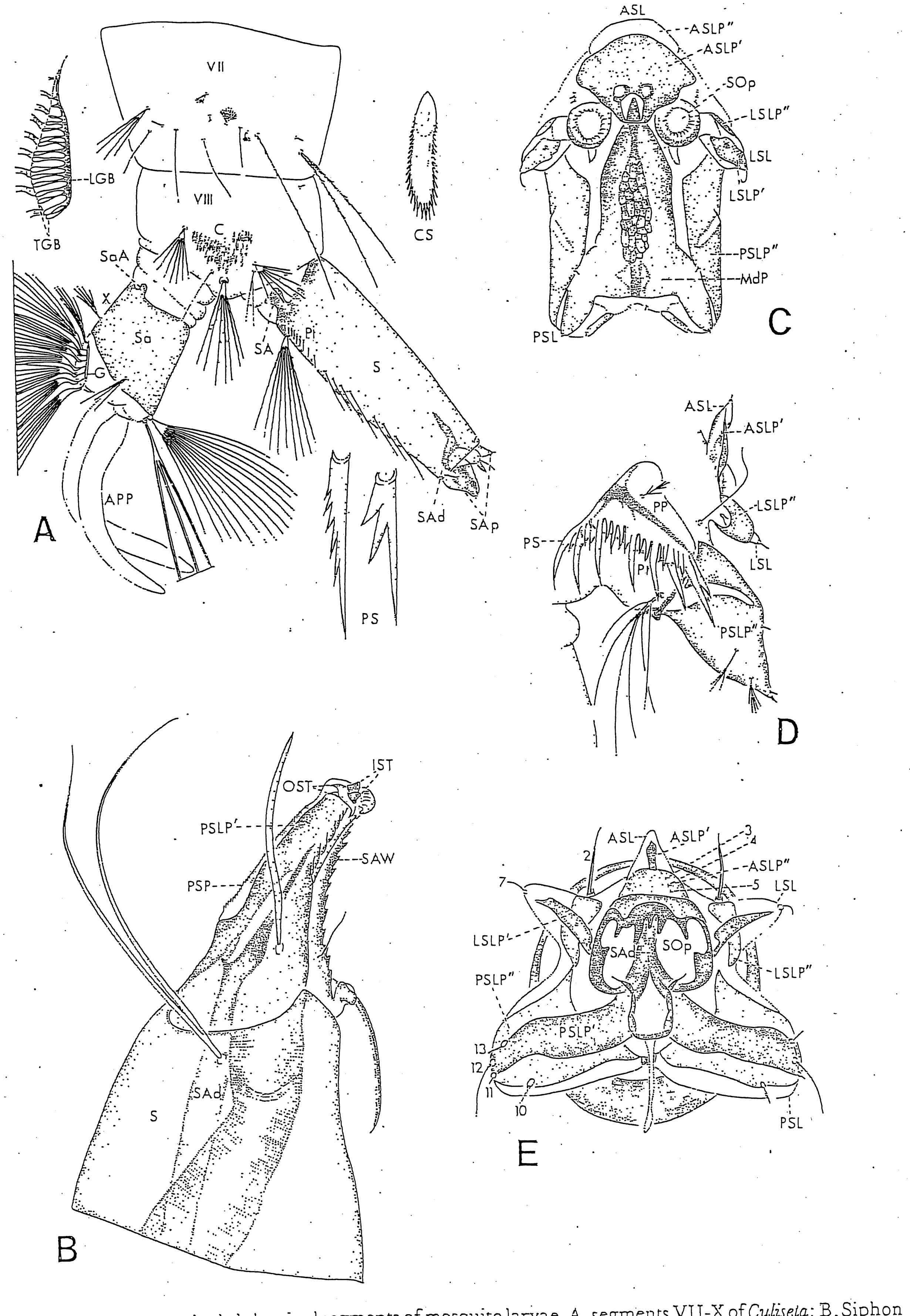


Plate 9. Morphology of terminal abdominal segments of mosquito larvae. A. segments VII-X of *Culiseta*; B. Siphon and spiracular apparatus of *Mansonia*; C,D. Spiracular apparatus of *Anopheles*; C. dorsal view, D. lateral view; E. dorsal view of spiracular apparatus of *Culex*.

Abbreviations used in the key to fourth instar larvae

A – antenna

APP – anal papilla

C – head

CS – comb scale

M – mesothorax

P – prothorax

PS – pecten spine

S – siphon

Sa – saddle

T - metathorax

TP – tergal plate

X – abdominal segment X

I-X – abdominal segments

KEYS TO THE FOURTH INSTAR LARVAE OF THE MOSQUITOES OF PENNSYLVANIA

KEY TO GENERA

1. Respiratory siphon absent; at least some abdominal terga with seta 1 palmate (Fig. 191) .... *Anopheles*

   Respiratory siphon present; seta 1 on abdominal terga never palmate (Fig. 192) 2

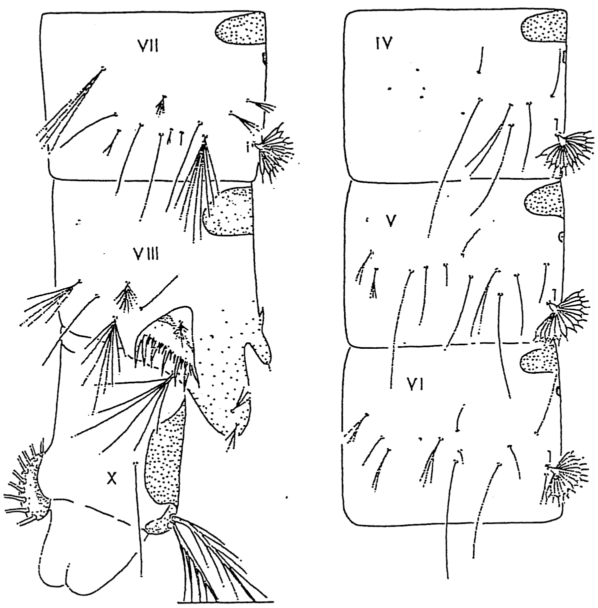


Fig. 191. Lateral view of abdominal segments IV-X- *An. quadrimaculatus*

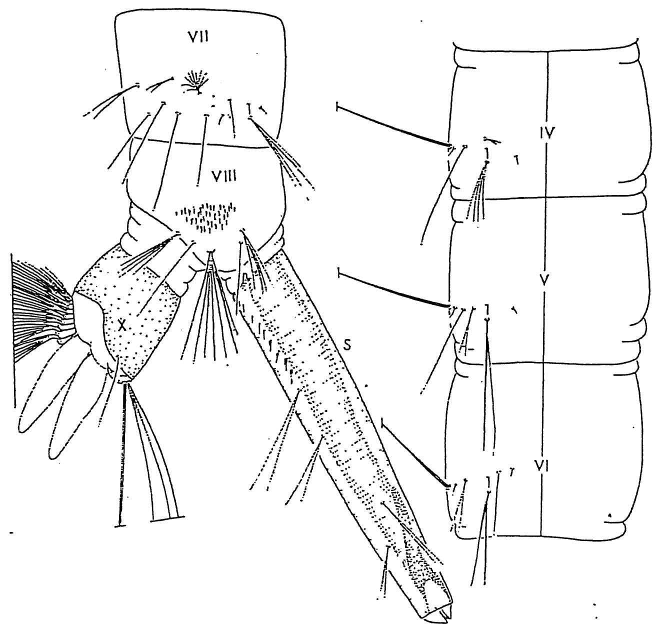


Fig. 192. Dorsal and lateral view of abdominal segments IV-X – *Cx. pipiens*

2(1). Siphon attenuated apically, with dorsal saw, adapted for piercing plant tissue (Fig. 193) .... *Coquillettidia perturbans*

   Siphon not attenuated apically, not adapted for piercing plant tissue (Fig. 194) 3

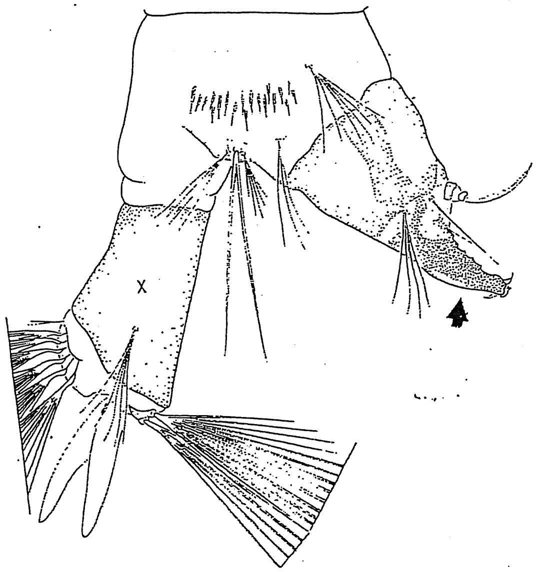


Fig. 193. Lateral view of abdominal segments VIII-X – *Cq. perturbans*

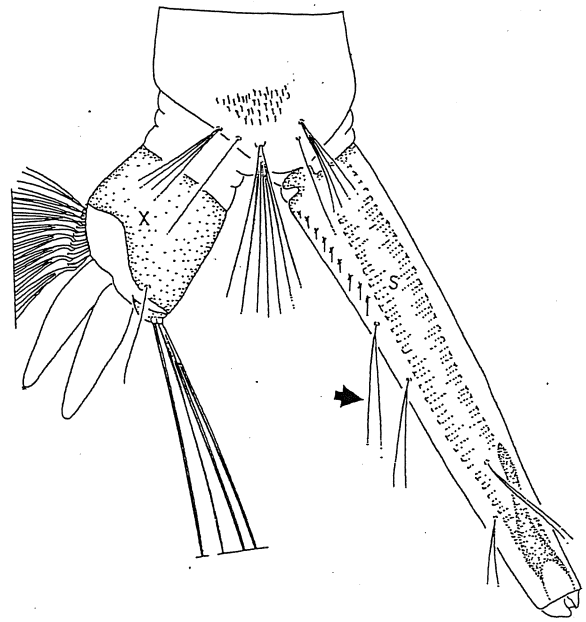


Fig. 194. Lateral view of abdominal segments VIII-X – *Cx. pipiens*

3(2). Siphon without pecten spines (Fig. 195) 4

Siphon with pecten spines (Fig. 196) 6

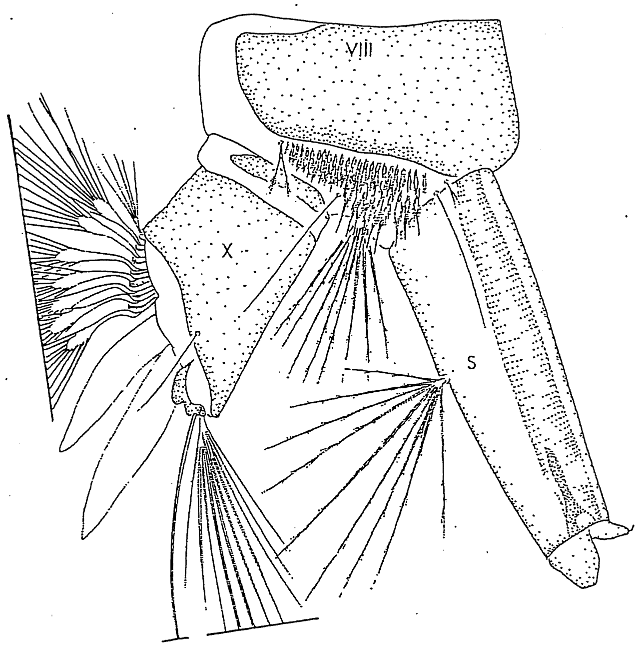


Fig. 195. Lateral view of abdominal segments VIII-X – *Or. signifera*

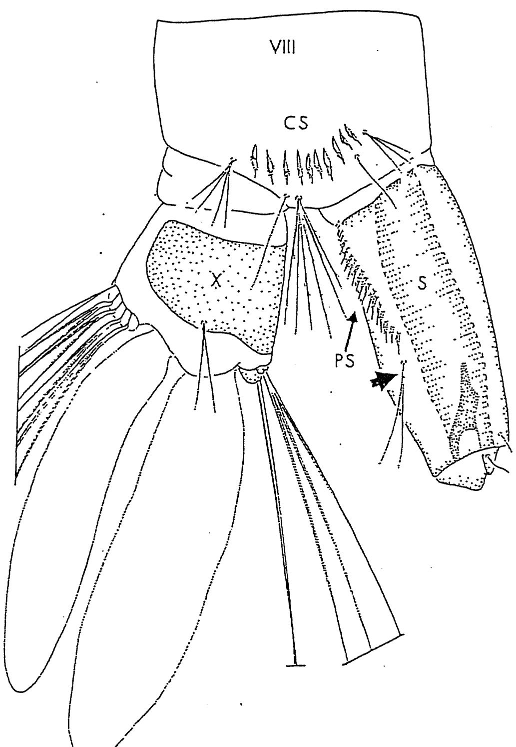


Fig. 196. Lateral view of abdominal segments VIII-X – *Ae. aegypti*

4(3). Lateral palatal brush composed of few curved rods (Fig. 197); comb scales absent (Fig. 198) . . . . *Toxorhynchites rutilus septentrionalis*

Lateral palatal brush composed of numerous thin, sometimes pectinate, filaments (Fig. 199); with comb scales (Fig. 200) 5

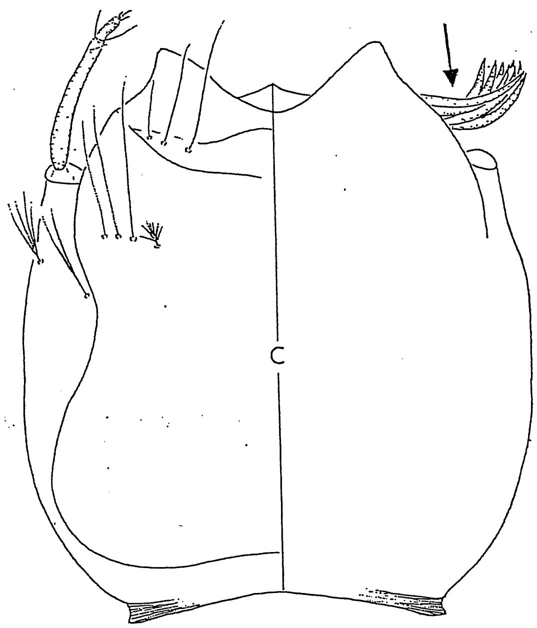


Fig. 197. Dorsal view of head – *Tx. r. septentrionalis*

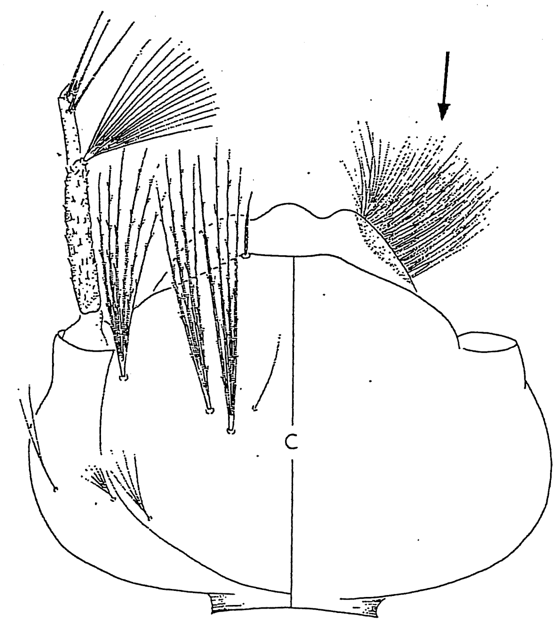


Fig. 199. Dorsal view of head – *Cx. pipiens*

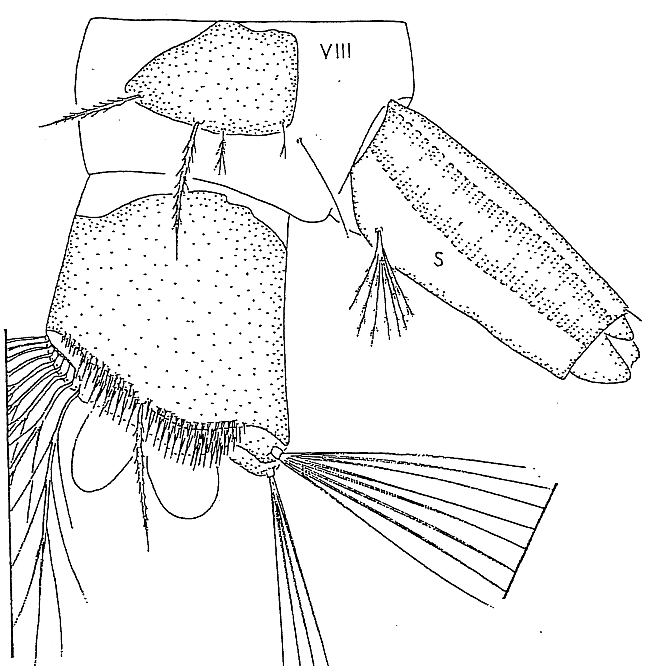


Fig. 198. Lateral view of abdominal segments VIII-X – *Tx. r. rutilus*

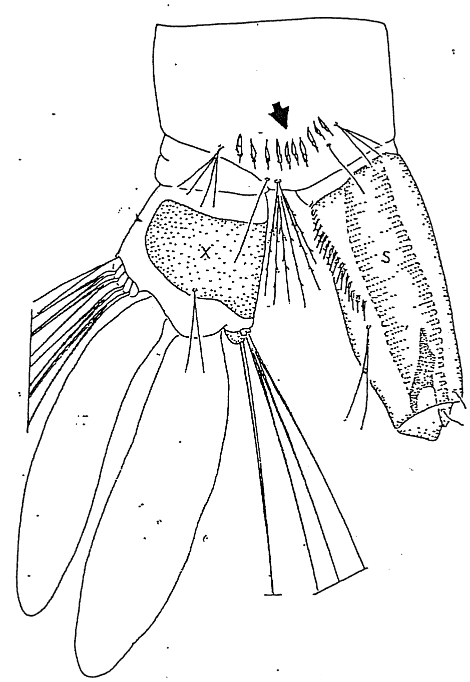


Fig. 200. Lateral view of abdominal segments VIII-X – *Ae. aegypt*

5(4). Segment X without median ventral brush, seta 4-X a pair of ventroposterolateral setae; comb scales in single row (Fig. 201) .... *Wyeomyia smithii*

Segment X with seta 4-X, a well developed median ventral brush; comb scales in 2 rows (Fig. 202) .... *Orthopodomyia*

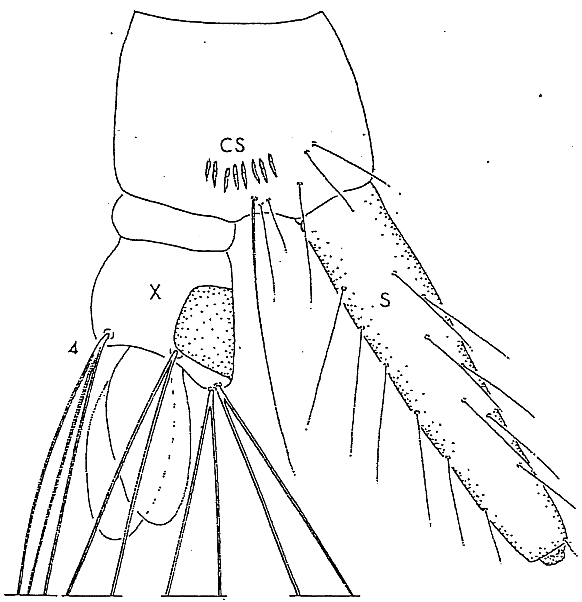


Fig. 201. Lateral view of abdominal segments VIII-X – *Wy. smithii*

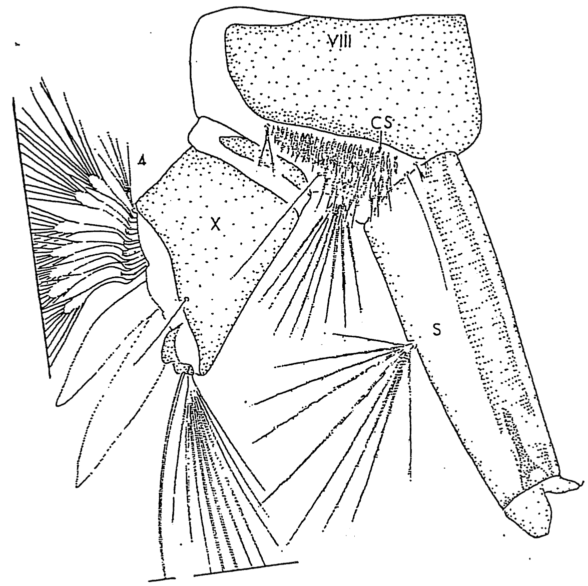


Fig. 202. Lateral view of abdominal segments VIII-X – *Or. signifera*

6(3). Segment VIII with large lateral comb plate bearing comb scales (Fig. 203); head longer than wide (Fig. 204) .... *Uranotaenia sapphirina*

Segment VIII without comb plate, or if present, small (Fig. 205); head wider than long (Fig. 206) 7

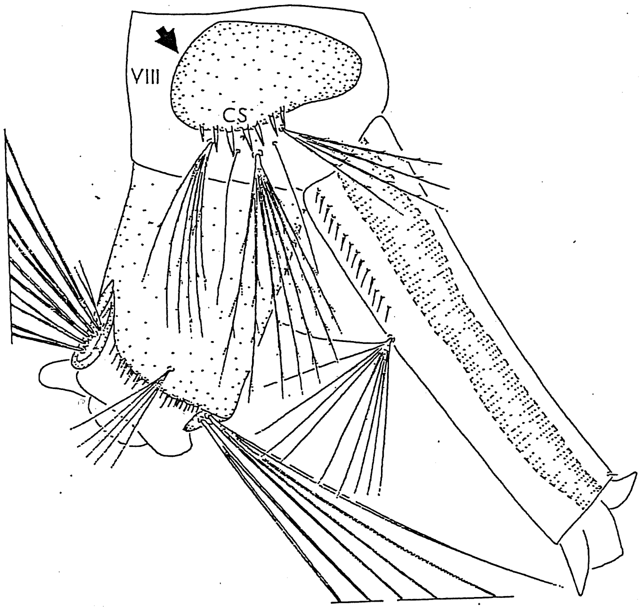


Fig. 203. Lateral view of abdominal segments VIII-X – *Ur. sapphirina*

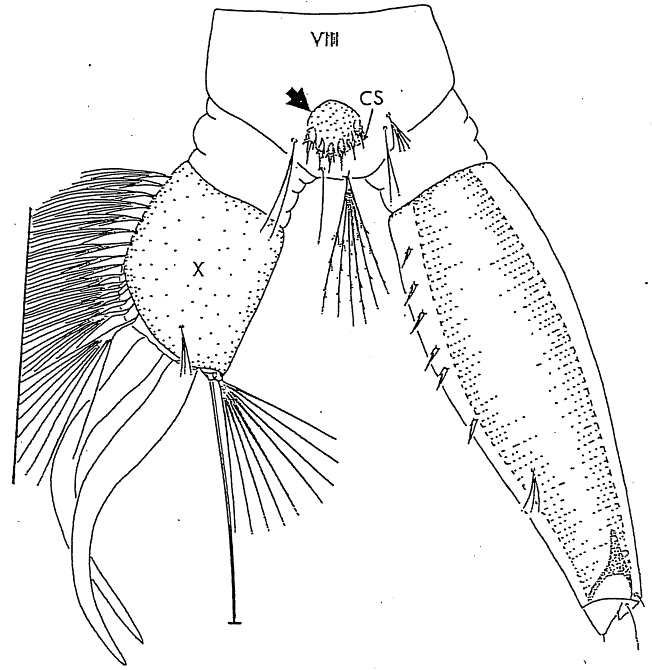


Fig. 205. Lateral of abdominal segments VIII-X – *Ps. columbiae*

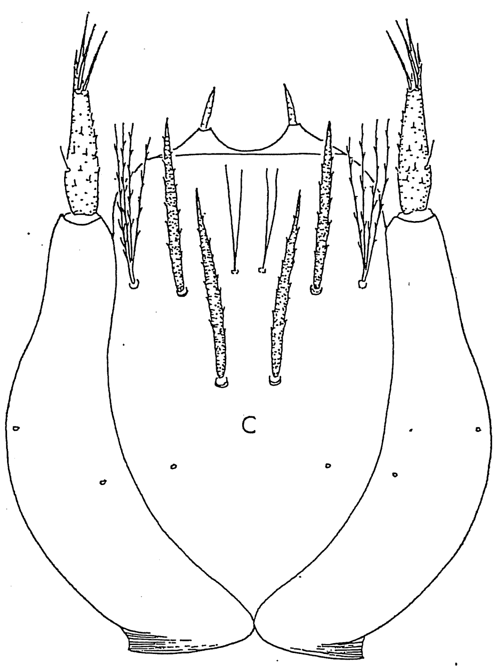


Fig. 204. Dorsal view of head – *Ur. sapphirina*

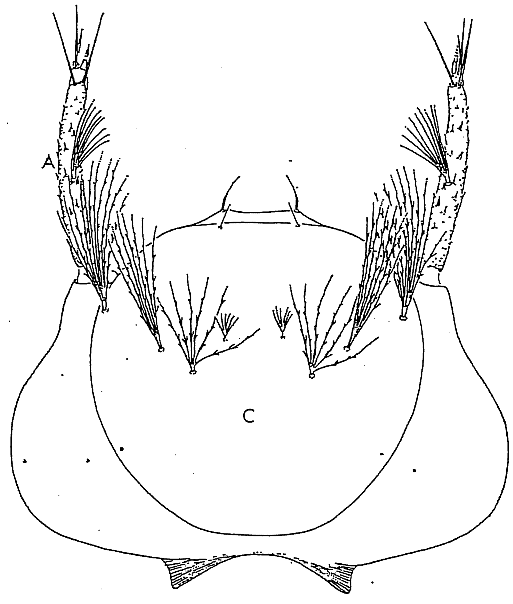


Fig. 206. Dorsal view of head – *Ps. columbiae*

7(6). Siphon with subbasal pair of ventral setae (Fig. 207) . . . . *Culiseta*

Siphon with setae elsewhere, not ventrally near base (Fig. 208) 8

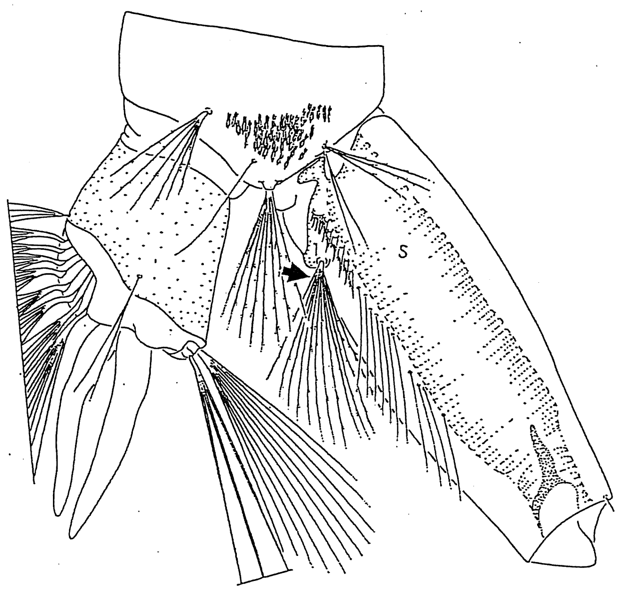


Fig. 207. Lateral view of abdominal segments VIII-X – *Cs. inornata*

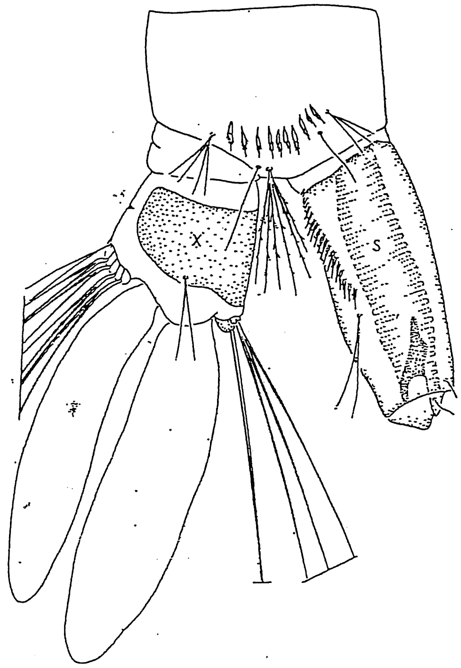


Fig. 208. Lateral view of abdominal segments VIII-X – *Ae. aegypti*

8(7). Siphon with 3 or more pairs of setae (Fig. 209) 9

Siphon with 1 pair of setae (Fig. 210) 10

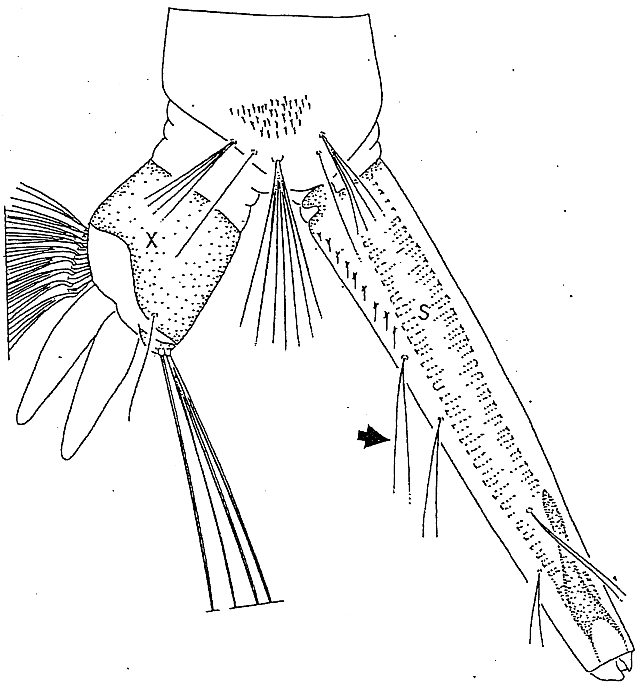


Fig. 209. Lateral view of abdominal segments VIII-X – *Cx. pipiens*

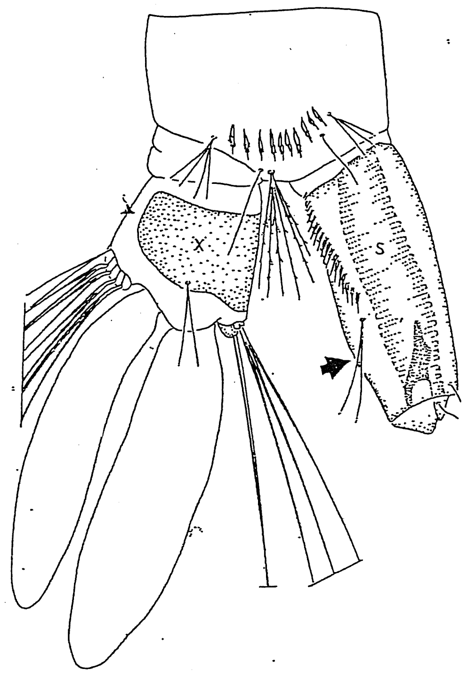


Fig. 210. Lateral view of abdominal segments VIII-X – *Ae. aegypti*

9(8). Saddle completely encircling segment X ; pecten spines evenly spaced (Fig. 211) .... *Culex*

Saddle not completely encircling segment X ; several pecten spines detached apically (Fig. 212) .... *Ochlerotatus provocans*

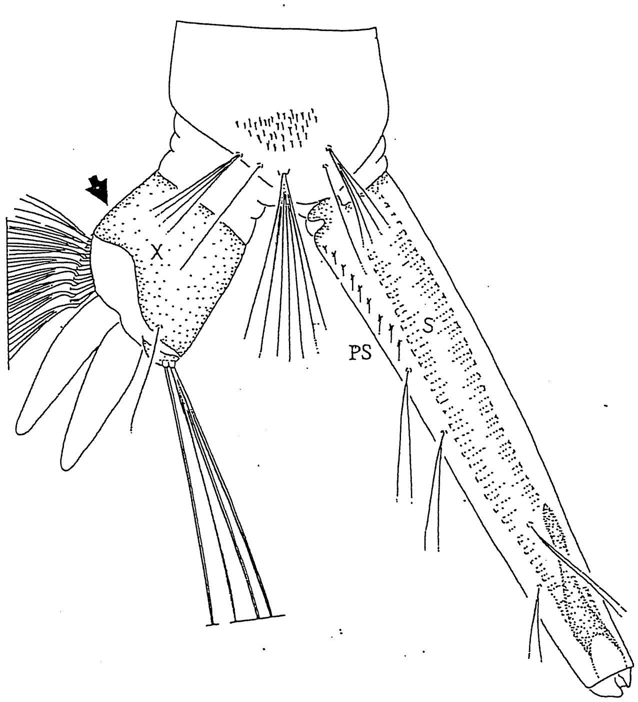


Fig. 211. Lateral view of abdominal segments VIII-X – *Cx. pipiens*

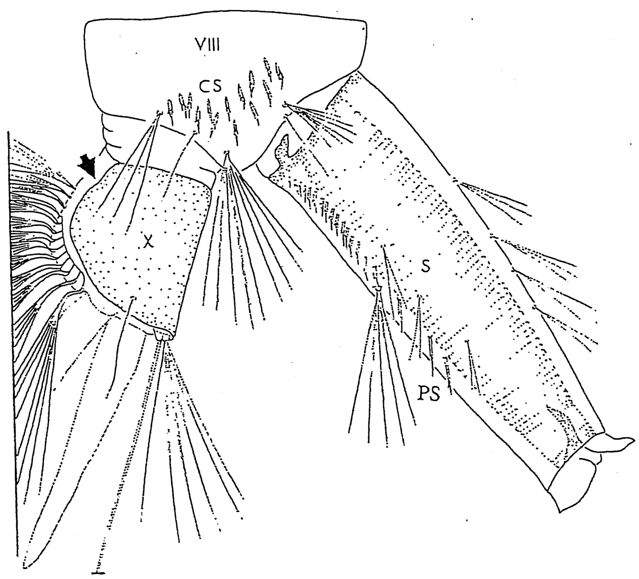


Fig. 212. Lateral view of abdominal segments VIII-X – *Oc. provocans*

10(8), Saddle completely encircling segment X, pierced along midventral line by row of precratal setal tufts (Fig. 213) .... *Psorophora*

Saddle usually not encircling segment X, but if so, then setal tufts of setae 4-X confined posterior to it (Fig. 214) .... *Aedes*
Ochlerotatus

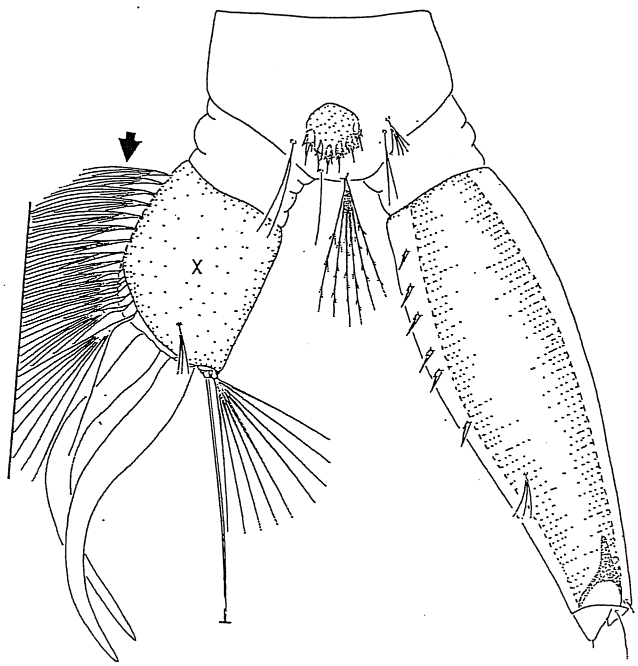


Fig. 213. Lateral view of abdominal segments VIII-X – *Ps. columbiae*

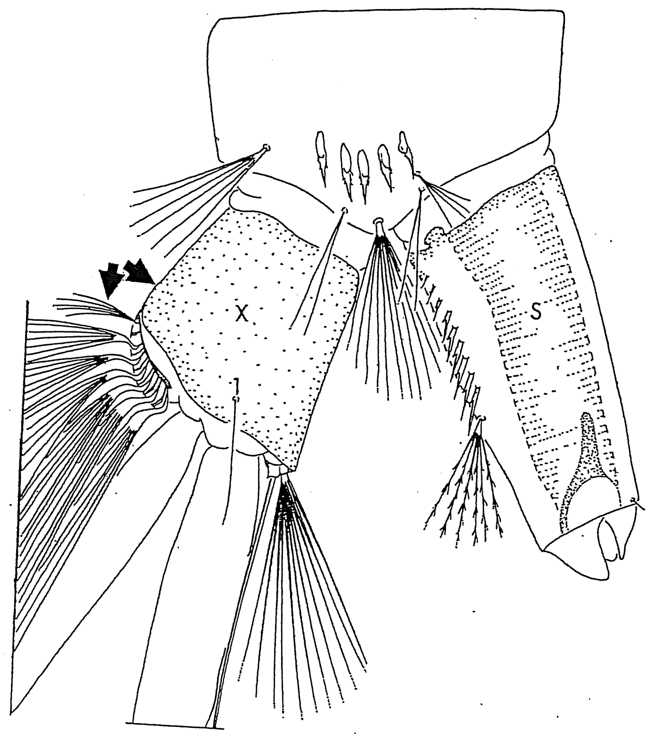


Fig.. 214. Lateral view of abdominal segments VIII-X – *Oc. atlanticus*

KEY TO GENUS ANOPHELES

1. Setae 5-7-C small, single or double (Fig. 215); setae 6-I-VI plumose (Fig. 216) .... *barberi*

Setae 5-7-C large, multibranched (Fig. 217); setae 6-IV-VI not plumose (Fig. 218) 2

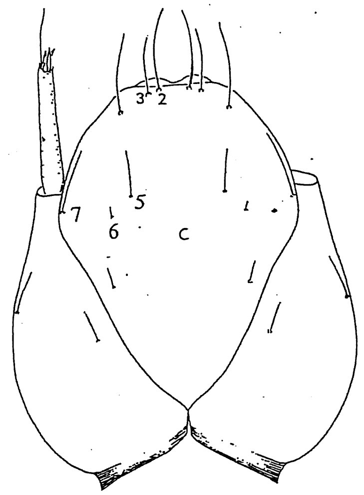


Fig. 215. Dorsal view of head – *An. barberi*

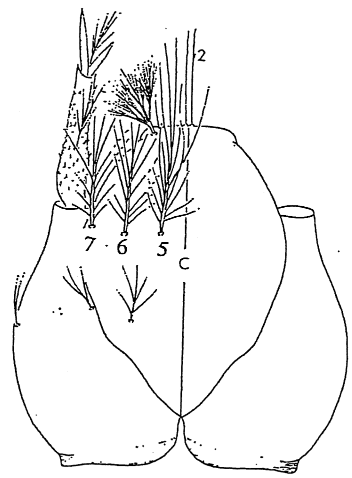


Fig. 217. Dorsal view of head – *An. walkeri*

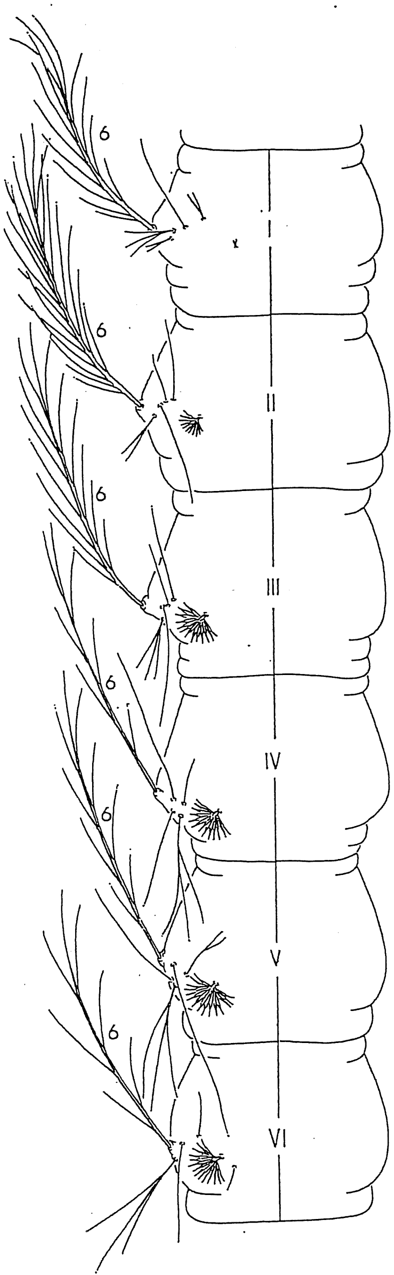


Fig. 216. Dorsal view of abdominal segments I-VI – *An. barberi*

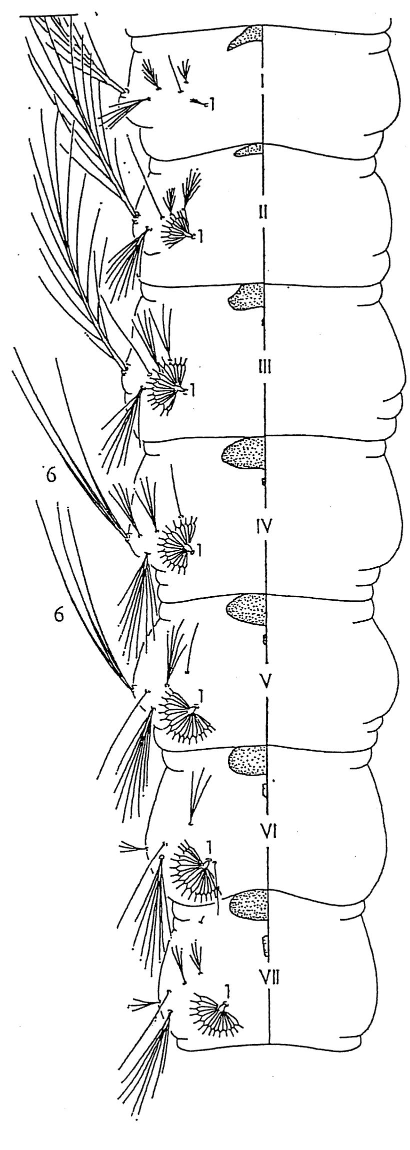


Fig. 218. Dorsal view of abdominal segments I-VI – *An. quadrimaculatus*

2)1). Seta 0 well developed on IV,V, with 4 or more branches, about equal to seta 2-IV,V (Fig. 219) .... *crucians*

Seta 0 minute on IV,V, single to triple, much smaller than seta 2-IV,V (Fig. 220) 3

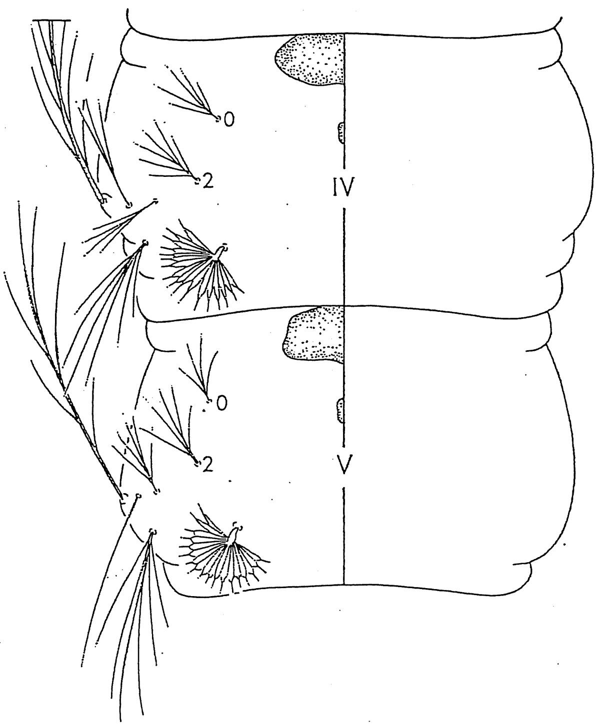


Fig. 219. Dorsal view of abdominal segments IV-V – *An. crucians*

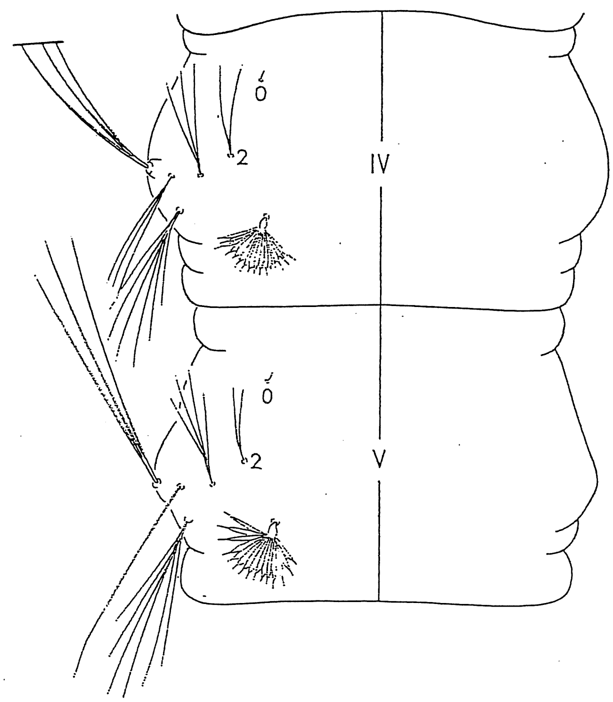


Fig. 220. Dorsal view of abdominal segments IV-V – *An. punctipennis*

3(2). Seta 2-C single, sparsely aciculate toward apex (Fig. 221); seta 1-P with 3-5 strong branches from near base (Fig. 222) .... *walkeri*

Seta 2-C single or forked in outer 0.5, without aciculae (Fig. 223); seta 1-P weak, single or branched in outer 0.5 (Fig. 224) 4

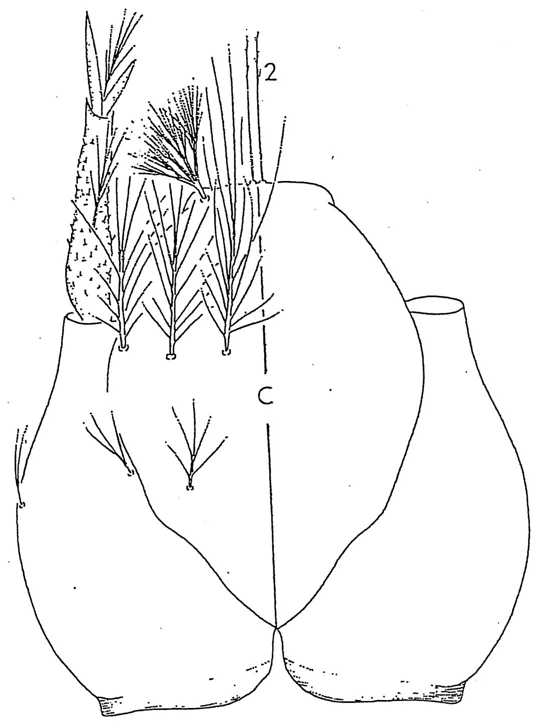


Fig. 221. Dorsal view of head – *An. walkeri*

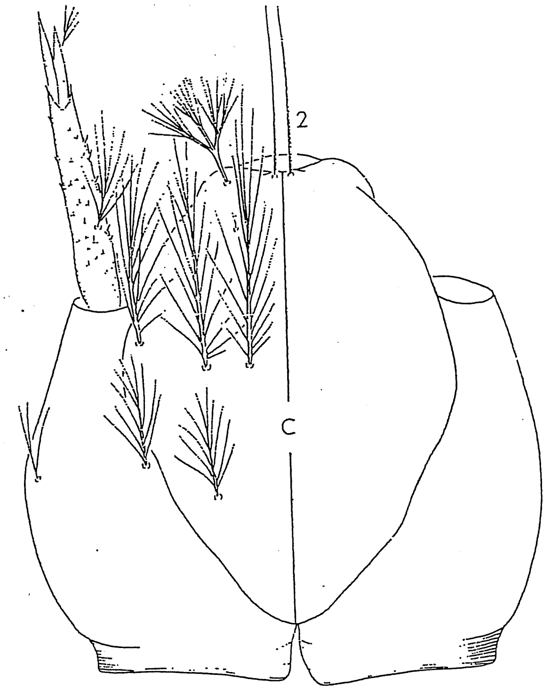


Fig. 223. Dorsal view of head – *An. quadrimaculatus*

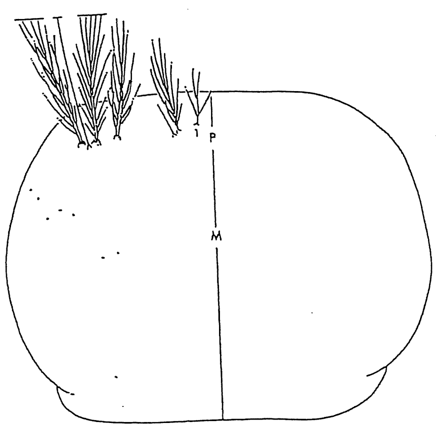


Fig. 222. Dorsal view of thorax – *An. walkeri*

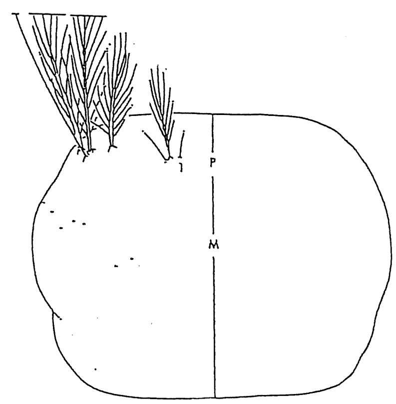


Fig. 224. Dorsal view of thorax – *An. quadrimaculatus*

4(3). Seta 2-C usually with 2-5 branches in outer 0.5 (Fig. 225) .... *earlei*

Seta 2-C single (Fig. 226) 5

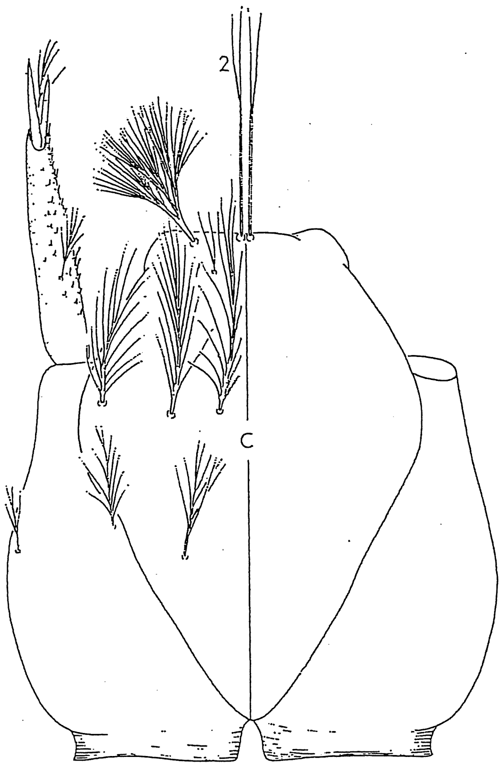


Fig. 225. Dorsal view of head – *An. earlei*

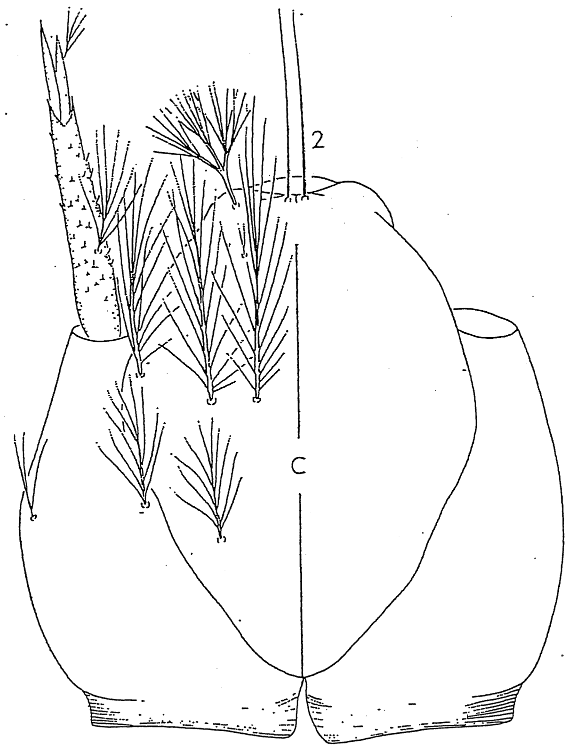


Fig. 226. Dorsal view of head – *An. quadrimaculatus*

5(4). Alveoli of setae 2-C separated by more than diameter of one alveolus; setae 8,9-C large, usually with 8-10 branches (Fig. 227) . . . . *quadrimaculatus* sl

Alveoli of setae 2-C closer than diameter of one alveolus; setae 8,9-C smaller, usually with 3-7 branches (Fig. 228) 6

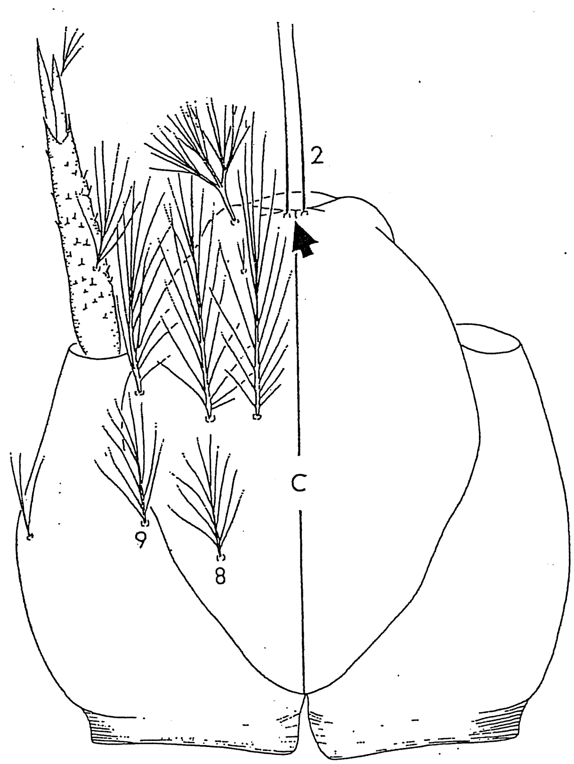


Fig. 227. Dorsal view of head – *An. quadrimaculatus*

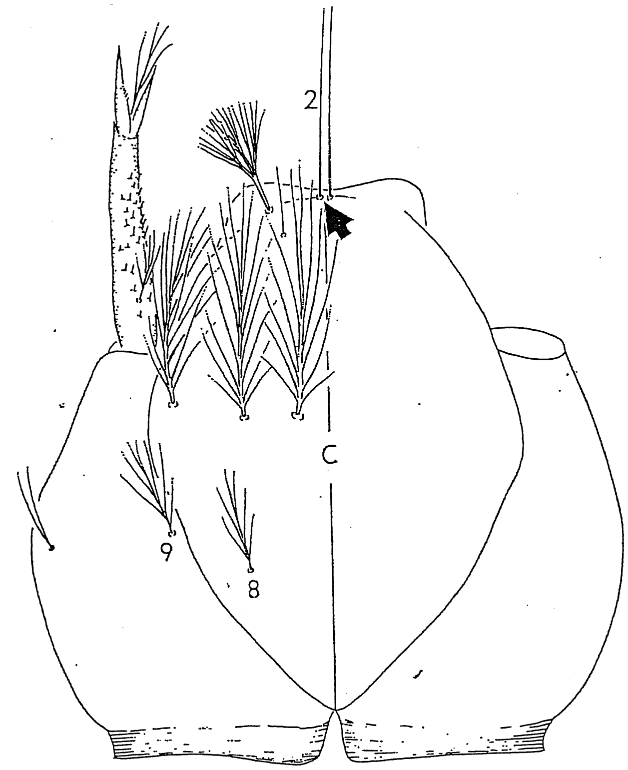


Fig. 228. Dorsal view of head – *An. punctipennis*

6(5). Setae 2-IV,V usually single (Fig. 229) .... (in part) *perplexens*

Setae 2-IV,V usually double or triple (Fig. 230) .... *punctipennis*
(in part) *perplexens*

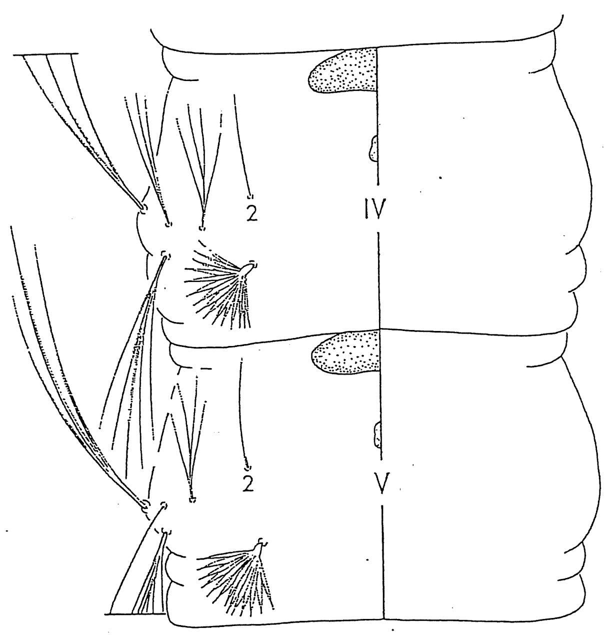


Fig. 229. Dorsal view of abdominal segments IV-V – *An. perplexens*

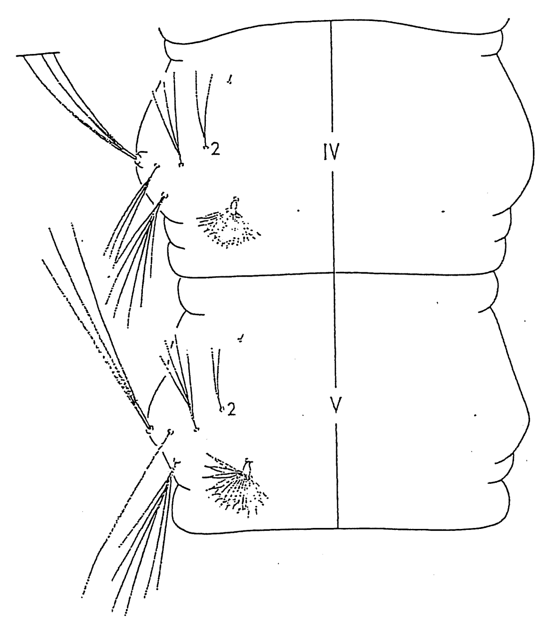


Fig. 230 – Dorsal view of abdominal segments IV-V – *An. punctipennis*

KEY TO GENERA AEDES (Ae) AND OCHLEROTATUS (Oc)

1. Siphon with more than 1 pair of setae (Fig. 231) 2

Siphon with 1 pair of setae (Fig. 232) 3

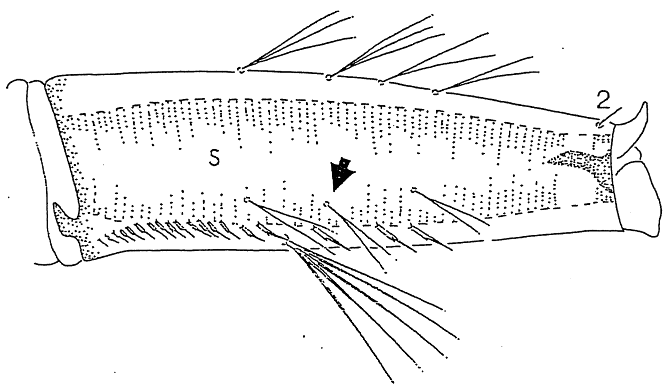


Fig. 231. Lateral view of siphon - *Oc. provocans*

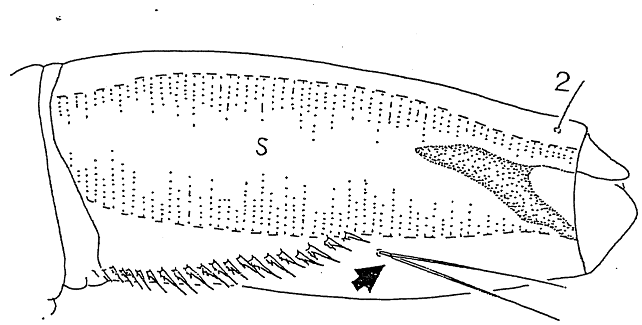


Fig. 232. Lateral view of siphon – *Ae. aegypti*

2(1). Bases of setae 5-7-C nearly in straight line (Fig. 233) .... (in part) *Ae. cinereus*

Base of seta 6-C anterior to 5-C and 7-C (Fig. 234) .... *Oc. provocans*

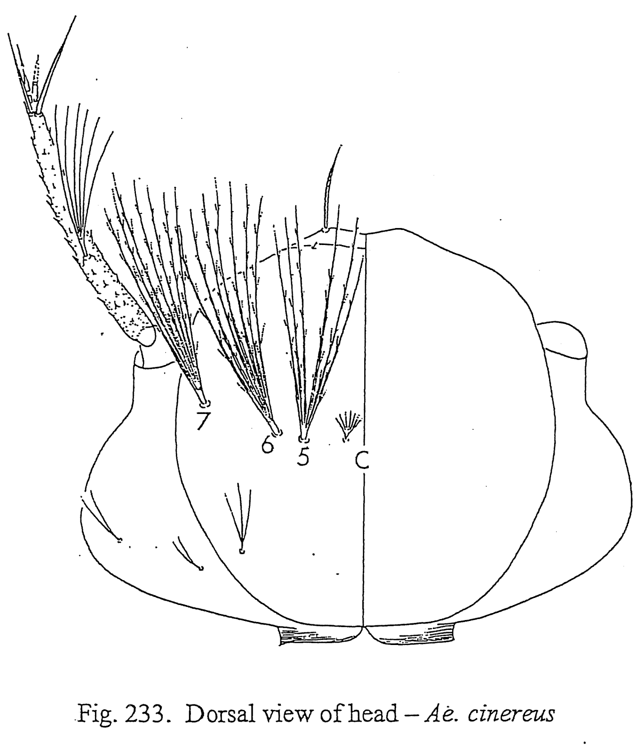


Fig. 233. Dorsal view of head – *Ae. cinereus*

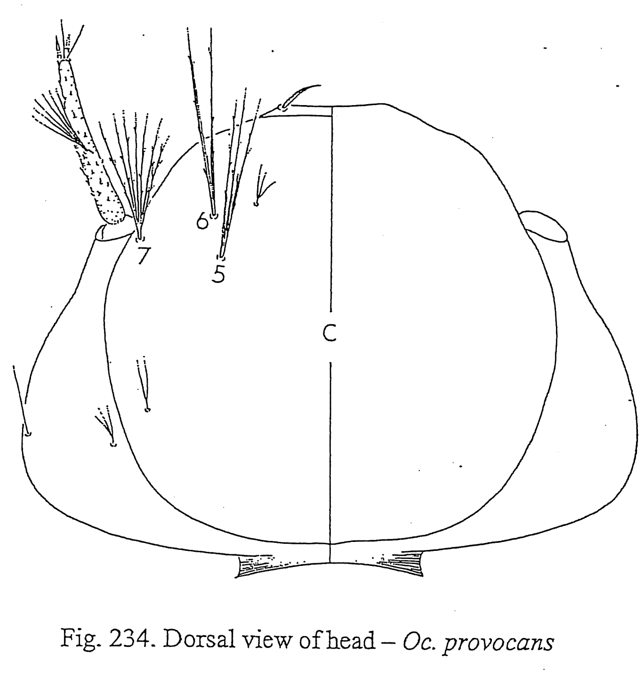


Fig. 234. Dorsal view of head – *Oc. provocans*

3(2) Saddle completely encircling segment X (Fig. 235) 4

Saddle not completely encircling segment X (Fig. 236) 13

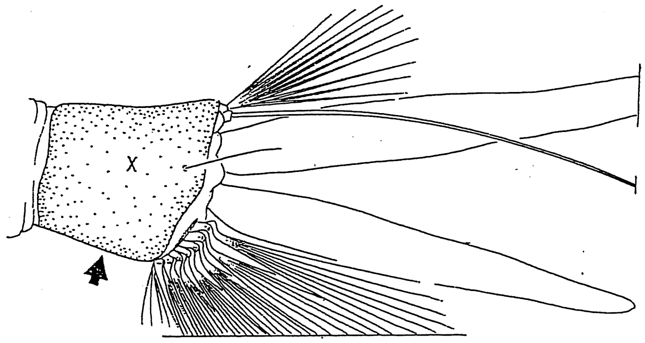


Fig. 235. Lateral view of abdominal segment X – *Oc. atlanticus*

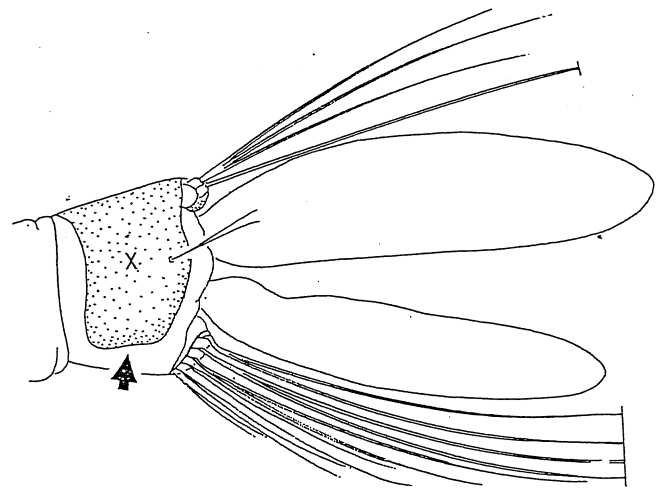


Fig. 236. Lateral view of abdominal segment X – *Ae. aegypti*

4(3). Seta 1-S attached within pecten (Fig. 237) .... *Oc. tormentor*

Seta 1-S attached distal to pecten (Fig. 238) 5

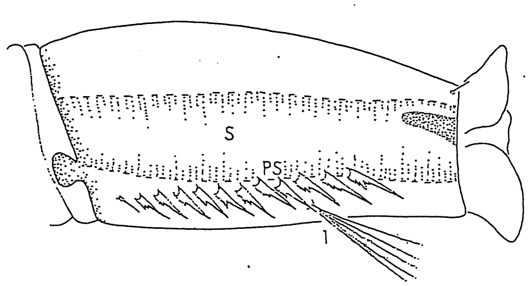


Fig. 237. Lateral view of siphon – *Oc. tormentor*

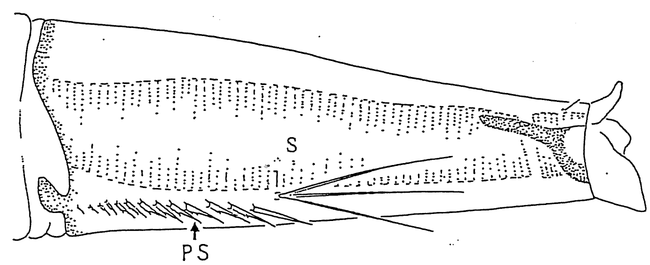


Fig. 238. Lateral view of siphon – *Oc. abeserratus*

5(4). Comb scale with apical spine at least 4.0 length of subapical spinules (Fig. 239); thoracic integument smooth (Fig. 240) 6

Comb scale with apical spine not more than 2.0 length of subapical spinules, or fringed by subequal spinules (Fig. 241); thoracic integument aculeate (Fig. 242) 11

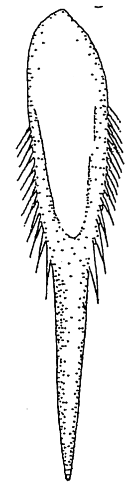


Fig. 239. Comb scale – *Oc. atlanticus*

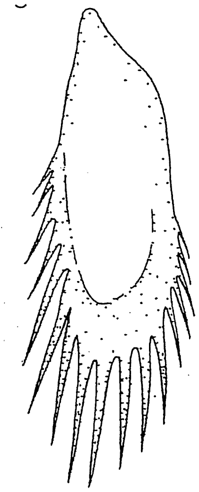


Fig. 241. Comb scale – *Oc. taeniorhynchus*

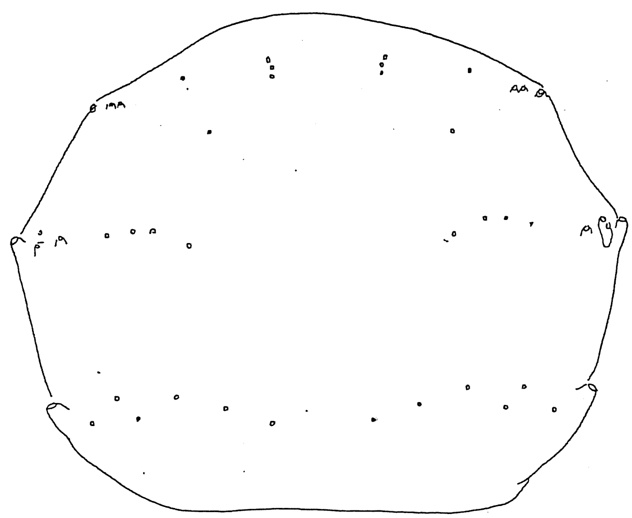


Fig. 240. Dorsal view of thorax – *Oc. sollicitans*

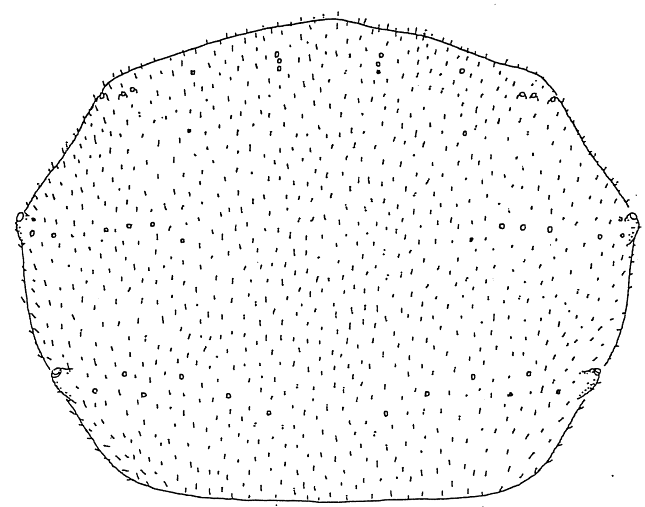


Fig. 242. Dorsal view of thorax – *Oc. taeniorhynchus*

6(5). Setae 2,3-X both single (Fig. 243); most setae on head and body coarse, about equal in diameter throughout (Fig. 244) . . . . *Oc. abserratus*

Seta 2-X multibranched, 3-X single (Fig. 245); head and body setae finely attenuated apically (Fig. 246) 7

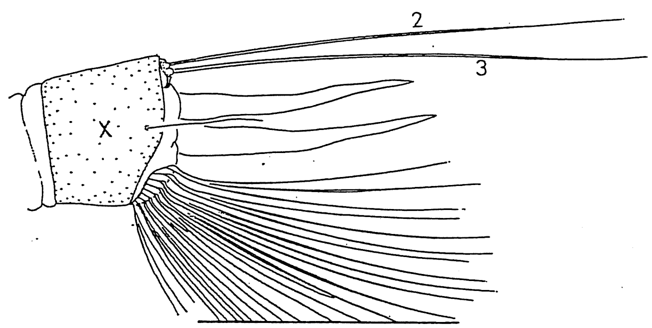


Fig. 243. Lateral view of abdominal segment X – *Oc. abserratus*

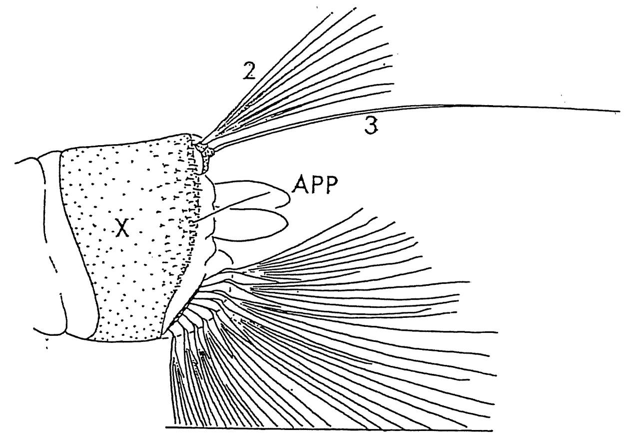


Fig. 245. Lateral view of abdominal segment X – *Oc. taeniorhynchus*

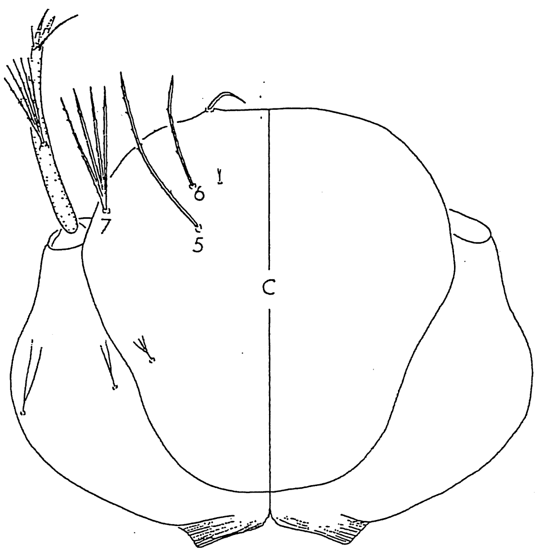


Fig. 244. Dorsal view of head – *Oc. abserratus*

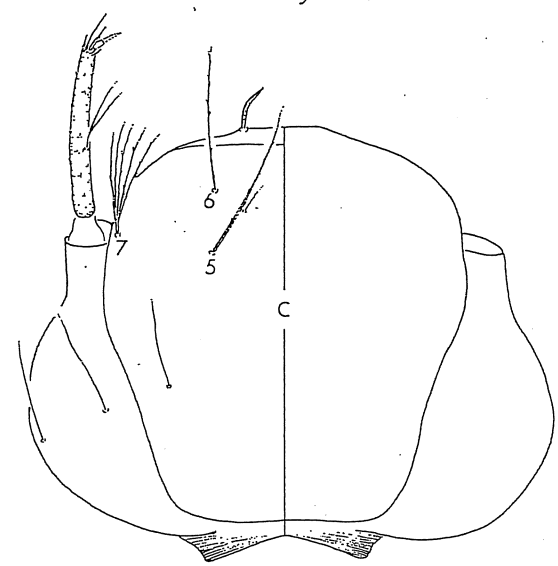


Fig. 246. Dorsal view of head – *Oc. taeniorhynchus*

7(6). Anal papilla-saddle index at least 8.0, papillae with darkly pigmented tracheae; setae 2-X with 2,3 branches (Fig. 247) . . . . . *Oc. dupreei*

Anal papilla-saddle index at most 5.0, usually much less; papillae lacking dark tracheae; seta 2-X with 4 or more branches (Fig. 248) 8

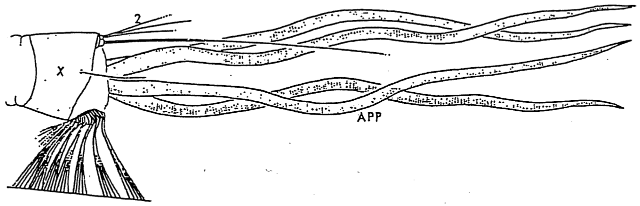


Fig. 247. Lateral view of abdominal segment X – *Oc. dupreei*

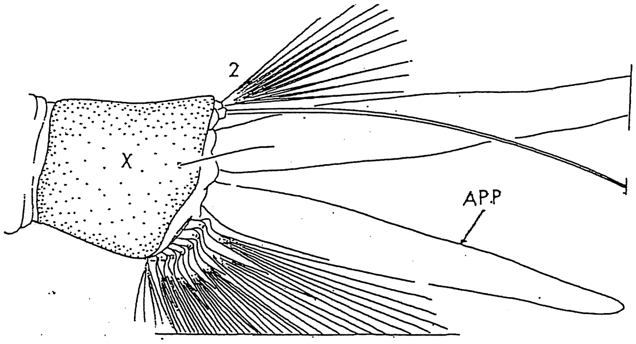


Fig. 248. Lateral view of abdominal segment X – *Oc. atlanticus*

8(7). Comb scales 4-9, large (Fig. 249) . . . . *Oc. atlanticus*

Comb scales 10-30, small (Fig. 250) 9

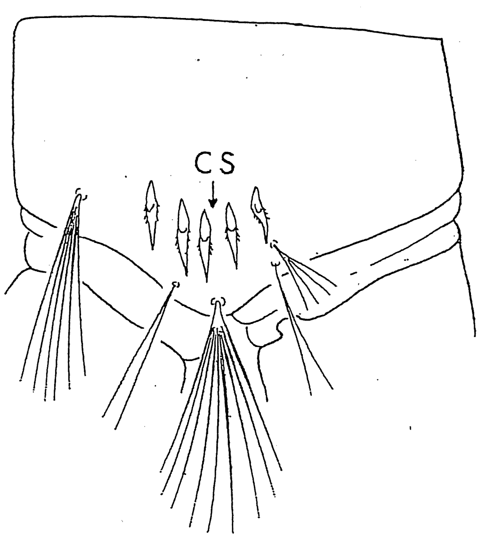


Fig. 249. Lateral view of abdominal segment VIII – *Oc. atlanticus*

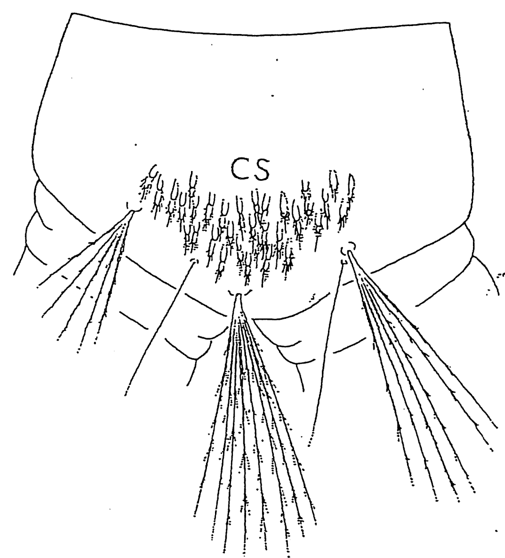


Fig. 250. Lateral view of abdominal segment VIII – *Oc. stimulans*

9(8). Seta 2-S much shorter than apical pecten spine; seta 1-X subequal to saddle length (Fig. 251) . . . . *Oc. punctor*

Seta 2-S equal to or longer than apical pecten spine; seta 1-X shorter than saddle length (Fig. 252) 10

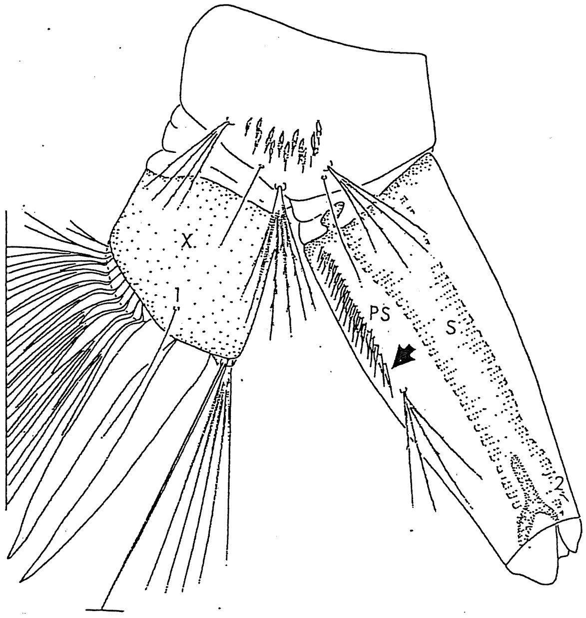


Fig. 251- Lateral view of abdominal segments VIII-X – *Oc. punctor*

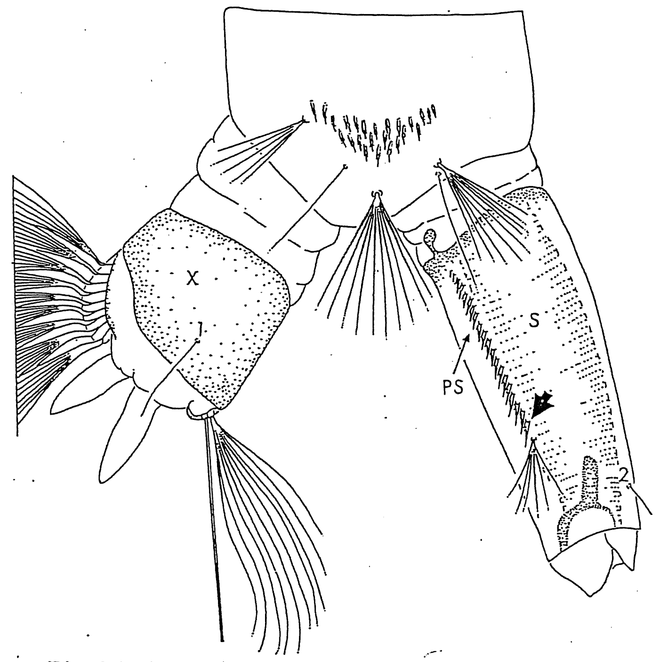


Fig. 252. Lateral view of abdominal segments VIII-X – *Oc. sollicitans*

10(9). Siphon index 3.0-3.5; pecten not reaching middle of siphon (Fig. 253); setae 5,6-C coarse, about equal in diameter to near apex (Fig. 254) .... *Oc. mitchellae*

Siphon index 2.0-2.5; pecten reaching to middle of siphon or more distally (Fig. 255); setae 5,6-C attenuated apically (Fig. 256) .... *Oc. sollicitans*

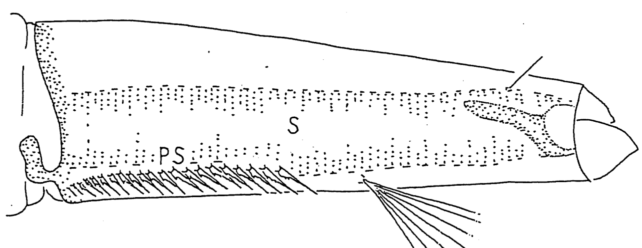


Fig. 253. Lateral view of siphon – *Oc. mitchellae*

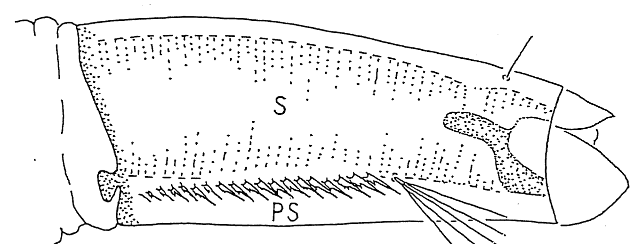


Fig. 255. Lateral view of siphon – *Oc. sollicitans*

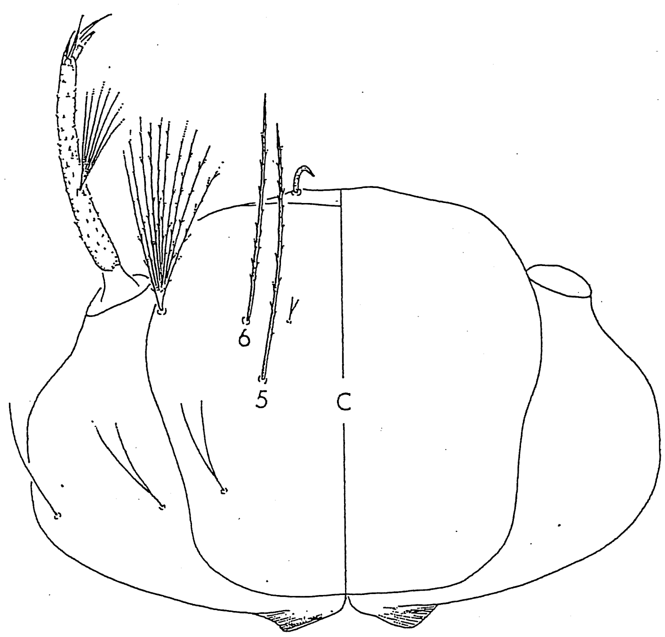


Fig. 254. Dorsal view of head – *Oc. mitchellae*

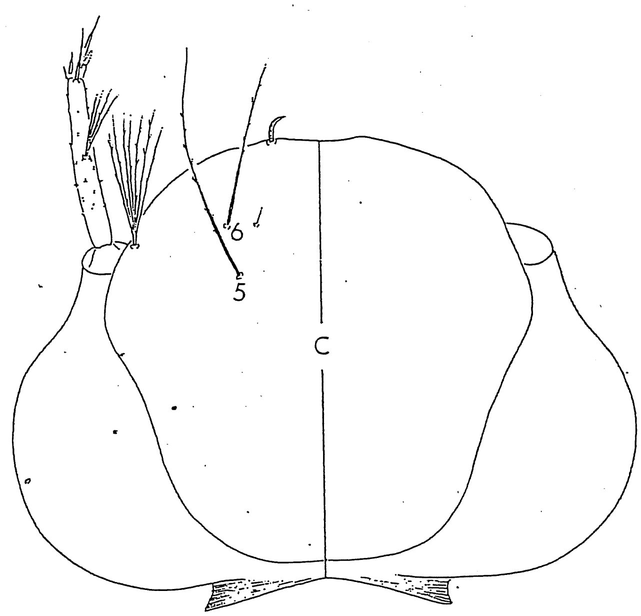


Fig. 256. Dorsal view of head – *Oc. sollicitans*

11(5). Comb scale with apical spine subequal to subapical spinules, or only slightly longer (Fig. 257) .... *Oc. taeniorhynchus*

Comb scale with apical spine about 2.0-3.0 length of subapical spinules (Fig. 258) 12

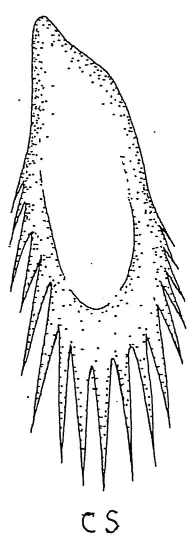


Fig. 257. Comb scale – *Oc. taeniorhynchus*

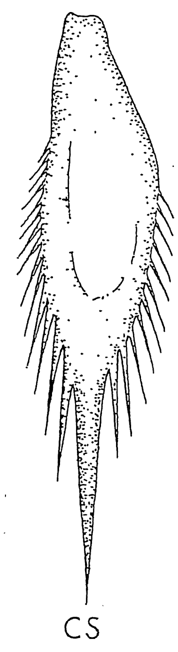


Fig. 258. Comb scale – *Oc. infirmatus*

12(11). Median spine of comb scale 6.0 broader at base, or more, and 2.0-3.0 longer than subapical spinules (Fig. 259) .... *Oc. infirmatus*

Median spine of comb scale no more than 2.0 broader at base and less than 2.0 longer than subapical spinules (Fig. 260) .... *Oc. trivittatus*

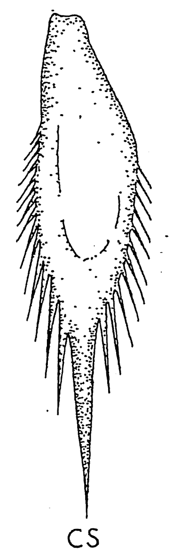


Fig. 259. Comb scale – *Oc. infirmatus*

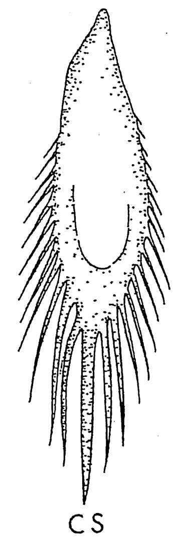


Fig. 260. Comb scale – *Oc. trivittatus*

13(3). Pecten on siphon with 1 or more spines detached apically (Fig. 261) 14

Pecten with spines more or less evenly spaced (Fig. 262) 22

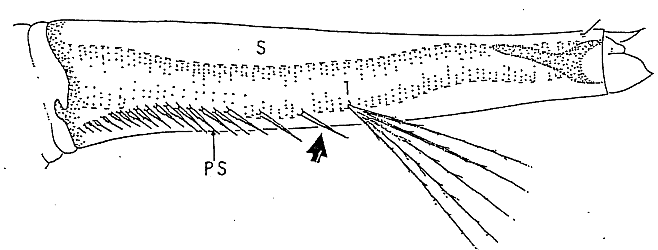


Fig. 261. Lateral view of siphon – *Oc. excrucians*

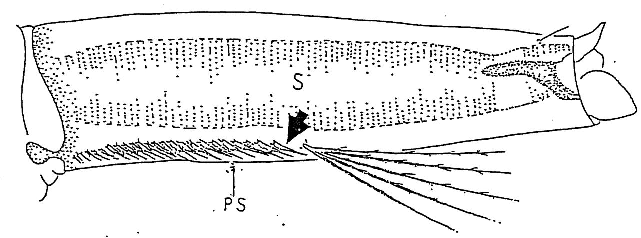


Fig. 262. Lateral view of siphon – *Oc. c. canadensis*

14(13). Seta 1-S attached within pecten (Fig. 263) 15

Seta 1-S attached distal to pecten (Fig. 264) 16

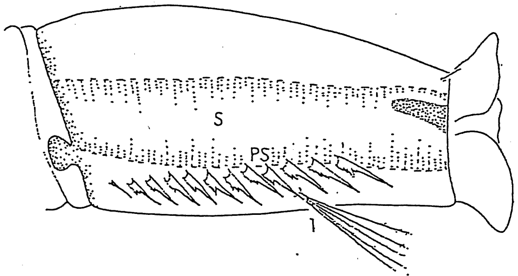


Fig. 263. Lateral view of siphon – *Oc. tormentor*

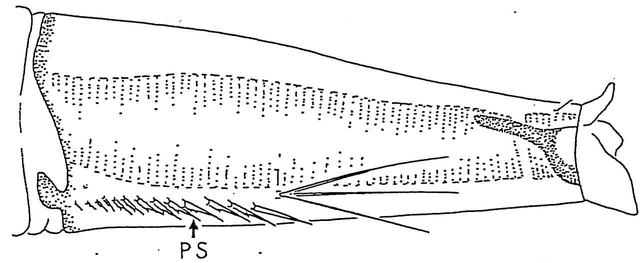


Fig. 264. Lateral view of siphon – *Oc. abserratus*

15(14). Setae 5,6-C with 3-6 branches, placed far forward, anterior to seta 7-C (Fig. 265) .... *Oc. japonicus japonicus*

Setae 5,6-C single or double, at least seta 5-C placed posterior to seta 7-C (Fig. 266) .... *Oc. atropalpus*

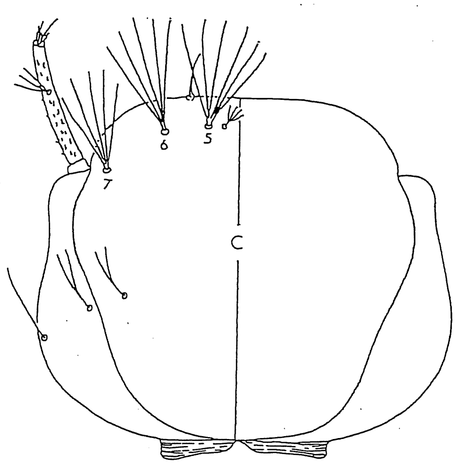


Fig. 265. Dorsal view of head – *Oc. j. japonicus*

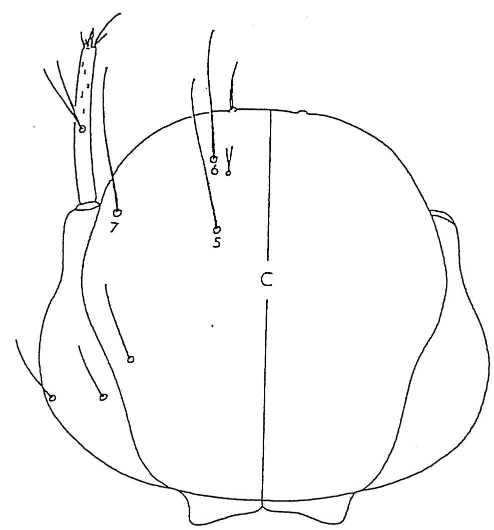


Fig. 266. Dorsal view of head – *Oc. atropalpus*

16(15). Antenna equal to length of head capsule, or longer (Fig. 267) 17

Antenna shorter than head capsule (Fig. 268) 18

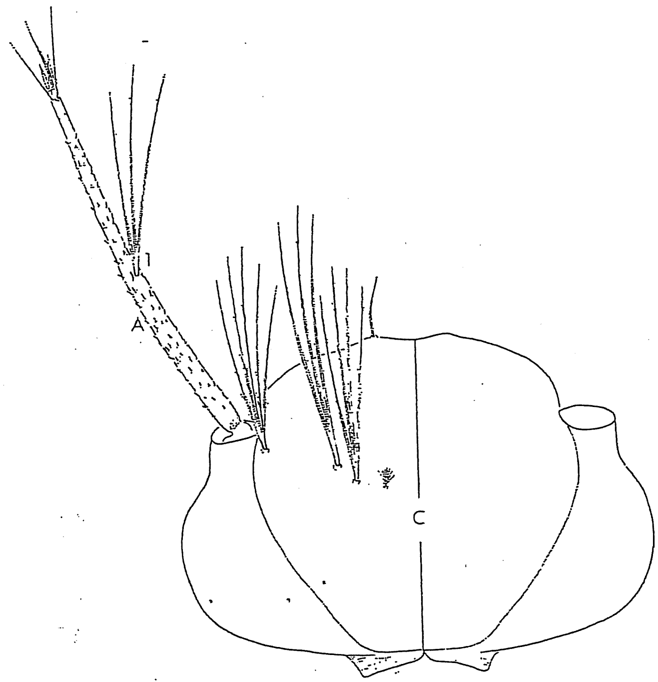


Fig. 267. Dorsal view of head and antenna –
Oc. diantaeus

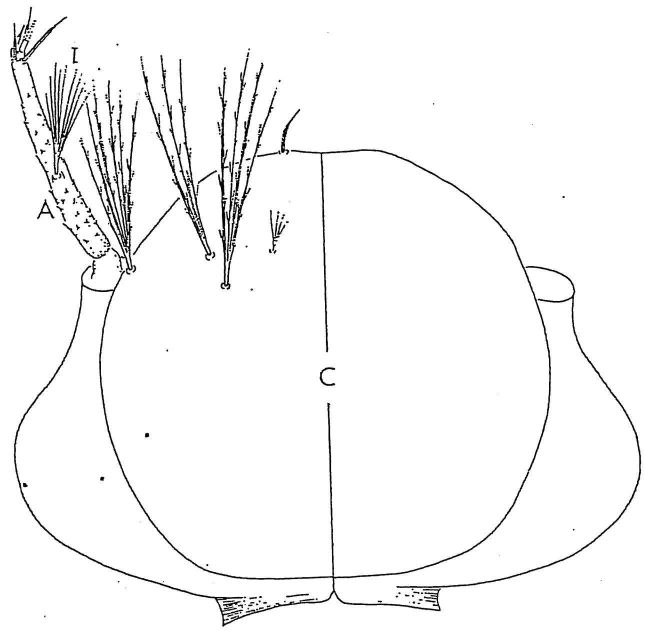


Fig. 268. Dorsal view of head and antenna –
Ae. vexans

17(16). Seta 1-A attached near middle of antenna (Fig. 269); with 15 or fewer comb scales in irregular row (Fig. 270) . . . . *Oc. diantaeus*

Seta 1-A attached to distal 0.4 of antenna (Fig. 271); with 20 or more comb scales in patch (Fig. 272) . . . . *Oc. aurifer*

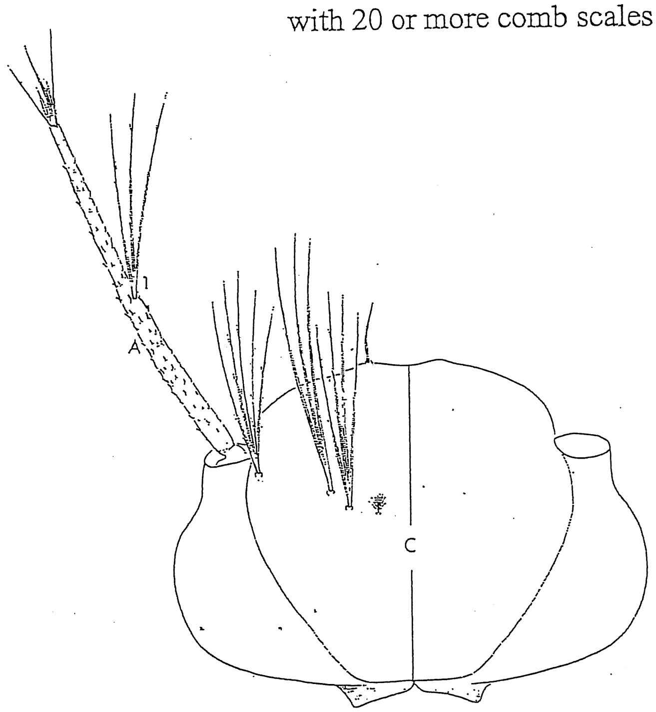


Fig. 269. Dorsal view of head and antenna
Oc. diantaeus

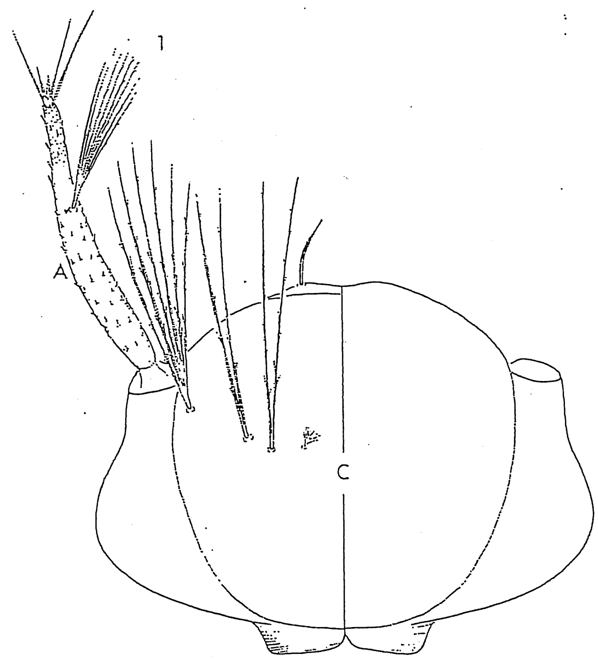


Fig. 271. Dorsal view of head and antenna –
Oc. aurifer

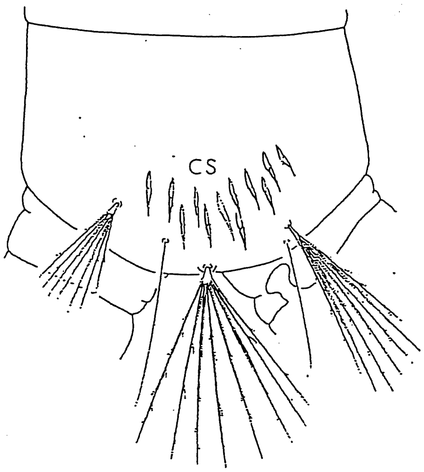


Fig. 270. Lateral view of abdominal segment VIII – *Oc. diantaeus*

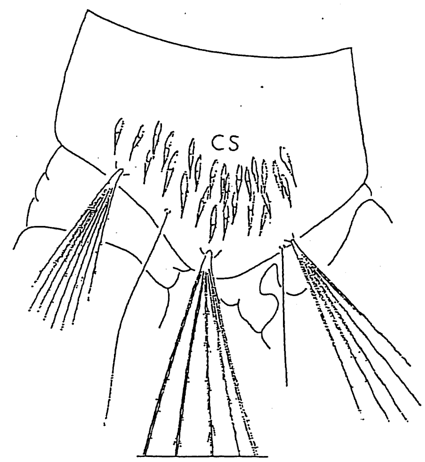


Fig. 272. Lateral view of abdominal segment VIII – *Oc. aurifer*

18(16). Comb scales in patch of 18 or more (Fig. 273) . . . . *Oc. excrucians*

Comb scales in single or irregular double row, usually 17 or fewer (Fig. 274) 19

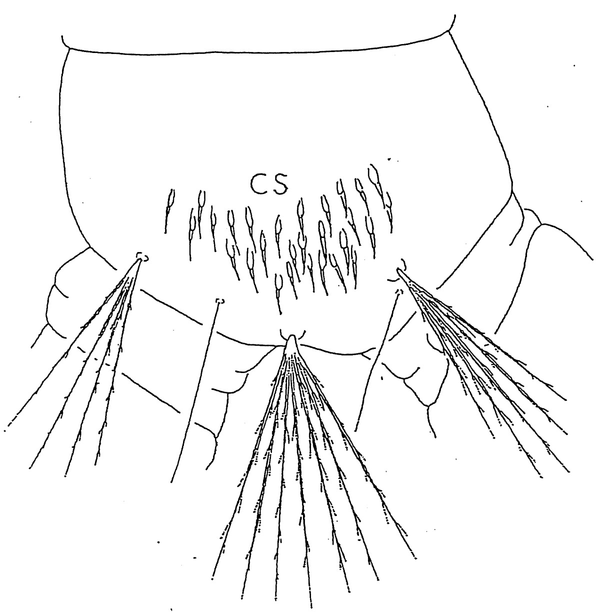


Fig. 273. Lateral view of abdominal segment VIII – *Oc. excrucians*

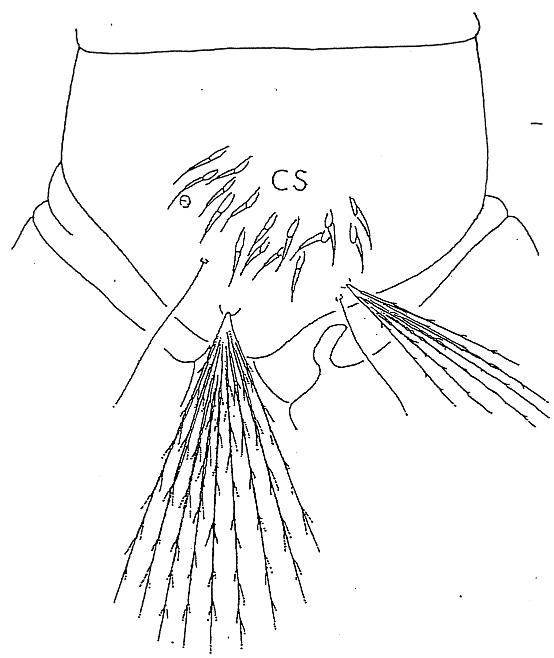


Fig. 274. Lateral view of abdominal segment VIII – *Oc. intrudens*

19(18). Bases of setae 5-7-C nearly in straight line (Fig. 275) .... (in part) *Ae. cinereus*

Base of seta 5-C posterior of setae 6,7-C (Fig. 276) 20

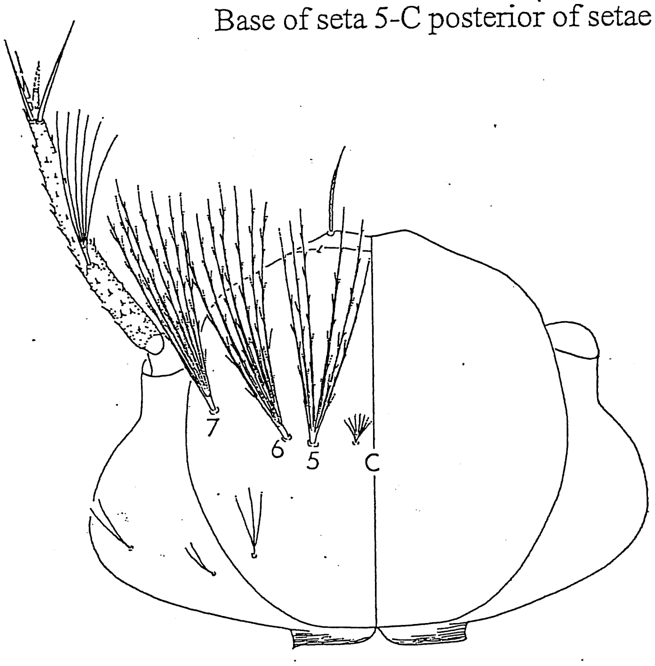


Fig. 275. Dorsal view of head – *Ae. cinereus*

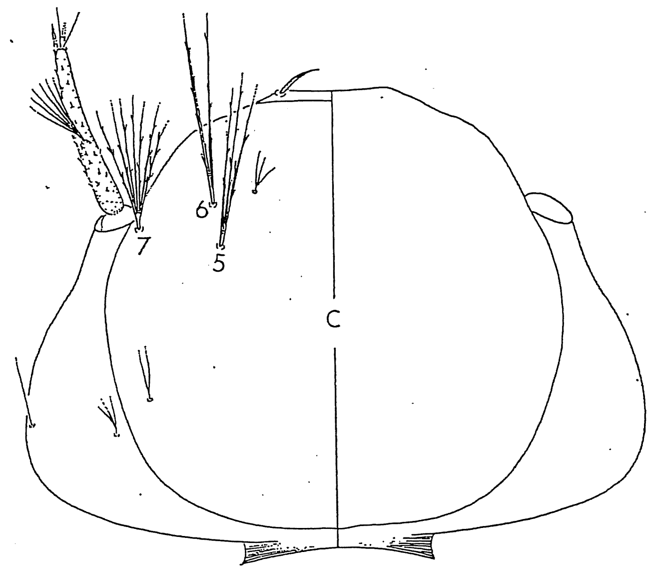


Fig. 276. Dorsal view of head – *Oc. provocans*

20(19). Seta 5-C single or double, rarely triple; seta 1-A single or double (Fig. 277) .... *Oc. decticus*

Seta 5-C at least triple; seta 1-A with 3 or more branches (Fig. 278) 21

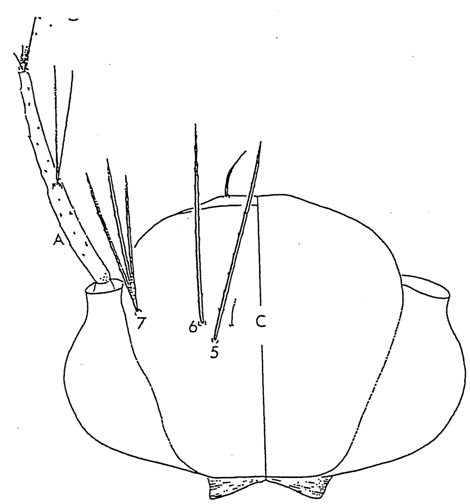


Fig. 277. Dorsal view of head – *Oc. decticus*

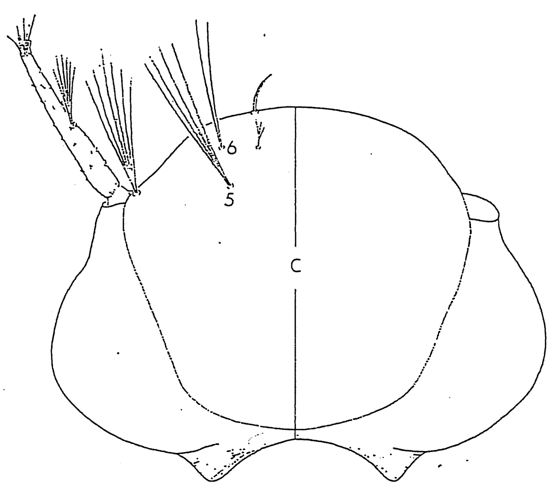


Fig. 278. Dorsal view of head – *Oc. sticticus*

21(20). Branches of seta 1-S rarely more than 0.5 length of basal diameter of siphon; saddle not incised on ventral margin (Fig. 279) . . . . *Ae. vexans*

Branches of seta 1-S equal to length of basal diameter of siphon; saddle deeply incised on ventral margin (Fig. 280) . . . . *Oc. intrudens*

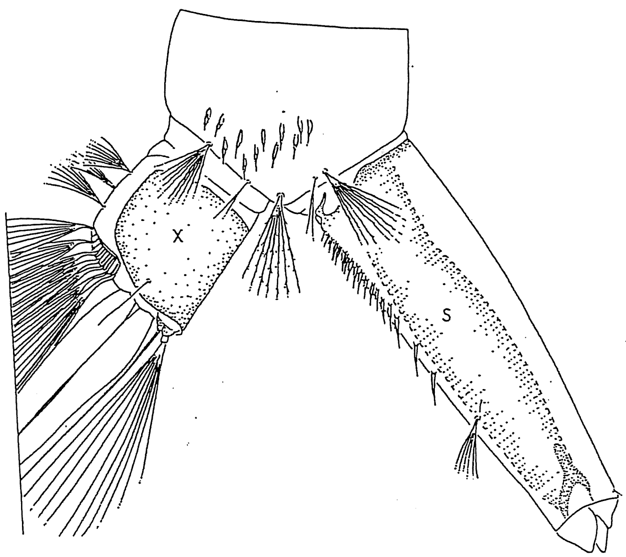


Fig. 279. Lateral view of abdominal segments VIII-X – *Ae. vexans*

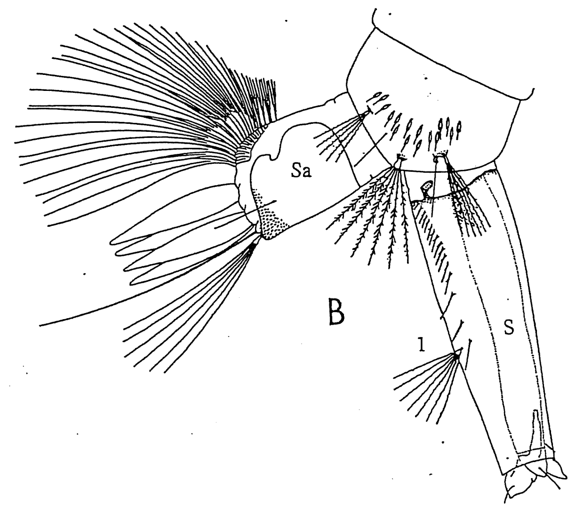


Fig. 280. Lateral view of abdominal segments VIII-X – *Oc. intrudens*

22(13). Seta 1-A single or double, antenna usually smooth or with tiny spinules (Fig. 281) 23

Seta 1-A with more than 3 branches, antenna with prominent coarse spicules (Fig. 282) 26

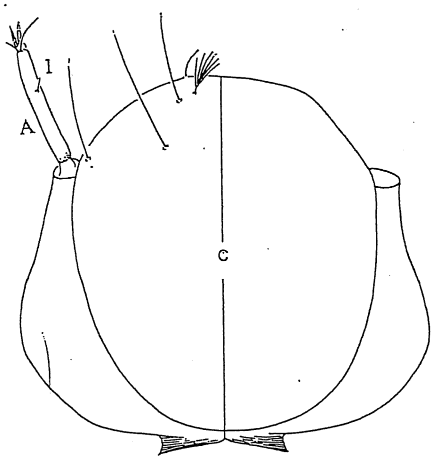


Fig. 281. Dorsal view of head – *Ae. aegypti*

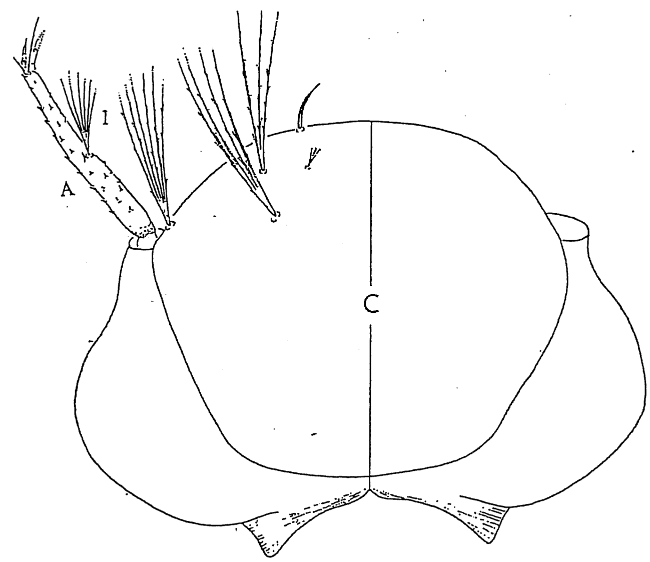


Fig. 282. Dorsal view of head – *Oc. sticticus*

23(22). Comb scale with pointed unfringed spine (Fig. 283) 24

Comb scale rather blunt apically, evenly fringed with short spinules (Fig. 284) 25

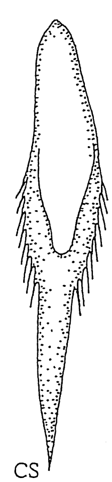


Fig. 283. Comb scale – *Ae. albopictus*

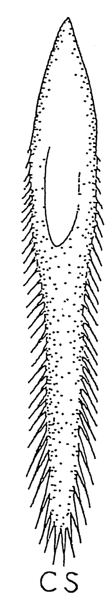


Fig. 284. Comb scale – *Oc. triseriatus*

24(23). Comb scale with strong subapical spines (Fig. 285); setal support plate of setae 9-12-M,T with prominent spine (Fig. 286); seta 7-C single (Fig. 287) .... *Ae. aegypti*

Comb scale with laterobasal fringe of small spinules (Fig. 288); setal support plate of setae 9-12-M,T with short thin spine (Fig. 289); seta 7-C double (Fig. 290) .... *Ae. albopictus*

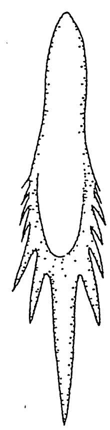


Fig. 285. Comb scale – *Ae. aegypti*

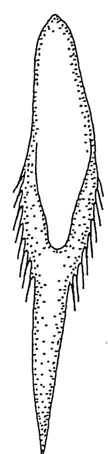


Fig. 288. Comb scale – *Ae. albopictus*

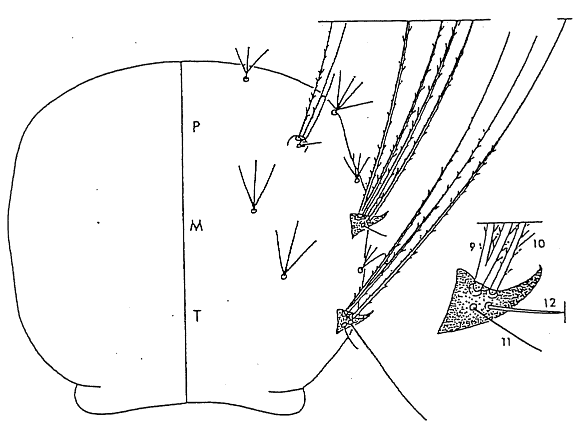


Fig. 286. Ventral view of thorax – *Ae. aegypti*

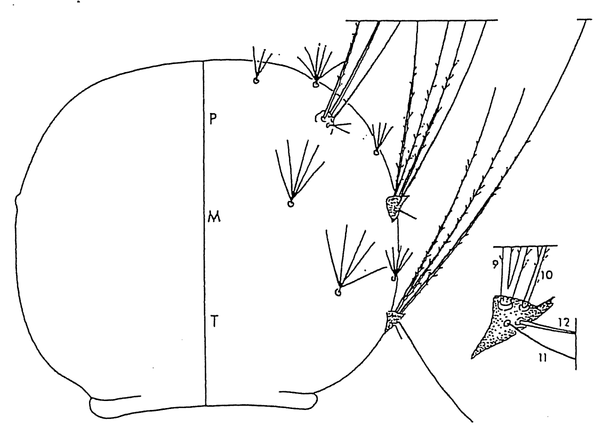


Fig. 289. Ventral view of thorax – *Ae. albopictus*

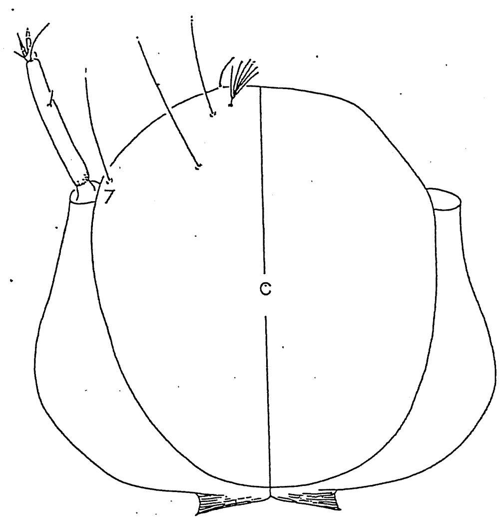


Fig. 287. Dorsal view of head – *Ae. aegypti*

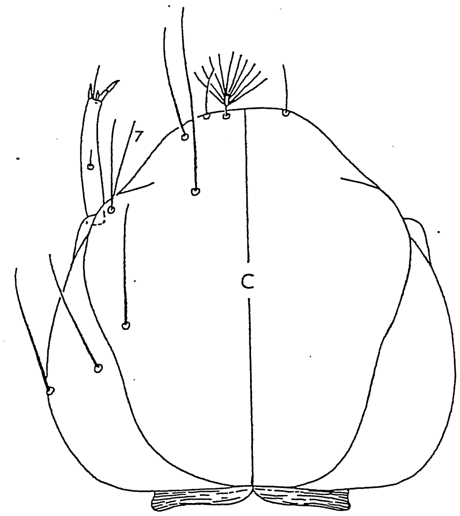


Fig. 290. Dorsal view of head – *Ae. albopictus*

25(23). Seta 4-X with 6 pairs of fanlike setae (Fig. 291); acus usually attached to siphon or detached and situated close to its base (Fig. 292); anal papillae not bulbous, dorsal pair longer than ventral pair (Fig. 291) .... *Oc. triseriatus*

Seta 4-X with 5 pairs of fanlike setae (Fig. 293); acus detached and removed from base of siphon (Fig. 294) both anal papillae about same length, bulbous (Fig. 293) .... *Oc. hendersoni*

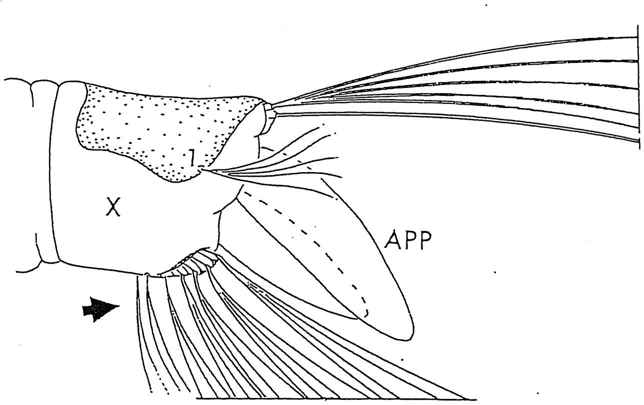


Fig. 291. Lateral view of abdominal segment X – *Oc. triseriatus*

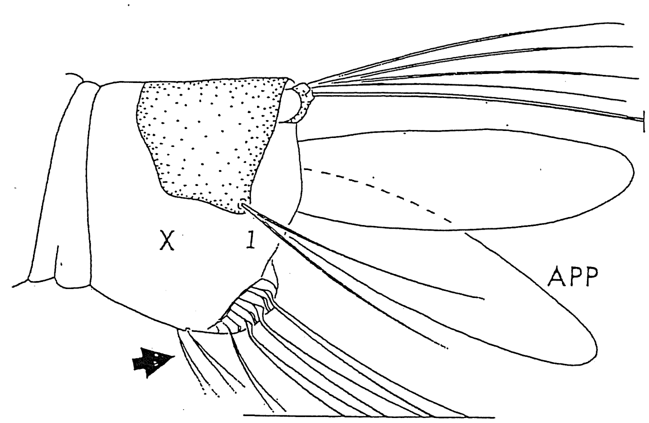


Fig. 293. Lateral view of abdominal segment X – *Oc. hendersoni*

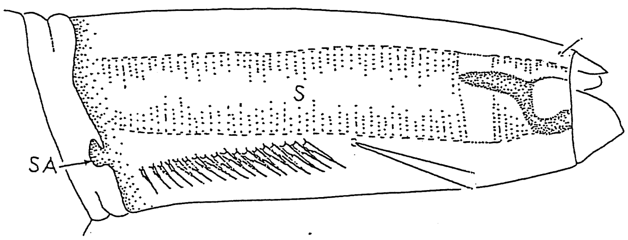


Fig. 292. Lateral view of siphon – *Oc. triseriatus*

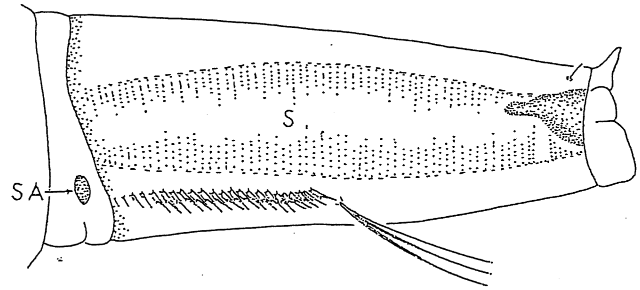


Fig. 294. Lateral view of siphon – *Oc. hendersoni*

26(22). Individual comb scale with apical spine 1.5 or more length of subapical spinules (Fig. 295) 27

Individual comb scale fringed with subequal spinules or with apical spine less that 1.5 length of subapical spinules (Fig. 296) 29

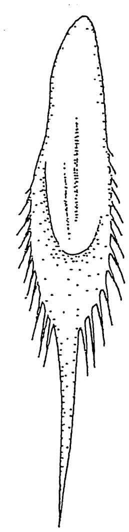


Fig. 295. Comb scale – *Oc. sticticus*

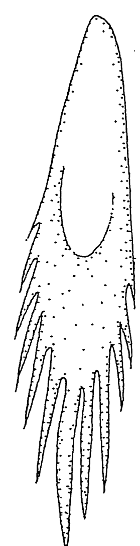


Fig. 296. Comb scale – *Oc. cantator*

27(26). Siphon index 4.0-5.0; apical pecten spine nearly equal to apical diameter of siphon (Fig. 297) .... *Oc. fitchii*

Siphon index usually less than 4.0; apical pecten spine not more than 0.5 of apical diameter of siphon (Fig. 298) 28

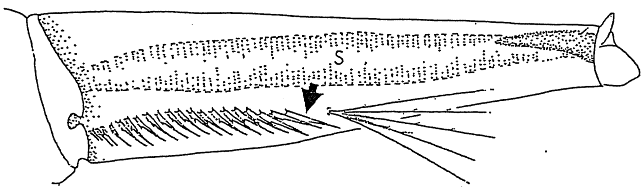


Fig. 297. Lateral view of siphon – *Oc. fitchii*

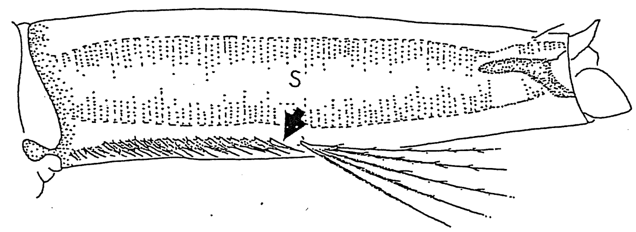


Fig. 298. Lateral view of siphon – *Oc. c. canadensis*

28(27). Setae 5,6-C single or double (Fig. 299); comb scale with subapical spinules about 0.5 as long as apical spine (Fig. 300) .... *Oc. stimulans*

Seta 5-C with 2-4 branches, 6-C usually double (Fig. 301); comb scale with subapical spinules much smaller than apical spine (Fig. 302) .... *Oc. sticticus*

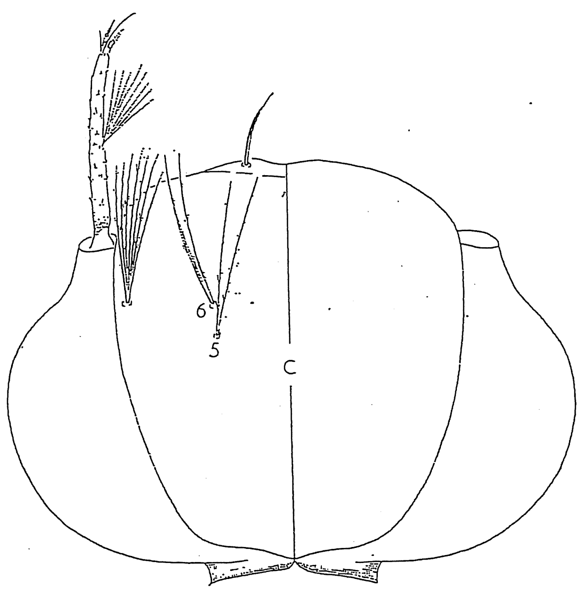


Fig. 299. Dorsal view of head – *Oc. stimulans*

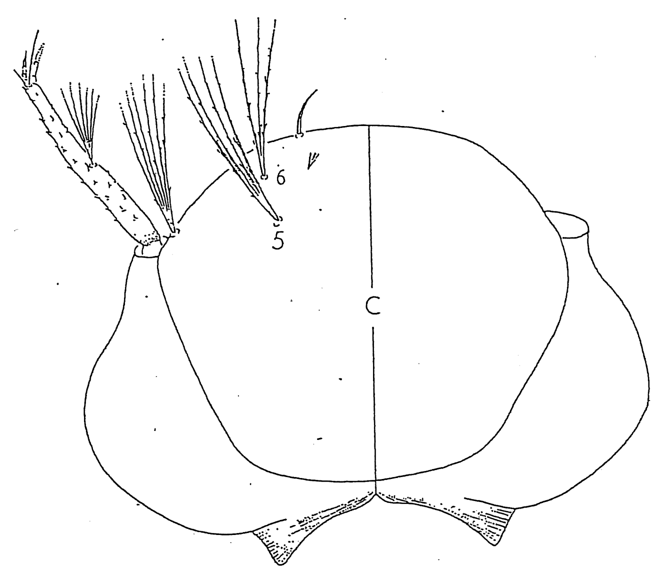


Fig. 301 – Dorsal view of head – *Oc. sticticus*

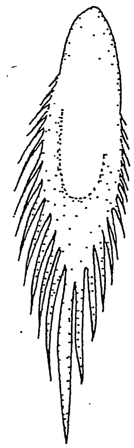


Fig. 300. Comb scale – *Oc. stimulans*

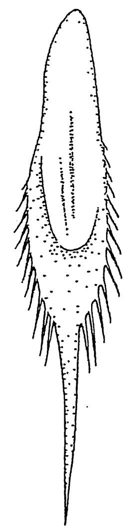


Fig. 302. Comb scale – *Oc. sticticus*

29(26). Seta 5-C with 4 or more and 6-C with 3 or more branches (Fig. 303) 30

Seta 5-C with 1-3 branches, rarely 4, 6-C single or double, rarely triple (Fig. 304) 32

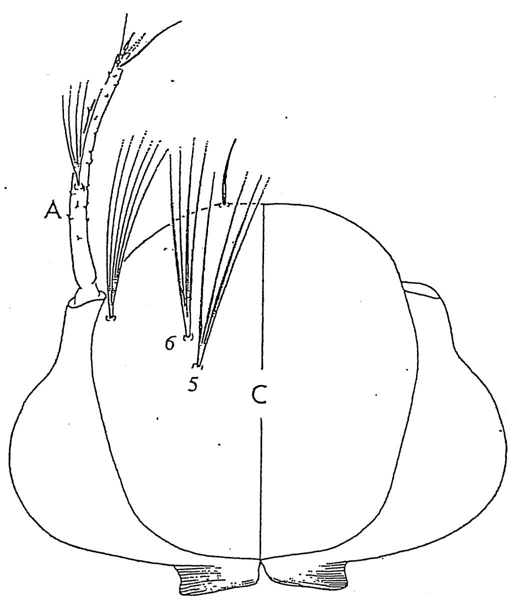


Fig. 303. Dorsal view of head – *Oc. c. canadensis*

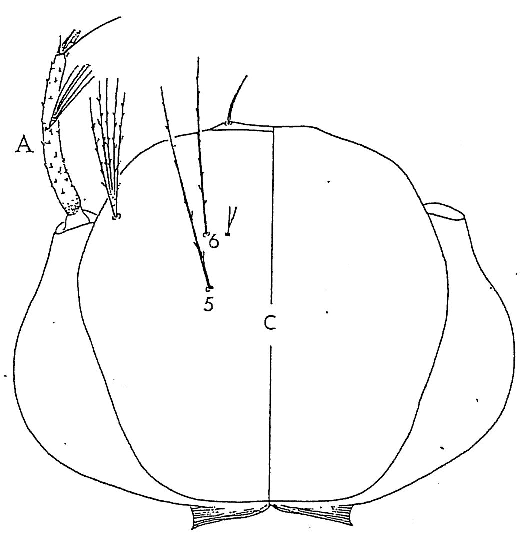


Fig. 304. Dorsal view of head – *Oc. dorsalis*

30(29). Seta 1-M about length of antenna or longer (Fig. 305) .... *Oc. cantator*

Seta 1-M much shorter than antenna (Fig. 306) 31

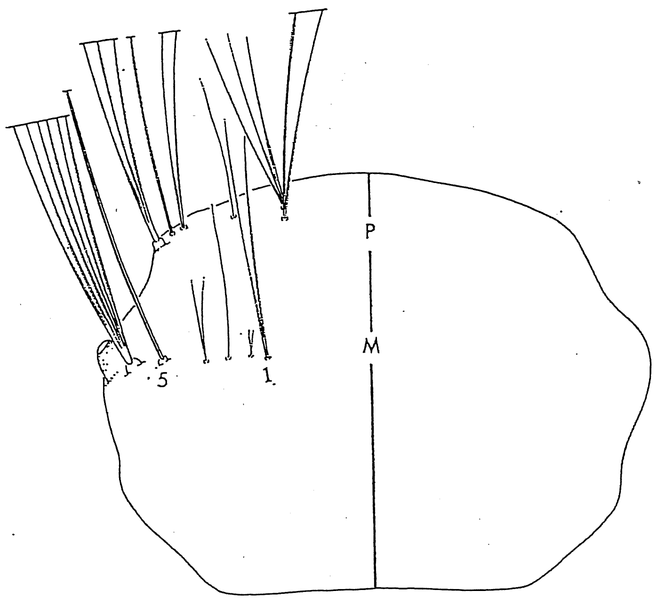


Fig. 305. Dorsal view of thorax – *Oc. cantator*

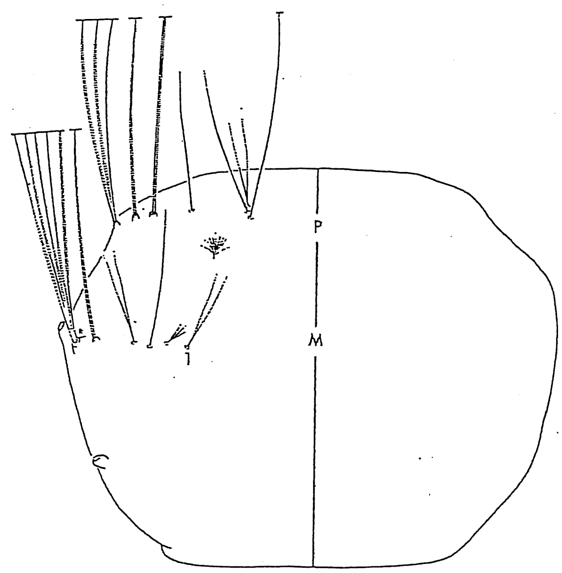


Fig. 306. Dorsal view of thorax – *Oc. c. canadensis*

31(30). Comb scale with apical and subapical spines much stouter than lateral spinules (Fig. 307); setae 6-I,II with 3,4 branches (Fig. 308) .... *Oc. thibaulti*

Comb scale fringed with subequal spinules (Fig. 309); setae 6-I,II double (Fig. 310) .... *Oc. canadensis canadensis*

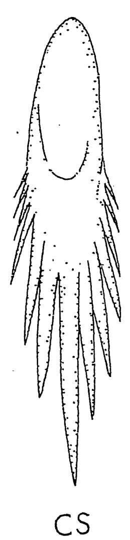


Fig. 307. Comb scale – *Oc. thibaulti*

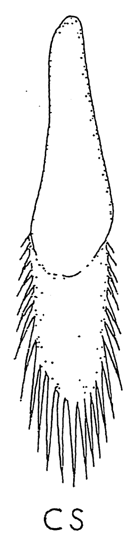


Fig. 309. Comb scale – *Oc. c. canadensis*

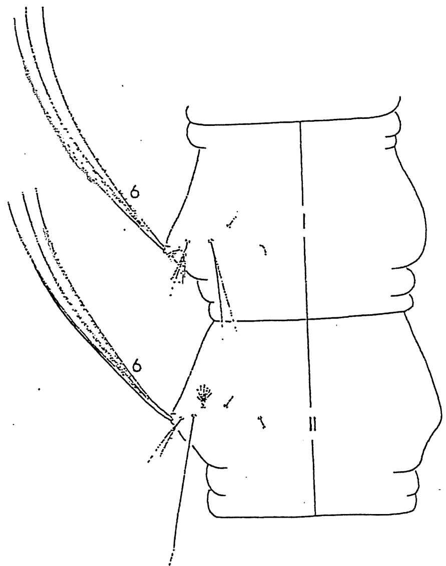


Fig. 308. Dorsal view of abdominal segments I-II – *Oc. thibaulti*

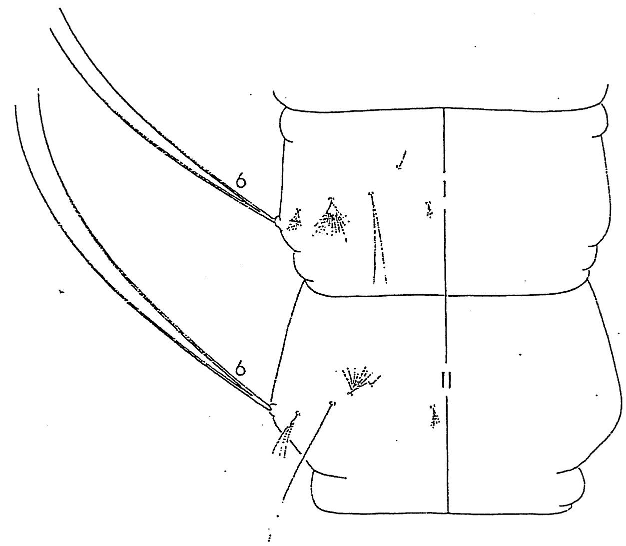


Fig. 310. Dorsal view of abdominal segments I-II – *Oc. c. canadensis*

32(29). Seta 1-M shorter than antenna (Fig. 311); seta 1-A not reaching near to apex of antenna (Fig. 312) . . . . *Oc. communis*

Seta 1-M about equal to length of antenna or longer (Fig. 313); seta 1-A reaching near to apex of antenna (Fig. 314) 33

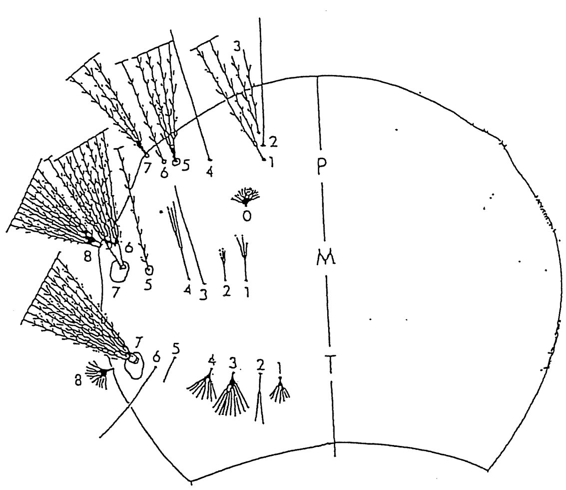


Fig. 311. Dorsal view of thorax – *Oc. communis*

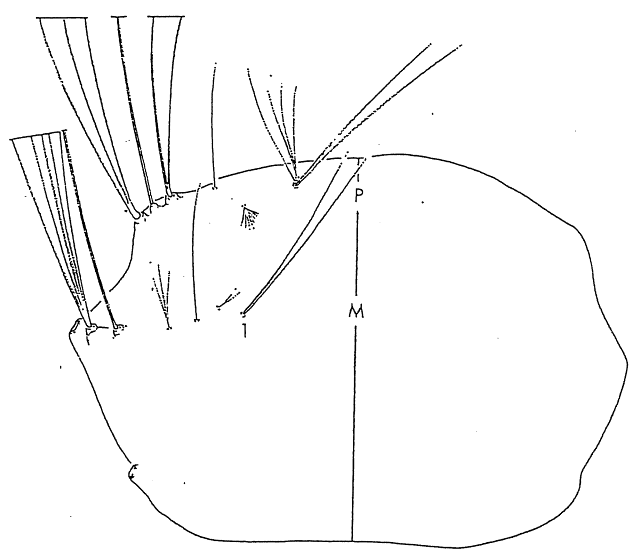


Fig. 313. Dorsal view of thorax – *Oc. dorsalis*

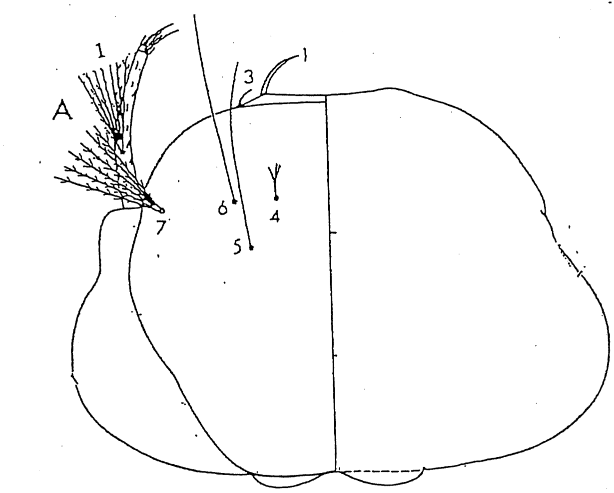


Fig. 312. Dorsal view of head – *Oc. communis*

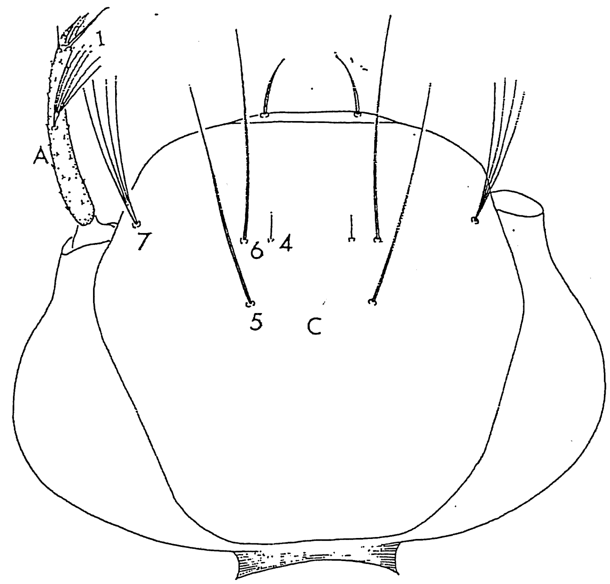


Fig. 314. Dorsal view of head – *Oc. dorsalis*

33(32). Seta 1-X about 0.5 dorsal length of saddle (Fig. 315); the 4 setae 5,6-C usually single, or total of single, and branches of branched, setae rarely more than 7 (Fig. 316) .... *Oc. dorsalis*

Seta 1-X almost equal to dorsal length of saddle (Fig. 317); the 4 setae 5,6-C usually branched, the total of single, and branches of branched, setae usually no fewer than 8 (Fig. 318) .... *Oc. grossbecki*

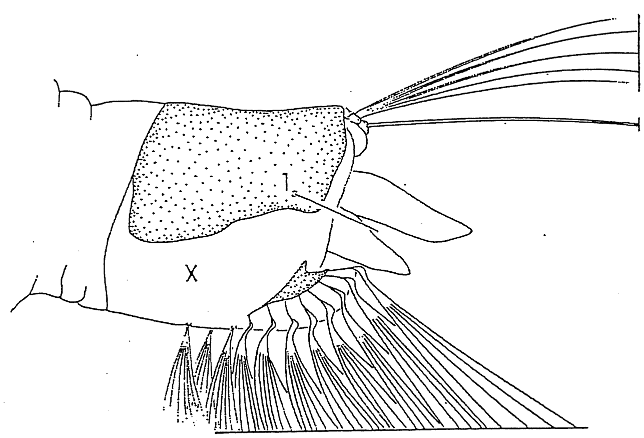


Fig. 315. Dorsal view of abdominal segment X – *Oc. dorsalis*

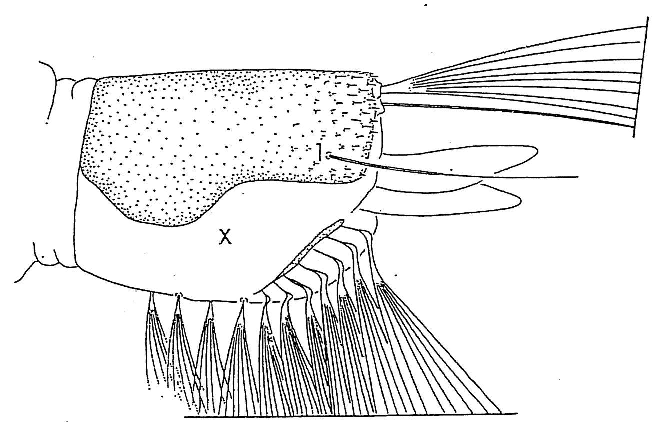


Fig. 317. Lateral view of abdominal segment X – *Oc. grossbecki*

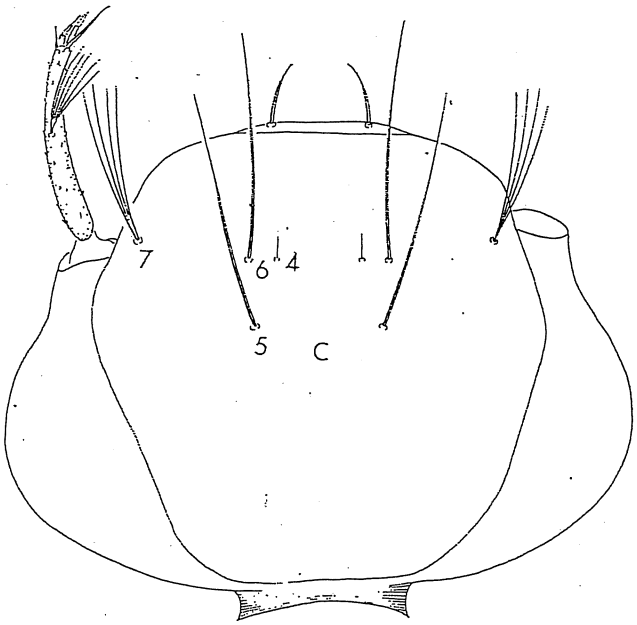


Fig. 316. Dorsal view of head – *Oc. dorsalis*

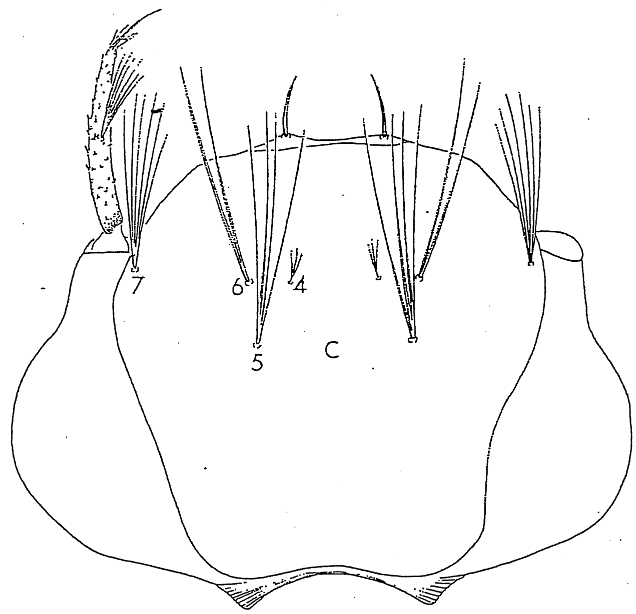


Fig. 318. Dorsal view of head – *Oc. grossbecki*

KEY TO GENUS PSOROPHORA

1. Head capsule truncate anteriorly (Fig. 319); pecten with 12 or more filamentous spines (Fig. 320); antenna small, hardly reaching beyond anterior border of head (Fig. 319) (Subgenus *Psorophora*) 2

   Head capsule rounded anteriorly (Fig. 321); pecten with fewer than 10 spines, not produced into filaments (Fig. 322); antenna reaching well beyond anterior border of head (Fig. 321) 3

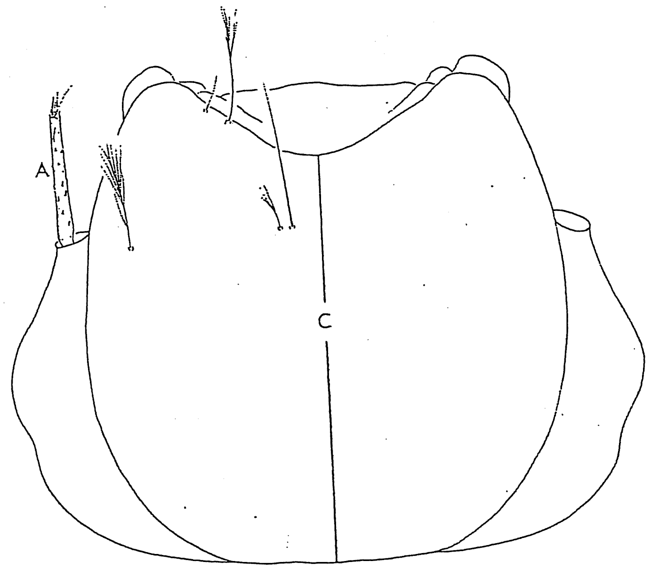


Fig. 319. Dorsal view of head – *Ps. ciliata*

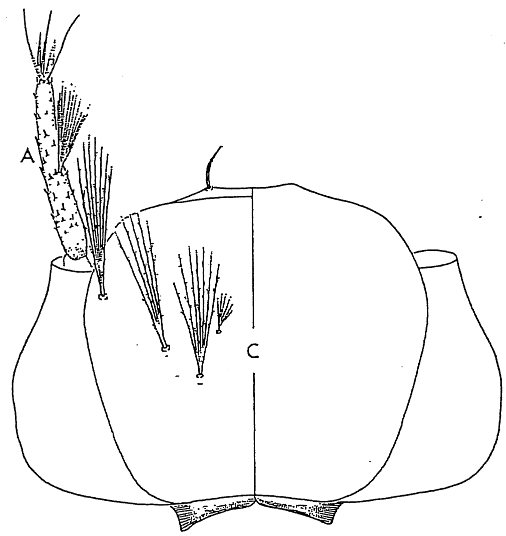


Fig. 321. Dorsal view of head - *Ps. columbiae*

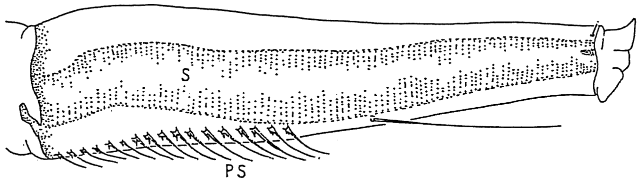


Fig. 320. Lateral view of siphon – *Ps. howardii*

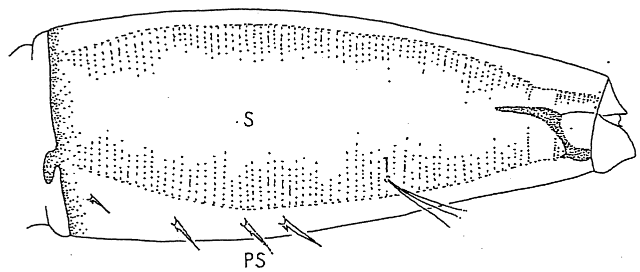


Fig. 322. Lateral view of siphon – *Ps. columbiae*

2(1). Seta 1-X with 3,4 branches from near base (Fig. 323) .... *ciliata*

Seta 1-X single or branched mainly in apical 0.5 (Fig. 324) .... *howardii*

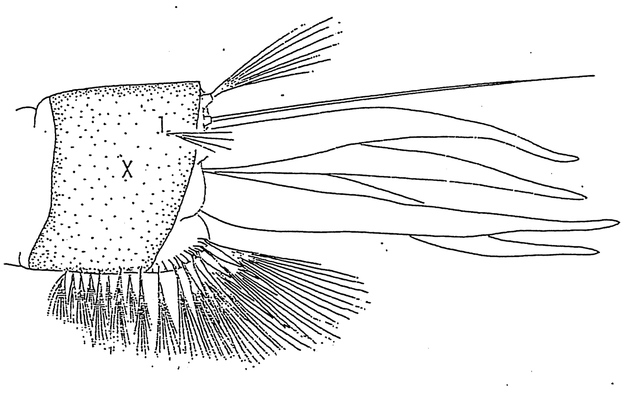


Fig. 323. Lateral view of abdominal segment X – *Ps. ciliata*

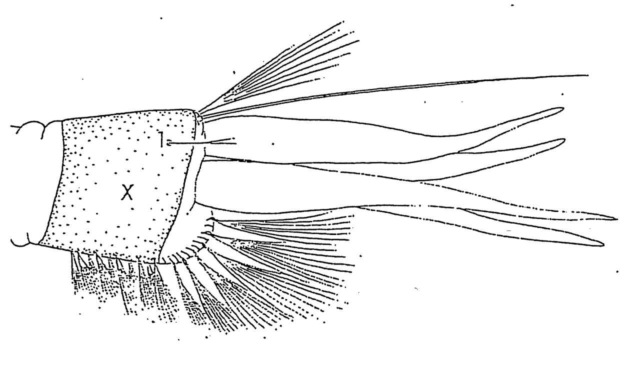


Fig. 324. Lateral view of abdominal segment X – *Ps. howardii*

3(1). Antenna shorter than middorsal length of head (Fig. 325) (Subgenus *Grabhamia*) . . . . *columbiae*

Antenna subequal to middorsal length of head, or longer (Fig. 326) (Subgenus *Janthinosoma*) 4

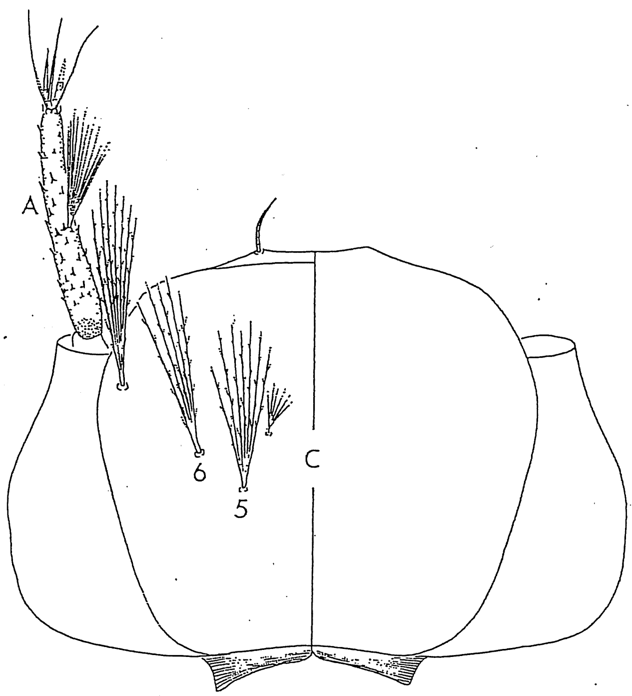


Fig. 325. Dorsal view of head – *Ps. columbiae*

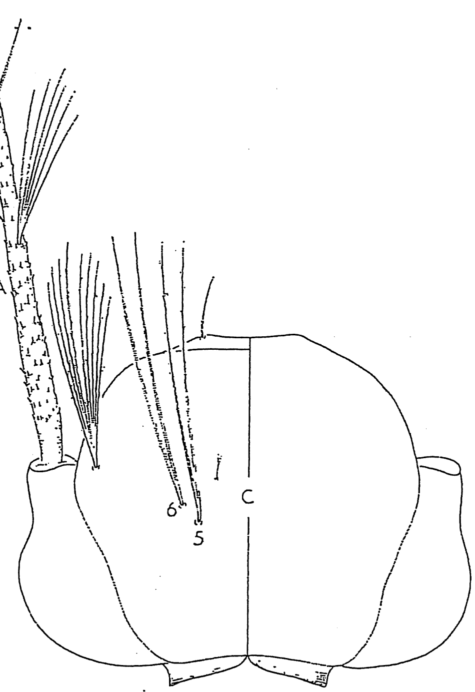


Fig. 326. Dorsal view of head – *Ps. ferox*

4(3). Antenna subequal to middorsal length of head; seta 6-C usually triple (Fig. 327) . . . . *horrida*

Antenna distinctly longer than middorsal length of head; seta 6-C double (Fig. 328) . . . . *ferox*

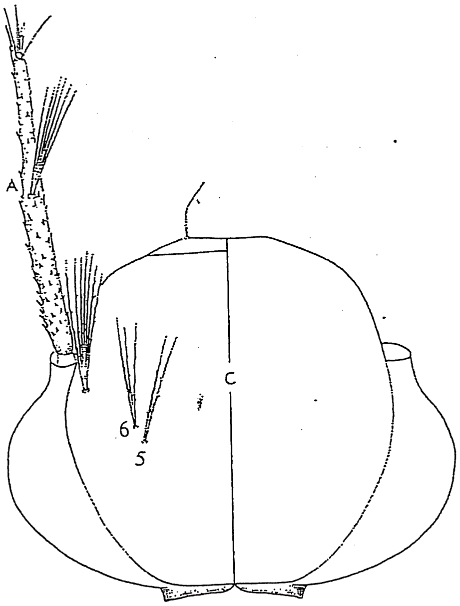


Fig. 327. Dorsal view of head – *Ps. horrida*

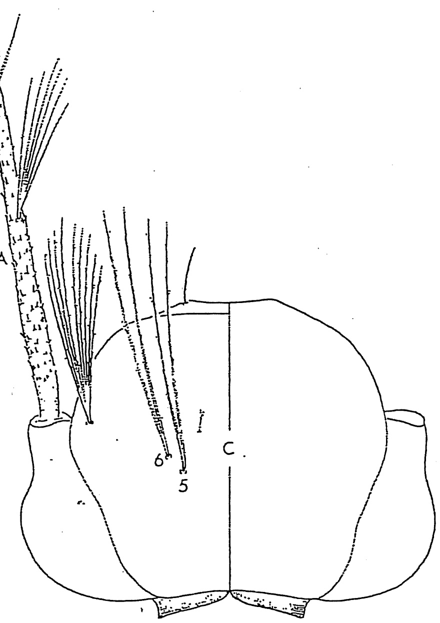


Fig. 328. Dorsal view of head – *Ps. ferox*

KEY TO GENUS CULEX

1.	Seta 6-C single or double (Fig. 329)	2
	Seta 6-C with 3 or more branches (Fig. 330) (Subgenus *Culex*)	3

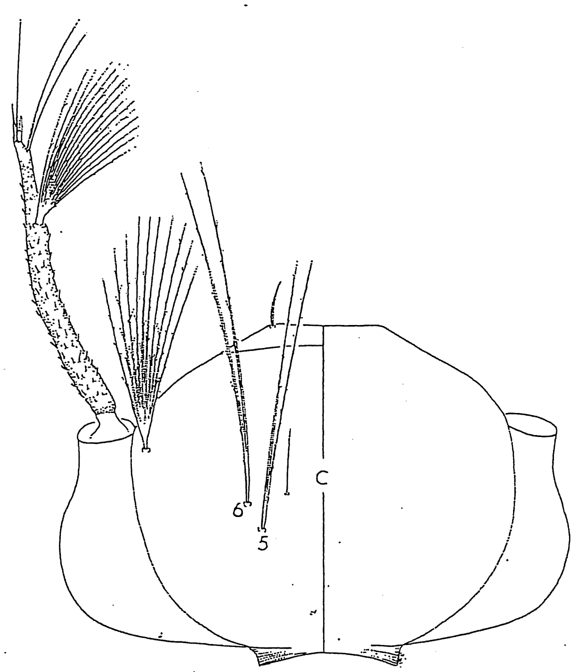


Fig. 329. Dorsal view of head – *Cx. territans*

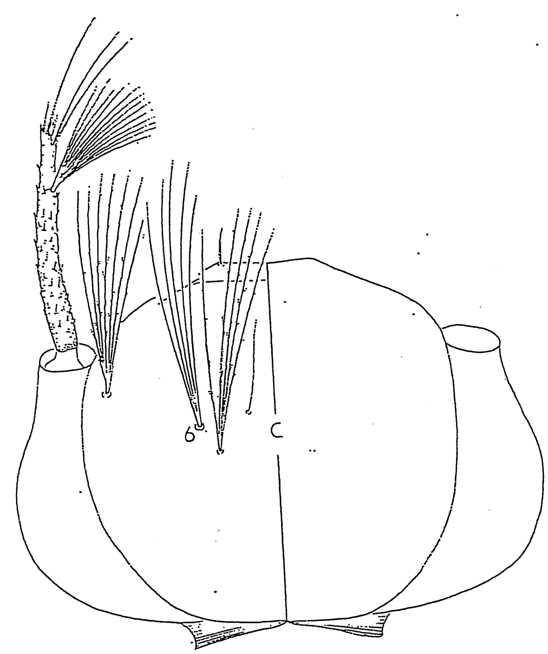


Fig. 330. Dorsal view of head – *Cx. pipiens*

2(1). Pecten spines with 1-4 marginal denticles; seta 2-S straight; siphon without subdorsal setae (Fig. 331) (Subgenus *Neoculex*) . . . . *territans*

Pecten spines with 10 or more marginal denticles; seta 2-S strongly curved; siphon with 1 or more pairs of subdorsal setae (Fig. 332) (Subgenus *Melanoconion*) . . . . *erraticus*

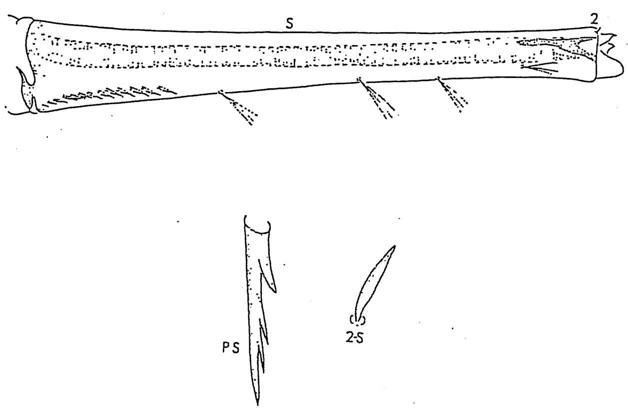


Fig. 331. Lateral view of siphon – *Cx. territans*

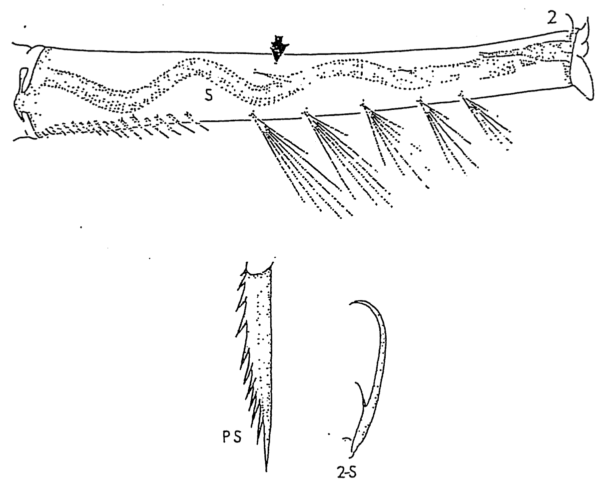


Fig. 332. Lateral view of siphon – *Cx. erraticus*

3(1). Siphon setae 1a,b,c-S irregularly placed, single (Fig. 333) . . . . *restuans*

Siphon setae 1a,b,c-S linear, usually 1 pair dorsally out of line, mostly branched (Fig. 334) 4

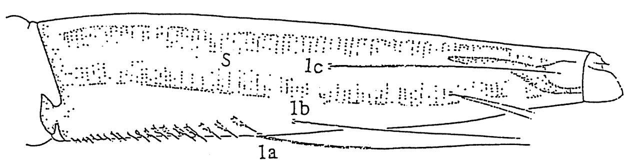


Fig. 333. Lateral view of siphon – *Cx. restuans*

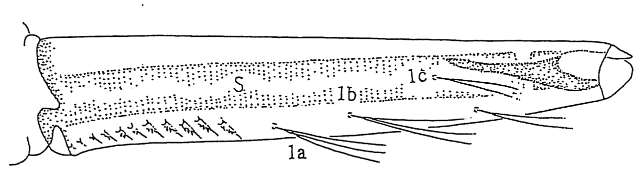


Fig. 334. Lateral view of siphon – *Cx. pipiens*

4(3). Siphon with setae in straight line, usually with 5-9 pairs (Fig. 335) . . . . *tarsalis*

Siphon with 3-5 pairs of setae not all in straight line, penultimate pair dorsally out of line (Fig. 336) 5

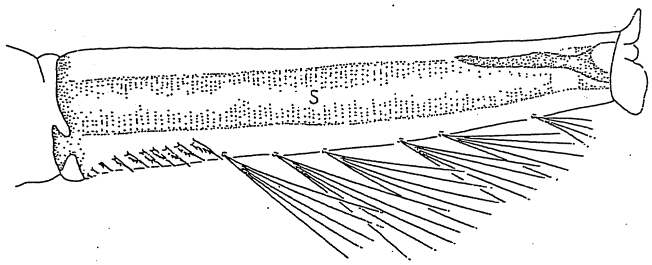


Fig. 335. Lateral view of siphon – *Cx. tarsalis*

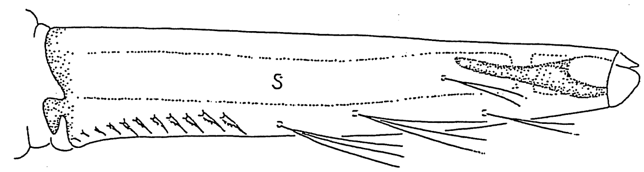


Fig. 336. Lateral view of siphon – *Cx, pipiens*

5(4). Siphon index 4.0-5.0 (Fig. 337); seta 1-X single (Fig. 338); seta 6-C usually with 5 or more branches (Fig. 339) . . . . *pipiens*

Siphon index 6.0-7.0 (Fig. 340): seta 1-X double (Fig. 341); seta 6-C with 3,4 branches (Fig. 342) . . . . *salinarius*

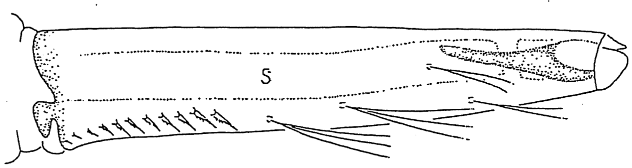


Fig. 337. Lateral view of siphon – *Cx. pipiens*

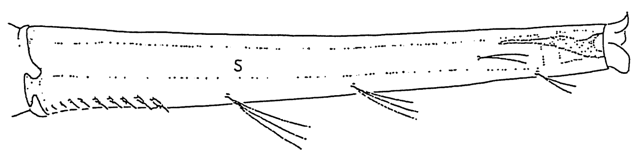


Fig. 340. Lateral view of siphon – *Cx. salinarius*

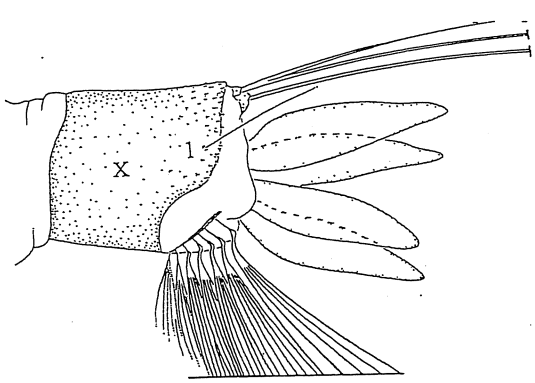


Fig. 338. Lateral view of abdominal segment X – *Cx. pipiens*

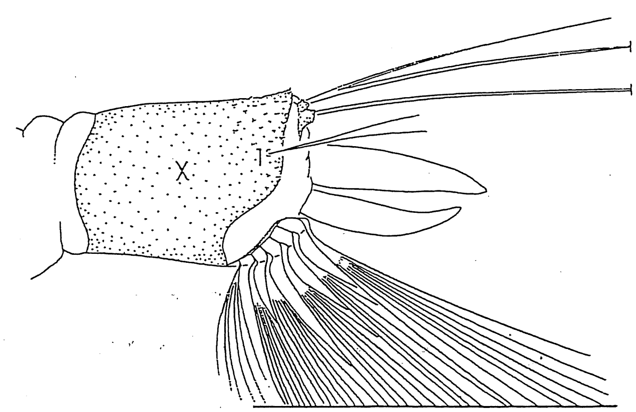


Fig. 341. Lateral view of abdominal segment X – *Cx. salinarius*

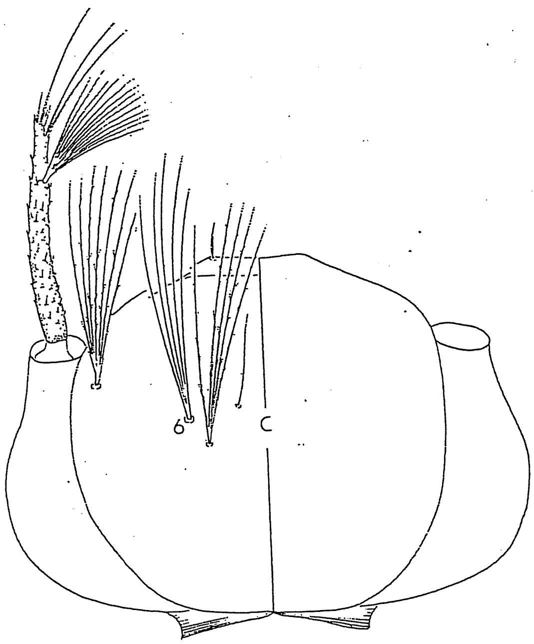


Fig. 339. Dorsal view of head – *Cx. pipiens*

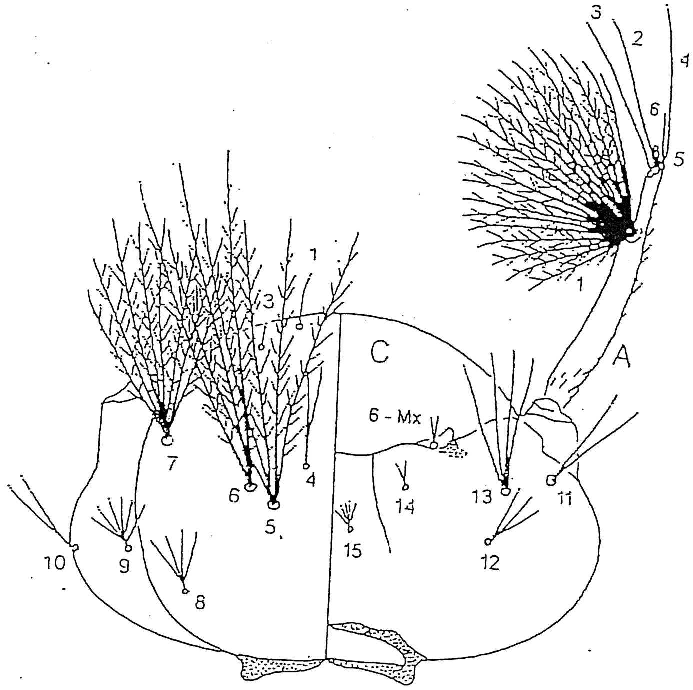


Fig. 342. Lateral view of head – *Cx. salinarius*

KEY TO GENUS CULISETA

1. Siphon with row of 8-14 setae along midventral line (Fig. 343) (Subgenus *Climacura*) . . . . *melanura*

   Siphon with setae otherwise distributed, no midventral row (Fig. 344) 2

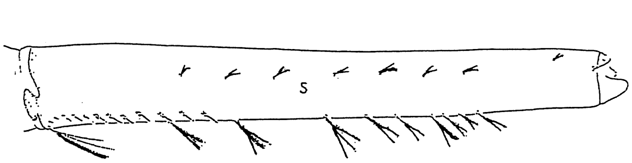


Fig. 343. Lateral view of siphon - *Cx. melanura*

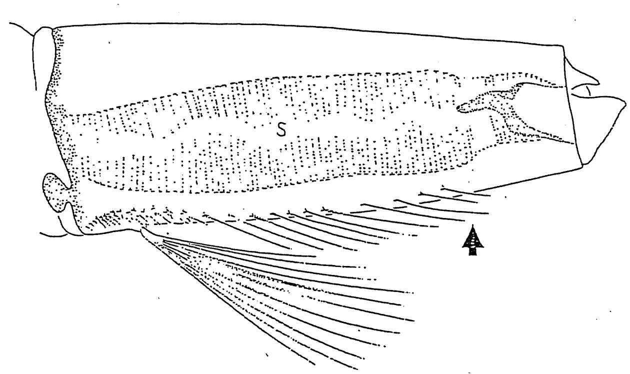


Fig. 344. Lateral view of siphon – *Cs, inornata*

2(1). Antenna longer than middorsal length of head, seta 1-A attached in distal 0.3 (Fig. 345); siphon without row of single spicules distal to pecten (Fig. 346) (Subgenus *Culicella*) 3

Antenna shorter than middorsal length of head, seta 1-A near middle (Fig. 347); siphon with row of single spicules distal to pecten (Fig. 348) (Subgenus *Culiseta*) 4

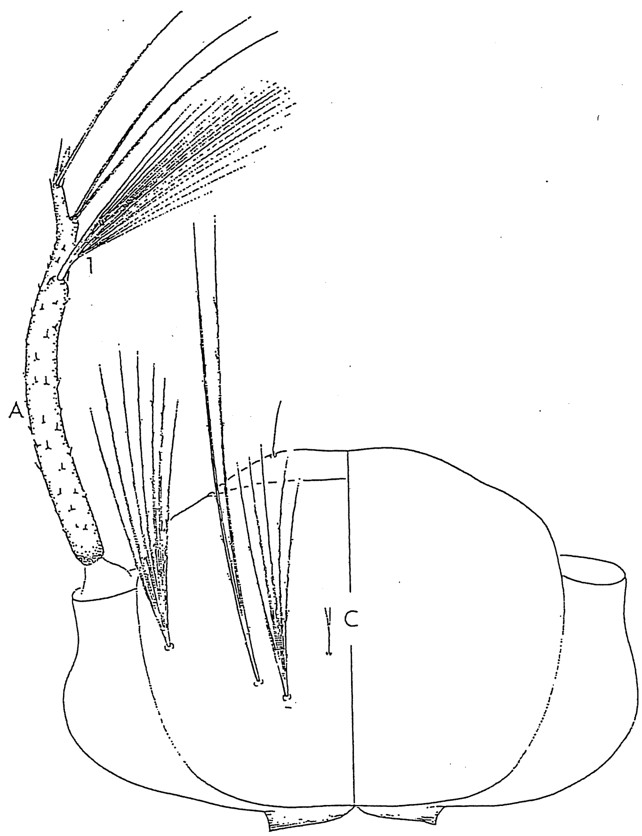


Fig. 345. Dorsal view of head – *Cs. morsitans*

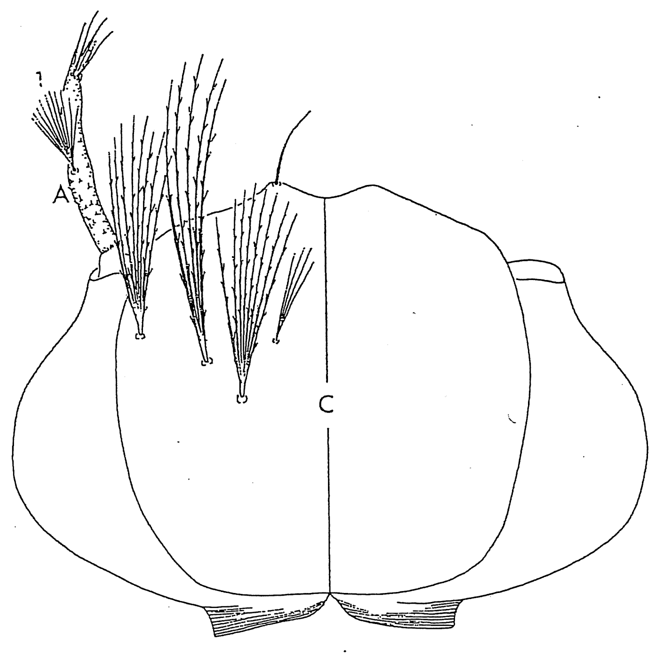


Fig. 347. Dorsal view of head – *Cs. inornata*

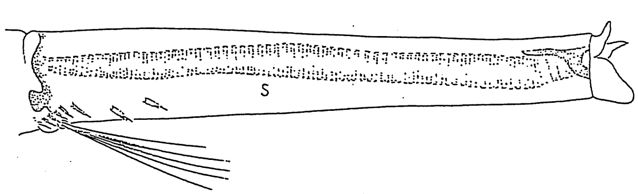


Fig. 346. Lateral view of siphon – *Cs. morsitans*

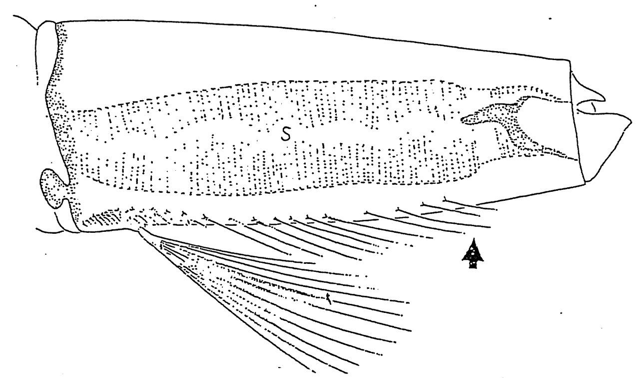


Fig. 348. Lateral view of siphon – *Cs. inornata*

3(2). Seta 5-C usually with 7 or more branches (Fig. 349); seta 4-X with 16-18 fanlike setae (Fig. 350); seta 7-C mostly with 9 or more branches (Fig. 349) .... *minnesotae*

Seta 5-C usually with 5 or fewer branches (Fig. 351); seta 4-X with 19-22 fanlike setae (Fig. 352); seta 7-C mostly with 8 or fewer branches (Fig. 351) .... *morsitans*

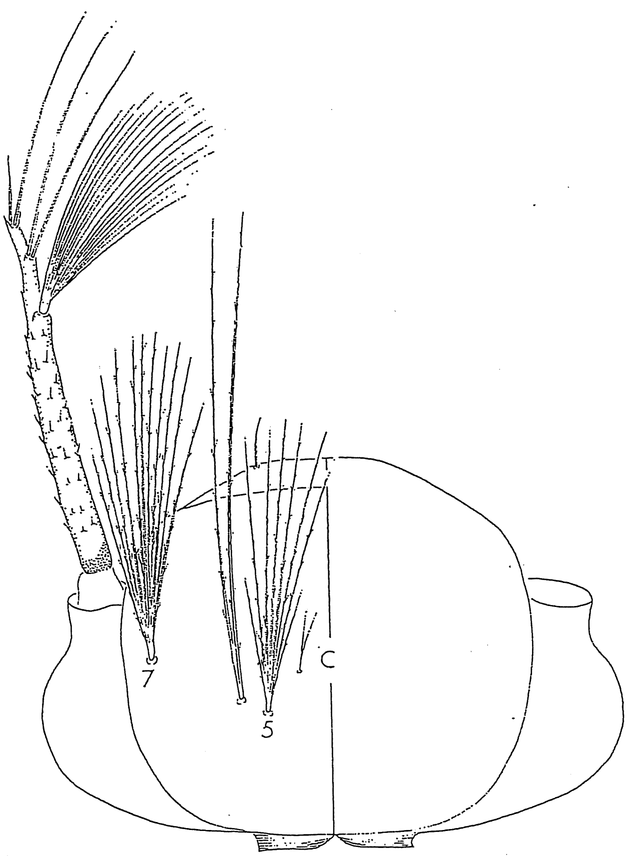


Fig. 349. Dorsal view of head – *Cs. minnesotae*

Fig. 351. Dorsal view of head – *Cs. morsitans*

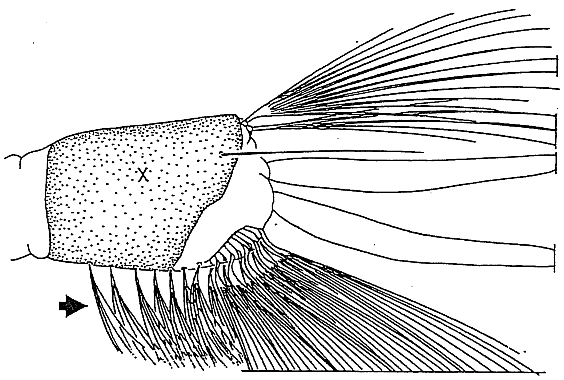


Fig. 350. Lateral view of abdominal segment X – *Cs. minnesotae*

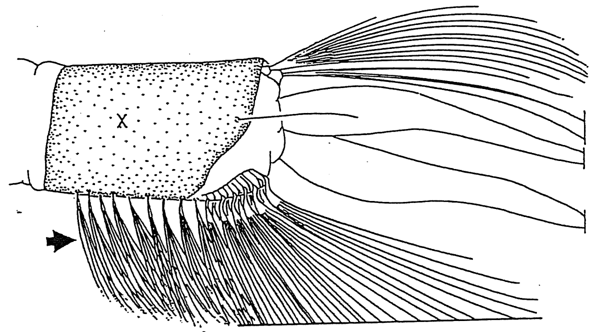


Fig. 352. Lateral view of abdominal segment X – *Cs. morsitans*

4(2). Setae 5,6-C similar in size and number of branches; setae 4-C single or double (Fig. 353) . . . . *impatiens*

Seta 6-C with fewer branches and usually somewhat longer than 5-C; seta 4-C with 3-5 branches (Fig. 354) . . . . *inornata*

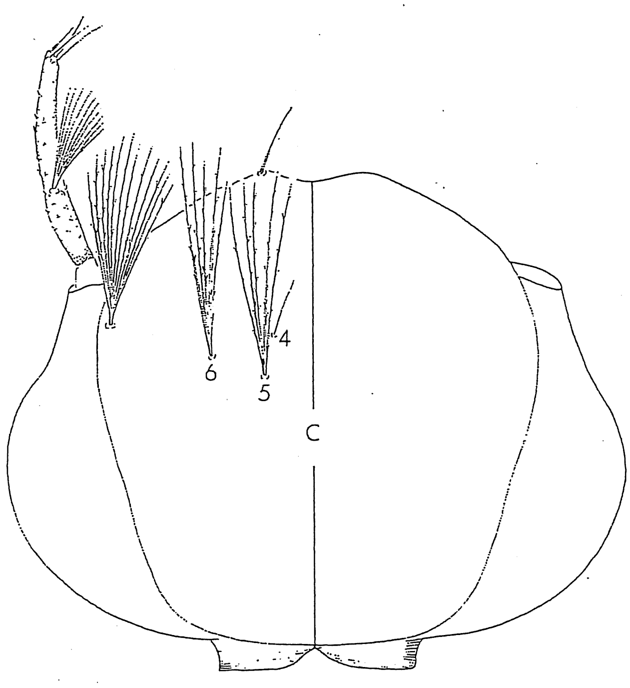


Fig. 353. Dorsal view of head – *Cs. impatiens*

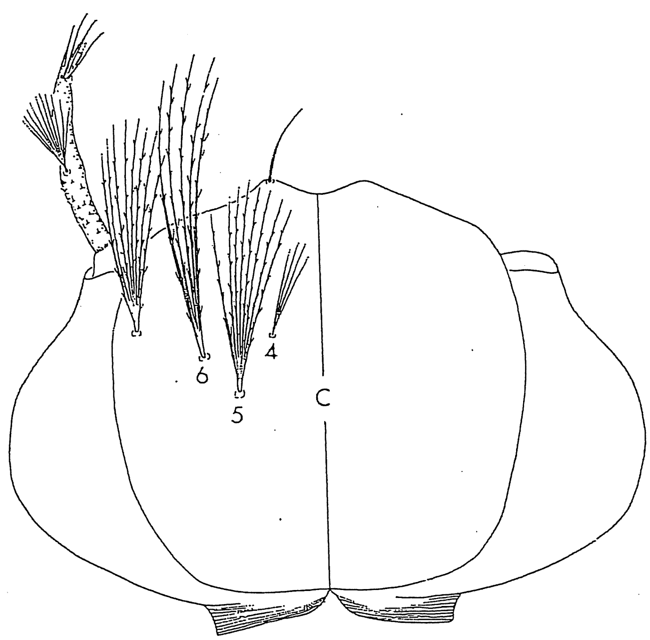


Fig. 354. Dorsal view of head – *Cs. inornata*

KEY TO GENUS ORTHOPODOMYIA

Seta 1-S usually with 3,4 branches, subequal in length to diameter of siphon at point of attachment; without large tergal plate on VIII (Fig. 355) . . . . *alba*

Seat 1-S usually with 6 or more branches, much longer than diameter of siphon at point of attachment; with large tergal plate on VIII (Fig. 356) . . . . *signifera*

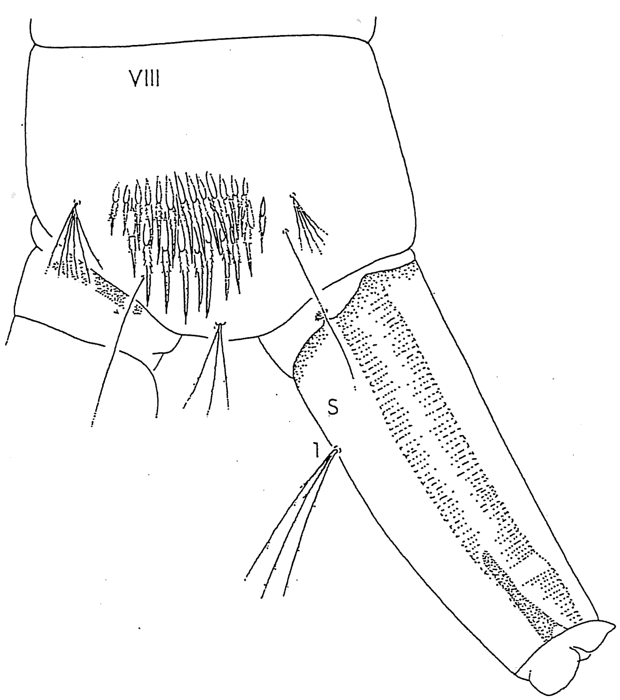


Fig. 355. Lateral view of siphon and abdominal segments VIII-X – *Or. alba*

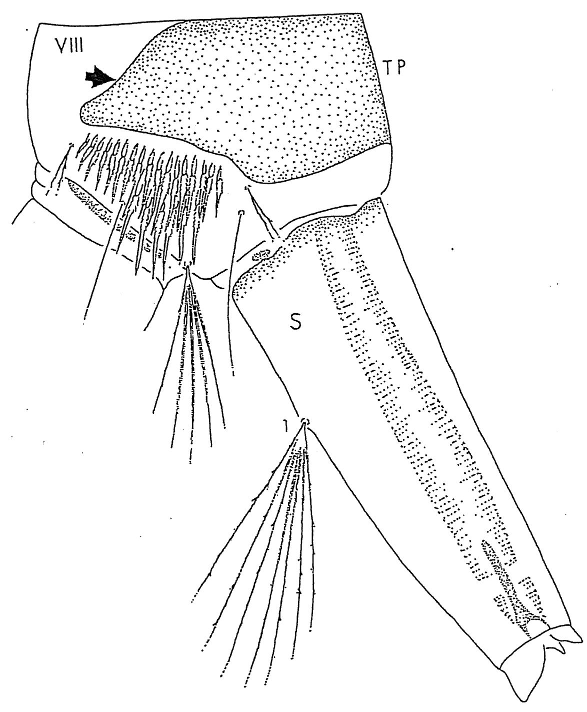
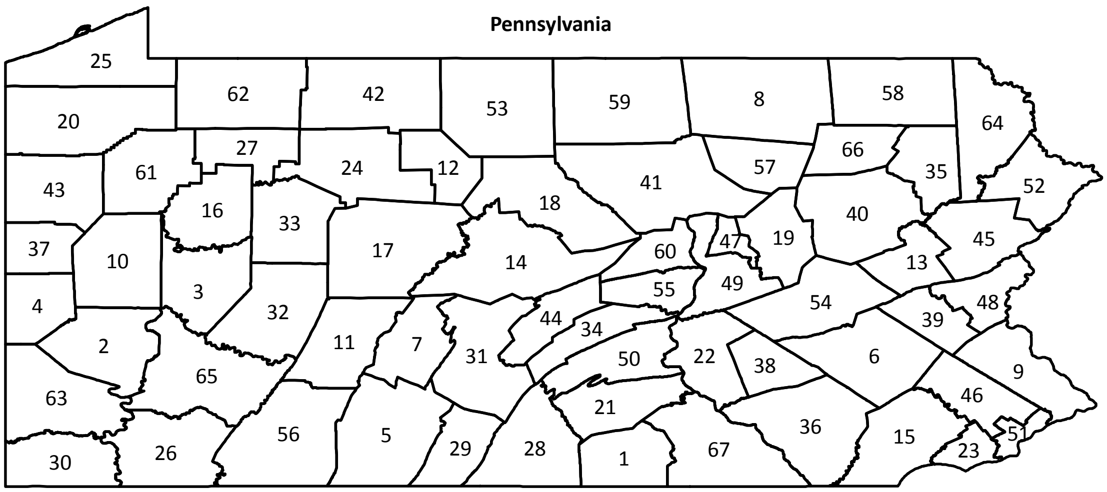


Fig. 356. Lateral view of siphon and abdominal segments VIII-X – *Or. signifera*

BIOLOGICAL SKETCHES

PENNSYLVANIA MAP WITH COUNTY CODES



County Key

1...Adams
2...Allegheny
3...Armstrong
4...Beaver
5...Bedford
6...Berks
7...Blair
8...Bradford
9...Bucks
10...Butler
11...Cambria
12...Cameron
13...Carbon
14...Centre
15...Chester
16...Clarion
17...Clearfield
18...Clinton
19...Columbia
20...Crawford
21...Cumberland
22...Dauphin
23...Delaware
24...Elk
25...Erie
26...Fayette
27...Forest
28...Franklin
29...Fulton
30...Greene
31...Huntingdon
32...Indiana
33...Jefferson
34...Juniata
35...Lackawanna
36...Lancaster
37...Lawrence
38...Lebanon
39...Lehigh
40...Luzerne
41...Lycoming
42...McKean
43...Mercer
44...Mifflin
45...Monroe
46...Montgomery
47...Montour
48...Northampton
49...Northumberland
50...Perry
51...Philadelphia
52...Pike
53...Potter
54...Schuylkill
55...Snyder
56...Somerset
57...Sullivan
58...Susquehanna
59...Tioga
60...Union
61...Venango
62...Warren
63...Washington
64...Wayne
65...Westmoreland
66...Wyoming
67...York

Aedes aegypti (Linnaeus)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

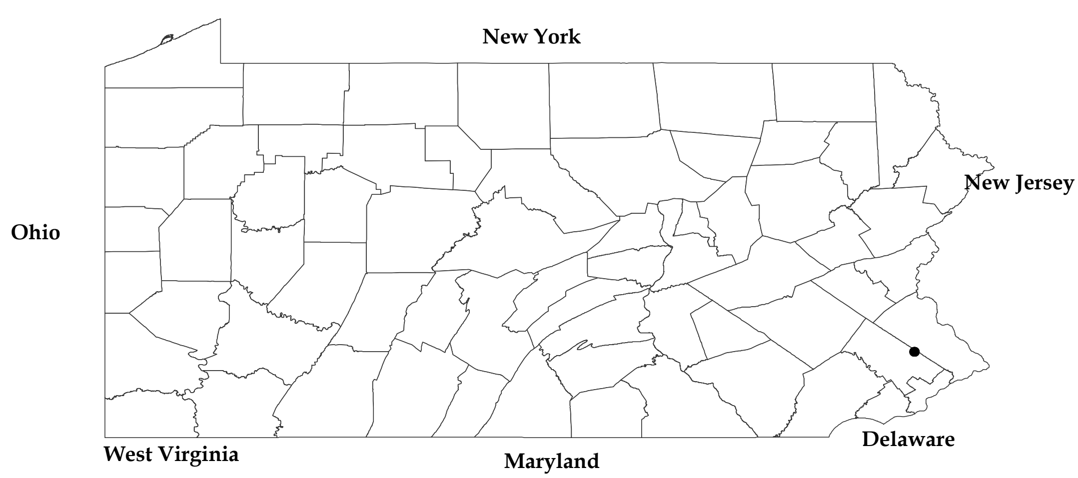
LARVAL HABITAT:
Larvae are found almost exclusively in artificial containers. This is an urban species with close ties to human habitation.

HOST PREFERENCES:
Females are aggressive day-biters that feed almost exclusively on humans. Host-seeking females tend to stay low to the ground and they prefer to bite the lower extremities of the body. Large mammals serve as secondary hosts when human hosts are unavailable.

VIRUS TESTING RESULTS:
Only 13 specimens have been tested for West Nile virus and the results were negative.

COMMENTS:
Ae. aegypti is an introduced species to North America and has been established here for several hundred years. It is one of the world's most troublesome species both with respect to pest activity and disease transmission. It is the primary vector of both Dengue and Yellow Fever in parts of the world where those viruses are present. Historical populations existed in Pennsylvania and were no doubt responsible for outbreaks of yellow fever that killed about 3,500 people in the Philadelphia area from late 1790's to the early 1800's. A small, transient population of females and a single larva were collected at one locality in Bucks Co. in 2002. It is doubtful that eggs of this species can successfully overwinter as far north as Pennsylvania.

Distribution*



*Historical records from Philadelphia area not shown

Aedes albopictus (Skuse)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae have been collected from a wide variety of artificial containers including tires, graveyard urns, tin cans, buckets, and natural containers such as tree holes.

HOST PREFERENCES:
These mosquitoes prefer to feed on large mammals, especially humans. When these hosts are not abundant, females will feed on a variety of animals, including small mammals, birds, snakes, turtles and frogs. They are persistent and aggressive day-biters, preferring to bite lower on the body. They will also enter houses in search of hosts.

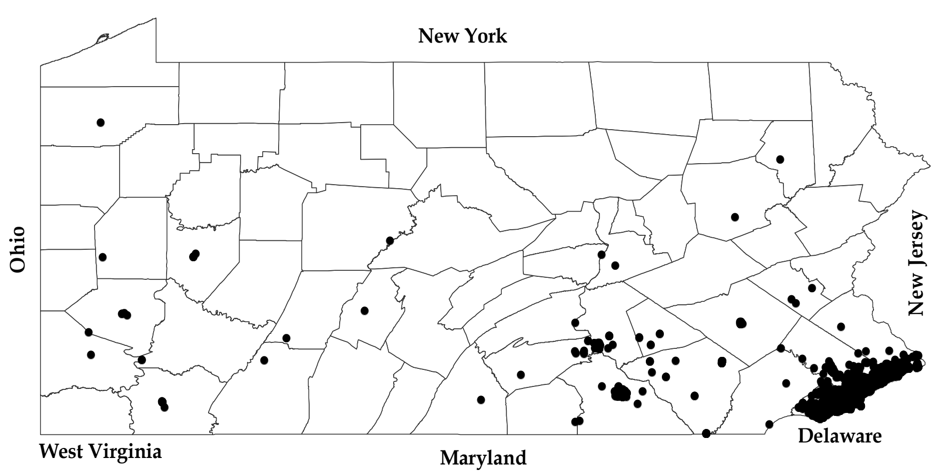
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	10,353*	1,487	3	0.29
EEE	3,910	534	0	0
La Crosse	1,042	102	0	0

*74% were from host-seeking traps; 26% were from gravid traps

COMMENTS:
Ae. albopictus is generally considered to be one of the most troublesome mosquito species in the world with respect to pest activity and disease potential. Its generalized feeding behavior contributes to its vector potential, which includes laboratory and/or field transmission of dog heartworm, Chikungunya, Dengue, Eastern Equine, La Crosse, St. Louis, West Nile viruses and at least 15 other viruses worldwide. *Ae. albopictus* is an exotic species that was originally Asian in distribution, but has been introduced to many parts of the world largely as a result of the international trade in used tires. A significant breeding population was discovered in Houston, Texas in 1985 and it spread rapidly over the southern states since then, but its northward spread has been slow due to the inability of its eggs to tolerate extreme cold temperatures.

Distribution



Aedes cinereus Meigen

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine, possibly bivoltine.

LARVAL HABITAT:
Larvae can be found in a wide variety of natural habitats, especially in woodland pools, temporary rain pools, bogs and other wetlands, and floodwaters. Larvae tend to avoid open water, preferring to congregate near dense vegetation.

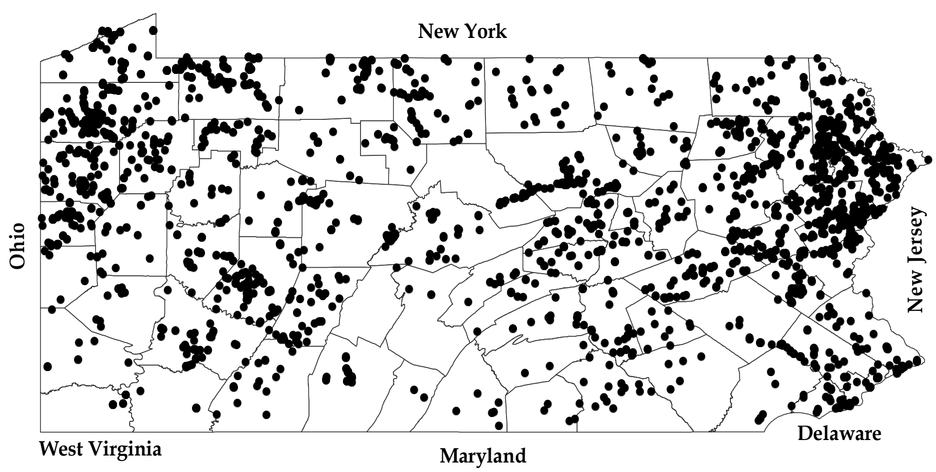
HOST PREFERENCES:
Ae. cinereus mosquitoes prefer mammalian blood and are moderately aggressive human biters, but do not occur in large numbers. Females prefer to bite during the day and early evening, concentrating on the lower portions of the body. Adults are not strong fliers and tend to stay close to their larval habitats.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	3,965	199	0	0
EEE	41	3	0	0
La Crosse	0	0	0	0

COMMENTS:
This is a relatively common species, especially early in the spring. Larvae are considerably smaller than most other spring species and adults are one of the smallest species in the state. The literature frequently reports only 1 generation per year, but not all of the overwintering eggs hatch in the spring, resulting in a later, fall brood. It is unclear whether this is the case in PA or whether there is truly a second generation. In the spring, larvae are most commonly collected with *Ochlerotatus canadensis*. The fall immatures are often collected with *Aedes vexans*.

Distribution



Aedes vexans (Meigen)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

LARVAL HABITAT:
Larvae are found in a variety of habitats including open, shallow grass-filled depressions, ditches, temporary woodland pools and other areas associated with heavy rains and floodwater.

HOST PREFERENCES:
Ae. vexans prefer to feed on large mammals such as deer, horses, cattle, and humans. However, they are generally considered to be opportunistic feeders and will feed on nearly any animal that is available. Adults are strong fliers and have been known to travel as far as 15 miles from their larval sites in search of hosts and/or breeding sites.

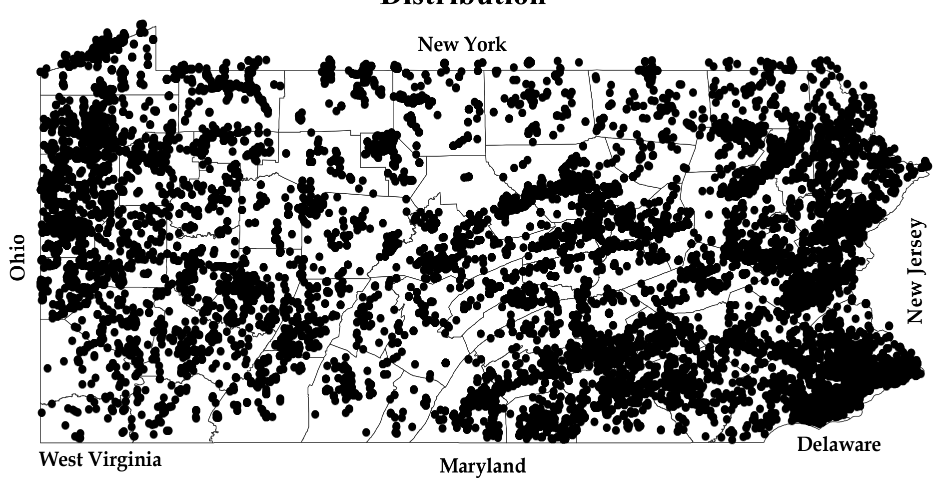
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	248,890*	8,130	16	0.06
EEE	13,571	329	0	0
La Crosse	50	2	0	0

*99% were from host-seeking traps; 1% were from gravid traps

COMMENTS:
This is one of the most common mosquitoes in the state and can be a major nuisance in areas that have recently experienced heavy rains. The eggs are laid on moist soil, require a period of drying before hatching and can remain viable for several years. They also exhibit hatching latency, whereby not all eggs will hatch when inundated the first time, but will hatch after a subsequent flooding. This mosquito's generalized feeding habits contribute to its potential to be a bridge vector of West Nile virus and other viruses. In addition, females can be fairly long-lived and can take as many as 8 blood meals in a season, which increases its likelihood of being infected by arboviruses. They have been implicated in the transmission cycles of WNV and EEE and have been shown to be a competent vector of Western Equine and St. Louis encephalitis viruses in the laboratory.

Distribution



Anopheles barberi Coquillett

OVERWINTERING STAGE: Early instar lava. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae are found almost exclusively in tree holes, their natural habitat. They will also live in artificial containers, especially tires. They are primarily filter feeders, but have been known to prey on other mosquito larvae and on Ceratopogonid midge larvae.

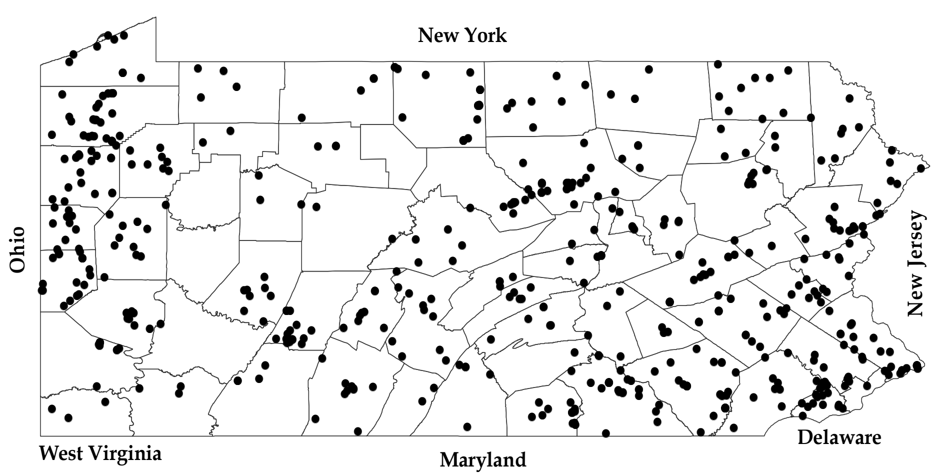
HOST PREFERENCES:
As with other *Anopheles*, *An. barberi* is a mammal feeder. They will bite humans, although they rarely occur in high enough numbers to be considered a nuisance.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	91	48	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This is a widely distributed, but infrequently collected mosquito in Pennsylvania. Less than 1,000 specimens of adults and larvae were collected from 2001-2007. Adults are rather non-descript for an *Anopheles*. They are easily the smallest *Anopheles* species in the state. Larvae are quite slow to develop, requiring up to a month to pupate. Larvae can survive the winter even if treehole water freezes solid. Females are capable of transmitting the malarial species *Plasmodium vivax* in the lab, but they are too uncommon throughout their range to pose a significant threat.

Distribution



Anopheles crucians s.l.

OVERWINTERING STAGE: Larva. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be found in semi-permanent pools, ponds, lakes and swamps. They prefer water that is slightly acidic and under partial shade.

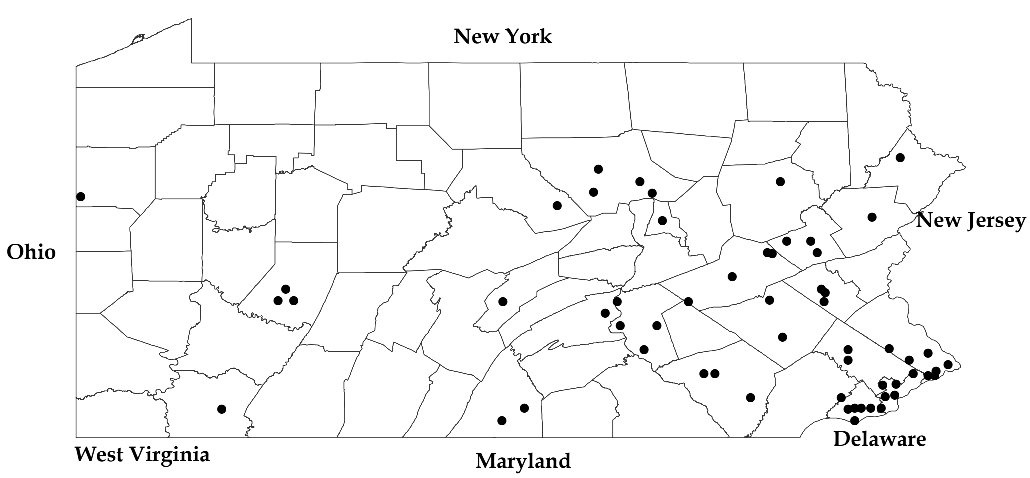
HOST PREFERENCES:
Females prefer to feed on mammalian hosts and will bite humans during the day or night.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	60	14	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
An. crucians s.l. is a complex of species that includes *An. crucians* Wiedemann, *An. bradleyi* King and *An. georgianus* King. Adults and larvae of these species are nearly impossible to differentiate morphologically. In a recent study, Wilkerson et. al (2004) used molecular techniques to attempt to differentiate these species and they concluded that the complex actually contains six species. The new species have not yet been named. No molecular analyses have been performed on PA specimens to date, so it is not possible to know for sure which species inhabit the state. *An. crucians* s.l is essentially a southern complex of mosquitoes whose range of one or more of the species extends to the southeast portion of Pennsylvania. Only 460 adult specimens were collected from 2001-2007 and 82% of those were taken from the southeastern portion of the state. The literature indicates that this species is probably more attracted to CO_2+octenol than to CO_2 alone. *An. crucians* has been found to be naturally infected with malaria, but they're too uncommon in PA to play a major role if malaria were introduced in the summer months.

Distribution



Anopheles earlei Vargas

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

Females overwinter in protected areas such as buildings, caves, animal burrows and beaver lodges. In PA, one overwintering specimen was collected in the basement of an abandoned building in January.

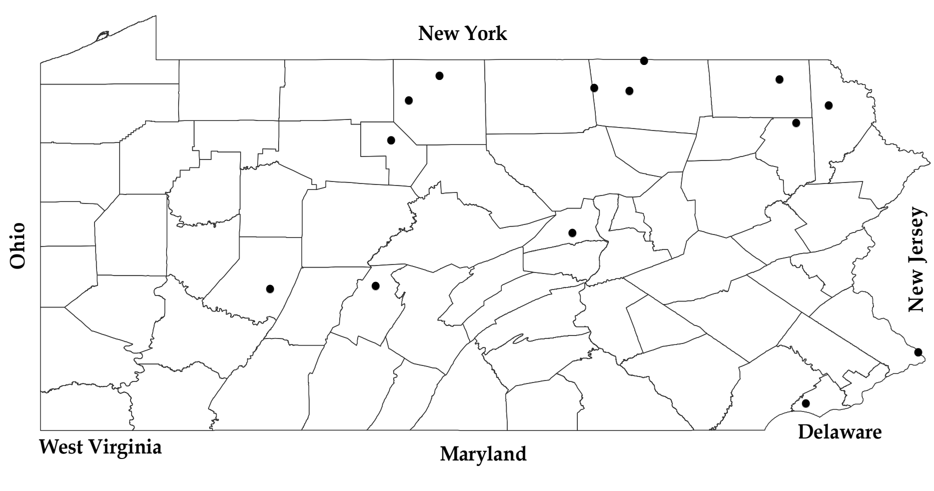
LARVAL HABITAT:
Larvae prefer cold, clear water in the shallow margins of semi-permanent and permanent ponds overgrown with emergent and floating vegetation. They will also exploit a variety of other natural habitats.

HOST PREFERENCES:
These are predominantly mammalian feeders. Hosts include humans, cattle, horses, deer, rabbits, foxes, squirrels, sheep, pigs and beavers.

VIRUS TESTING RESULTS:
No specimens have been tested for any arbovirus in PA.

COMMENTS:
This is a very infrequently collected mosquito in Pennsylvania. In fact, it was a new state record in the year 2000. Only 7 larvae and 10 adults have been collected in PA. Four of the larvae were collected from the edges of ponds, 1 from a canal and 1 from a woodland pool. Western Equine encephalomyelitis (WEE) has been isolated from this species in Manitoba, but WEE does not occur in PA.

Distribution



Anopheles perplexens Ludlow

OVERWINTERING STAGE: Adult female.

PHENOLOGY: Multivoltine.

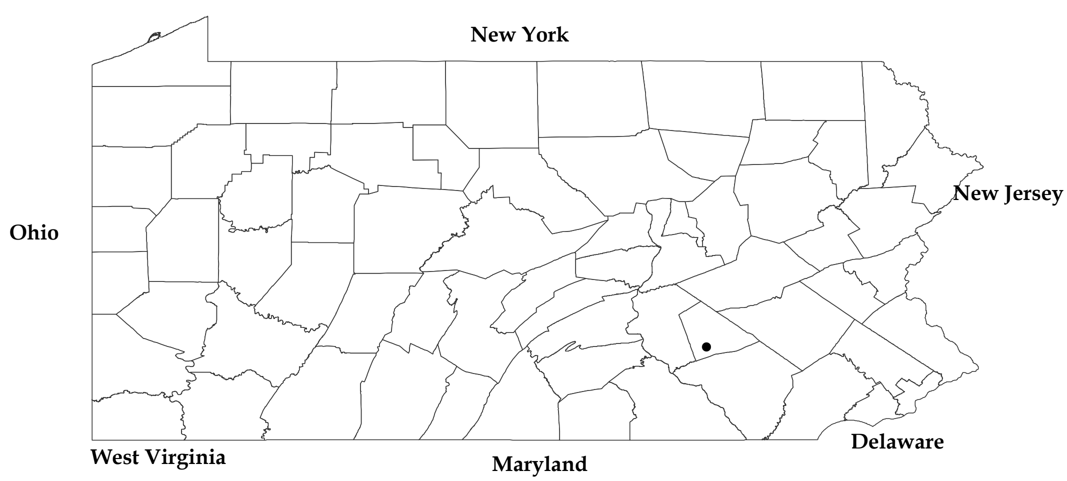
LARVAL HABITAT:
Larval habitats are not well defined, but they have been collected from limestone springs in Georgia.

HOST PREFERENCES:
Females are mammalian feeders.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
The original description of this species was from Mt. Gretna, Pennsylvania in 1907. Since then there has been considerable confusion regarding its taxonomic status. In 1917 *An. perplexens* was considered to be a dark form of the more common *An. punctipennis* and was placed in synonymy with the latter. In 1956 all life stages of both forms were studied and it was concluded that both forms exist and *An. perplexens* was resurrected as a valid species, although, it was still not clear if the original Mt. Gretna specimen was *An. perplexens* or just a dark form of *An. punctipennis*.
If it is eventually determined that the Mt. Gretna specimen was simply a dark form of *An. punctipennis,* then the name *An. perplexens* was created in error. Technically, the species that is currently being referred to as *An. perplexens* in the south should be renamed. During the course of the current survey, a small number of specimens have been collected that fit the description of *An. perplexens*. Interestingly, 3 adult female specimens were collected in 2007 near an artificial, alkaline lake with a pH in the vicinity 10.0, which concurs with their presumed preference for alkaline habitats. However, since their identity is not certain, only the 1907 record appears in the distribution map.

Distribution*



*Historical record.

Anopheles punctipennis (Say)

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

Adult females overwinter in caves, animal burrows, hollow trees, root cellars, bank barns, abandoned buildings, tunnels, spring houses and other protected places. They prefer cool, dark areas with high humidity.

LARVAL HABITAT:
Larvae can be collected from a wide variety of habitats including temporary pools with or without emergent vegetation or floating plants, wetlands, canals, ditches, retention basins, ponds, catch basins, still areas along the edges of streams and the occasional tire.

HOST PREFERENCES:
This species is primarily a large mammal feeder. It will bite humans during the day or night and has been known to enter houses to feed.

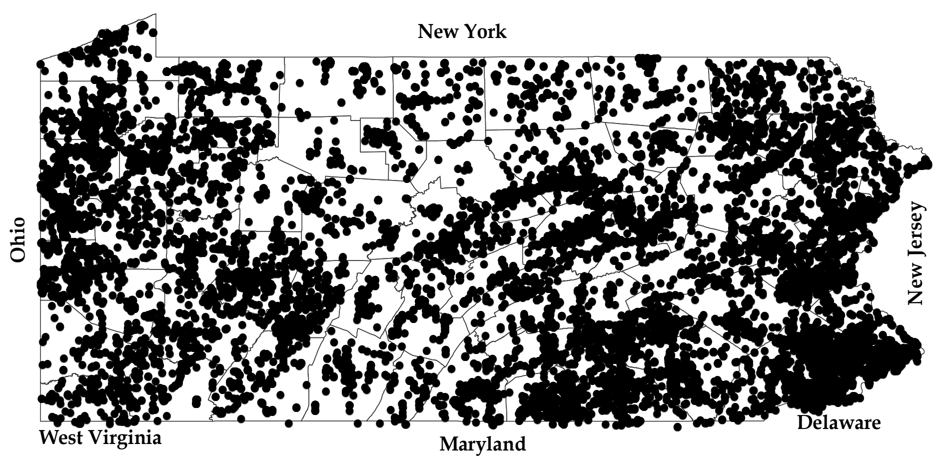
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	14,869*	1,839	2	0.13
EEE	46	24	0	0
La Crosse	0	0	0	0

*94% were from host-seeking traps; 6% were from gravid traps

COMMENTS:
Larvae and adults are widespread throughout the state, but are usually not collected in large numbers in any one sample. The largest single collection of adults in PA was from an overwintering site where several hundred were taken from an abandoned building adjacent to a wetland. This is the most common *Anopheles* in the state.

Distribution



Anopheles quadrimaculatus s.l.

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

These mosquitoes overwinter as adult females in caves, animal burrows, hollow trees, root cellars, bank barns, abandoned buildings, tunnels, spring houses and other protected places. They prefer cool, dark areas with high humidity.

LARVAL HABITAT:
Larval habitat depends on the sibling species, but the species known to live in Pennsylvania can be found in a wide variety of habitats including wetlands, ponds, puddles, retention ponds, ditches and stream edges.

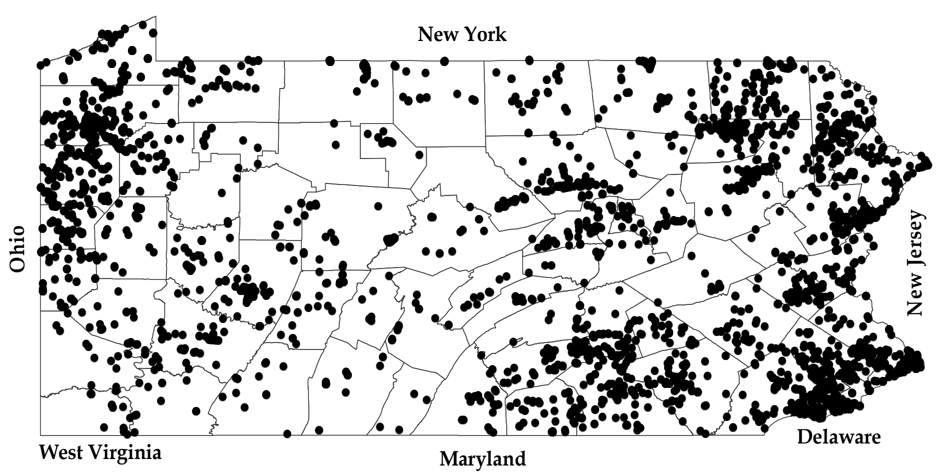
HOST PREFERENCES:
Females prefer large mammals including humans, domestic and wild animals including livestock, white-tailed deer and horses.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	5,926	516	0	0
EEE	148	16	0	0
La Crosse	0	0	0	0

COMMENTS:
When malaria was prevalent in the United States, this species served as a competent vector and can do so again if malaria reappears, particularly in the southeastern U.S. *An. quadrimaculatus* s.l. is actually a complex of 5 sibling species as follows: *An. diluvialis, An. inundatus, An. maverlius, An. smaragdinus*, and *An. quadrimaculatus* s.s. The only species that is known to occur in Pennsylvania is *An. quadrimaculatus* s.s. This species is the second most common *Anopheles* in PA after *An. punctipennis*. Females are readily collected throughout the winter months in their typical overwintering sites.

Distribution



Anopheles walkeri Theobald

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae are said to prefer permanent water such as wetlands and pond edges with an abundance of vegetation.

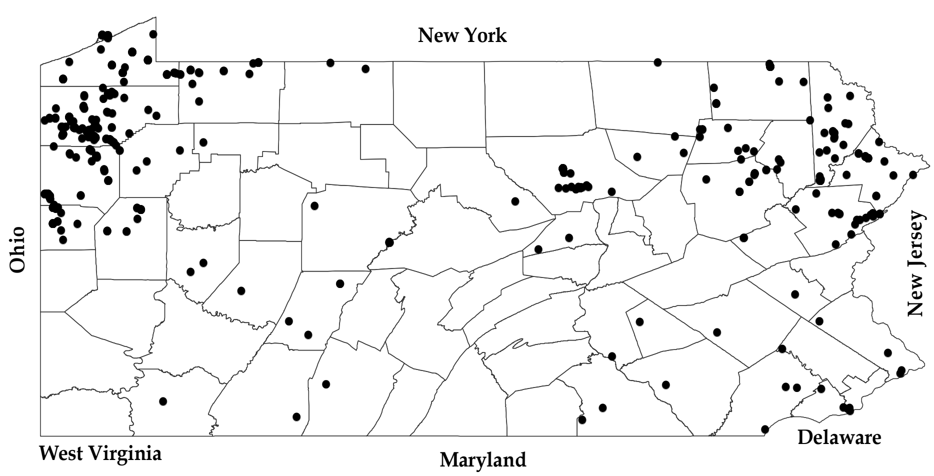
HOST PREFERENCES:
These are mammalian biters and prefer to bite at night. However, females will bite during the day if their habitat is invaded.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	4,047	131	0	0
EEE	14	0	0	0
La Crosse	0	0	0	0

COMMENTS:
Larvae have been only rarely collected in Pennsylvania, but dipping among emergent vegetation in wetlands should yield specimens. Adults can be collected in fairly large numbers where populations exist using a CO_2-baited light trap. Females are probably more attracted to CO_2+octenol rather than CO_2 alone. This species is rare in the southern half of the state, but is quite common in the northwestern part where they frequently outnumber *An. quadrimaculatus* s.l. and *An. punctipennis*. Females are more attracted to light than are most other species of mosquitoes. Resting adults prefer to stay close to the water on emergent vegetation in their larval habitats in contrast to *An. quadrimaculatus* s.l. and *An. punctipennis*, which seek shelters during the day. This is the only species of *Anopheles* in North America that overwinters in the egg stage.

Distribution



Coquillettidia perturbans (Walker)

OVERWINTERING STAGE: Larva. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
Wetlands with muddy bottoms and abundant vegetation are the preferred habitat. The presence of thick muck or peat appears to be more important than the plant species as larvae have been collected from the roots of cattails (*Typha sp.*), arrowhead *(Sagitaria sp.*), pickerelweed (*Pontederia sp.*), water lily (*Nymphaea sp.*), rushes *(Juncus sp.*), reeds (*Phragmites sp.*), sedges (*Carex sp.*), and water arum (*Calla sp.*).

HOST PREFERENCES:
Cq. perturbans prefer to feed on mammals, including humans. However, they will readily feed on birds as well. Peak feeding activity typically occurs at dusk.

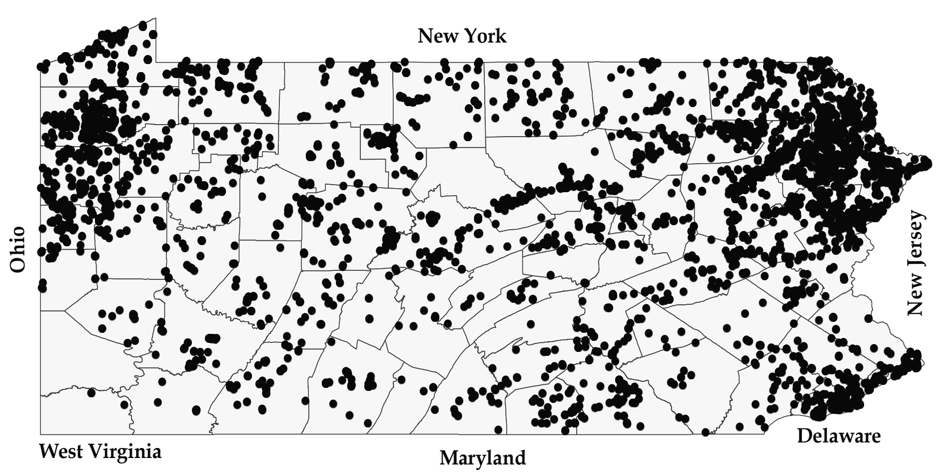
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	111,241*	2,381	2	0.02
EEE	51,928	914	0	0
La Crosse	165	6	0	0

*99% were from host-seeking traps; 1% were from gravid traps or resting boxes

COMMENTS:
Larvae have respiratory siphons that are attenuated and modified into saw-shaped structures used to pierce the stems and roots of submerged vegetation. They obtain oxygen from the air tubes within the plants, which enables the larvae to remain submerged for their entire larval development. The pupae also remain submerged, using modified trumpets to pierce aquatic vegetation. Larvae can detach readily and burrow in the substrate if they are disturbed. Larval collection is challenging since larvae do not need to surface to breathe. Larval collection techniques that have been used with some success include uprooting host plants, scraping intact plant stems with a screened dipper, and using a modified bilge pump to collect substrate near plant roots. Females are involved in the transmission cycle of EEE.

Distribution



Culex erraticus (Dyar and Knab)

OVERWINTERING STAGE: Adult female.

PHENOLOGY: Multivoltine

LARVAL HABITAT:
Larvae prefer ponds, wetlands and the edges of lakes and streams. They appear to have a particular affinity for pond habitats, especially those with a large number of root mats and partially submerged stumps.

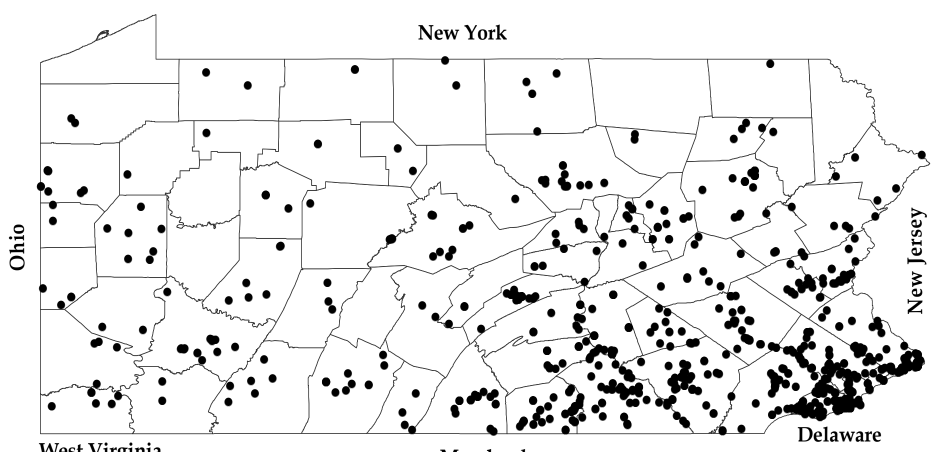
HOST PREFERENCES:
Females exhibit opportunistic feeding preferences. Mammals appear to be slightly preferred over birds with occasional feeding on amphibians and reptiles.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	13,214	583	0	0
EEE	275	10	0	0
La Crosse	0	0	0	0

COMMENTS:
Larvae have been infrequently collected in Pennsylvania, with ponds being the most productive habitat. Adults are moderately common in the southeastern counties, but are rarely collected in most other parts of the state. Roughly 63% of PA specimens were collected from Philadelphia and Bucks counties alone. Adult females were collected from overwintering sites in PA on several occasions, but not in great numbers. The opportunistic feeding behavior along with detection of positive EEE and WNV pools in North America make this species a concern as a potential bridge vector of those diseases.

Distribution



Culex pipiens Linnaeus

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

Adult females overwinter in caves, animal burrows, hollow trees, root cellars, bank barns, abandoned buildings, tunnels, spring houses and other protected places. They prefer cool, dark areas with high humidity.

LARVAL HABITAT:
Larvae can be found in sewage treatment plants, artificial containers, catch basins and other habitats associated with human activity. They are particularly tolerant of polluted water.

HOST PREFERENCES:
Females are primarily bird feeders, but they will feed on mammals, snakes and turtles at times. They will feed on humans in populated areas, especially when their primary hosts are not abundant, sometimes entering houses to feed. Some studies show a switch from avian to mammalian feeding later in the season.

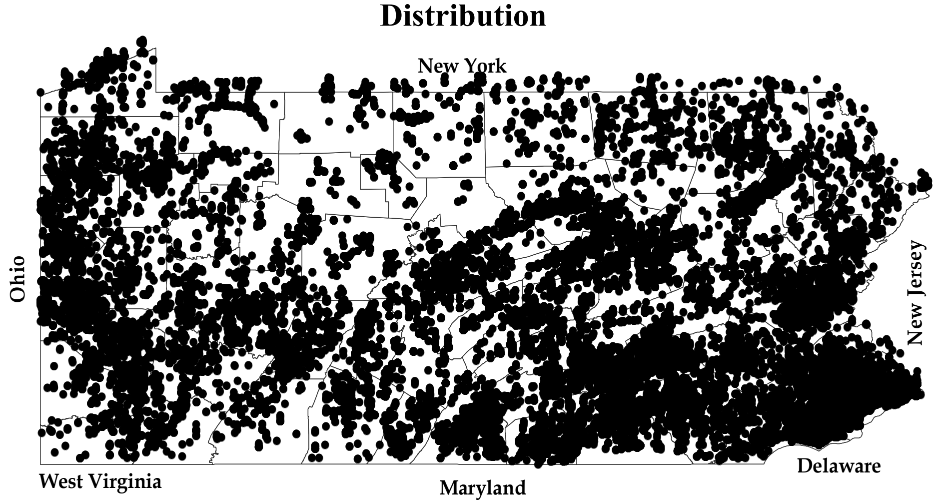
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	593,599*	40,358	1,468	2.47
EEE	7,945	407	0	0
La Crosse	844	32	0	0

* 67% from gravid traps, 27% from host-seeking traps, 6% from overwintering/resting sites

COMMENTS:
This species is an important enzootic vector of West Nile virus in the Northeastern states as demonstrated by its preference for feeding on birds coupled with the large number of pools that have tested positive. It is also generally accepted that *Cx. pipiens* is the primary vector of WNV to the human population. In Pennsylvania, *Cx. pipiens* has the highest infection rates of any species. Additionally, three pools have tested positive for WNV from winter collections, suggesting females serve as important overwintering reservoirs for the virus in Pennsylvania.

Distribution



Culex restuans Theobald

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

It is generally agreed that this species survives the winter as hibernating adult females. However, extensive winter sampling from caves, root cellars, bank barns, abandoned buildings, tunnels and spring houses have not yielded any specimens.

LARVAL HABITAT:
Larvae can be found in a wide variety of habitats including artificial containers, catch basins, ditches, puddles, temporary pools, and ponds. They are tolerant of pollution, but not to the same degree as *Cx. pipiens*.

HOST PREFERENCES:
Most recent bloodmeal analysis studies reveal a strong preference for avian blood. Amphibians, reptiles and mammals are also sometimes fed upon. Some older literature indicates that females can be pests of humans on occasion.

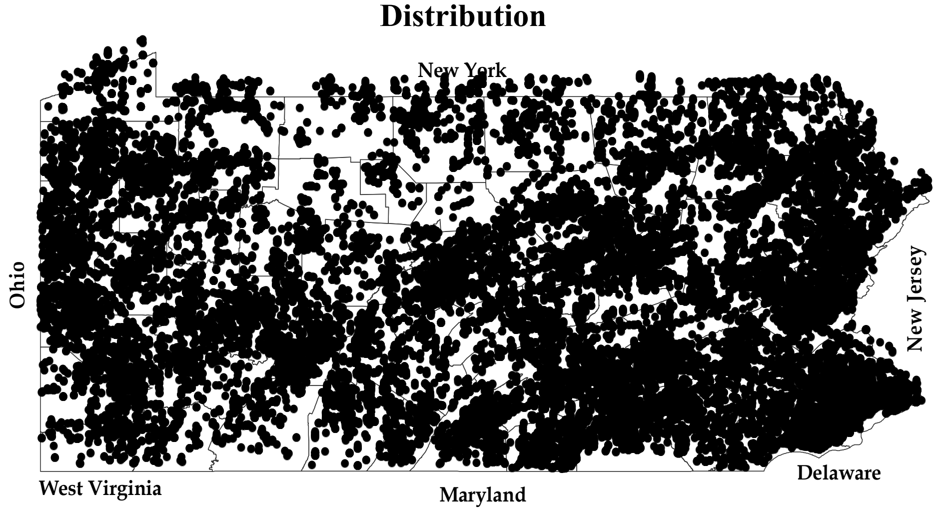
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	1,147,617*	52,486	1,196	1.04
EEE	11,080	419	0	0
La Crosse	793	37	0	0

*96% were from gravid traps, 4% were from host-seeking traps

COMMENTS:
This is probably the most common species of mosquito in Pennsylvania because they are able to exploit a wide range of habitats including both artificial containers and natural habitats. *Cx. restuans* is clearly one of the species principally responsible for the early season amplification of WNV based on their bird biting habits, their extreme abundance early in the season and on the large number of pools that have tested positive, second only to *Cx. pipiens*. Their role in the transmission of WNV to humans is not yet well-defined.

Distribution



Culex salinarius Coquillett

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

Females overwinter in natural shelters such as animal burrows rather than in dwellings as with *Cx. pipiens*. This species is capable of coming out of diapause to seek a blood meal on warm winter days. No overwintering specimens have been collected in Pennsylvania.

LARVAL HABITAT:
Larvae can be found in brackish or freshwater wetlands and are often associated with *Phragmites*. They are also frequently taken from temporary, grassy pools. Larvae prefer natural habitats to artificial ones, but they are occasionally found in tires and other containers.

HOST PREFERENCES:
Cx. salinarius is an opportunistic feeder that will readily bite both birds and mammals, including humans. Females are most active shortly after dusk.

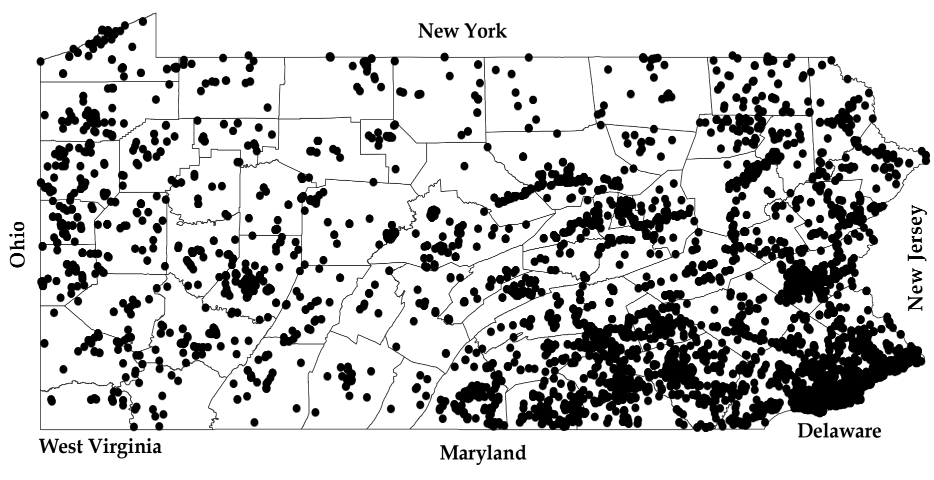
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	276,454*	9,747	124	0.45
EEE	14,924	234	0	0
La Crosse	37	2	0	0

* 99% were from host-seeking traps; 1% were from gravid traps.

COMMENTS:
Although this mosquito is widely distributed throughout the state, its distribution is quite uneven. Over 80% of adults were collected from only two wetlands about 10 miles apart in Philadelphia. This species is considered to be an important potential bridge vector of WNV because of its willingness to bite both birds and mammals and its moderately high field infection rates in many parts of the U.S. In Pennsylvania, WNV infection rates are the 3rd highest of all species after *Cx. pipiens* and *Cx. restuans*. This species is also considered a secondary vector of EEE throughout its range.

Distribution



Culex tarsalis Coquillett

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

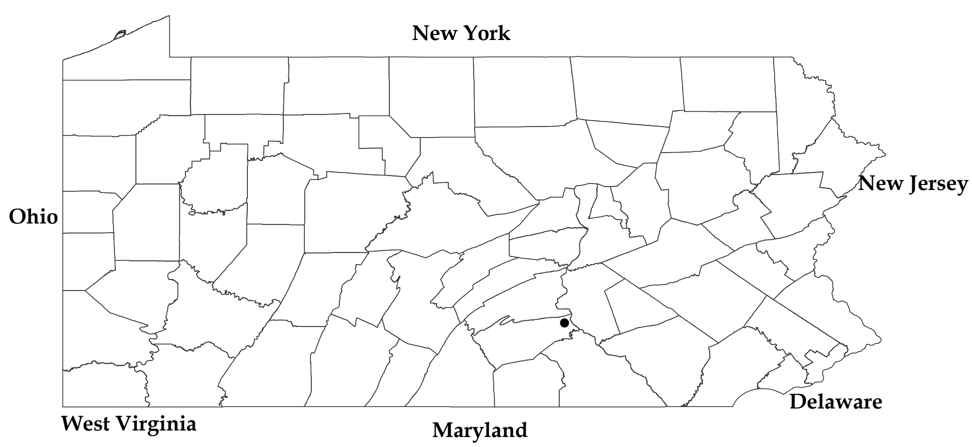
LARVAL HABITAT:
Larvae can be found in permanent and semi-permanent ponds, ditches with vegetation, temporary pools, artificial containers, agricultural tailwater, alkaline lake beds, fresh and saline wetlands, treated sewage effluent and oil field run-off.

HOST PREFERENCES:
Females will feed on birds early in the season and will switch their feeding preferences to mammals later in the season. They are known to feed on rabbits, horses, cattle, humans and many species of birds. Adults are strong fliers and have been known to travel up to 17 miles in search of hosts, mates and/or oviposition sites.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species' willingness to feed heavily on both birds and mammals makes it an ideal candidate as a bridge vector of encephalitis viruses. It is the most important vector in western North America for St. Louis, West Nile and Western equine viruses. It is also an efficient laboratory vector of Japanese and Venezuelan viruses. This species has only been collected once in Pennsylvania in 1970 from an army depot in Cumberland County. It is likely that this collection was the result of an accidental introduction from the transport of military equipment.

Distribution*



*Historical record.

Culex territans Walker

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

Adult females overwinter in caves, animal burrows, hollow trees, root cellars, bank barns, abandoned buildings, tunnels, spring houses and other protected places. They prefer cool, dark areas with high humidity.

LARVAL HABITAT:
Larvae can be found in a wide range of natural habitats, but prefer relatively clean, cool water. Typical habitats include semi-permanent pools, wetlands, ponds and stream edges. They are more abundant in habitats that are choked with emergent vegetation and/or duckweed. Larvae can also be found in artificial containers that hold relatively clean water. Many of the collections made in Pennsylvania have been from ponds and tires.

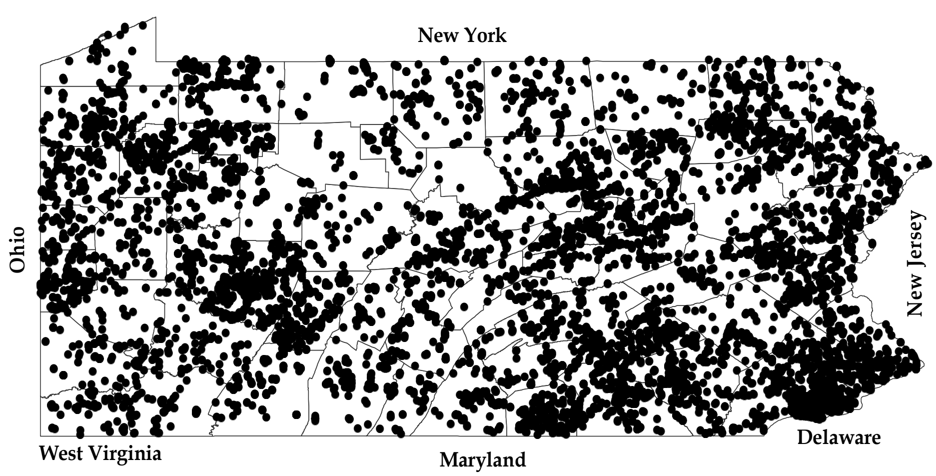
HOST PREFERENCES:
Females are known to feed almost extensively on frogs. They are attracted to frog vocalizations.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	678	156	1	Too few specimens tested
EEE	14	5	0	0
La Crosse	0	0	0	0

COMMENTS:
This species has not been implicated in the transmission cycle of any arbovirus that could be a threat to humans or other mammals in Pennsylvania. They have been known to transmit a nematode that causes frog filariasis in bullfrogs. It is conceivable that *Cx. territans* could be cycling arboviruses in the amphibian population, but the threat to humans would still be minimal because there are no good mosquito bridge vectors.

Distribution



Culiseta impatiens (Walker)

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Reportedly univoltine.

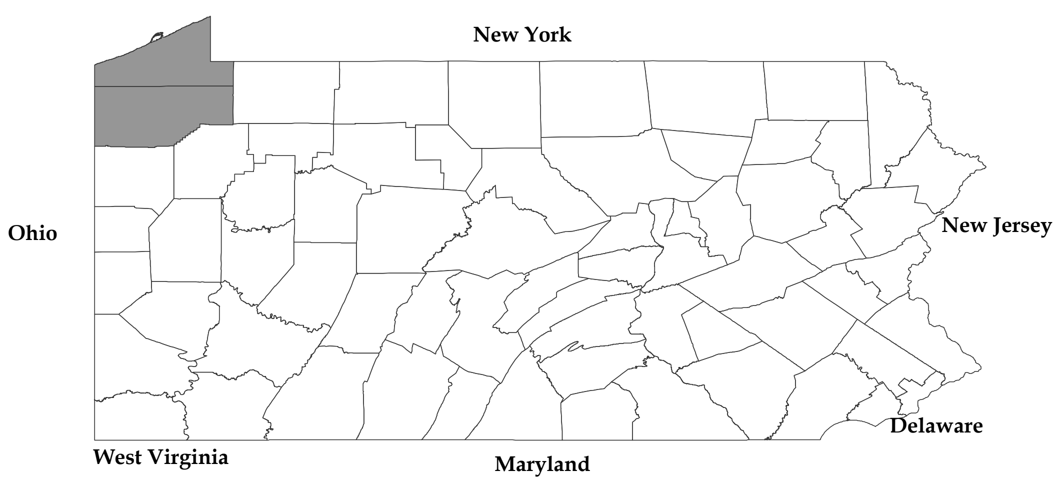
LARVAL HABITAT:
Larvae prefer deep, well-shaded woodland pools and snow pools. In Canada and Alaska, they are generally associated with coniferous forests. They can also be found in semi-permanent ponds and bogs. One report from Alaska showed that they can tolerate extremely polluted impoundment water. In Illinois, they have been collected from roadside ditches adjacent to agricultural crops.

HOST PREFERENCES:
Females probably feed primarily on mammals. They will bite humans and they prefer to feed at dusk.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
The only PA collection record is from the Northwestern portion of the state in the 1970's, although the exact location is not known. Extensive CO_2-baited trap collections from that region during WNV surveillance from 2001-2007 did not yield additional specimens.

Distribution*



*Historical record from NW PA; exact location unknown

Culiseta inornata (Williston)

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be found in a wide variety of habitats, including woodland pools, ditches, wetlands, tree holes and artificial containers. Desiccant-resistant eggs have been recovered from dry material in a tree hole in Texas. Larvae are capable of surviving in polluted and/or brackish water.

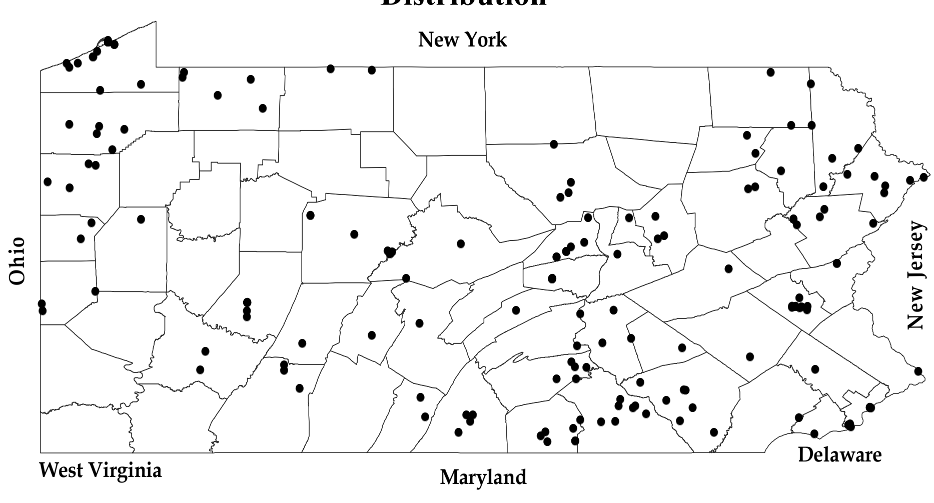
HOST PREFERENCES:
Mammals are the primary hosts of this species. Large mammals such as cattle and horses are especially preferred. Females will sometimes bite humans, but are not considered to be major pests.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	13	7	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
Cs. inornata is an uncommon, but widely distributed species in the state. Only about 300 specimens were collected from 2001-2007. Females reportedly overwinter in animal burrows. Males don't create mating swarms as do most mosquitoes. They mate with newly emerged females, which become receptive one to two minutes after emergence.

Distribution



Culiseta melanura (Coquillett)

OVERWINTERING STAGE: Larva. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be found in semi-permanent to permanent acidic swamps, usually those with a pH of 5.0 or lower. Larvae tend to avoid open water and can often only be found in deep crypts in the basal cavities of trees or partially submerged stumps.

HOST PREFERENCES:
Females feed almost exclusively on birds, especially perching birds. They are also known to feed on small mammals and snakes on rare occasions. Females prefer to bite in the evening and they spend a good deal of time in the tree canopy.

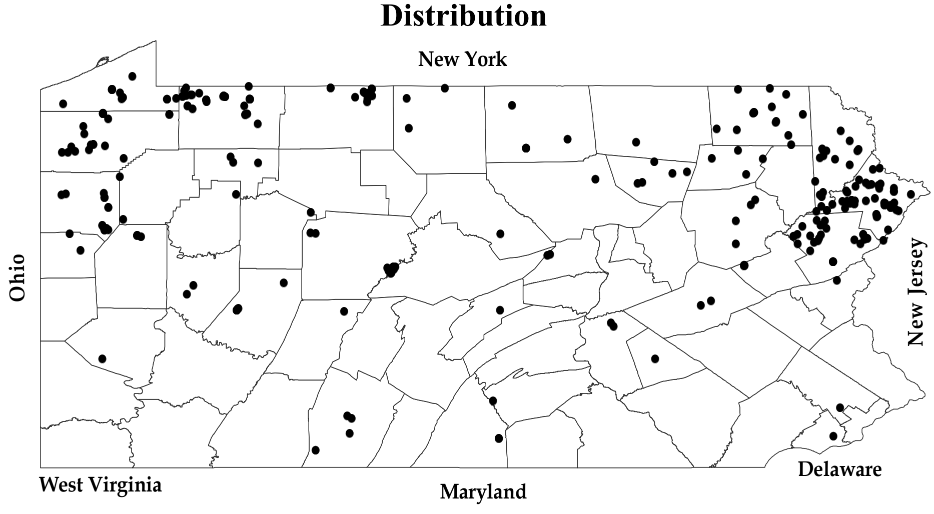
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	2,534*	526	2	0.79
EEE	2,240‡	394	1	0.45
La Crosse	20	1	0	0

* 51% from resting boxes, 44% from CO_2-baited traps; 5% from gravid traps
‡ 57% from resting boxes, 39% from CO_2-baited traps; 4% from gravid traps

COMMENTS:
Larvae are fairly difficult to collect because they live in areas that are often not accessible using a standard dipper. The crypts in which they live are often deep enough that the water cannot be seen from the surface. A suction device with a long hose could be used to access the habitats and withdraw the water from the crypts. Adults have been collected rather infrequently in PA compared to other states in the Northeast. Most collections have been from acidic bogs in the Northeastern and Northwestern parts of the state. Resting boxes and CO_2-baited light traps are effective surveillance tools for adults.

Distribution



Culiseta minnesotae Barr

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Probably multivoltine.

LARVAL HABITAT: Larvae can be found in semi-permanent to permanent sedge and cattail marshes as well as other wetland and bog habitats.

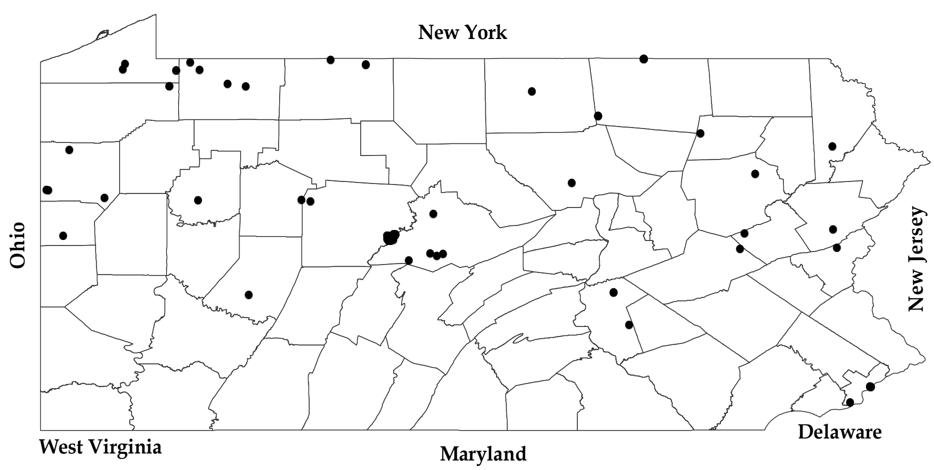
HOST PREFERENCES:
Females prefer birds to other hosts, but will occasionally feed on small mammals and turtles. They do not readily feed on humans.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	7,172	122	0	0
EEE	276	3	0	0
La Crosse	0	0	0	0

COMMENTS:
This species was first collected in Pennsylvania in the year 2000. The Philipsburg swamp that spans Centre and Clearfield Counties produces the only significant population of this species in the state. The wetland is acidic due to acid mine discharge and iron precipitate is often visible on the emergent vegetation. The habitat is shared with an abundant population of *Ochlerotatus cantator*, which is also generally rare in the state outside of this location.

Distribution



Culiseta morsitans (Theobald)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Reportedly univoltine

This species overwinters as desiccant-resistant eggs in the form of a raft.

LARVAL HABITAT:
Larvae can be found in semi-permanent swamps, cattail swamps, acidic bogs, temporary woodland pools, cedar swamps, cold rain-filled pools and marshes. They tend to aggregate near emergent vegetation, partially submerged stumps and root mats.

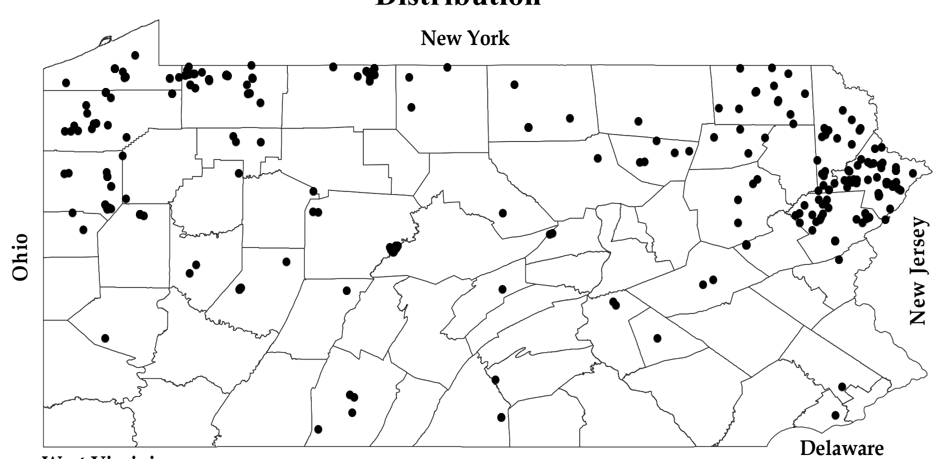
HOST PREFERENCES:
The primary hosts for this species are birds. In addition to birds, they will occasionally feed on small mammals and snakes, but typically not humans. Females do not fly far from their larval habitats in search of hosts.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	180	24	0	0
EEE	15	6	0	0
La Crosse	0	0	0	0

COMMENTS:
The literature reports that there is only one generation per year and that it is rare to find adults into the summer. In Pennsylvania, most specimens were collected from July-September suggesting multiple generations or long-lived adults. They are rather uncommon in the state, with less than 1,000 adults and larvae being collected. Female egg laying behavior is unusual for a *Culiseta* in that the egg rafts are laid on moist soil or leaf litter about 1.5-2 inches *above* the water line. EEE has been isolated from this species in New York suggesting they may be involved in the transmission cycle of the virus.

Distribution



Ochlerotatus abserratus (Felt and Young)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
Larvae are most commonly found in acidic bogs, often in association with *Culiseta melanura*, *Ochlerotatus canadensis,* and *Oc. punctor*. Other preferred habitats include woodland pools, cattail swamps and sedge marshes. They can be found in fairly large numbers early in the spring, congregating in and around emergent vegetation.

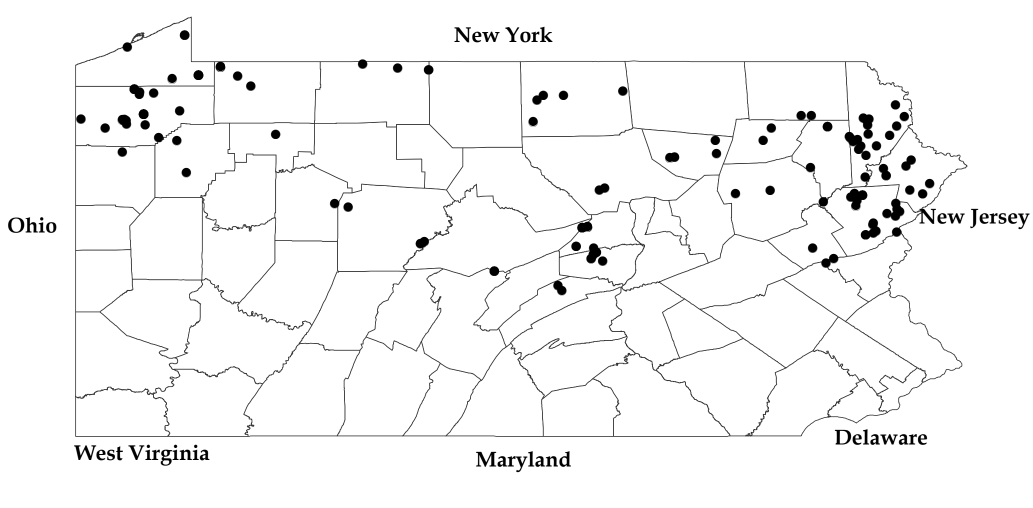
HOST PREFERENCES:
Females are mammals feeders (including humans) and prefer to bite in the evening.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	95	1	0	0
EEE	1	1	0	0
La Crosse	0	0	0	0

COMMENTS:
This spring species is rare in the southern part of the state, but is relatively common in the northern half, especially in acidic bog habitats. Adult females are nearly indistinguishable from *Oc. punctor*. The data for virus testing results, seasonality and distribution includes adult female specimens that were identified as *Oc. abserratus/punctor*. Larvae of these two species are easily differentiated, so *Oc. punctor* larval records are not included in the distribution. These species share very similar habitats and life cycles.

Distribution



Ochlerotatus atlanticus (Dyar and Knab)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

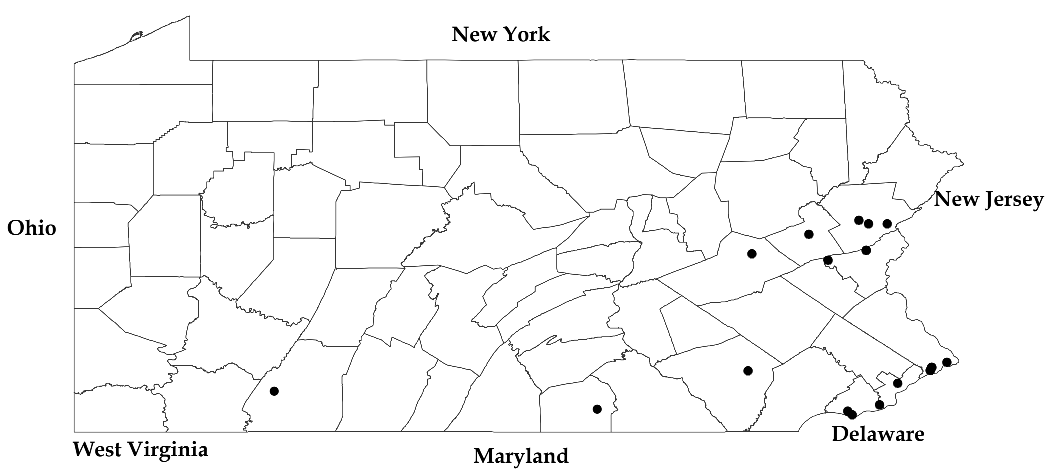
LARVAL HABITAT:
Larvae prefer semi-permanent to permanent, shaded woodland pools.

HOST PREFERENCES:
Females generally prefer mammalian blood. They feed at dusk or whenever their habitat is disturbed.

VIRUS TESTING RESULTS:
No specimens have been tested for any arboviruses in Pennsylvania.

COMMENTS:
Adult females are nearly indistinguishable from *Oc. tormentor*, although larvae are easily differentiated. This species is rare in the state. Only 109 specimens of *Oc. atlanticus/tormentor* have ever been collected in PA with ninety of those being taken from southern Bucks County. No larvae were collected.

Distribution



Ochlerotatus atropalpus (Coquillett)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

LARVAL HABITAT:
The natural habitat of this mosquito is in rock pools. However, the vast majority of PA specimens have been from tires.

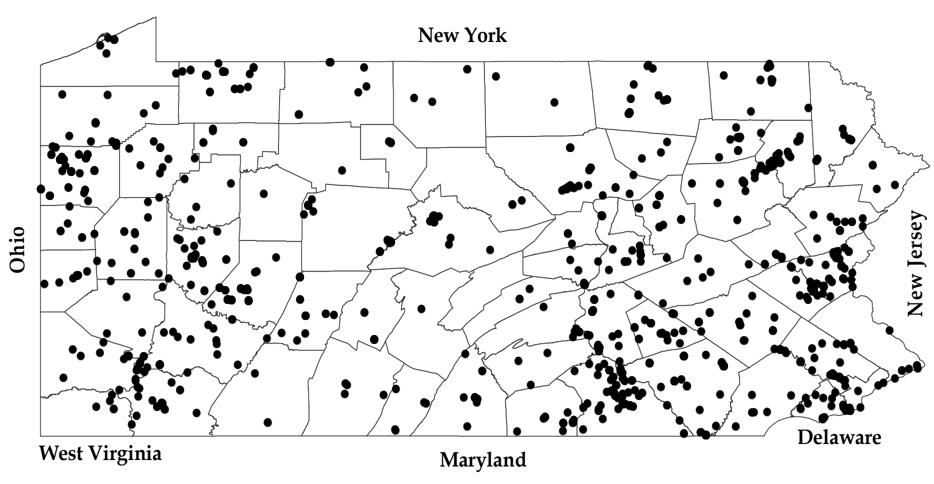
HOST PREFERENCES:
Females prefer mammalian hosts, including humans, and will bite during the day or at night. They are poor fliers and don't travel far in search of hosts.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	3,813	355	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species was relatively common in the first few years of WNV surveillance, but numbers have declined dramatically in recent years. One potential reason could be competitive exclusion from the introduced species, *Oc. japonicus*, which shares the same habitats.

Distribution



Ochlerotatus aurifer (Coquillett)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Univoltine.

LARVAL HABITAT:
Larvae can be found most commonly in freshwater swamps, cranberry bogs, other acidic bogs and temporary woodland pools in the spring.

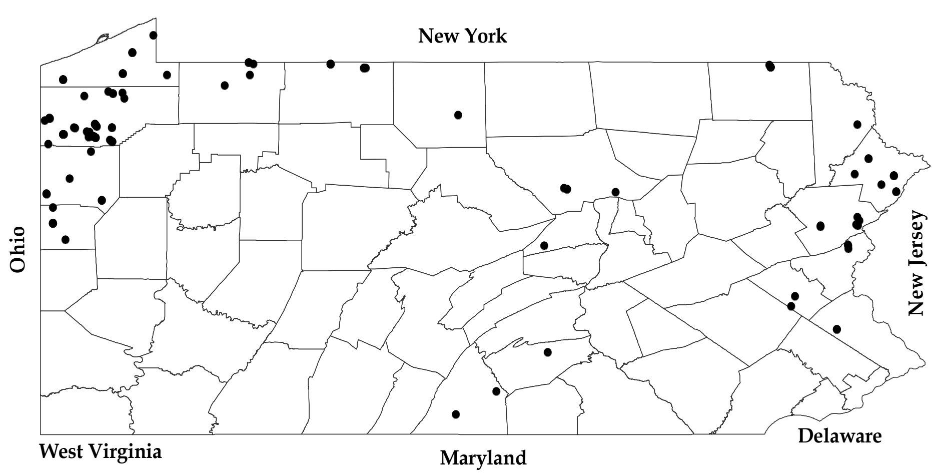
HOST PREFERENCES:
Mammals are the primary hosts for this species and they are aggressive human biters in the spring. Females do not travel far from their larval habitats in search of hosts.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	279	14	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species is locally abundant in the spring, mostly in the extreme Northeastern and Northwestern Counties. Eighty percent of the specimens collected were from the counties of Crawford, Erie, Pike, Susquehanna and Wayne.

Distribution



Ochlerotatus c. canadensis (Theobald)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine, possibly bivoltine.

LARVAL HABITAT:
Larvae can be found early in the season in temporary woodland pools, snow pools, ditches, swamps and acidic bogs.

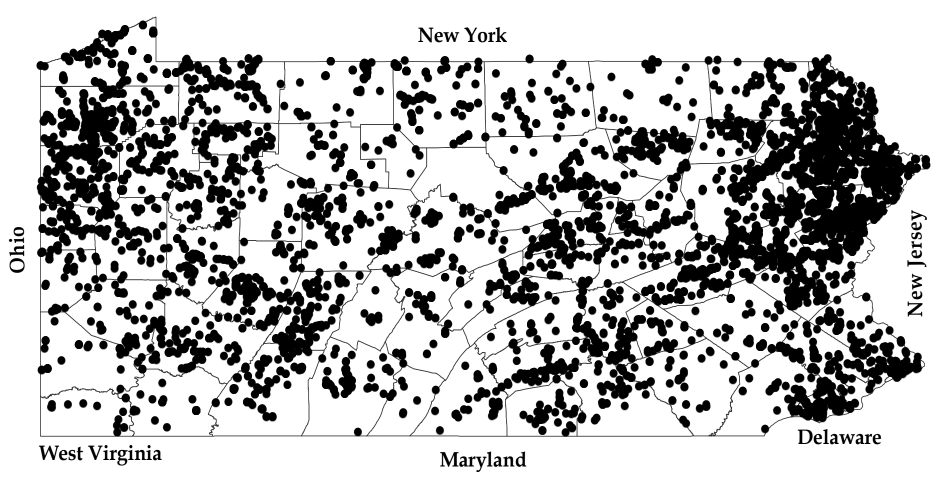
HOST PREFERENCES:
Adults do not travel far from their larval habitats in search of hosts. They are opportunistic feeders on large and small mammals, birds, reptiles (especially turtles), and amphibians. Females prefer to bite during the day.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	46,544	1,806	0	0
EEE	691	21	0	0
La Crosse	0	0	0	0

COMMENTS:
This is the most common univoltine spring species in Pennsylvania. There is a sharp decline in population size by August, with a few long-lived adults and newly emerged adults from a second, smaller brood comprising the fall population. The second brood is probably derived from overwintering eggs that did not hatch in the spring, although some of the brood may have hatched from recently deposited eggs.

Distribution



Ochlerotatus cantator (Coquillett)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae are able to tolerate water with a high salt content. Along the Atlantic seaboard, they are considered a saltmarsh mosquito, but they can be found in both saline and fresh water.

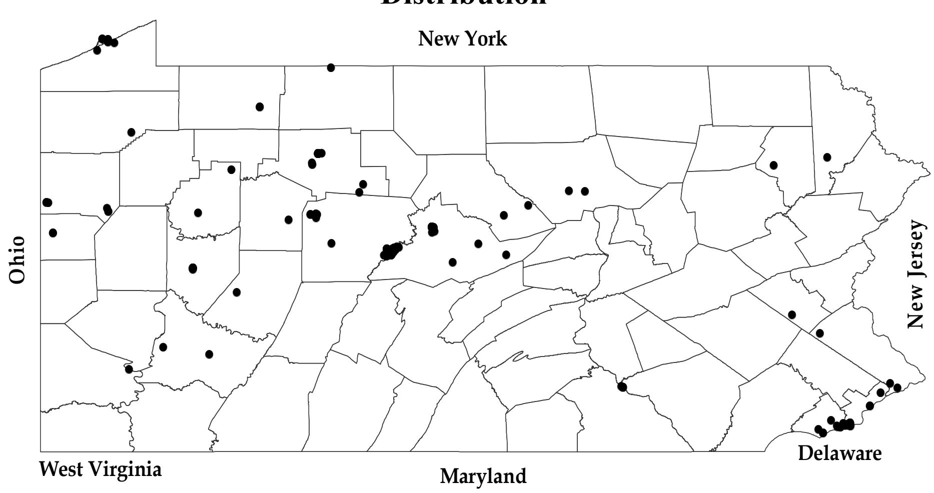
HOST PREFERENCES:
Females prefer mammalian hosts, but will also feed on birds and frogs to a lesser extent. They prefer to feed at night or when their habitat is invaded. Adults will travel several miles in search of hosts.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	3,831	133	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
The Philipsburg swamp that spans Centre and Clearfield Counties produces the only significant population of this species in the state. The wetland is acidic due to acid mine discharge and iron precipitate is often visible on the emergent vegetation. The habitat is shared with an abundant population of *Culiseta minnesotae*, which is also generally rare in the state outside of this location. They are a bit unusual for a multivoltine species in that they are much more common in June than they are later in the season.

Distribution



Ochlerotatus communis (De Geer)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
Larvae prefer deep snow pools and woodland pools with or without vegetation.

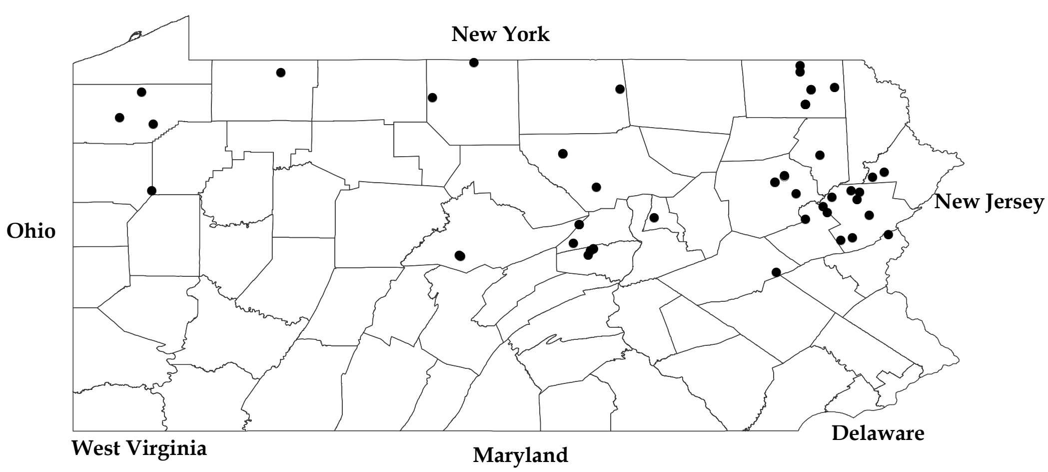
HOST PREFERENCES:
Females do not fly far from their larval habitats in search of hosts. They are primarily mammal feeders (including humans).

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	312	7	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This is one of the earliest species encountered in the spring. Eggs hatch in March and larvae are difficult to collect past April. Larvae have been collected infrequently, but some of those collections yielded hundreds, sometimes thousands of specimens. Apparently some woodland pools are comprised almost exclusively of this species, but those pools are uncommon. Field collected adults are often difficult to distinguish from the more common and widely distributed *Oc. sticticus*.

Distribution



Ochlerotatus decticus (Howard, Dyar & Knab)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Univoltine.

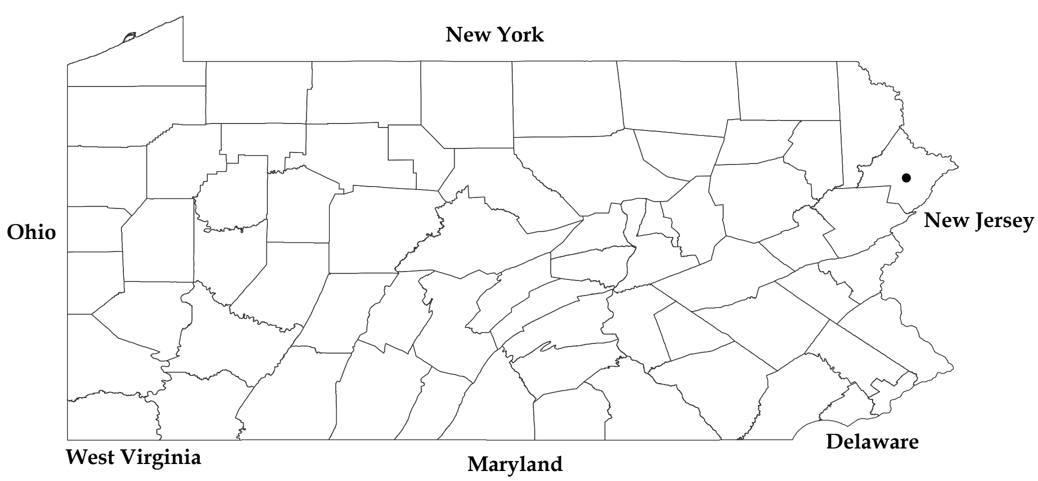
LARVAL HABITAT:
Larvae probably prefer sphagnum bog habitats, but may also be found in woodland pools.

HOST PREFERENCES:
Females are primarily mammal feeders.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species has only been collected on one occasion in Pennsylvania. The larval collection was on April 22, 1966 from a bog surrounding a lake in Pike County. Numerous CO_2-baited light trap collections from Pike County from 2001-2007 failed to yield additional specimens.

Distribution*



*Historical record. Exact location unknown; record displayed as a centroid.

Ochlerotatus diantaeus (Howard, Dyar & Knab)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

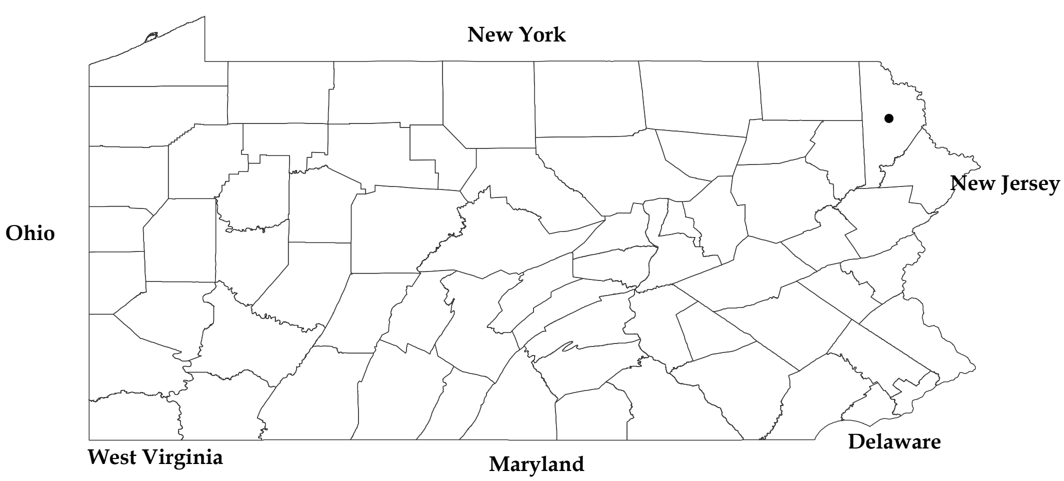
LARVAL HABITAT:
Larvae can be found in woodland pools and boggy areas in the spring.

HOST PREFERENCES:
Females prefer mammalian hosts.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species has only been collected twice in Pennsylvania. Third and 4th instar larvae were collected at two locations in Wayne County in 1967. Both collections were made from clear, cold, shaded semi-permanent woodland pools at the edges of lakes. Numerous CO_2-baited light trap collections from Wayne Co. from 2001-2007 failed to produce additional records.

Distribution*



*Historical record. Exact location unknown; record displayed as a centroid.

Ochlerotatus dorsalis (Meigen)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoline.

LARVAL HABITAT:
Larvae prefer alkaline habitats and can also tolerate water with a high salt content.

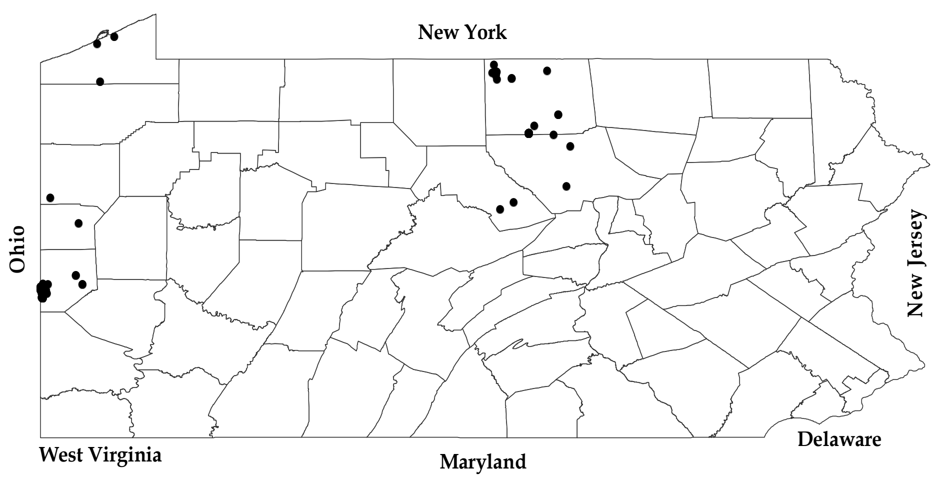
HOST PREFERENCES:
This species has the ability to migrate at least 30 miles in search of hosts, mates and/or oviposition sites. Females are extremely aggressive human biters. Their preferred hosts are large mammals, especially domestic animals and humans, but they will also feed on large birds.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	7,896	175	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
Nearly all of the roughly 15,000 specimens that were collected in Pennsylvania came from only 2 locations. One location was a hide tannery in Tioga County that used salts and alkaline dyes in its hide processing operation. The effluent from that procedure accumulated in several holding ponds. Those ponds were extremely productive habitats for *Oc. dorsalis* and also for *Culex pipiens.* That facility is no longer active and the ponds have since been filled in with soil. No collections of *Oc. dorsalis* have been taken in Tioga County since 2002.
The second location is a large, artificial lake in Beaver County that is the repository for alkaline fly ash from a coal-fired power plant. This population was first detected in 2006 as a result of numerous complaints of mosquito bites from adjacent property owners, many of whom had lived in the area for years without any significant mosquito pest problems.
At both locations, this species appears to be unable to maintain viable populations outside of these very unique habitats.

Distribution



Ochlerotatus dupreei (Coquillett)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

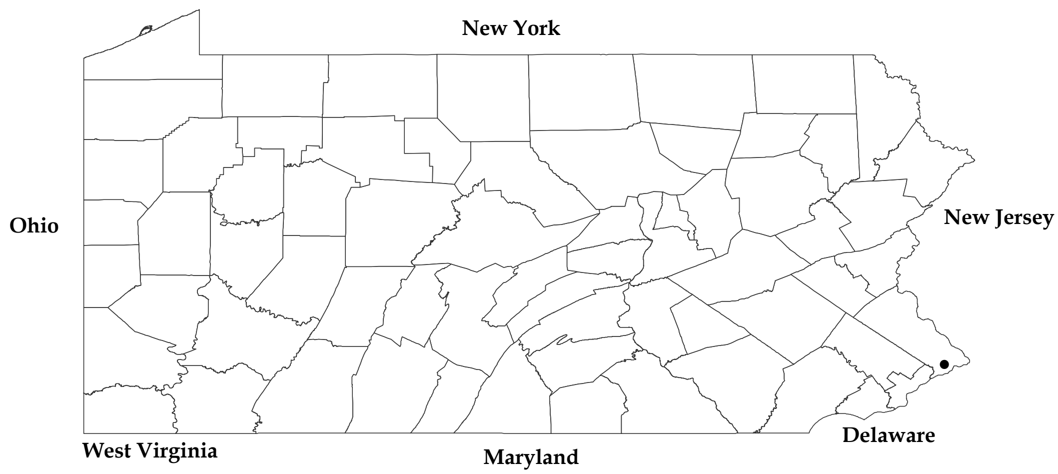
LARVAL HABITAT:
Larvae prefer temporary rain-filled pools.

HOST PREFERENCES:
Females are probably primarily mammal feeders, although they do not appear to feed readily on humans.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species was discovered in Pennsylvania for the first time in 2006 from a single adult, female specimen in southern Bucks County. The larva of this species is unique in that it has anal papillae that are as long as or longer than its entire body.

Distribution



Ochlerotatus excrucians (Walker)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
Larvae prefer snow pools, woodland pools, and semi-permanent wetlands with an abundance of vegetation.

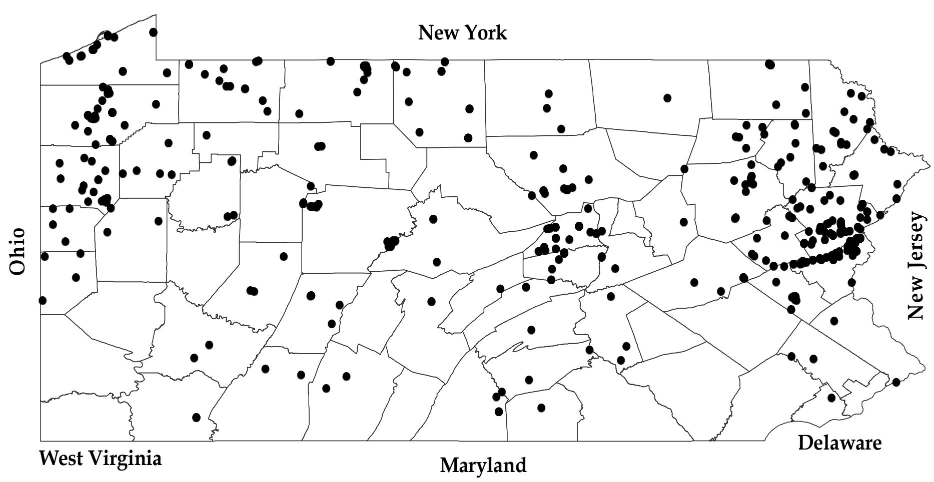
HOST PREFERENCES:
Females do not fly far from their larval habitats in search of hosts. They are primarily mammal feeders (including humans).

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	873	35	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This spring species is much more common in the northern counties than in the southern ones. Adults are somewhat difficult to differentiate from *Oc. stimulans* and were sometimes lumped together as "*Oc. stimulans* group" if specimens were in poor conditions. The data in the virus testing results and distribution map represent specimens that were confirmed as *Oc. excrucians*.

Distribution



Ochlerotatus fitchii (Felt and Young)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Univoltine.

LARVAL HABITAT:
Larvae can be found in wetlands, bogs, temporary to semi-permanent pools and snow pools.

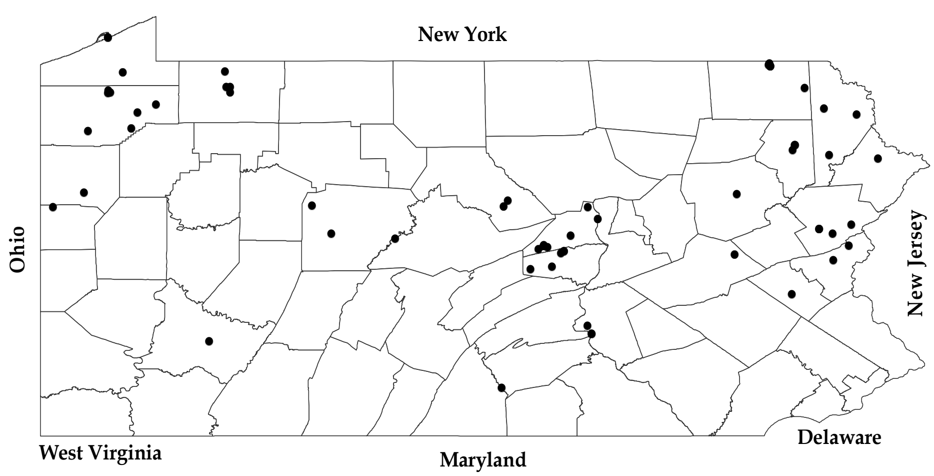
HOST PREFERENCES:
Females are primarily mammal feeders (including humans) and prefer larger hosts, especially cattle.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	0	0	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This mosquito is quite uncommon in Pennsylvania. Adults are difficult to distinguish from *Oc. stimulans* and field collected specimens that were in poor conditions were often identified as "*Oc. stimulans* group". The rarity with which larvae were collected (less than 200 specimens) suggests that this species is far less common than *Oc. stimulans*.

Distribution



Ochlerotatus grossbecki (Dyar and Knab)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Univoltine.

LARVAL HABITAT:
This is an early season species that prefers snow pools and woodland pools.

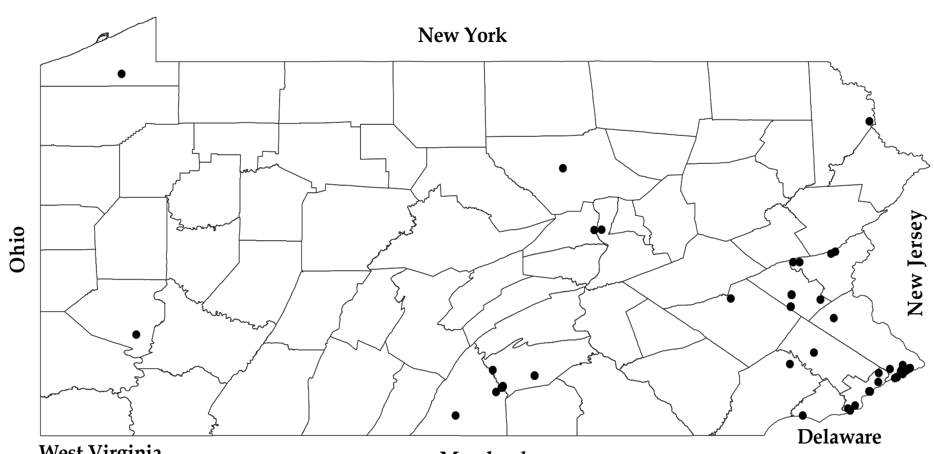
HOST PREFERENCES:
Females prefer mammals to other hosts. They are fairly aggressive human biters, but their populations are rarely high enough to be considered a significant pest in Pennsylvania.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	66	3	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species has a statewide distribution, but is generally uncommon wherever it is found. The only significant population exists in a series of woodland pools in southern Bucks County. This is one of the earliest spring species to appear and adults have been collected as early as the first week of May.

Distribution



Ochlerotatus hendersoni Cockerell

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae prefer to live in tree holes at an elevation of at least 20 feet, as opposed to its sibling species, *Oc. triseritatus*, which prefers tree holes much closer to the ground. They seem to prefer water with an extremely high level of organic material.

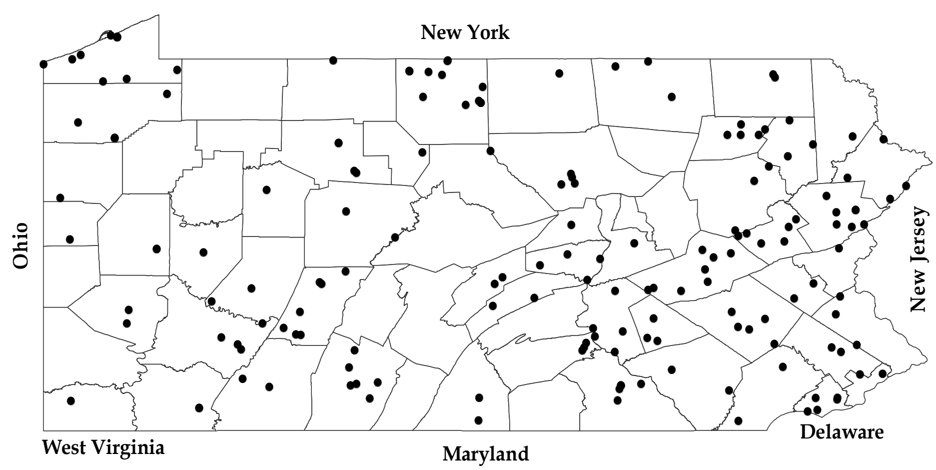
HOST PREFERENCES:
Females are mammalian feeders and preferred to feed on chipmunks, squirrels and raccoons in one study.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	145	78	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species is uncommonly collected in Pennsylvania. It may be somewhat more common than collection data would suggest due to its preference for elevated tree holes that are difficult to sample. It would be reasonable to expect that this species could be important in the transmission cycle of La Crosse virus based on the important role that the closely related *Oc. triseriatus* plays with that disease. However, *Oc. hendersoni* has been shown to be an inefficient vector of La Crosse virus as a result of a salivary gland escape barrier. Both adult females and larvae are similar in appearance to *Oc. triseriatus*. In the present survey, adult specimens that were in poor condition and early instar larvae that keyed out to *Oc. hendersoni*/*Oc. triseriatus* were often simply referred to as the more common *Oc. triseriatus*. This strategy may have underestimated the real numbers of *Oc. hendersoni*. The distribution map includes only those specimens that were in good enough condition to separate from *Oc. triseriatus* with a reasonably level of confidence.

Distribution



Ochlerotatus infirmatus (Dyar and Knab)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

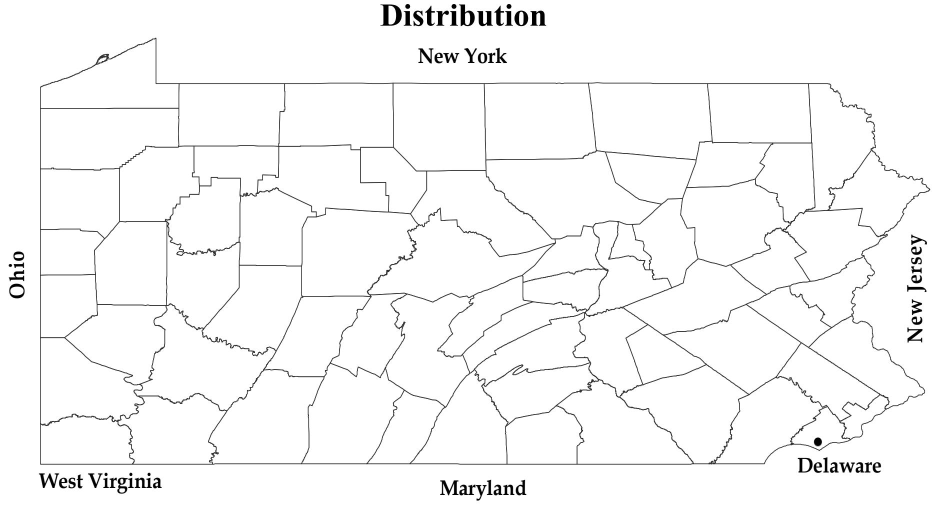
LARVAL HABITAT:
Larvae can be collected from woodland pools that periodically fill with rain.

HOST PREFERENCES:
Females prefer mammalian hosts, but will feed on other animals if the opportunity arises.

VIRUS TESTING RESULTS:
No specimens have been tested for any arboviruses in Pennsylvania.

COMMENTS:
This species is represented in Pennsylvania by a single female collected on July 12, 2006 in Delaware County. The collection site has produced other rare PA species such as *Oc. sollicitans* and *Oc. atlanticus/tormentor*.

Distribution



Ochlerotatus intrudens (Dyar)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Univoltine.

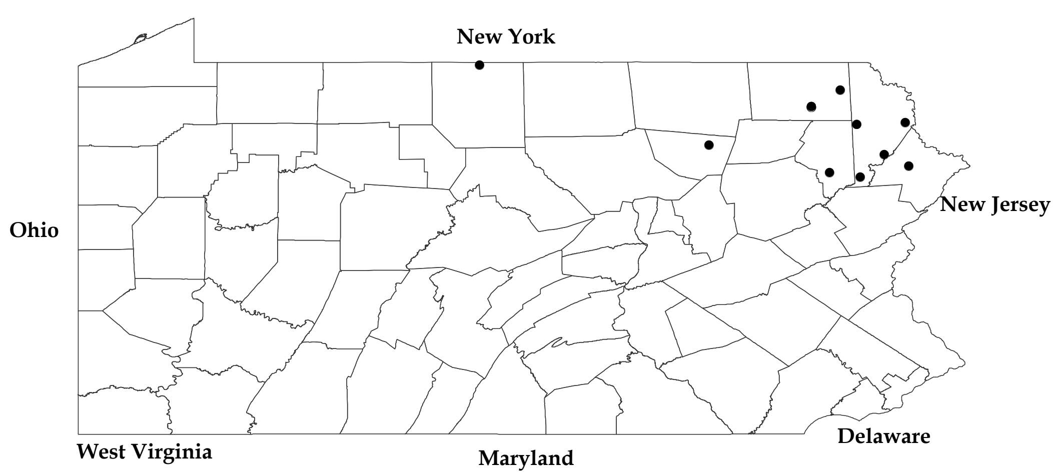
LARVAL HABITAT:
Larvae can be found early in the season in snow pools, woodland pools, bogs, and marshes.

HOST PREFERENCES:
Females are mammalian feeders and will not hesitate to bite humans.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species appears to be uncommon in Pennsylvania. The majority of collections have come from woodland pools in the Northeastern part of the state. Less than 100 confirmed adult specimens were taken from 12 different collections. Those collections were all from the months of May and June.

Distribution



Ochlerotatus j. japonicus (Theobald)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be collected in a wide variety of artificial containers including tires, birdbaths, wooden and concrete barrels, porcelain bathtubs, tarps, toys and earthenware containers. Favored natural containers include tree holes and rock pools.

HOST PREFERENCES:
Bloodmeal studies show that this species is predominantly a mammalian feeder, including humans. In the laboratory, they feed readily on chickens, mice, guinea pigs, and humans.

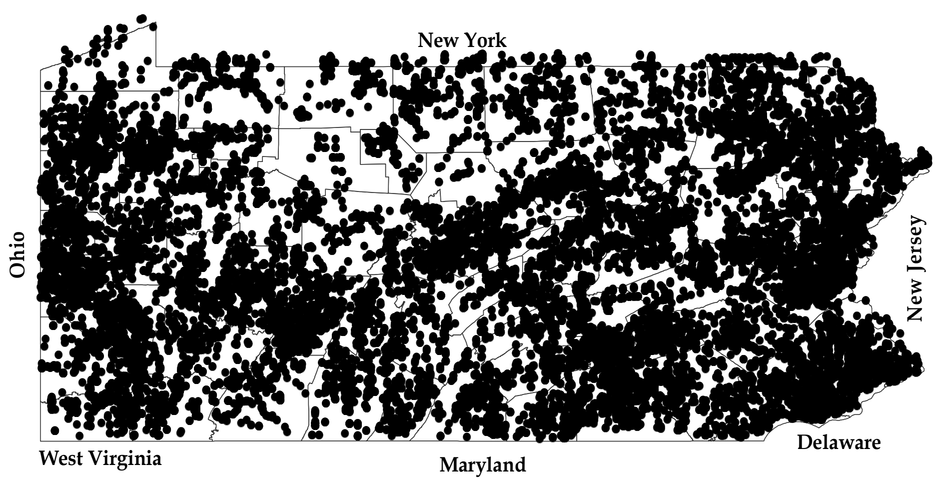
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	73,138*	13,763	12	0.16
EEE	645	112	0	0
La Crosse	23,386	3,459	0	0

*94% were from gravid traps, 6% were from host-seeking traps

COMMENTS:
This is one of the most common and widely distributed species in the state despite not being discovered in North America until 1998 in NY, NJ, and CT. Vector competency studies in the laboratory show that females are capable of transmitting EEE, La Crosse, St. Louis, and WNV viruses. The inability to yield a positive result of La Crosse virus in PA despite substantial testing efforts suggests that La Crosse is either rare in the state (despite its prevalence in West Virginia and Ohio) or *Oc. japonicus* does not feed heavily on typical La Crosse intermediate hosts such as chipmunks or foxes.

Distribution



Ochlerotatus mitchellae (Dyar)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

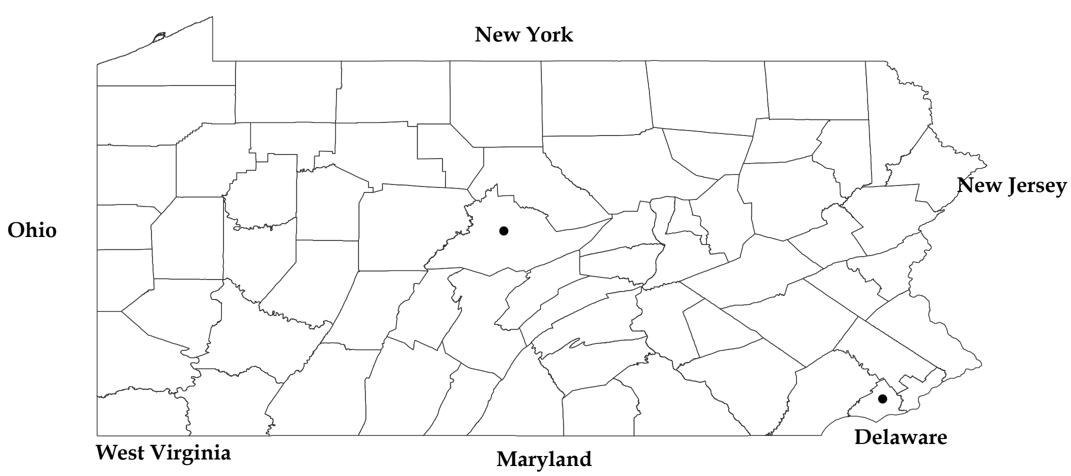
LARVAL HABITAT:
Larvae prefer temporary pools.

HOST PREFERENCES:
Females feed primarily on mammals and will not hesitate to bite humans.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species is only known in Pennsylvania from historical records. It was recorded from Delaware County in 1945 and from Centre County in 1965.

Distribution*



*Historical records. The exact locations of these records are unknown, therefore the points have been placed in the center of each county.

Ochlerotatus provocans (Walker)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
Larvae can be found in snow pools, temporary woodland pools, swamps and bogs.

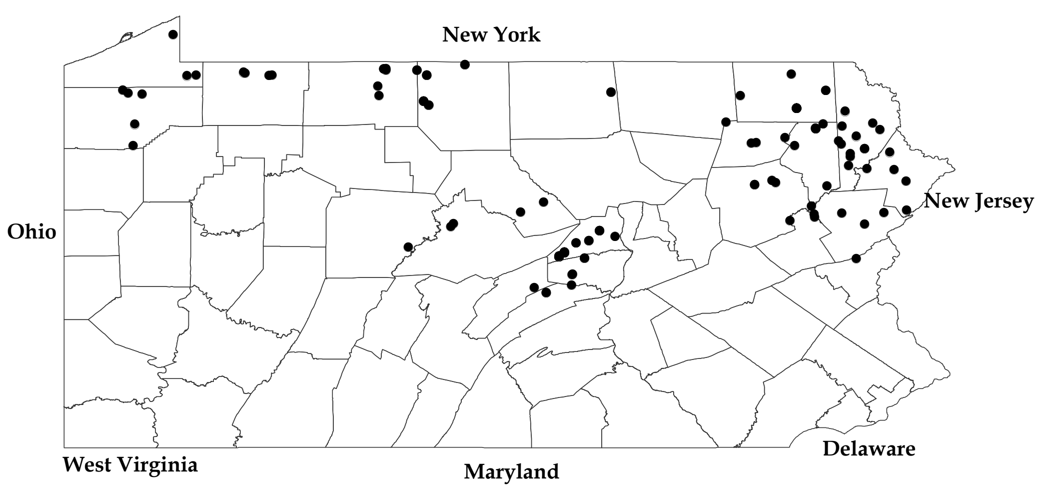
HOST PREFERENCES:
Females prefer mammalian blood to other potential hosts.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	199	12	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
Surprisingly, this moderately common and widespread spring species was not discovered in the state until 1975. Eggs are among the earliest to hatch and larvae can be collected from the middle of March through April. By May, most larvae have pupated or emerged as adults.

Distribution



Ochlerotatus punctor (Kirby)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
Larvae can be found in snow pools, coniferous forest pools, grassy pools, sphagnum bogs and other acidic bogs.

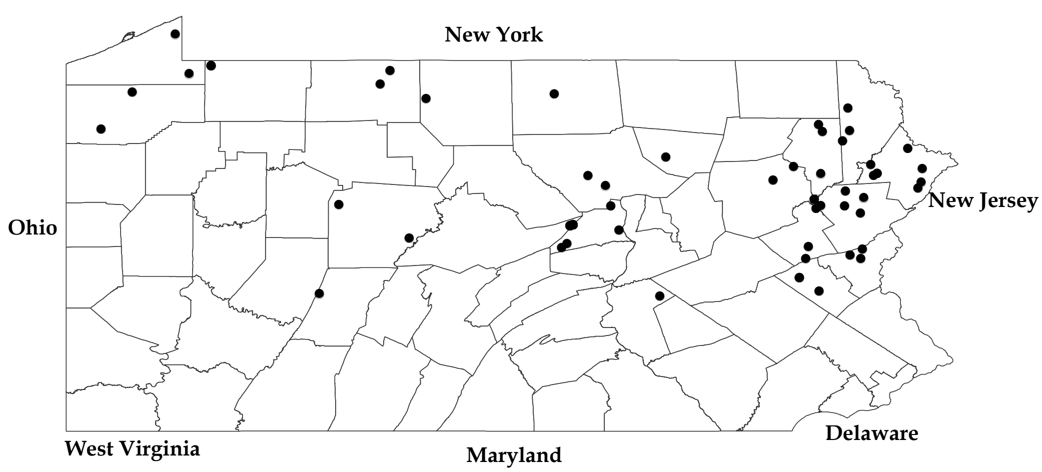
HOST PREFERENCES:
Females are primarily mammal feeders (including humans).

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	31	5	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This spring species is rare in the southern part of the state, but is relatively common in the northern half, especially in acidic bog habitats. Adult females are nearly indistinguishable from *Oc. abserratus*. The data for virus testing results, seasonality, and distribution includes adult female specimens that were identified as *Oc. abserratus/punctor*. Larvae of these two species are easily differentiated, so *Oc. abserratus* larval records are not included in the distribution. These species share very similar habitats and life cycles.

Distribution



Ochlerotatus sollicitans (Walker)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

LARVAL HABITAT:
Larvae show a preference for saline water and are common along the east coast of the United States. They are also capable of exploiting inland saline water situations such as those from oil fields, mine tailings, wastewater holding ponds from various industrial plants, or roadside ditches with a high salt content.

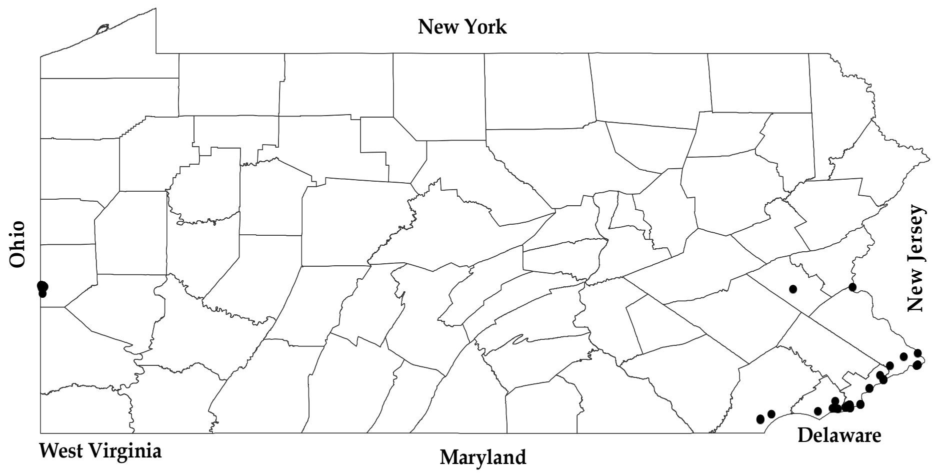
HOST PREFERENCES:
Females are major human pests along the Atlantic seaboard. They prefer to feed in the evening, but will attack during the day if hosts enter their habitat. Females feed primarily on mammals, but will also take blood from birds. They are extremely strong fliers and have been collected many miles from their larval habitats, although most probably do not travel more than 5 miles.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	11	7	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species appears sporadically in Pennsylvania. Its presence is often associated with saline situations from industrial lagoons, power plant wastewater retention basins, or ponds associated with oil fields.

Distribution



Ochlerotatus sticticus (Meigen)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
Larvae can be found in the floodwaters associated with the floodplains of large rivers or in other areas where extensive flooding has occurred.

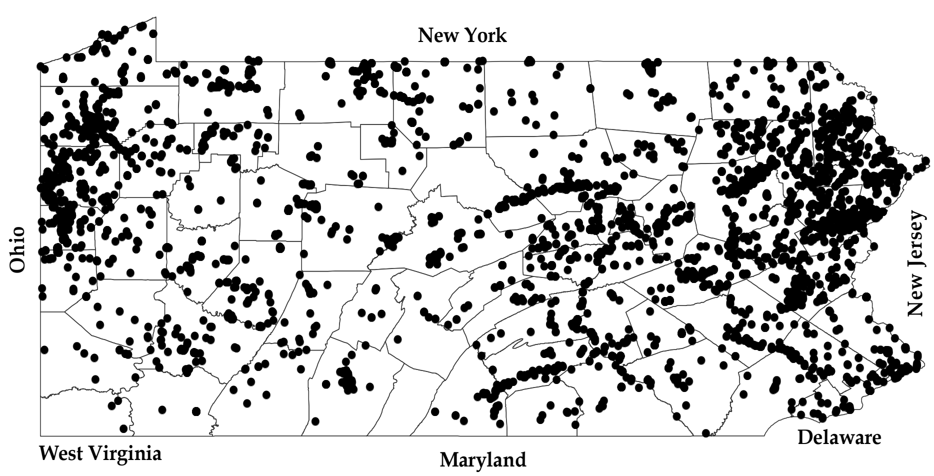
HOST PREFERENCES:
Females have been known to fly up to seven miles in search of hosts, mates and/or oviposition sites. Their preferred hosts are mammals and they will not hesitate to bite humans both during the day and at night.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	37,286	1,001	0	0
EEE	306	11	0	0
La Crosse	0	0	0	0

COMMENTS:
This species is extremely common in the northern half of the state and moderately common in the southern half. Females are among the worst pest species in the state. There is a large spring brood that emerges later than most other spring species. Not all of the eggs hatch in the spring, which results in limited adult emergence in the fall.

Distribution



Ochlerotatus stimulans (Walker)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

LARVAL HABITAT:
This spring species favors snow pools and temporary pools in shaded, woodland habitats.

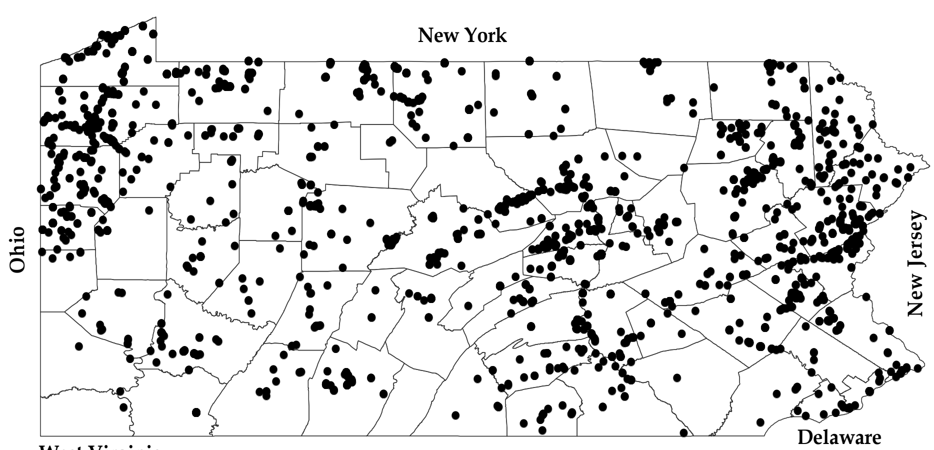
HOST PREFERENCES:
Females feed almost exclusively on mammals and can be a significant human pest in wooded areas. They are known to fly at least two miles from their larval habitats in search of hosts and/or mates. They are a large species and can inflict a painful bite.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	6,817	287	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species is probably the second most common univoltine spring species in Pennsylvania after *Oc. canadensis*. Adults are long-lived and tattered specimens can be collected into the fall.

Distribution



Ochlerotatus taeniorhynchus (Wiedemann)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

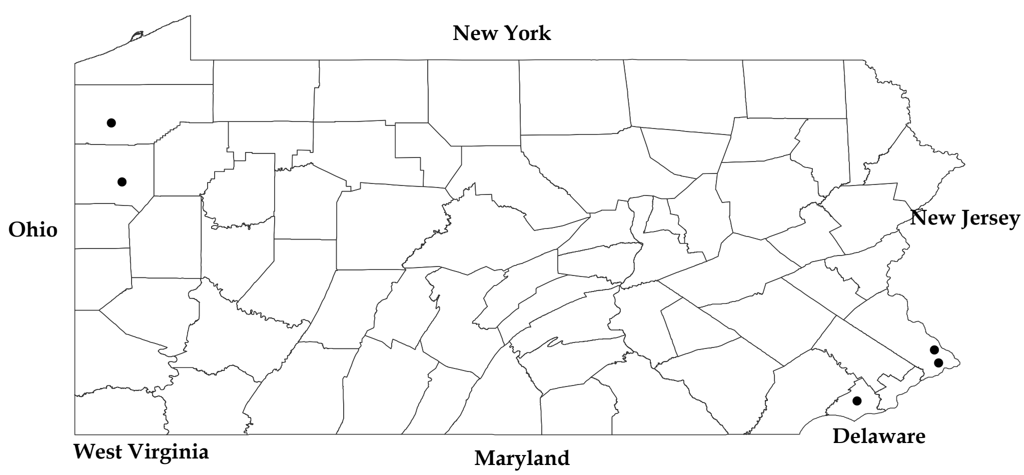
LARVAL HABITAT:
The preferred habitat is in the salt marshes along the Atlantic and Gulf coasts. In Pennsylvania, they have been collected from saline water associated with abandoned oil fields.

HOST PREFERENCES:
Females prefer to feed on mammals, but will also feed on birds. This species is a vicious human biter and is the main target of mosquito control districts along the Atlantic and Gulf coasts. Their numbers are too low to be a pest problem in Pennsylvania. Females prefer to feed in the evening.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species is exceptionally rare in the state and appears only sporadically. The collections from Crawford, Delaware and Mercer counties shown in the map below are historical records from the 1960's. The present survey has yielded only 3 additional specimens from lower Bucks County in 2005 (1 female) and 2006 (2 females).

Distribution



Ochlerotatus thibaulti (Dyar and Knab)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Univoltine.

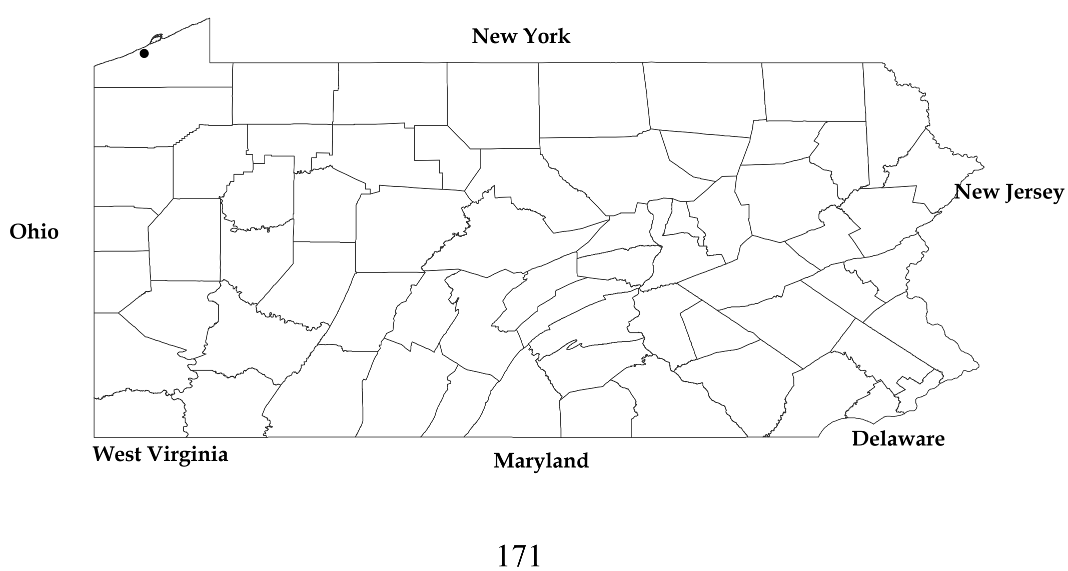
LARVAL HABITAT:
Larvae live in habitats that are very similar to those of *Culiseta melanura* and can probably be found in association with them. Preferred sites include the flooded basal cavities of trees that are inundated in wetland habitats. Gum, cypress, and red maple trees appear to be indicators of the presence of *Oc. thibaulti*. As with *Cs. melanura*, they live a nearly subterranean life, congregating in the crypts of partially submerged trees and stumps. The water within the crypts is often not visible from the surface.

HOST PREFERENCES:
Females are mammal feeders.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
The only collection record of this species in Pennsylvania is a single adult female collected from Erie County in June of 2003.

Distribution



Ochlerotatus tormentor (Dyar and Knab)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

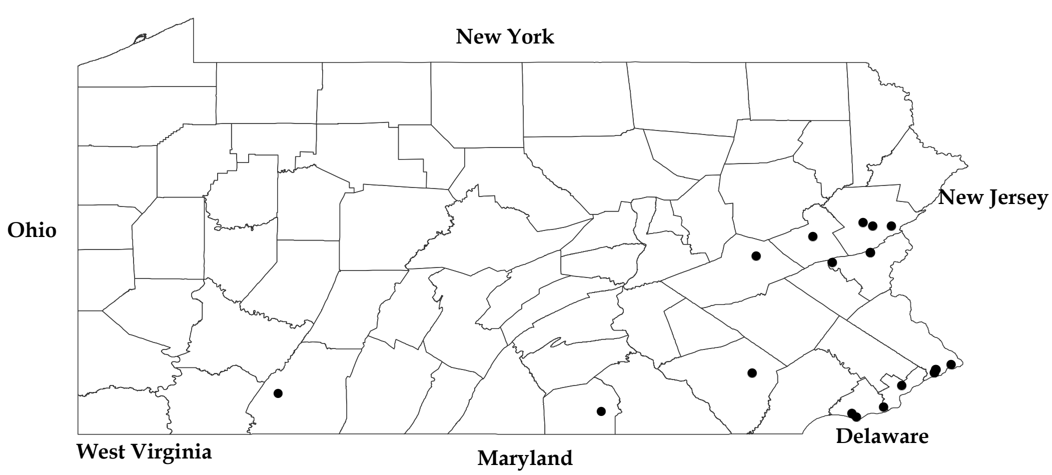
LARVAL HABITAT:
Larvae prefer semi-permanent to permanent, shaded woodland pools.

HOST PREFERENCES:
Females generally prefer mammalian blood.

VIRUS TESTING RESULTS:
No specimens were tested for arboviruses in Pennsylvania.

COMMENTS:
Adult females are nearly indistinguishable from *Oc. atlanticus*, although larvae are easily differentiated. This species is rare in the state. Only 109 specimens of *Oc. atlanticus/tormentor* have ever been collected in PA with ninety of those being taken from southern Bucks County. No larvae were collected.

Distribution



Ochlerotatus triseriatus (Say)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
This species exploits tree holes from a wide variety of tree species. In addition to tree holes, they are abundant in used scrap tires and can be found in other artificial containers.

HOST PREFERENCES:
Oc. triseriatus are best characterized as opportunistic feeders. They are known to feed on large and small mammals, birds and turtles. However, their preferred hosts are mammals. They feed on hosts that live in the vicinity of their larval habitats because adults have a very short flight range. Females are moderately aggressive human biters.

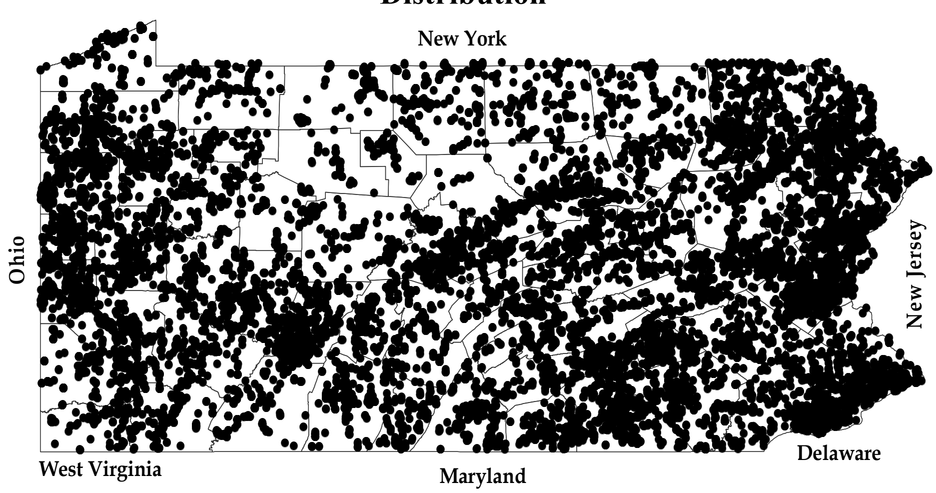
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	77,719*	7,751	8	0.10
EEE	96	30	0	0
La Crosse	10,276	1,517	0	0

*25% were from gravid traps, 75% were from host-seeking traps

COMMENTS:
This is the most important enzootic and bridge vector of the La Crosse strain of California encephalitis virus. La Crosse is maintained in squirrels and chipmunks and the virus can be transmitted from the mosquito egg, through the larval stages, and into the adult. Males infected in this manner can infect females during mating. La Crosse has been most commonly detected in the following states in recent years: Ohio, Wisconsin, Minnesota, Illinois, Indiana and West Virginia. Based on the proximity of these states to PA, it is almost certain that the virus also circulates in the state. However, significant efforts to detect viral RNA in mosquito pools did not yield any positive results.

Distribution



Ochlerotatus trivittatus (Coquillett)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be found in floodwater pools in woodlands, marshes, open pools and meadows. They prefer temporary water situations and large broods will emerge from flooded areas after summer rains.

HOST PREFERENCES:
Females prefer to bite in the evening, but will bite during the day when their habitat is disturbed. They are aggressive human biters and the bite is particularly painful. Their preferred hosts in urban areas are dogs, rabbits and cats; while in rural and suburban areas they prefer deer, horses and raccoons. However, they are opportunistic and will occasionally feed on birds, reptiles, and amphibians if these hosts are readily available.

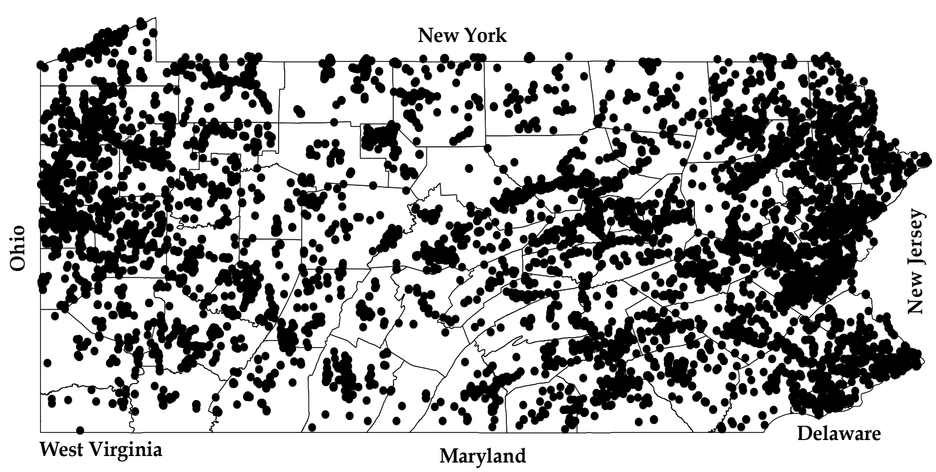
VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	491,859*	9,747	27	0.06
EEE	1,953	53	0	0
La Crosse	22	5	0	0

* 92% were from host-seeking traps; 8% were from gravid traps.

COMMENTS:
Females are among the most aggressive and persistent human biters of any Pennsylvania mosquito species. They are typically the most abundant and significant pest species in the state following heavy rains that flood their larval habitats.

Distribution



Orthopodomyia alba Baker

OVERWINTERING STAGE: Late instar larva. **PHENOLOGY:** Probably multivoltine.

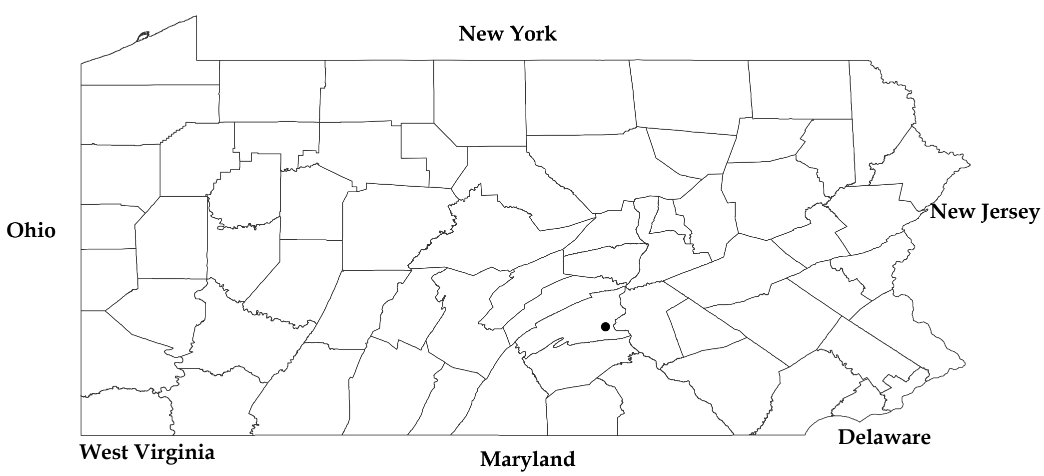
LARVAL HABITAT:
The preferred habitat is tree holes, sometimes in association with *Or. signifera*. They appear to prefer highly organic rot holes that are in the forest canopy and may prefer sugar maples (*Acer saccharum*) to other tree species. Females seem to prefer to oviposit in tree holes with a small opening and with large quantities of water. They are capable of surviving temporarily in the moist muck of a tree hole when the water has all nearly evaporated and they can survive freezing.

HOST PREFERENCES:
The host preferences of this species are not well studied. They may feed on birds, but they may also be able to develop a batch of eggs without any blood meal.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species has only been documented from the state on one occasion from a tree hole in Perry County in 1969. They were collected in association with larger numbers of *Or. signifera* and *Anopheles barberi*.

Distribution*



*Historical record.

Orthopodomyia signifera (Coquillett)

OVERWINTERING STAGE: Larva. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be found in tree holes and artificial containers, including tires. They are relatively intolerant of low temperatures and mortality rates are high when their larval habitats become completely frozen.

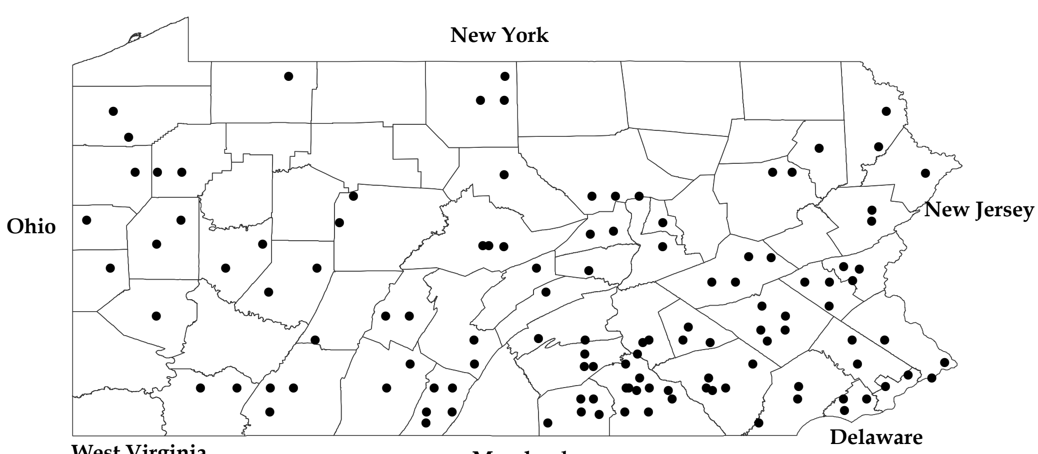
HOST PREFERENCES:
Females of this species probably feed primarily on birds, although they may not always require a blood meal to develop a batch of eggs. They have been induced to feed on chickens and on pads of rabbit blood in the laboratory. This species is not known to feed on humans.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	18	17	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species is uncommon and females are not readily attracted to traps. Most of the roughly 100 females collected were taken from gravid traps in July, August and September. Nearly 450 larvae were collected, mostly from artificial containers.

Distribution



Psorophora ciliata (Fabricius)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae live in temporary rain-filled pools, drainage ditches and puddles.

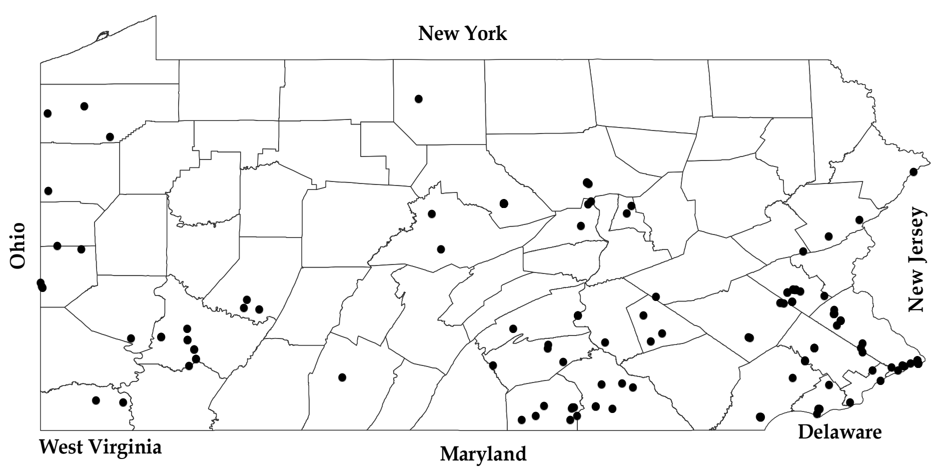
HOST PREFERENCES:
Females prefer mammalian hosts. It is a large species that can inflict a painful bite.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	31	15	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
This species is fairly widespread in the state, but is not particularly common. Larvae are predaceous on other mosquito larvae and on various aquatic arthropods that share their habitat.

Distribution



Psorophora columbiae (Dyar and Knab)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be found in temporary water situations including floodwaters, temporary pools, puddles, retention ponds and drainage ditches.

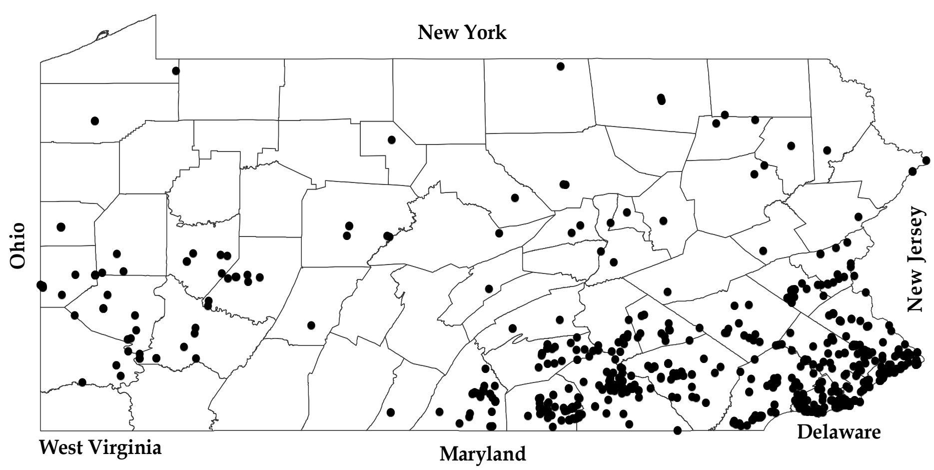
HOST PREFERENCES:
Females will feed on virtually any larege mammal, but cattle seem to be preferred when they are available. They are strong fliers and can travel up to eight miles in search of hosts. They can be severe human pests following heavy rains. Populations can get so dense in the southwestern United States that they have been known to kill cattle by clogging their nasal passages.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	975	85	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
Ps. columbiae will key to *Ps. confinnis* in some older North American keys. It is now known that *Ps. confinnis* is a South American species and the North American members of the complex are referred to as *Ps. columbiae.*

Distribution



Psorophora ferox (von Humboldt)

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

LARVAL HABITAT:
Larvae are most often found in temporary rain-filled pools. Secondary habitats include potholes from dried streambeds, woodland pools and wetlands.

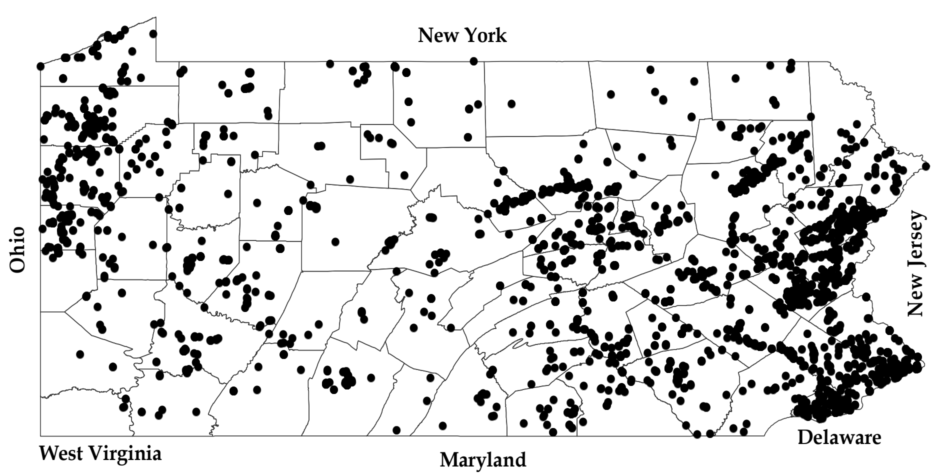
HOST PREFERENCES:
Females feed primarily on mammals, especially rabbits, deer and cattle, but will also feed on an occasional bird or reptile. Females are extremely aggressive and painful human biters.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	17,749	456	0	0
EEE	192	7	0	0
La Crosse	0	0	0	0

COMMENTS:
After heavy rains, this species is one of the most aggressive and abundant pest species in Pennsylvania. Mating occurs at the female emergence sites, so males don't swarm as with most mosquito species.

Distribution



Psorophora horrida (Dyar and Knab)

OVERWINTERING STAGE: Egg. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae live in temporary, shaded pools following heavy and prolonged summer rains.

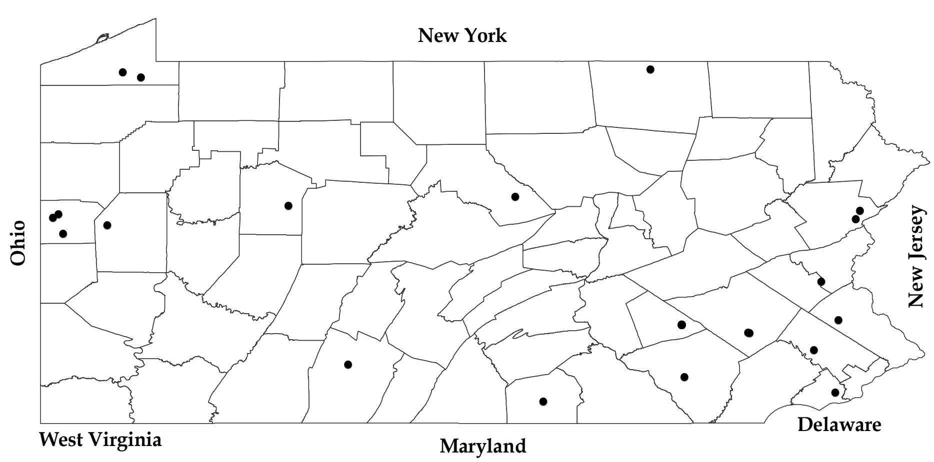
HOST PREFERENCES:
As with other *Psorophora*, these are primarily mammalian feeders.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	72	4	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
Adult females are similar in appearance to *Ps. ferox* and can be easily confused with them if the specimens are in poor condition. Very few specimens were collected, mostly in July.

Distribution



Psorophora howardii Coquillett

OVERWINTERING STAGE: Egg.

PHENOLOGY: Multivoltine.

LARVAL HABITAT:
Larvae can be found in temporary rain-filled pools, wetlands, floodwater ponds and drainage areas.

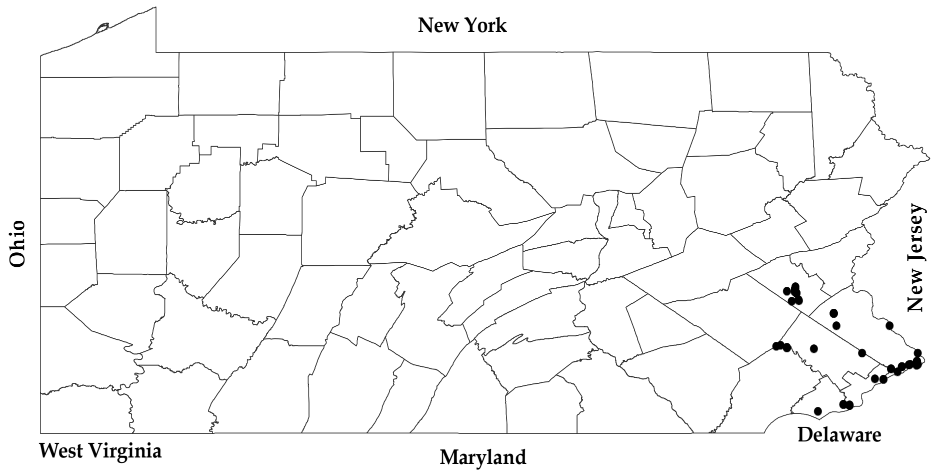
HOST PREFERENCES:
Females feed almost exclusively on medium to large-size mammals.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	33	3	0	0
EEE	0	0	0	0
La Crosse	0	0	0	0

COMMENTS:
In PA, this species is limited to the southeastern part of the state. Over 75% of the females collected were from Bucks and Lehigh Counties. Larvae are predaceous on other mosquito larvae and on various aquatic arthropods that share their habitat. Males have been observed mating with females at their emergence sites, rather than creating mating swarms as do most male mosquitoes.

Distribution



Toxorhynchites rutilus septentrionalis Dyar and Knab

OVERWINTERING STAGE: Late instar larva. **PHENOLOGY:** Multivoltine.

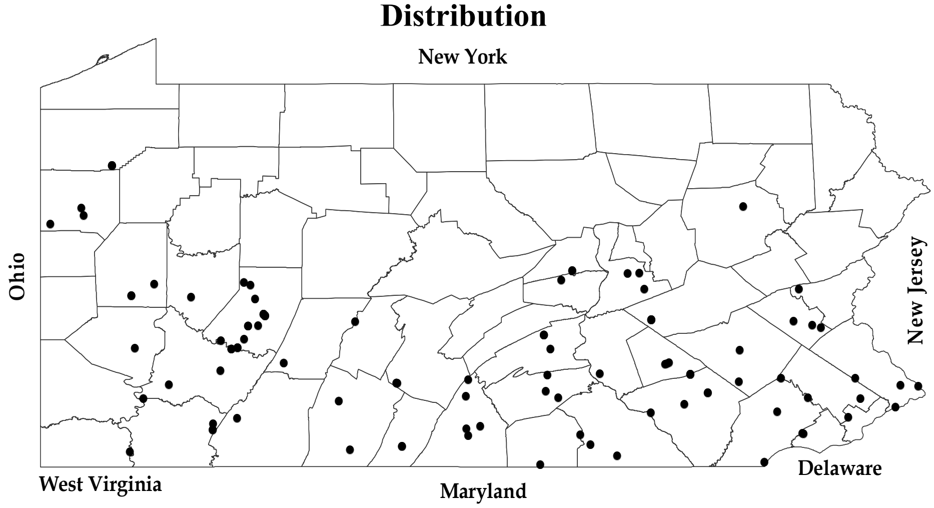
LARVAL HABITAT:
Larvae can be found in tree holes and artificial containers, especially tires.

HOST PREFERENCES:
This species does not require a blood meal for egg production, relying on leftover larval fat body to develop its first batch of eggs.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
The larvae are predaceous and are voracious feeders on other mosquitoes that share their habitat. The combination of a predaceous larva and a nectar-feeding adult makes this species an excellent candidate for a bio-control agent. One larva can eat up to 400 mosquito larvae during its development. Larvae engage in cannibalism as well as compulsive killing. Fourth instar larvae in an advanced stage of development stop feeding, but continue killing other larvae in the container, especially conspecifics. They have been observed grasping a larva and scraping it across needle-like spines on the posterior margin of the saddle, ripping the larva in half. The ecological advantage of this behavior is not known, but one hypothesis is that the larvae that are ready to pupate would gain a selective benefit from killing conspecifics that may attack it during the vulnerable pupal stage. Adults are difficult to collect because they are not attracted to traps.

Distribution



Uranotaenia sapphirina (Osten Sacken)

OVERWINTERING STAGE: Adult female. **PHENOLOGY:** Multivoltine.

LARVAL HABITAT:
Larvae can be found in permanent pools, ponds, wetlands and lakes with abundant aquatic vegetation. They are commonly associated with duckweed in Pennsylvania. Larvae prefer to congregate in areas exposed to sunlight, avoiding more shaded areas.

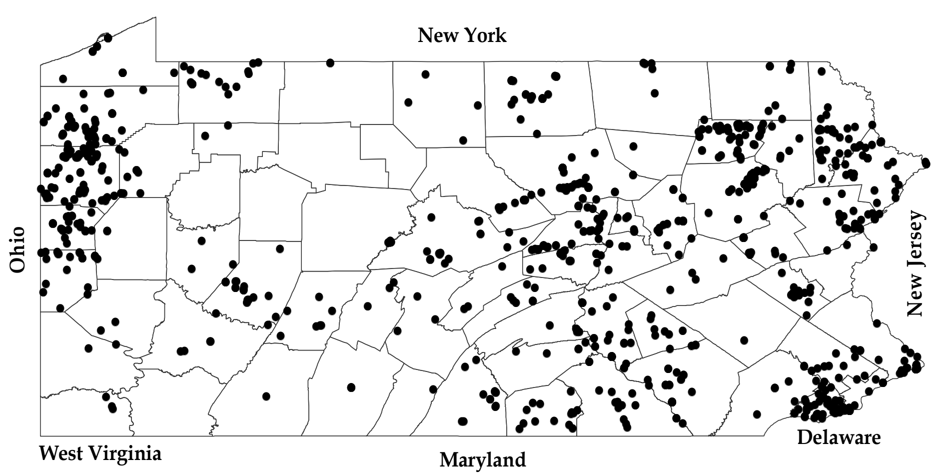
HOST PREFERENCES:
Adult females prefer to feed on amphibians and/or reptiles in the wild. This species rarely, if ever, bites humans and they refuse mammalian hosts in the laboratory.

VIRUS TESTING RESULTS:

Virus	# specimens tested	# pools tested	# positive pools	MIR
WNV	635	46	0	0
EEE	11	2	0	0
La Crosse	0	0	0	0

COMMENTS:
This small species is attractive under magnification because its thorax is partially covered with sapphire-colored scales.

Distribution



Wyeomyia smithii (Coquillett)

OVERWINTERING STAGE: Larva. **PHENOLOGY:** Multivoltine.

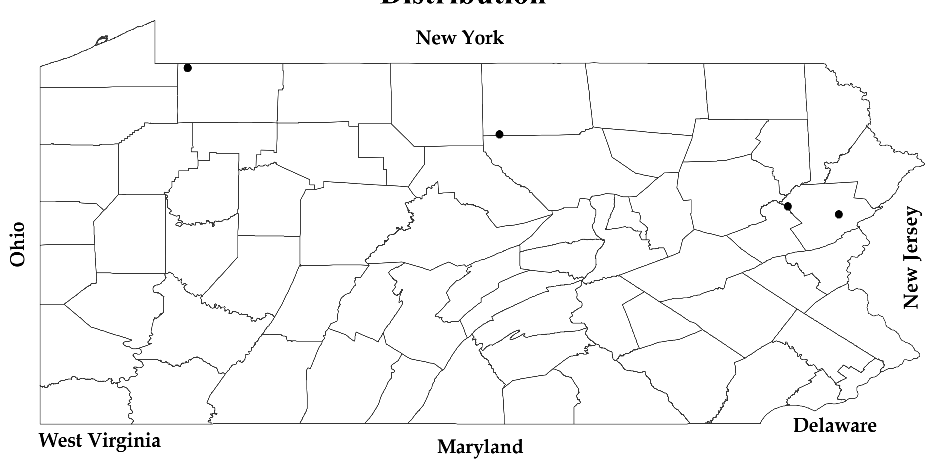
LARVAL HABITAT:
The larvae can only be found within the water filled leaves of pitcher plants, which grow primarily in acidic bog habitats.

HOST PREFERENCES:
No blood meal has ever been recorded from this species in the northern part of its range. Southern populations have been known to seek mammalian blood.

VIRUS TESTING RESULTS:
No specimens were tested for any arboviruses in Pennsylvania.

COMMENTS:
This species does not require a blood meal for egg production, relying on leftover larval fat body to develop its first batch of eggs. Larvae are capable of cutaneous respiration, so they do not need to surface to breathe. They feed on the remains of insects and other debris in the leaves of pitcher plants. Larvae are capable of surviving even if the water in the leaves freezes solid over the winter. Adults are most easily obtained from larval rearing.

Distribution



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