Mosquitoes of Iowa: Diptera: Culicidae

Kenneth L. Knight
Iowa State University

Michael Wonio
North Carolina State University

Follow this and additional works at: http://lib.dr.iastate.edu/specialreports
Part of the Entomology Commons, and the Zoology Commons

Recommended Citation
http://lib.dr.iastate.edu/specialreports/53
MOSQUITOES OF IOWA
(DIPTERA: CULICIDAE)

by Kenneth L. Knight and Michael Wonio

Department of Zoology and Entomology

Special Report No. 61

Agriculture and Home Economics Experiment Station
Iowa State University of Science and Technology
Ames, Iowa. . . . . . . . . . . . . . . . . . . . . June 1969
MOSQUITOS OF IOWA (DIPHTEROCUCICIDE)
CONTENTS

Summary....................................................................................................................... 4
Introduction .................................................................................................................. 5
Family Culicidae (mosquitoes) ..................................................................................... 5
   Classification ........................................................................................................... 5
   Recognition .............................................................................................................. 5
   Systematics .............................................................................................................. 6
   Geographic distribution .......................................................................................... 6
   Biology .................................................................................................................... 8
   Importance .............................................................................................................. 11
Keys to genera ........................................................................................................... 12
   Adult ....................................................................................................................... 12
   Adult: Male ............................................................................................................ 12
   Egg ......................................................................................................................... 13
   Larva: First instar .................................................................................................. 13
   Larva: Fourth instar ............................................................................................... 14
   Pupa ....................................................................................................................... 14
Genus Aedes.................................................................................................................. 14
   Recognition ............................................................................................................ 14
   Biology .................................................................................................................... 15
   Keys to the species of Aedes .................................................................................. 15
      Aedes (Ochlerotatus) aurifer (Coquillett) ............................................................ 19
      Aedes (Ochlerotatus) campestris Dyar and Knab ............................................. 20
      Aedes (Ochlerotatus) canadensis canadensis (Theobald) .................................... 20
      Aedes (Aedes) cinereus Meigen ........................................................................ 21
      Aedes (Ochlerotatus) dorsalis (Meigen) ............................................................ 21
      Aedes (Ochlerotatus) dupreii (Coquillett) ........................................................... 22
      Aedes (Ochlerotatus) fitchii (Felt and Young) ................................................. 22
      Aedes (Ochlerotatus) flavescens (Müller) ........................................................... 22
      Aedes (Ochlerotatus) implicatus Vockeroth ..................................................... 23
      Aedes (Ochlerotatus) nigromaculatus (Ludlow) ................................................. 23
      Aedes (Ochlerotatus) riparius Dyar and Knab ................................................. 24
      Aedes (Ochlerotatus) spencerii spencerii (Theobald) ........................................ 24
      Aedes (Ochlerotatus) sticticus (Meigen) ............................................................. 24
      Aedes (Ochlerotatus) stimulans (Walker) ........................................................... 25
      Aedes (Finlaya) triseriatus (Say) ....................................................................... 25
      Aedes (Ochlerotatus) trivittatus (Coquillett) ...................................................... 26
      Aedes (Aedimorphus) vexans (Meigen) ............................................................. 27
Genus Anopheles .......................................................................................................... 27
   Recognition ............................................................................................................ 27
   Biology .................................................................................................................... 27
   Keys to the species of Anopheles ......................................................................... 27
      Anopheles (Anopheles) barbieri Coquillett ....................................................... 29
      Anopheles (Anopheles) crucians Wiedemann ................................................... 29
      Anopheles (Anopheles) earlei Vargas ................................................................. 30
      Anopheles (Anopheles) punctipennis (Say) ...................................................... 30
      Anopheles (Anopheles) quadrimaculatus Say ................................................... 31
      Anopheles (Anopheles) walkeri Theobald ......................................................... 31
Genus Culex.................................................................................................................... 32
   Recognition ............................................................................................................ 32
   Systematics ............................................................................................................. 32
   Biology .................................................................................................................... 32
   Key to the species of Culex .................................................................................... 32
      Culex (Melanoconion) erraticus (Dyar and Knab) .......................................... 34
      Culex (Culex) pipiens Linnaeus ....................................................................... 34
      Culex (Culex) quinquefasciatus Say ................................................................. 35
      Culex (Culex) restuans Theobald ...................................................................... 35
      Culex (Culex) salinarius Coquillett ................................................................. 36
      Culex (Culex) tarsalis Coquillett ...................................................................... 36
      Culex (Neoculex) terryi Walker ....................................................................... 36
SUMMARY

The Culicidae, or mosquitoes, constitute a large and widely distributed family of medically important insects. The blood sucking habits of the females, coupled with the ability of some to transmit disease organisms, make them extremely serious pests of man and domestic animals.

This publication, prepared as an aid to medical doctors, veterinarians, public health personnel, and mosquito control personnel, is a compilation of most of the knowledge now available relating to the identification of the different mosquito species of Iowa. Also included are a generalized description of the morphological features of the different life history stages of mosquitoes and a discussion on the systematics, geographical distribution, biology, and economic importance of mosquitoes.

To date, 8 genera and 43 species of mosquitoes have been recorded from Iowa. An additional 2 genera and 29 species occur in one or more of the adjoining states and may eventually be taken in Iowa.

Identification keys have been prepared to the subfamilies, genera, and species of the mosquitoes occurring in Iowa. Summary statements on the subfamilies and genera are included, as are descriptions and notes on the biology and distribution of each species. Distribution within Iowa is given by counties.
Mosquitoes of Iowa (Diptera: Culicidae)\textsuperscript{1}

by Kenneth L. Knight and Michael Wonio \textsuperscript{2}

The Culicidae constitute a large and widely distributed family of medically important insects. The bloodsucking habits of the females, coupled with the ability of some species to transmit disease agents of man and domestic animals, make the culicids serious pests. Eight genera and 43 species have been recorded in Iowa. An additional 2 genera and 29 species occur in one or more of the adjoining states and may eventually be taken in Iowa.

The only comprehensive investigations previously made on the mosquitoes of Iowa were by Rowe (1941, 1942a, 1942b, 1942c) who did extensive biological and distributional studies. His results have been drawn upon extensively for this publication. The additional distribution information given here is based principally on field collections taken during the study and on the collections of Culicidae in the Iowa State University insect collection.

This report includes keys to subfamilies, genera, and species; a brief description of each species; and notes on the biology and Iowa distribution where these are known. All structures are figured at least once.

FAMILY CULICIDAE (MOSQUITOES)

Classification

Order Diptera, Suborder Nematocera, Superfamily Culicoidea, Family Culicidae.

Recognition

ADULT.\textsuperscript{3} Mouthparts in form of a proboscis, many times longer than head (fig. 2). Antenna with first segment (scape) small, cylindrical, and hidden beneath enlarged globular second segment (torus or pedicel) (fig. 2); flagellum with 13 filamentous segments (fig. 2), basal hair whorls on all segments except first, these basal hair whorls strongly developed in male (fig. 5). Compound eyes uniform; ocelli absent. Thorax dorsally clothed with scales of various forms and with setae, laterally usually with one or more patches of scales. Legs clothed with scales. Wings narrow elongate, with long slender fringe scales on posterior margin (fig. 25). Wing veins clothed with scales of various sizes, shapes, and colors; vein R\textsubscript{4,5} extending beyond base of vein R\textsubscript{4,5} (fig. 23). Abdomen clothed with scales (bare or sparsely scaled in the Arotphelinae), long and slender, with 8 distinct pregenital segments, bearing 2 small cerci posteriorly in female and a rather elaborate genitalic apparatus, posteriorly in male. Male genitalia undergo a rotation of 180° on their longitudinal axis within a few hours after emergence from pupa.

To use the following keys it is necessary first to determine the sex of the specimens to be identified. Sex can be distinguished easily by observing the antennae, bushy in the male (fig. 1) and simple in the female (fig. 2). Differences are also found in the palpi. In culicine mosquitoes, the palpi are short in the females and usually long in the males. In the anophelines, the palpi of both males and females (figs. 1, 2) are as long as the proboscis, but the males differ in having the last two segments enlarged and club shaped (fig. 1).

EGG. (figs. 67-94). White when first laid, becoming dark within an hour or so (except in Toxorhynchites); elongate and elliptical; not more than 1 mm long.

LARVA. (figs. 95-155). Aquatic; free-swimming; four larval instars. Head capsule sclerotized, complete. Mouth brushes well developed. Thorax and abdomen largely membranous. Thoracic segments rather completely fused, always wider than abdomen. Abdomen with 8 distinct segments and a complex terminal area, lacking prolegs and eversible groups of hooks. Only 1 pair of functional spiracles, situated dorso-posteriorly on the eighth abdominal segment. Four bladelike "gills" extending posteriorly from the last abdominal segment. The last 3 larval instars do not differ markedly from one another except that in general, proportionate sizes and numbers of subdivisions increase with each instar. The first instar differs markedly in having an egg-burster dorsally on the head (fig. 119) and in lacking the ventral brush of the anal segment (fig. 126). Wyeomyia, however, lacks the ventral brush in all instars.

PUPA. (figs. 156-167). Aquatic; free-swimming. Body composed of enlarged cephalothorax and abdomen. Abdomen slender, 8-segmented, terminating in

\textsuperscript{1}Projects 1553 and 1554 of the Iowa Agriculture and Home Economics Experiment Station.

\textsuperscript{2}Formerly professor of entomology, Iowa State University and University of Georgia; now head, Department of Entomology, North Carolina State University, Raleigh; and graduate student in Zoology. Mr. Wonio's work was done while he was an undergraduate and was supported by Undergraduate Research Participation Program, National Science Foundation (G6349).

\textsuperscript{3}The characters used in this and subsequent generic descriptions and in the keys are not all familial or generic in the broad sense and will not necessarily hold for species outside Iowa.
a pair of flattened paddles. Paired respiratory trumpets borne dorsally by the cephalothorax. First abdominal segment usually with a pair of large dorsal dendritic hair tufts (hair 1). Pupa floats with cephalothorax horizontal and abdomen curved beneath. The nomenclature used for mosquito larval and pupal structures is after Belkin (1962).

**Systematics**

Following the classification of Stone, Knight, and Starcke (1959), the family Culicidae is divided into three subfamilies: Anophelinae, Toxorhynchitinae, and Culicinae (tribes Sabethini and Culicini). The first subfamily is represented in Iowa only by the genus *Anopheles*, the second subfamily has not been recorded from the state, and the third contains the remainder of the genera found in Iowa. Belkin (1962) and most earlier authors also include the dixid and chaoborid midges in the family Culicidae. When this is done, these groups become, respectively, the following sub-

**Geographic Distribution**

Species of Culicidae are widely distributed throughout the world, being absent only from Antarctica (however, they range to within 150 miles of the North Pole) and from some isolated oceanic islands. Mosquitoes occur everywhere on the continents except in areas of permanent snow or ice, but the most species are found in the tropics. There are more than 2,600 known species. Stone (1965) treats 156 species and subspecies for North America north of Mexico, of which 43 are presently known from Iowa (table 1).

---

**Table 1. Mosquito species reported from Iowa and (or) adjoining states.**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aedes</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>abserratus</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>aegypti</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>atlanticus</td>
<td>-</td>
<td>+</td>
<td>b</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>atropalpus</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>aurifer</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>campestris</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>c. canadensis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>cinereus</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>communis</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>c</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>denticus</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>diantaeus</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>dorsalis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>dupreei</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>excrucians</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>fitchii</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>flavescens</td>
<td>+</td>
<td>+</td>
<td>d</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>fulvus paliens</td>
<td>+</td>
<td>+</td>
<td>d</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>grossbecki</td>
<td>-</td>
<td>+</td>
<td>f</td>
<td>+</td>
<td>e</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>hendersoni</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>implicatus</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>infirmatus</td>
<td>+</td>
<td>+</td>
<td>d</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>intrudens</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>mitchellae</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>nigromaculis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>punctor</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>riparius</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>sollicitans</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>s. spencerii</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>sticticus</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>stimulans</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>thibaulti</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>tormentor</td>
<td>+</td>
<td>+</td>
<td>d</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>trichurus</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>triseriatus</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>trivittatus</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>vexans</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Species</td>
<td>State</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anopheles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>barberi</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>+g</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>crucians</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>earlei</td>
<td>+</td>
<td>—</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>—</td>
</tr>
<tr>
<td>pseudopunctipennis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>punctipennis</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>quadrimaculatus</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>wakeri</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Culex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>erraticus</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>+g</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>peccator</td>
<td>—</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
</tr>
<tr>
<td>pipiens</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>quinquefasciatus</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>restuans</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>salinarius</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>tarsalis</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>territans</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Culiseta</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>impatient</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>—</td>
</tr>
<tr>
<td>incidens</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>inornata</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>melanura</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>minnesota</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>morsitans dyari</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Psorophora</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ciliata</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>confinis</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>cyaneascens</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>discolor</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>ferox</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>horrida</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>howardii</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>longipalpis</td>
<td>—</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>signipennis</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>varipes</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Mansonia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>perturbans</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Orthopodomyia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>alba</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>+g</td>
<td>+i</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>signifera</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Toxorhynchites</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rutulus septentrionalis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Uranotaenia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>saphirina</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Wyeomyia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>smithi</td>
<td>+</td>
<td>+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

*From Carpenter and LaCasse (1955) except where otherwise indicated.

†Hedeen (1963).

‡Ross and Horsfall (1965, 5): an unverified record.

§Ross and Horsfall (1965, 5).

¶Ross and Horsfall (1965, 5).

*Thompson and DeFoliart (1966).
Biology

Mosquitoes are best known because of the blood-sucking habits of the females. Not all mosquitoes, however, suck blood. The females of many species also utilize plant and animal nectar secretions, some exclusively so (*Toxorhynchites*), and males live solely on such secretions. Much variation exists as to host specificity for the blood meal, but evidently only terrestrial vertebrates are normally used, although fish and even insects have been reported as occasional hosts (Horsfall 1955, 25).

Mosquitoes are usually crepuscular and nocturnal, but there are some distinctly diurnal species. Flight habits are extremely variable among the family as a whole. Some species undergo compulsory dispersal flights of many miles, whereas others seldom ever move far from their larval habitats. Mating takes place in a great variety of situations, although occurring in flight in almost all species. Crepuscular male swarms are a common phenomenon.

In general, female mosquitoes require a blood meal before they can mature eggs. Some individuals of many genera and species, however, are capable of utilizing food reserves carried over from the larval stage to mature a somewhat smaller-than-normal first batch of eggs. These “autogenous” females must then take a blood meal if they are to lay eggs again. It has been established that autogenous individuals inherit the ability to secrete a gonadotrophic hormone after emergence, which triggers ovarian development without the prior stimulus of a blood meal (Clements 1963, 174).

The gravid female shows a considerable amount of specificity in selecting oviposition sites. Stimuli used in this process are principally visual, olfactory, and tactile and operate in varying combinations, depending on species.

Egg-laying habits of mosquitoes vary widely among the different genera. *Anopheles* deposit their eggs singly on the water, either while standing on the surface or hovering over it. *Psorophora*, *Aedes*, and *Orthopodomyia* of this region deposit their eggs in crevices in moist ground litter and soil at the retreating water line of water-holding depressions or in natural water-holding containers such as tree holes that will again be flooded during rains. Females of *Culex*, *Mansonia*, *Culiseta*, and *Uranotaenia* generally glue their eggs together in raftlike masses that float on the water. In these instances, the females stand on the water's surface or very close to it while ovipositing.

Mosquito eggs of species that lay directly on water surfaces hatch very shortly after the completion of embryonic development, provided that the temperature is satisfactory. The eggs of species that lay on moist surfaces other than water, however, must undergo an appropriate “conditioning process” before they will hatch (Horsfall 1956). With some species of *Aedes* (*Ochlerotatus*), this even includes the necessity of first overwintering (these species are, accordingly, univoltine or single-brooded). With all aedine species, hatching requires that embryonic development be completed before the eggs are flooded. Furthermore, when flooding is finally accomplished, it must occur at or above the threshold developmental temperature for the species.

As pointed out, mosquito larval habitats reflect distinct selective processes on the part of the ovipositing female. Some mosquito species show a high degree of specificity in this regard, but others are much more indiscriminate (table 2). Very broadly, mosquito larval habitats can be classified as (adapted from Barr 1958, 9):

1. **ground water sites**
   - (a) temporary water
   - (b) permanent water
2. **specialized water sites (container habitats)**
   - (a) natural habitats
   - (b) artificial habitats

In general, *Aedes* and *Psorophora* larvae are found in temporary ground waters. In Iowa, most larval habitats of this type fall into one of four classifications: winter seepage ponds, floodplain ponds, summer rain ponds, and marsh edges. The mosquitoes that use the permanent ground water sites are those that lay their eggs directly on the surface of the water; i.e., *Anopheles*, *Culex*, *Culiseta*, *Mansonia*, and *Uranotaenia*. The category of specialized water sites encompasses such natural habitats as tree holes, rock holes, pitcher plants, and such semidomestic habitats as fish ponds, tin cans, piles of rubber tires, stopped-up eaves troughs, drains, and cisterns. Larvae of *Anopheles barberi*, for example, are taken nowhere else except in water held in tree holes.

All mosquito larvae, except members of the genus *Mansonia*, must come to the surface at frequent intervals to obtain oxygen. *Mansonia* larvae and pupae, however, insert their respiratory siphons and trumpets into the submerged roots and stems of aquatic plants and obtain their oxygen directly from the plant tissue.

The food of mosquito larvae consists chiefly of organic detritus, but extremely small plants and animals are also swept up and used. The larva of *Anopheles* rotates its head 180° and, with its mouth brushes upward, sweeps the surface film for food; in contrast, the culicine larva sweeps in particles either suspended or resting on underwater surfaces and rarely feeds from the surface. It can feed from the surface, however, by twisting its body until the mouth brushes are uppermost. The larvae of *Toxorhynchites* and *Psorophora* (*Psorophora*) are predacious and feed on small aquatic organisms, including other mosquito larvae. The length of the larval stage varies with the species and with the availability of food (table 3).

---

*Marshall (1938, 33) stated that *Culiseta* (*Culicella*) species lay their eggs separately and, for the most part, on soil likely to be flooded.*
Table 2. The frequencies with which larvae of Iowa mosquitoes were found in various habitats. (Rowe 1942a, 135).

<table>
<thead>
<tr>
<th>Species</th>
<th>Larval Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Permanent ponds</td>
</tr>
<tr>
<td>Aedes campestris</td>
<td>1</td>
</tr>
<tr>
<td>c. canadensis</td>
<td>1</td>
</tr>
<tr>
<td>cinereus</td>
<td>1</td>
</tr>
<tr>
<td>dorsalis</td>
<td>1</td>
</tr>
<tr>
<td>fitchii</td>
<td></td>
</tr>
<tr>
<td>flavescens</td>
<td></td>
</tr>
<tr>
<td>impictatus</td>
<td></td>
</tr>
<tr>
<td>nigromaculis</td>
<td></td>
</tr>
<tr>
<td>nigripes</td>
<td></td>
</tr>
<tr>
<td>s. spenceri</td>
<td></td>
</tr>
<tr>
<td>strictus</td>
<td></td>
</tr>
<tr>
<td>stimulans</td>
<td></td>
</tr>
<tr>
<td>vexans</td>
<td>10</td>
</tr>
<tr>
<td>Psorophora ciliata</td>
<td>2</td>
</tr>
<tr>
<td>confinis</td>
<td></td>
</tr>
<tr>
<td>ferox</td>
<td></td>
</tr>
<tr>
<td>horrida</td>
<td></td>
</tr>
<tr>
<td>Eggs laid singly</td>
<td></td>
</tr>
<tr>
<td>Anopheles</td>
<td></td>
</tr>
<tr>
<td>barberi</td>
<td>2</td>
</tr>
<tr>
<td>earlei</td>
<td>46</td>
</tr>
<tr>
<td>punctipennis</td>
<td>37</td>
</tr>
<tr>
<td>quadrimaculatus</td>
<td></td>
</tr>
<tr>
<td>walkeri</td>
<td>2</td>
</tr>
<tr>
<td>Eggs laid in rafts</td>
<td></td>
</tr>
<tr>
<td>Culex</td>
<td></td>
</tr>
<tr>
<td>eraticus</td>
<td>16</td>
</tr>
<tr>
<td>pipiens</td>
<td>8</td>
</tr>
<tr>
<td>restuans</td>
<td>11</td>
</tr>
<tr>
<td>salinarius</td>
<td>20</td>
</tr>
<tr>
<td>tarsalis</td>
<td>27</td>
</tr>
<tr>
<td>territans</td>
<td>32</td>
</tr>
<tr>
<td>Culiceta inornata</td>
<td>17</td>
</tr>
<tr>
<td>moritans dyari</td>
<td></td>
</tr>
<tr>
<td>Uranotaenia sapphirina</td>
<td>18</td>
</tr>
</tbody>
</table>

The pupal stage appears with the fourth larval molt. Because it is lighter than water, the pupa rests at the surface. Movement is accomplished with a jerking tumbling motion. Except for Mansonia species, pupae obtain air from the surface through the pair of respiratory trumpets born dorsally on the cephalothorax. The pupal stage lasts only a few days (usually 2 to 4) for most mosquito species.

Male mosquitoes emerge from the pupae slightly earlier than do females. This results in males having a shorter aquatic existence than do the females. Because the pupal stages of the two sexes are of about the same length, the shortening in development of males takes place primarily in the larval stages; pupal and adult males are therefore of a correspondingly smaller size.
Male swarms are a common feature of many of the mosquito species of this area. These swarms are initiated by a changing low-level light intensity and, accordingly, can occur at both twilight and dawn. The precise level of light intensity necessary to initiate swarming varies with the species, but is mostly in the range of 0.2 to 10.0 ft-c. Almost invariably, females happening to pass near a swarm are precipitously copulated. It is doubtful, however, that the male swarm is primarily a mating mechanism. As a rule,

Table 3. Seasonal distribution of Iowa mosquitoes (Rowe 1942a).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aedes aurifer</td>
<td>A.</td>
<td></td>
<td>A.</td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. canadensis</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cinereus</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>dorsalis</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>dupreei</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fitchii</td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>flavescens</td>
<td>L.</td>
<td>A.</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>implicatus</td>
<td>L.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>nigromaculis</td>
<td>L.</td>
<td>A.</td>
<td></td>
<td></td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>riparius</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>s. spencerii</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sticticus</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>stimulans</td>
<td>L.</td>
<td>A.</td>
<td></td>
<td></td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>triseriatus</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>trivittatus</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>confinis</td>
<td>L.</td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>discolor</td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ferox</td>
<td></td>
<td></td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>signipennis</td>
<td>A.</td>
<td>L.</td>
<td>L.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anopheles eariei</td>
<td></td>
<td>A.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
<td>L.</td>
</tr>
<tr>
<td></td>
<td>punctipennis</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
</tr>
<tr>
<td></td>
<td>walkeri</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
</tr>
<tr>
<td></td>
<td>quinquefasciatus</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Culiseta impatiens</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>melanura</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mansonia perturbans</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orthopodomyia signifera</td>
<td>A.</td>
<td>A.</td>
<td>A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10
Mating probably takes place soon after emergence because females taken near the larval habitat and shortly after a general emergence period are almost invariably found inseminated.

In the northern United States, mosquitoes normally overwinter either as eggs or as adults, depending on the genera and species involved. However, *Wyeomyia smithii* (recorded from Minnesota) and *Mansonia perturbans* are reported to overwinter as larvae, presumably frozen in the ice.

**Importance**

Mosquitoes are of great economic importance for at least two reasons: the effects of their bites and their capacity to serve as vectors or transmitters of disease agents. The nature and appearance of mosquito bites are too well known to require extensive description here (table 4). The bites tend to be irregularly distributed over exposed parts of the body, especially the face, hands, legs, and ankles. Mosquitoes can also bite through thin and loosely woven clothing. On some people, these bites cause much discomfort, which often leads to scratching and even to secondary infection.

Because of their biting, mosquitoes often cause serious economic loss to farmers by interfering with planting, cultivating, and harvesting of crops. They may also lower milk production, cause weight loss in beef cattle, and reduce egg production in poultry. In extreme cases, mosquitoes have caused the death of domestic animals, apparently due to blood loss or as a result of anaphylatic shock. Additionally, the presence of biting mosquitoes restricts real estate development and the use of recreation areas, or, on the other hand, requires time, effort, and money for control measures.

Mosquitoes serve as vectors of a number of pathogenic microorganisms, including the malarias, certain filarial worm diseases, and numerous viruses (yellow fever, dengue, encephalitides, etc.).

---

**Table 4. Host-blood sources of mosquitoes as determined by precipitin tests in Kansas (Edman 1964, 38).**

<table>
<thead>
<tr>
<th>Species</th>
<th>Beef</th>
<th>Human</th>
<th>Pig</th>
<th>Bird</th>
<th>Dog</th>
<th>Horse</th>
<th>Sheep</th>
<th>Rodent</th>
<th>Rabbit</th>
<th>Not identified</th>
<th>Mixed a</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aedes dorsalis</td>
<td>18</td>
<td>5</td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nigromaculis</td>
<td>163</td>
<td>9</td>
<td>1</td>
<td>5</td>
<td>80</td>
<td>5</td>
<td>35</td>
<td>47</td>
<td>44</td>
<td>389</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sollicitans</td>
<td>40</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trivittatus</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>13</td>
<td>2</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vexans</td>
<td>723</td>
<td>192</td>
<td>29</td>
<td>2</td>
<td>14</td>
<td>142</td>
<td>46</td>
<td>139</td>
<td>263</td>
<td>1556</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anopheles punctipennis</td>
<td>1</td>
<td>1</td>
<td></td>
<td>8</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culex erraticus</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>pipiens</td>
<td>18</td>
<td>5</td>
<td>1</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>restuans</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>saliniarius</td>
<td>22</td>
<td>7</td>
<td>2</td>
<td>6</td>
<td>11</td>
<td>2</td>
<td>9</td>
<td>29</td>
<td></td>
<td>88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tarsalis</td>
<td>73</td>
<td>8</td>
<td>4</td>
<td>34</td>
<td>2</td>
<td>27</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>44</td>
<td></td>
<td>210</td>
</tr>
<tr>
<td>tertiatus</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culiseta inornata</td>
<td>56</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>15</td>
<td>3</td>
<td>8</td>
<td>12</td>
<td></td>
<td>101</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psorophora ciliata</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>42</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>confinns</td>
<td>46</td>
<td>13</td>
<td>3</td>
<td>5</td>
<td>20</td>
<td>7</td>
<td>59</td>
<td>12</td>
<td>15</td>
<td>13</td>
<td>100</td>
<td>293</td>
</tr>
<tr>
<td>discolor</td>
<td>28</td>
<td>7</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>2</td>
<td>15</td>
<td>5</td>
<td>1</td>
<td>38</td>
<td>119</td>
<td></td>
</tr>
<tr>
<td>signipennis</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>6</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a Host records from mixed feedings are not itemized here.*
KEYS TO GENERA

Adult. 5 (adapted from Peyton and Hill 1957)

1. Proboscis stout on basal half, apical half tapered and strongly curved downward (figs. 3,4), large species with broad metallic-colored scales on head, thorax, abdomen, and legs. Torxorhynchites rutilus septentrionalis 6
Proboscis slender, of nearly uniform thickness, not strongly curved downward on apical half (fig. 2) ........................................... 2

2. Scutellum with posterior margin smoothly rounded, the hairs arranged evenly along it (fig. 8); palpus of female nearly as long as proboscis (fig. 2); abdomen bare of scales or only sparsely scaled. ........................................... 6
Scutellum with posterior margin trilobed, the hairs grouped on these lobes (fig. 7); palpus of female less than half the length of proboscis; abdomen densely scaled. ........................................... 3

3. Wing vein R 2+3 branching close to apical margin of wing so that cell R 2 is only half the length of its stalk, R 2+3 (fig. 23); groups of iridescent blue scales present. ........................................... 7
Wing vein R 2+3 branching much farther from apical margin of wing so that cell R 2 is at least as long as its stalk, R 2+3 (fig. 24); iridescent blue scales not present. ........................................... 4

4. Scutum covered with a close mat of blue-black scales, having bristles only around periphery; postnotum with a tuft of small bristles (fig. 21). ........................................... 7
Scutum either having scales other than blue-black or having several series of erect bristles extending above scales; postnotum without a tuft of hairs. ........................................... 5

5. Spiracular bristles present (fig. 21). ........................................... 6
Spiracular bristles absent. ........................................... 7

6. Postspiracular bristles present (fig. 21); observed from above, apex of abdomen markedly tapered (fig. 35). ........................................... 2
Postspiracular bristles absent; observed from above, apex of abdomen more bluntly rounded (fig. 34). ........................................... 6

7. Postspiracular bristles present (fig. 21). ........................................... 8
Postspiracular bristles absent. ........................................... 7

8. Wing scales narrow, uniformly dark. ........................................... 9

9. Scutum black-scaled with a series of sharply contrasting narrow white lines (fig. 11); hind tarsus with segments I-IV banded apically and basally. ........................................... 10
Scutum with intermixed dark brown and pale gold scales; hind tarsus with segments II-V basally banded only. ........................................... 12

Adult: Male (adapted from Ross and Horsfall 1965)

1. Fork of vein R 2+3 close to apical margin of wing, cell R 2 half or less the length of its stalk (fig. 23). ........................................... 2
Fork of vein R 2+3 much farther from apical margin of wing so that cell R 2 is as long as or longer than its stalk (fig. 24). ........................................... 3

2. Palpus short and inconspicuous (fig. 5); wing less than 3.5 mm long. ........................................... 2
Palpus long and massive (fig. 3); wing more than 6.0 mm long. ........................................... 3

3. Scutellum with apical margin rather evenly rounded, the hairs arranged evenly along its posterior margin (fig. 8); palpus apically enlarged (fig. 1). ........................................... 4
Scutellum with apical margin incised to form a mesal lobe and 2 lateral lobes, with the hairs grouped on these 3 lobes (fig. 7); apex of palpus not noticeably enlarged (fig. 6). ........................................... 5

4. Clasper distally multilobed and markedly swollen. ........................................... 6
Clasper simple, without irregular lobes (fig. 38). ........................................... 5

5. Apical spine of clasper double, each ray short and stout (fig. 61). ........................................... 6
Apical spine of clasper single (fig. 38); subapical in Aedes vexans. ........................................... 6

6. Apical spine of clasper cone shaped, wide and truncate at apex, and with what seems a minute fringe along the edge (fig. 63). ........................................... 7
Apical spine of clasper either parallel sided or tapering to apex (fig. 38). ........................................... 8

7. Apex of sidepiece continuing as a pointed lobe beyond insertion of clasper (fig. 37). ........................................... 7
Clasper situated at apex of sidepiece (fig. 38). ........................................... 8

8 From here on characters of the male genitalia are used exclusively.

---

5 Since males tend to be more sparsely scaled than females, sometimes male specimens cannot be identified in the general keys to adults. In these instances, the specimens can usually be dependably identified by the special keys to males.

6 Neither Torxorhynchites nor Wyeomyia have been found in Iowa. Since they occur in adjacent states, however, they are included in the generic keys.

7 See footnote 6.

8 From here on characters of the male genitalia are used exclusively.
8. A subcylindrical projection (claspette) arising from near base of each sidepiece (figs. 40, 45). .......... 9
Claspette not present .................. 10
9. Apex of claspette stem either bearing a single sclerous process that is filamentous or bladelike, the claspette filament (fig. 43), or crowned with setae (fig. 46). .......... Aedes
Apex of claspette stem bearing a cluster of spines, one of which may appear to be a process (fig. 64). .......... Psorophora

Sidepiece with a subapical lobe, this lobe bearing a cluster of specialized bladelike or spathulate spines, which are frequently complex in structure (fig. 54). .......... Culex
Sidepiece without a subapical lobe, with a stout rodlike structure on mesal face near middle; clasper broadened bladelike (fig. 62) .......... Mansonia perturbans

Egg (adapted from Ross and Horsfall 1965)

1. Eggs glued together in the form of floating rafts (fig. 69) .......... 2
Egg found singly .......................... 5
2. Surface of egg with many small raised nodules (fig. 72) .......... Mansonia perturbans
Surface of egg without nodules .......... 3
3. Egg with frothy cap on posterior or small end (fig. 74) .......... Uranotaenia sapphirina
Egg without frothy cap on posterior end ..................................................................... 4
4. Egg bluntly rounded at anterior end (fig. 71) .......... Culiseta
Egg cup-shaped at anterior end (fig. 70) .......... Culex
5. Egg strongly biconvex in lateral profile (fig. 81); ratio of diameter to length not greater than 1:2. .......... 6
Egg slender (fig. 80); ratio of diameter to length greater than 1:2. .......... 7
6. Egg in water-holding rot holes of trees; white ........................................................................ 8
Egg on soil subject to flooding; egg darkens in color after laying .......................... Psorophora
7. Egg in cavities of leaves of pitcher plant (Sarracenia) .......... Wyomyia smithii
Egg elsewhere ........................................ 8
8. Egg with pair of longitudinal membranous flanges (fig. 73); found in container-type habitats ........................................................................... Orthopodomia signifera
Egg without such longitudinal flanges .......... 9
9. Egg with lateral “floats” (fig. 67); found lying on water surface of ground pools and rot holes of trees; no ventrolateral spines; a ventrolateral hair in addition to lateral hair present on anal segment (fig. 141). .......... Wyomyia smithii
10. Dorsal profile less arched than ventral profile (fig. 79); eggshell with spiral rows of stubby, anteriorly directed spicules; on soil subject to flooding .......... Aedes

Dorsal profile more strongly arched than ventral profile (fig. 82); eggshell with spiral rows of stubby, anteriorly directed spicules; on soil subject to flooding .......... Psorophora

Larva: 1st Instar (adapted from Dodge 1946)

1. Siphon absent; head hairs 2 and 3 well developed (fig. 124); body dorsally with some lanceolate (broadened and flattened) hairs; anal segment uniformly, sparsely pilose; saddle absent .......... Anopheles
Siphon present (fig. 126); head hairs 2 and 3 not or rarely evident (fig. 114); body without lanceolate hairs; anal segment not uniformly pilose; saddle present (fig. 126) .......... 2

2. Mouth brushes reduced to about 10 stout rods; abdomen with 3 pairs of lateral platelets on segments I-VII; comb present (fig. 140); comb and pecten absent (fig. 140) .......... Toxorhynchites rutilis septentrionalis
Mouth brushes of numerous fine hairs; abdomen without 3 pairs of lateral platelets on segments I-VII; anal segment not completely ringed by the saddle (fig. 126); comb present (fig. 126) .......... 3
3. Pecten absent (fig. 139) .......... 4
Pecten present (fig. 126) .......... 6
4. Abdominal hairs 1-5-VIII normally spaced in an arc nearly half encircling the comb (fig. 139) .......... Orthopodomia signifera
Abdominal hairs 3-5-VIII in a close lateral triangular group, none ventral (fig. 138) .......... 5
5. Siphon with attenuated apex (fig. 138); antenna much longer than the head, with a pair of subapical spines; no ventrolateral hair on anal segment (fig. 138) .......... Mansonia perturbans
Siphon of normal shape (fig. 141); antenna much shorter than the head, without subapical spines; a ventrolateral hair in addition to lateral hair present on anal segment (fig. 141) .......... Mansonia perturbans
6. Prothoracic hairs 1-3 close together, with at least 2 of the hairs long and stout, setal rings prominent, arising from a sclerotized platelet that is rarely divided or poorly defined in the first instar (fig. 125) .......... 7
Prothoracic hairs 1-3 well separated, with the hairs rarely long or stout, not arising from prominent setal rings, and very rarely associated with a platelet .......... 9
7. Maxillary suture absent; head elongate, with stout head hairs; anal segment nearly ringed by saddle .......... Uranotaenia sapphirina
Maxillary suture present (fig. 95); head rounded or subtriangular, wider than long, with slender head hairs (fig. 119); saddle small, dorsal (fig. 126) .......... 8
8. Siphon with 3 or more pairs of ventrolateral hairs (fig. 136) .......... Culex

13
Recognition

**GENUS ADIES**

1. Seta 1-IX present, placed laterally, sometimes even anteriorly to abdominal segment V III (fig. 163); trumpet with a branched hair basally on each side at the spiral opening (fig. 148). Abdominal segment V III without comb scales. 8

2. Outer part of paddle lobelike and extending posterior lateral corners of segments tapered, without a lateral saw-toothed projection (fig. 152). Abdominal segment V III with a prominent sclerotized plate with the comb scales on posterior margin. 1

3. Head longer than wide (fig. 113); abdominal segment V III with an elongate dark disk (fig. 119). 5

4. Siphon with several pairs of hair tufts (fig. 148). 5

5. Siphon without comb scales (fig. 152). Abdominal segment V III without an elongate dark disk (fig. 119). 1

6. Seta 1-IX absent, when present placed on each side at the spiral opening (fig. 148). Siphon with a pecten (fig. 152). Abdominal segment V III with comb scales. 7

7. Abdominal segment V III without comb scales. 8

8. Seta 1-IX present (fig. 163); trumpet with a branched hair basally on each side at the spiral opening (fig. 148). Abdominal segment V III without comb scales. 7

**ADULT.** Palpus of female rarely more than one-fourth as long as proboscis in length and width, when fully extended, the proboscis being in apposition with the palpus. Abdominal segments V III and VI usually slightly united in front.

**Psorophora.** Only the female has a proboscis in apposition with the palpus, the male, whose proboscis is considerably shorter, being used for scratching purposes.

**Egg-burster.** A median conical point on a small plate (fig. 99) is present on the anterior surface of the head in both sexes of Psorophora, and is usually divided into two or more parts by a transverse ridge.

**Pupa.** Length of pupa usually less than half the length of the adult. The pupal case is usually dark-colored and is attached to the aerially-colored bag in a characteristic manner.

**Pupa** (adapted from Darie 1957; Hill 1957).
conspicuous scale patches. Abdomen of female with tip distinctly tapered (when viewed dorsally), segment VIII retractile. Tarsal claws of fore and mid legs of male unequal, each with one tooth; tarsal claws of female usually equal and toothed; without pulvilli.

**EGG.** (fig. 75-80, 83-94). Spindle shaped or elliptical, usually with fine hexagonal sculpturing on exochorion.

**LARVA.** (fig. 95-99). Siphon usually short, rarely more than 4 times as long as its basal diameter; pecten well developed; a single pair of siphonal hair tufts, never inserted near base. Anal segment with saddle complete or incomplete; ventral brush with a grid, usually well developed, arising posterior to saddle when saddle is complete.

**PUPA.** Respiratory trumpet usually short, somewhat dilated apically. Hair 1 (dendritic tuft) of abdominal segment I well developed.

**Biology**

Where winter freezing occurs, all members of this genus overwinter in the embryonated egg stage. The eggs of most species are laid on damp soil in depressions subject to filling by rains, melting snow, or floodwater; a few species utilize more restricted habitats, such as rot cavities in trees and artificial containers. The eggs hatch upon being flooded, provided that embryonic development is complete and the temperature is adequate. Some species have but one generation a year (univoltine) because the eggs must overwinter before they will hatch. The others (multivoltine species) do not have this requirement and usually have 2 or more generations per year, depending upon the latitude and the occurrence of flooding rains. The adults commonly feed on plant nectars, and the females additionally take vertebrate blood meals (usually mammalian).

**Keys to the Species of Aedes**

*(adapted from Stojanovich 1961)*

**ADULTS: FEMALES**

1. Tarsi ringed with white bands (fig. 30) .............. 2
   Tarsi not ringed with white bands (fig. 29) .......... 10

2. Tarsi with white bands at both ends of some segments (fig. 31) ......................................................... 3
   Tarsi with white bands only at base of segments (fig. 30) ......................................................... 5

3. Wing scales dark, except sometimes for a patch of white scales at base of costa (anterior vein of wing) ........... c. canadensis
   Wing scales mixed pale and dark ............................................. 4

4. Apical portions of veins R 4.5, M 1.2, and M 3.4 with numerous black scales and few white scales (see fig. 23 for names of veins); tooth of fore and middle tarsal claws only about one-fourth as long as portion of claw beyond tooth. ........... dorsalis
   Apical portions of veins R 4.5, M 1.2, and M 3.4 with white scales predominating; tooth of fore and middle tarsal claws nearly one-half as long as portion of claw beyond tooth. ........... campestris

5. Proboscis usually with a pale band at middle (sometimes reduced or absent); upper surface of abdomen with a definite longitudinal stripe of pale scales .............................................. 6
   Proboscis without a pale median band, abdomen without a longitudinal dorsal pale stripe .............................................. 7

6. Pale tarsal bands narrow (fig. 30); abdominal segments 3, 4, and 5 with V-shaped notch posteriorly in basal pale bands .............................................. 8
   Pale tarsal bands broad ......................................................... 7

7. Upper surface of abdomen entirely covered with yellow scales, without definite banding; scutum entirely yellowish golden brown; most costal scales white .............................................. 9
   Upper surface of abdomen not covered with pale scales, segments usually with distinct bands; scutum at least partially dark scaled; majority of costal scales dark .............................................. 8

8. Female tarsal claw with accessory tooth short and blunt (fig. 32) .............................................. 7
   Female tarsal claw with accessory tooth long and slender (fig. 33) .............................................. 9

9. Lower mesepimeral bristles (fig. 21) usually 3 or more; torus usually without pale scales; woodland species .............................................. 10
   Lower mesepimeral bristles 0-2, rarely 3 or 4; torus usually pale scaled; savanna species (reliable identification characters that will separate all females of these 2 species have not been found) .............................................. 11

10. Scutum with one or two broad stripes of white scales near middle (fig. 20) .............................................. 11
    Scutum without such stripes of white scales near middle (fig. 14) .............................................. 12

11. Scutum with two broad white to yellowish-white stripes separated by a bronzy-brown median stripe (fig. 20) .............................................. 11
    Scutum with only one median stripe, which is about as broad as occiput (fig. 13); occiput completely white scaled .............................................. 12

12. Wing with mixed dark and pale scales; abdomen with pale scales forming a mesal stripe along entire dorsum, often almost entirely white scaled .............................................. 12
    s. spencerii
    Wing entirely dark, or with only white scale patches at bases of veins or with scattered pale scales on anterior veins .............................................. 13

13. Postcoxal area with pale scales (fig. 22) .............................................. 13
    Postcoxal area without scales .............................................. 14
14. Scutum uniformly dark; fore coxa with patch of flat dark scales; occiput with dark scales behind eyes; torus with dark scales only. ... cinereus
Scutum not uniformly dark (fig. 14); fore coxa, occiput and torus not scaled as described immediately above. ... 15

15. Upper surface of abdomen with basal pale bands distinct; hind tibia speckled. ... sticticus
Upper surface of abdomen without basal pale bands; hind tibia dark scaled. ... 16

16. Sides of scutum silvery white (fig. 17); occiput entirely white scaled. ... triseriatus
Sides of scutum golden yellow (fig. 15); occiput usually with patches of dark scales. ... aurifer

ADULTS: MALES 10 (ADAPTED FROM ROSS AND HORSFALL 1965)

1. Clasper arising before apex of sidepiece, the portion of the sidepiece that extends beyond the clasper forming an apical cone (fig. 37). ... cinereus
Clasper arising at extreme apex of sidepiece (fig. 38). ... 2

2. Clasper wide near apex, terminating in a sharp projection that is nearly as long as the subapical spine (fig. 46). ... vexans
Clasper narrow at apex, tipped by apical spine (fig. 38). ... 3

3. Sidepiece without apical lobe (fig. 45). ... 4
Sidepiece with apical lobe definitely developed (fig. 40), or represented by a mass of long hairs. ... 5

4. Sidepiece with a thick brush of hairs (db) medially on ventral side (fig. 45). ... triseriatus
Sidepiece without a brush of hairs on ventral side. ... nigromaculis

5. Sidepiece with a dense brush or tuft of long posteriorly directed hairs at apex. ... aurifer
Sidepiece without a dense apical brush of long hairs, but with a well-developed apical lobe (fig. 40). ... 6

6. Apical lobe of sidepiece with a large dense patch of short spatulate hairs. ... c. canadensis
Apical lobe of sidepiece with hairs tapering evenly. ... 7

7. Basal lobe of sidepiece with 2 stout spines and many small hairs (fig. 38). ... dorsalis
Basal lobe at most with only 1 stout spine (fig. 43), sometimes with some of the hairs on basal lobe very long. ... 8

8. Basal lobe appearing detached, joined to sidepiece by only a narrow sclerotized strip (fig. 43). ... 9
Basal lobe forming a solid part of the sidepiece (fig. 41). ... 11

9. Apical lobe of sidepiece slender (fig. 39). ... duplex
Apical lobe of sidepiece broad (fig. 43). ... 10

10. Filament of claspette wide, its lower basal corner produced into a definite angle (fig. 49); claspette stems convergent apically, strongly divergent basally; setae on apical lobe of sidepiece very short, curved. ... s. spencerii
Filament of claspette narrower than that in fig. 49, its lower margin almost continuous in outline with the stem of the claspette. Claspette stems parallel or divergent apically, only slightly divergent basally; setae on distal lobe of sidepiece longer, either curved or straight. ... sticticus

11. Filament of claspette having an upper point produced backward into a sharp basal barb (fig. 50). ... triseriatus
Filament of claspette without a barb, at most with a sharp upper corner (fig. 47). ... 12

12. Basal lobe composed primarily of an area of short hairs forming the basal portion of the mesal face of the sidepiece (fig. 44). ... 13
Basal lobe represented by a distinct lobe projecting mesally from the sidepiece (fig. 40). ... 14

13. Basal lobe long and triangular (fig. 41); filament of claspette fairly short; no area of membrane present within the basal lobe. ... flavescens
Basal lobe shorter than that in fig. 41, its lower portion somewhat projecting (fig. 44); filament of claspette long and slender; an oval area of membrane present above the stout spine. ... stimulatus

14. Apical lobe of sidepiece moderately narrow and forming a somewhat angulate mesal flange (fig. 36). ... campesiis
Apical lobe of sidepiece large and ovate (fig. 40). ... 15

15. Claspette filament with a sharp angle or notch near base of the concave side (fig. 40). ... fitchii
Claspette filament without a sharp angle or notch near base of concave side (fig. 47). ... 16

16. Claspette filament with a sharp angular expansion in the form of an obtuse angle on the convex side (fig. 47); conspicuous tuft of long setae arising from base of apical lobe of sidepiece. ... implicata
Claspette filament roundedly expanded or evenly curved on the convex side (fig. 48); sidepiece apical lobe not as above. ... riparius

10In mounting genitalia of male Aedes, one of the claspettes should be removed and mounted laterally. Otherwise its shape will be impossible to determine adequately.
EGGS 11 (ADAPTED FROM ROSS AND HORSFALL, 1965)

1. Reticulation of eggshell at wide part of egg differing dorsally and ventrally; cells of ventral reticulation at wide part of egg not elongated transversely (fig. 92) .............. \textit{triseriatus}

Reticulation of eggshell at wide part of egg alike dorsally and ventrally. ......................... 2

2. In lateral profile, dorsal surface of egg conspicuously bent near midpoint (fig. 79). ................. 3

In lateral profile, egg fusiform or sausage shaped (fig. 80). .................................................... 4

3. Venter of egg bent only slightly near midpoint; shape and reticulations as shown in figs. 79 and 90; from floodplains and woodland depressions. ................. \textit{sticticus}

Venter of egg bent sharply near midpoint; shape and reticulations as shown in figs. 78 and 89; from savanna depressions. ....................................................... \textit{flavescens}

4. Color shiny bronze; reticulation of shell having appearance of longitudinal lines (fig. 94); lateral profile as shown in fig. 80. ..................................................... \textit{vexans}

Color usually black or gray ............................................. 5

5. Egg small (0.6-0.7 mm); color shiny black; shell at wide part of egg with cells of reticulation appearing as fine transverse wrinkles (fig. 87); in woodland depressions in shade of low canopy. ................. \textit{duprei}

Egg larger; color variable; shell at wide part of egg with cells of reticulation not appearing as transverse wrinkles .................................................. 6

6. Egg slender, tapered from near anterior end (fig. 77); color shiny black; reticulations in anterior area of shell as shown in fig. 85; in woodland depressions. ...................... \textit{cinereus}

Egg not as just described ........................................... 7

7. Eggshell having cells of reticulation faint except in anterior area; each cell not angular but with a lateral budlike expansion on each side (fig. 93). ..................................................... 8

Eggshell having cells of reticulation angular and without visible lateral budlike expansions. .......... 10

8. Eggshell having lateral buds situated opposite each other near center of cell, most conspicuous on anterior third of shell (fig. 94). ...................... \textit{trivittatus}

Eggshell having lateral buds not opposite each other ......................................................... .9

9. Eggshell having cells of reticulation little longer than wide ............................................. \textit{sollicitans}

Eggshell near anterior end having cells of reticulation two or more times as long as wide. ........... \textit{nigromaculis}

10. Eggshell having margins of cells of reticulation knifelike; surface of each cell smooth, or crinkled only at sides (fig. 91). ......................................................... 11

Eggshell having margins of cells of reticulation flattened; surface of each cell marked by subcells (fig. 84). ......................................................... 12

11. Eggshell having reticulations in low relief; surface of cells flat (fig. 91). .......................... \textit{stimulans}

Eggshell having reticulations in high relief (fig. 88). ............................................................... \textit{fitchii}

12. Eggshell having subcells of reticulation circular or nearly so (fig. 86). ............................. \textit{dorsalis}

Eggshell having subcells of reticulation with angular margins (fig. 84). ............................. 13

13. Eggshell dull bronze; shape and reticulations as shown in figs. 76 and 84. ...................... \textit{c. canadensis}

Eggshell dull black; shape and reticulations as shown in figs. 75 and 83. ............................. \textit{aurifer}

LARVA: 1ST INSTAR 12 (ADAPTED FROM PRICE 1960)

1. Siphon hair branched on one or both sides (fig. 127) ......................................................... 2

Siphon hair unbranched on both sides (fig. 126). ................................................................. 4

2. Lateral hair of anal segment branched (fig. 133), usually double or triple; antennal hairs 3 and 4 shortened, approximately half length of antennal hair 2 (fig. 121); antenna smooth. \textit{triseriatus}

Lateral hair of anal segment simple (fig. 126); antennal hairs 2, 3, and 4 long, of equal length (fig. 114); antenna spiculate. ......................................................... 3

3. Primary spine of distal pecten tooth followed by a gradually descending row of shorter spines, the longest being two-thirds the length of primary spine (fig. 127); head hair 4 slightly posterior to head hair 5 (fig. 115). ....................................................... \textit{cinereus}

Primary spine of distal pecten tooth followed by a group of small spines, the longest being less than one-third as long as the primary spine (fig. 135); head hair 4 slightly anterior to hair 5 (fig. 123). ..................................................... \textit{vexans}

4. Siphon of much smaller diameter than anal segment; gills very long; thorax strongly transverse ................................................................. \textit{duprei}

Siphon equal in diameter to anal segment ................................................................. 5

5. Siphon very long and slender; ratio of length to width (at point of insertion of siphon hair) 6:1 to 7:1 (fig. 129); proximal edge of secondary sclerotized ring reaching well over halfway to base of siphon (fig. 129). .................................................. \textit{fitchii}

Siphon stouter, ratio of length to width not exceeding 5:1; proximal edge of secondary sclerotized ring not reaching over halfway to base of siphon (fig. 132), often much less (fig. 130). ......................................................... 6

---

\textsuperscript{11} Eggs to be identified should be submerged in water and viewed at 75-100x in reflected white light against a dull black background.

\textsuperscript{12} Species not included: \textit{aurifer}, \textit{canestris}, \textit{implicatus}, \textit{riparius}, and \textit{spenceri}.
6. Primary sclerotized ring of siphon distinctly shorter than its apical diameter (fig. 130) ..... 7
   Primary sclerotized ring of siphon as long or longer than its apical diameter (fig. 126) ..... 10

7. Dorsal preapical hair (2) of siphon inserted near base of primary sclerotized ring (fig. 130). .............. nigromaculis
   Dorsal preapical hair (2) of siphon inserted near apex of primary sclerotized ring (fig. 128) ..... 8

8. Siphon short and stout, ratio of length to width (at insertion of siphon hair) 2:1 (fig. 128); secondary sclerotized ring covering the same or less area than primary ring (fig. 128); comb scale rounded apically (fig. 128). .................. dorsalis
   Siphon longer, ratio of length to width about 3:1; secondary sclerotized ring covering more area than primary ring (fig. 132); comb scale tapered apically into a prominent terminal spine (fig. 132) ..... 9

9. Insertions of head hairs 4, 5 and 6 on each side essentially in a straight line (fig. 120); distal pecten tooth very slender with long primary spine and several much shorter basal spines (fig. 132). .................................. sticticus
   Insertions of head hairs 4, 5 and 6 on each side not in a straight line, the lower hair being displaced well lateroanterior to a line through the other 2 hairs (fig. 122); distal pecten tooth broader with relatively short primary spine followed by gradually descending series of fragile spines (fig. 134). .................................. trivittatus

10. Hair 3 of abdominal segment VIII of essentially same length and thickness as other hairs of segment VIII. .......... flavescens stimulans
    Hair 3 of abdominal segment VIII much stouter than, and almost twice the length of, the other hairs of segment VIII (fig. 126) ................. s. canadensis

LARVA: 4TH INSTAR

1. Antenna glabrous; antennal hair (hair 1) simple; (comb scales evenly fringed with minute spicules). .......... Subgenus Finlaya .......... triseriatus
   Antenna spiculose; antennal hair usually branched ................................................. 2

2. Without detached (more widely spaced) pecten teeth, if detached pecten teeth are present, head hair 6 single and hair 5 single or rarely double. ............................................ Subgenus Ochlerotatus .......... 4
   Pecten with apical teeth detached; head hairs 5 and 6 with 2 or more branches. ............ 3

3. Head hair 5 usually in line with head hairs 6 and 7 (fig. 104). ........................................ Subgenus Aeodes ................. cinereus
   Head hair 5 distinctly posterior to a line through hairs 6 and 7 (fig. 105). .................... Subgenus Aedimorphus .......... vexans

4. One or more distal pecten teeth more widely spaced (fig. 147) ........................................ 5
   Pecten teeth evenly spaced (fig. 99) ................................................. 10

5. Antenna as long as head (fig. 103); antennal hair tuft (hair 1) inserted beyond middle (fig. 103). .......... unfithe
   Antenna shorter than head (fig. 95); antennal hair tuft inserted at middle or before (fig. 95) .......... 6

6. Comb teeth arranged in a single (fig. 143) or double (fig. 147) irregular row .................. 7
   Comb teeth arranged in a patch (fig. 146) .......... 9

7. Anal segment completely ringed by saddle (as in fig. 146) ............................................ nigromaculis
   Anal segment not ringed by saddle (fig. 142) .................. ripatus

8. Siphon 3.0-3.5 times as long as greatest width; abdomen not spiculate. .................. flavescens
   Siphon 2.0-2.5 times as long as greatest width; abdomen spiculate. s. spenceri

9. Gills budlike, can vary up to twice length of saddle if reared in fresh water (fig. 142); pecten reaching beyond middle of siphon (fig. 142) .............. campestris and dorsalis
   Gills not budlike, usually as long as, or longer than, saddle (fig. 144); pecten not reaching beyond middle of siphon. .................................. flavescens

10. Anal segment completely ringed by saddle (fig. 146) .......... 11
    Anal segment not completely ringed by saddle (as in fig. 144) .................................. 12

11. Comb scales in a single row (fig. 143); gills about 8 times as long as saddle (fig. 143) .......... dupreii
    Comb scales in a double irregular row or in a patch (fig. 146); gills not longer than 3 times length of saddle (fig. 146) .................. trivittatus

12. Median spine of some comb scales at least 2 times as long as subapical spines (fig. 144) .......... 13
    Median spine of comb scale only slightly longer than subapical spines (fig. 142) .......... 16

13. Gills about 8 times as long as saddle, with prominent darkly pigmented tracheae. .......... dupreii
    Gills distinctly shorter, not tracheated. ................................................. 14

14. Siphon about 4.5 times as long as greatest width, tapering markedly (fig. 145); apical seta (9) on ventro-lateral valve of siphon long and recurved (fig. 145) .......... fitheii
    Siphon, at most, 4 times as long as greatest width, siphon tapering less than above (fig. 144); apical seta (9) on ventro-lateral valve of siphon not particularly developed (fig. 144) .......... 15

15. Anal segment almost completely ringed by saddle; head hairs 5 and 6 usually single. ...... sticticus
16. Pecten teeth extending beyond middle of siphon (fig. 142)... ......... .campesiris
Pecten teeth never extending beyond middle of siphon. ............. 17

17. Head hair 5 with 4-9 branches; head hair 6 with 3-8 branches. .......... 16

18. Spicules at apex of saddle very fine; gills usually budlike and shorter than saddle (as in fig. 142) ..................... .dorsalis
Spicules at apex of saddle small but distinct; gills longer than saddle. .... 19

19. Head hair 5 usually double (1-2); siphon 3.5 times or more longer than greatest width. ............................ .stimulusan
Head hair 5 usually single (1-2); siphon 3.0 or fewer times as long as wide at middle. .................. implicatus

PUPA 13 (ADAPTED FROM DARSIE 1951, 1957)
(USE FIG. 161 FOR SETAL LOCATIONS.)

1. Hair 5-VII small, usually 3- to 5-branched (2-5);14 respiratory trumpet generally less than 4 times as long as its pinna (as in figs. 156-157) ............ .trivittatus
Hair 5-VII medium to long, usually single or double (1-9); trumpet generally more than 4 times as long as its pinna ................. 2

2. Hair 1-IV-VI reduced in length, not half the length of the following tergum; metanotal hair 10 usually double (1-3); the larger abdominal setae heavily pigmented, almost black .................................... .pinnatatus
Hair 1-IV-VI long, usually much longer than half the length of the following tergum; metanotal hair 10 mostly 4 or more branched (2-12); the larger abdominal setae not heavily pigmented, usually light brown. .3

3. Hair 5-IV-VI almost invariably single (5-IV occasionally double or triple); hair 9-VII single, rarely double; hair 9-VII simple. .............. .cinereus
Hair 5-IV-VI never all single; hair 9-VII usually with 2 or more branches (1-13); hair 9-VII generally double to quadrate (1-9). .......... 4

4. Hair 1-IV-V usually not less than triple (2-6); hair 6-VI generally double (1-3); hair 6-IV usually not less than triple (1-5); hair 5-II generally 4- or 5-branched (2-7) ........................................... 5

Hair 1-IV-V usually double (1-5); hair 6-VI single, sometimes double; hair 6-IV usually single or double (1-4); hair 5-II generally double or triple (1-10) ... 8

5. Lines of reticulation between float hairs on tergum 1 thin or absent; hair 1-II usually 11-branched (8-22); lines of reticulation between float hairs on tergum 1 heavy; hair 1-II usually 5- or 6-branched (4-9) ..... 6

6. Hair 5-IV usually quadrifid (3-5); metanotal hair 10 generally with 6 or more branches (5-10); hair 1-VI mostly 4-branched (3-6) ........ .aurifer
Hair 5-IV double, rarely triple; metanotal hair 10 generally with 5 or fewer branches (3-7); hair 1-VI mostly double (2-4) ............ 7

7. Metanotal hair 11 single, rarely double; hair 5-I generally double (1-4); hair 7-II usually triple. ........................................... .fitchii
Metanotal hair 11 double, rarely single; hair 5-I with 3 or more branches (3-8); hair 7-II usually double. ................................. .excrucians

8. Hair 4-III generally 5-branched (1-6); hair 4-IV double, seldom triple; hair 4-VI chiefly double (2-5); hair 9-VIII generally with 5 or fewer branches (1-8) . ....... .canadensis
Hair 4-III generally 7-branched (4-9); hair 4-IV usually 4-branched (2-6); hair 4-VI chiefly 6-branched (4-8); hair 9-VIII usually with 6 or more branches (3-11) ................. 9

9. Reticulation between float hairs on tergum 1 well developed; hair 3-VII usually double (1-3); metanotal hair 12 double or triple; hair 4-VI with 4 or fewer branches (2-4); hair 4-VIII single, seldom double; hair 9-I single. ................................................... stimulatus
Reticulation between float hairs on tergum 1 poorly developed or absent; hair 3-VII usually triple (2-4); hair 12-C usually 4- or 5-branched (3-5); hair 4-VI generally 5-branched (4-7); hair 4-VIII chiefly double (1-2); hair 9-I generally double (1-3). . stricticus

Aedes (Ochlerotatus) aurifer (Coquillett)
RECOGNITION
Adult. (fig. 15). Tarsi unbanded. Scutum with a broad median dark stripe widening posteriorly, the sides and most of the prescutellar space with pale golden scales. Occiput with a large median patch of yellowish scales; a submedian patch of black scales on either side behind the eyes and yellowish-white appressed scales laterally. First tergum dark, with a few pale scales intermixed; remaining terga dark-scaled, with small baso-lateral triangular patches of white scales. Lower mesepimeral bristles absent. Wing dark scaled. Clasper simple. Sidepiece with distinct apical and basal lobes; a prominent tuft of long hair on each sidepiece distad of the apical lobe.


13 Aedes species not included: campesiris, dorsalis, dupreei, flavescens, implicatus, nigromaculis, riparius, and s. spenceri.
14 Numbers in parentheses refer to total range of hair branches observed.
**Larva.** 1st instar. Undescribed.

**Larva.** 4th instar (fig. 103). Antenna about as long as the head; antennal hair tuft inserted beyond the middle. Head hairs 5 and 6 usually double, occasionally one or more may be triple. Lateral abdominal hair 6 multiple on I-II, usually double on III-IV, single on VI. Comb of 20-30 scales in a patch. Pecten with 1-3 of the distal teeth more widely spaced. Saddle incomplete. Anal gills about as long as saddle, pointed.

**Pupa.** Described and figured by Darsie (1951).

**DISTRIBUTION**

Manitoba to Quebec, south to Iowa and Delaware. The only Iowa record is from a single locality 2 miles north of Marquette (Clayton county) near the mouth of the Yellow River.

**BIOLOGY**

Univoltine. The larvae occur early in the spring in temporary woodland and bog pools. They do not hug the edge of the pool as much as do some of the other species, but prefer tufts of grass or vines several feet from the shore. The females bite man freely, apparently either in the evening or during the day in shaded locations.

**IMPORTANCE**

Too uncommon to be important.

*Aedes (Ochlerotatus) campestris* Dyar and Knab

**RECOGNITION**

**Adult.** Females are very similar to those of *A. dorsalis*, and the shape of the tarsal claws of the fore and middle legs appears to offer the only reliable means for separating these two species (Barr 1958, 108). Proboscis black, with pale scales intermixed on basal half to two-thirds. Femora and tibiae largely white-scaled, speckled anteriorly with dark scales; tarsi darker, banded on both ends of segments. Scutum with a broad median stripe of narrow brown scales, lateral margins brown, remainder with narrow yellowish-white scales. Abdomen largely pale scaled dorsally. Clasper simple (fig. 36). Sidepiece with distinct basal and apical lobes; apical lobe with long fine setae; basal lobe bearing many fine setae, about 3 coarser setae, and a single slightly larger seta (not distinguishable in fig. 36).

**Egg.** Undescribed.

**Larva.** 1st Instar. Undescribed.

**Larva.** 4th Instar (fig. 142). Head hair 5 double or triple (rarely 4-branched); hair 6 usually single (occasionally double). Lateral abdominal hair 6 usually double on I-VI. Comb with about 19-33 scales in a patch. Siphon index about 3.0; pecten of 19-32 teeth, distal 1-4 teeth usually more widely spaced. Saddle incomplete. Anal gills small, budlike, much shorter than the saddle. Nielsen (personal communication) reported that in the western states this species differs from *dorsalis* in having the pecten extending beyond the middle of the siphon (rarely does in *dorsalis*) and in having the distal pecten teeth either more widely spaced or conspicuously larger than the remaining pecten teeth.

**Pupa.** Undescribed.

**DISTRIBUTION**

Western semiarid plains of Canada, Alaska, United States, and Mexico. The Iowa records of *A. campestris* are from five northwestern counties.

**BIOLOGY**

Apparently univoltine. Typically a mosquito of the semiarid regions with a preference for waters on the alkaline side. They have been found in Iowa only in temporary rain pools, in animal tracks filled with water, and in low areas covered with shallow sheet water. The females bite any time but are more annoying during the evening and early morning hours than at other times. A few adults apparently survive the summer because they have been found in the fall.

**IMPORTANCE**

Considered relatively unimportant in Iowa because of its scarcity.

*Aedes (Ochlerotatus) canadensis canadensis* (Theobald)

**RECOGNITION**

**Adult.** The female is easily recognized by its reddish-brown scutum and legs with white rings on both ends of the tarsal segments. The wing scales are all dark. Abdominal segments with narrow basal white bands (occasionally lacking or incomplete) and prominent basolateral patches of white scales. Side-piece with basal and apical lobes. Claspette filament about half as long as stem, cylindrical, bent near base.

**Egg.** (figs. 76, 84). Described and figured by Horsfall and Craig (1956).

**Larva.** 1st Instar. Described and figured by Dodge (1966).

**Larva.** 4th Instar. Head hairs 5 and 6 multiple. Lateral abdominal hair 6 usually double on I-II, double or occasionally single on III-V, single on VI. Comb with about 20-36 scales in a patch, apical spine equal to lateral spines or with central one somewhat longer. Siphon index 3.0-4.0; pecten of about 13-24 evenly spaced teeth. Gills tapered, 1-2 times as long as saddle.

**Pupa.** Described and figured by Darsie (1951). According to Darsie, this species is difficult to separate from *intrudens*. In *canadensis*, however, the branches of 1-11 are long, slender, and branching almost from the base. In the other species, branches of this hair are a little stouter, not so long, and branched only in the outer three-fourths.
DISTRIBUTION

Forested areas of Canada and United States, Alaska, and Mexico. Probably widely distributed in Iowa. The other subspecies, A. c. mathesoni Middlekauff, is restricted to the extreme southeastern United States.

BIOLOGY

Univoltine. The eggs hatch over a considerable period in the spring. The larvae commonly occur in woodland pools or streambed pools in wooded areas; sometimes in spring-fed pools in more or less open country. Females commonly bite during the day in wooded areas.

IMPORTANCE

This species is not an important pest in Iowa, although it is bothersome for a short time in the spring in certain southeastern localities.

Aedes (Aedes) cinereus Meigen

RECOGNITION

Adult. Small reddish-brown mosquito with un­
banded tarsi. Scutum clothed with fine reddish-brown scales, paler scales marginally. Wing scales dark. Abdominal segments unbanded or with narrow partial or complete bands; basolateral spots usually joined to form a continuous line. Male clasper inserted well before apex of sidepiece, unequally bifurcate basally; the short inner branch bearing several small apical setae; the main branch bifurcate at apex (fig. 37). Both the males and females have the palpi shorter than the proboscis.


Larva. 1st Instar. (figs. 115, 127). Described and figured by Price (1960); also see Dodge (1966). Apparently only three Aedes of this area have the siphon hair branched, A. cinereus, A. vexans, and A. triseriatus; of these, only the first two are likely to be confused, and these can be readily separated by the characters given in the key. The siphon hair is usually double on one side and single on the other, rarely double on both sides. The pecten tooth character used in the key can only be observed by using the high power on a compound microscope.

Larva. 4th Instar. (fig. 104). Head hairs 5 and 6 multiple. Lateral abdominal hair 6 usually double (1-3) on 1 and 11, single on III-V. Comb with about 9-16 scales in a partial double row. Siphon index 4.0-4.5. Pecten with 12-21 teeth, distal 1-3 teeth more widely spaced. Anal segment not ringed by the saddle; gills long and tapering.

Pupa. Described and figured by Darsie (1951). According to Darsie, the obvious distinctive character of this species is the simple hair 9-VIII, which separates it from most other species. It is also distinctive that hair 5-IV-VI is almost invariably single (rarely double or triple on IV).

DISTRIBUTION

Northern Holarctic Region. In Iowa, A. cinereus has been taken from widely scattered localities over the eastern two-thirds of the state.

BIOLOGY

Formerly believed univoltine, but Barr (1958) reported that at least some eggs will hatch without prior exposure to cold. Adults are found either in wooded areas or in the open near woods. It is a diurnal biter in woodlands.

IMPORTANCE

Not sufficiently abundant to be important.

Aedes (Ochlerotatus) dorsalis (Meigen)

RECOGNITION

Adult. The female is not easily separated from A. campestris. This species is a medium-sized, buff mosquito. The female has pale bands on both ends of the tarsal segments (fig. 31) and the wings have both dark and light scales intermingled. Scutum covered with white scales except on a relatively narrow median stripe where they are bright brown. Legs with femora, tibiae, and first tarsal segments yellowish-white scaled, speckled with dark scales; hind tarsus with segments 1-3 ringed basally and apically with white, 4 with a basal white band, 5 almost entirely white. Abdomen usually covered with white scales, with two large quadrate patches of black ones on the dorsal surface of each segment. Clasper simple. Apical and basal lobes of the sidepieces distinctly elevated; 2 stout spines are present on the margin of the basal lobe. Claspette filament nearly as long as stem, broadly expanded medially on convex side, tapered to a recurved tip.

Egg. (fig. 86). Described by Rees and Nielsen (1947).

Larva. 1st Instar. (fig. 116, 128). Described by Bohart (1954) and Price (1960). Head hairs single, with hairs 4, 5, and 6 on a side being in straight line. Antennal hairs 2, 3, and 4 essentially of same length. Siphon hair single, inserted immediately beyond distal pecten tooth or rarely on same level with tooth, usually longer than diameter of siphon.

Larva. 4th Instar. Head hairs 5 and 6 usually single. Lateral abdominal hair 6 usually double or triple on I-IV, double on V, single on VI. Comb with 19-33 scales in a patch. Siphon index about 3.5; pecten with about 23-25 teeth on IV-VI. Occasionally one is detached on side and rarely on both. Saddle incomplete. Anal gills varying from short and budlike (if reared in brackish water) to nearly twice as long as the saddle.

Pupa. Undescribed.

DISTRIBUTION

Holarctic Region, Formosa, and Mexico. It has been taken in nearly all sections of Iowa, but is much more common in the western half.
BIOLOGY

Multivoltine. Larval habitats are mostly open brackish or alkaline floodwater pools. The adults attack viciously any time.

IMPORTANCE

A. dorsalis is an important pest in certain areas in the Missouri River valley. It has been found naturally infected with western equine encephalitis in California (Hammon, Reeves, and Galindo, 1945).

Aedes (Ochlerotatus) dupreei (Coquillett)

RECOGNITION

Adult. A. dupreei is a small dark mosquito with unbanded tarsi. It is the only Iowa species with a relatively wide median band of silvery scales on the scutum (fig. 13). Clasper simple. Sidepiece with apical and basal lobes distinct, the apical lobe nearly bare and the basal lobe with long hairs and 1 stout spine (fig. 39). Claspette filament nearly as long as the stem, gradually tapered to a point.

Egg. (fig. 87). Described and figured by Horsfall and Craig (1956).


Larva. 4th Instar (fig. 143). The larvae have distinctively long anal gills (8 times as long as the saddle or longer) that are prominently tracheated. Comb with 7-10 scales in a single row. Siphon index about 3.5-4.0; pecten of 7-12 evenly spaced teeth. Saddle complete.

Pupa. Undescribed.

DISTRIBUTION

Southeastern United States to New Jersey and west to Kansas and Texas. Mexico. This species has been taken once in Iowa at Des Moines (Rowe 1942a, 95).

BIOLOGY

The single Iowa record is from a light-trap catch. The larvae are found in temporary rain-filled pools, particularly in woodlands following summer rains (Carpenter and LaCasse 1955). They have a habit of hiding among the leaves and debris on the bottom, making them difficult to recognize and collect. Adults are often taken in light traps, but are rarely encountered in the field.

IMPORTANCE

The females are not attracted to man.

Aedes (Ochlerotatus) fitchii (Felt and Young)

RECOGNITION

Adult. Medium-sized mosquito with basal white tarsal bands (broad on hind tarsi). Scales of scutum predominantly reddish-brown, rather long and slender; intermingled in these are spots or narrow lines of white scales (fig. 16). Prescutellar space white scaled. Abdomen black with wide basal white bands, white scales sometimes forming a median line. Wing scales mostly dark with numerous white ones on costa, subcosta, and radius. Clasper simple (fig. 40). Sidepiece with distinct basal and apical lobes; apical lobe clothed with some setae; basal lobe densely clothed with setae, a stout dorsal spine near base. Claspette filament rather short, bladelike, notched on concave side near base, apex strongly narrowed and recurved.

Egg. (fig. 88). Figured by Ross and Horsfall (1965).

Larva. 1st Instar (figs. 117, 129). Head hairs single; hairs 4, 5, and 6 on each side in straight line. Antennal hair 4 shorter than hairs 2 and 3, being about two-thirds length of hair 2, with hair 3 intermediate in length. Siphon hair very long, single, inserted beyond pecten.

Larva. 4th Instar (fig. 145). Head hair 5 with 3-4 branches (occasionally double); hair 6 double or triple, occasionally single. Lateral abdominal hair 6 double or triple on I-I1; double on I11-V1. Comb of 12-28 scales in a patch. Siphon index 4.0-5.0; pecten of 15-24 evenly spaced teeth. Saddle incomplete. Anal gills about 1½-2 times as long as saddle, pointed.

Pupa. Described and figured by Darsie (1951).

DISTRIBUTION

Widely distributed in the forests of the northern United States, Canada, and Alaska. In Iowa, occurring over the northern half of the state.

BIOLOGY

Univoltine. Larval habitats are snow-melt pools.

IMPORTANCE

In the mountain valleys of the western states A. fitchii is an important pest species. In Iowa, however, it is not abundant enough to be important.

Aedes (Ochlerotatus) flavescens (Müller)

RECOGNITION

Adult. A large yellow mosquito. Legs generally yellow scaled; tarsi darker, with broad basal white bands. Scutum with narrow yellowish scales and a wide median stripe of reddish-brown ones. Abdomen covered with dull yellow scales. Male clasper simple (fig. 41). Basal and apical lobes of sidepiece distinct; basal lobe with fine hairs and a stout spine. Filament of claspsette as long as stem, expanded and strongly angulate near middle.


Larva. 4th Instar (fig. 144). Head hairs 5 and 6 usually multiple, sometimes double. Lateral abdominal hair 6 double on segments I to V1. Comb with about 20-36 scales in a patch. Siphon index about 3.2 to
4.0; pecten of about 17-28 teeth, 1-2 apical teeth may be more widely separated. Saddle incomplete. Anal gills from shorter than saddle to about twice as long.

**Pupa.** Undescribed.

**DISTRIBUTION**

Europe, Asia, the interior plains of the northern United States, Canada, and Alaska. It has been taken in Iowa at 3 localities in the north-central area and once in west-central Iowa.

**BIOLOGY**

Univoltine. Not much is known of its life history in Iowa. Larvae were found in temporary pools and marshes in the spring; the latest record was May 4. These habitats were all in the more open and flatter sections of north-central Iowa. Larvae were associated with those of *A. vexans* and *Culiseta inornata*. Adults were collected in May and June. Females were taken twice, biting in full morning sunlight.

**IMPORTANCE**

The adults are reported to be bad biters on the plains, but are not common enough in Iowa to be of practical importance. This species was found naturally infected with western equine encephalitis in Saskatchewan in 1962 (Spalatin et al. 1963).

*Aedes (Ochlerotatus) implicatus* Vockeroth

**SYNONYMY**

This species was known as *Aedes impiger* (of authors) from nearly 1920 until the naming of *A. implicatus* by Vockeroth in 1954.

**RECOGNITION**

**Adult.** A small dark mosquito with black un-banded legs. Female scutum with 2 median stripes of dark brown scales, white scales marginally. Abdomen black scaled with broad basal white bands. Wing scales dark. Male clasper simple; apical lobe of side-piece slender, thumblike, clothed with small setae; basal lobe short, conical, clothed with slender setae, and with an apical row of rather stout setae preceded by a large strong dorsal spine. Filament of claspette shorter than the stem, with a sharp toothlike projection near the base, bladelike, tapered, curved apically (fig. 47).

**Egg.** Undescribed.

**Larva. 1st Instar.** Described by Dodge (1966).

**Larva. 4th Instar.** Head hairs 5 and 6 usually single. Lateral abdominal hair 6 usually double on I-V, single on V-VI. Comb scales many in a patch. Pecten teeth evenly spaced. Saddle incomplete. Anal gills about 1½ times as long as saddle.

**Pupa.** Figured by Barr (1958).

**DISTRIBUTION**

Northern United States, Canada, and Alaska. It has been collected from 5 localities in the northern half of Iowa.

**BIOLOGY**

Little is known of the biology of this species in Iowa. Adults were taken only in May. Owen (1937) reported the latest Minnesota record as June 24. It is apparently an early spring species having a single annual brood of adults. Earliest larval records for Iowa are March 30, and the latest April 29. All collections were from temporary snow-water pools in or near wooded areas.

*Aedes (Ochlerotatus) nigromaculis* (Ludlow)

**RECOGNITION**

**Adult.** Rather large mosquito with wide basal white tarsal bands and a distinct white band mediially on the proboscis (band on proboscis sometimes reduced or absent in female). Scutum generally covered with yellowish scales marked with a wide median stripe of bronzy-brown scales; some brown scales usually present laterally. Male clasper simple. Sidepiece with basal lobe distinct, which is covered with short stout spine-like hairs. Claspette filament as long as the stem, slender, curved apically. The female of *Aedes sollicitans*, recorded from Nebraska, Missouri, and Illinois, is distinguishable from this species only with difficulty.

**Egg.** Described by Jones and Arnold (1952).

**Larva. 1st Instar (figs. 118, 130).** Head hairs single; hairs 4, 5, and 6 on each side in a straight line. Antennal hair tuft with 2-4 branches; antennal hair 4 approximately two-thirds length of hairs 2 and 3. Siphon hair single, inserted immediately beyond last pecten tooth.

**Larva. 4th Instar.** Head hairs 5 and 6 single, rarely double. Lateral abdominal hair 6 usually double or triple on I-V. Comb with 6-12 scales in uneven single row or irregular patch. Siphon index about 2.0-2.5; pecten with about 16-23 teeth, apical 2-4 teeth more widely spaced. Anal segment with saddle complete. Anal gills usually about 1½-2 times as long as saddle, bluntly pointed.

**Pupa.** Undescribed.

**DISTRIBUTION**

Southern Canada. Central and western United States. Mexico. Occurs in all sections of Iowa, but is more numerous in the western half.

**BIOLOGY**

Multivoltine. Adults have been taken from May 16 until Oct. 22. Larvae have been found from May 12 until Sept. 6. These were taken almost exclusively from temporary open rain pools or from sheet water after floods. Females bite readily in daylight but appear more active in the late afternoon than in the morning or at midday.
IMPORTANCE

A. nigromaculis is a severe pest of man and animals in some western Iowa localities. It has been experimentally demonstrated that this species can transmit the virus of western encephalitis (Madsen et al. 1936).

Aedes (Ochlerotatus) riparius Dyar and Knab

RECOGNITION

Adult. Medium-sized mosquito with broad white basal tarsal bands. Scutum with brown scales; white ones usually present laterally and on the prescutellar space, posterior half stripes present. Abdomen black with white basal bands, the segments more or less speckled with white scales. Male clasper simple (fig. 48). Both basal and apical lobes of sidepiece well developed, the former conical in shape with a stout spine and many setae. Claspette filament nearly as long as stem, roundly expanded from near base, sickle shaped.

Egg. Undescribed.

Larva. 1st Instar. Undescribed.

Larva. 4th Instar. Head hairs 5 and 6 usually double. Lateral abdominal hair 6 usually double on segments I-VI. Comb with about 7-13 scales in an irregular partly double row. Siphon index about 2.0-2.5; pecten of 13-17 teeth, 2-3 more widely separated. Anal segment not ringed by the saddle; the anal gills about 2-3 times as long as the saddle, pointed.

Pupa. Undescribed.

DISTRIBUTION

The prairie regions of the northern United States from western New York to Colorado and Montana, and from Ontario to Alberta in Canada. Europe. Iowa’s records are from central and east-central localities.

BIOLOGY

Univoltine. Nothing is known about the adults in Iowa. Dyar (1923) reported finding them emerging in Minnesota May 22, and Owen (1937) collected a specimen in Minnesota June 12. Larval records from Iowa are all for April and were taken from temporary snow-water pools in open country.

IMPORTANCE

Not abundant enough in Iowa to be important. However, Mail (1934) describes this mosquito as being bloodthirsty and, when numerous, making rural life a torture.

Aedes (Ochlerotatus) spencerii spencerii (Theobald)

RECOGNITION

Adult. Medium-sized grayish mosquito with un­banded tarsi. Scutum generally yellowish-white scaled and with a broad short reddish-brown median stripe. Abdomen black above, with basal white bands and an incomplete median stripe of white scales. Wings with black and white scales; those on the costa, R1, R4-5, and Cu nearly all black. Male clasper simple; basal and apical lobes of sidepiece distinct; apical lobe with short retrorse setae, basal lobe narrowly attached with short setae and 1 long stout spine. Filament of claspette shorter than stem, expanded from near base, tapered to a slightly recurved tip, a small but pronounced notch near base on convex side (fig. 49).

Egg. Undescribed.

Larva. 1st Instar. Undescribed.

Larva. 4th Instar. Head hairs 5 and 6 single, rarely one double. Lateral abdominal hair 6 usually triple on segment I, double on II-III, single on IV-VI. Comb with about 7-13 scales in an irregular partly double row. Siphon index 2.0-2.5; pecten of 13-17 teeth, 2-3 more widely spaced. Anal segment not ringed by the saddle; the anal gills about 2-3 times as long as the saddle, pointed.

Pupa. Undescribed.

DISTRIBUTION

The prairie regions of the northern United States and southern Canada. It has been found in 3 localities in Iowa. A. spencerii idahomensis (Theobald) occurs throughout most of Montana, Idaho, Wyoming, and Montana (Nielsen and Rees) (1959).

BIOLOGY

It is believed univoltine. Owen (1937) reported taking adults as late as Sept. 15 in Minnesota; the latest Iowa record is July 13. Bites during day and evening hours in full sunlight and in dark shaded woods. Larvae were found only in April in temporary rain pools in low pastures.

IMPORTANCE

Not abundant enough in Iowa to be important. However, Mail (1934) describes this mosquito as being bloodthirsty and, when numerous, making rural life a torture.

Aedes (Ochlerotatus) sticticus (Meigen)

RECOGNITION

Adult. Medium-sized, grayish-brown. Tarsi un­banded. Scutum with a broad golden-brown median stripe (sometimes divided by a narrow median line) and a short stripe of similar scales above wing base; otherwise, the scales are yellowish white (fig. 14). Basal white abdominal bands narrow, extending triangularly on the sides. Wing scales dark; a few light ones may be present on the costa or subcosta. Considerable size range. Male clasper simple; basal and apical lobe of sidepiece distinct, basal lobe with a dense subapical hair tuft and a large recurved dorsal spine, apical lobe broadly rounded and bearing many short flat retrorse setae (fig. 43). Claspette filament much shorter than stem, roundly expanded at basal third, blade-
like, tapered to a recurved tip, with a small notch on concave side near base.

**Egg.** (figs. 79, 90). Described and figured by Horsfall and Craig (1956).

**Larva.** 1st Instar (figs. 120, 132). Head hairs single; hairs 4, 5, and 6 essentially in straight line on each side. Antennal tuft usually double, occasionally single or triple; antennal hair 3, half to two-thirds as long as longer hairs 2 and 4. Siphon hair single, inserted close to but not within distal pecten tooth.

**Larva.** 4th Instar. Head hair 5 with 2-4 branches, hair 6 double (sometimes single or triple). Lateral abdominal hair 6 usually double on segment I-VI. Comb of eighth segment with about 18-25 scales in a patch, individual scale thornlike, with a long median spine and shorter lateral spines. Siphon index 2.5-3.0; pecten of about 15-20 evenly spaced teeth. Anal segment with saddle incomplete; gills usually 2.0-2.5 times as long as the saddle.

**Pupa.** Described and figured by Darsie (1951).

**DISTRIBUTION**
Holarctic; in North America from Atlantic to Pacific and from southern Canada to Florida and Texas. Generally distributed in woodland areas of Iowa.

**BIOLOGY**
Univoltine. A woodland species. Adults commonly encountered in the wooded areas along creeks and rivers. Daytime biters. Temporary woodland pools constitute the principal larval habitat.

**IMPORTANCE**
Vicious crepuscular biter. It will also bite during the day if disturbed from its resting places. Because of the abundance and the viciousness of this species, it is an important pest during May and June in the wooded areas along eastern Iowa rivers.

**Aedes (Ochlerotatus) stimulans** (Walker)

**RECOGNITION**
Three *Aedes* species, *A. stimulans*, *A. excrucians*, and *A. fitchii*, form a group of which the females are frequently difficult to identify. Characters of the larvae and male genitalia offer very satisfactory means of diagnosis.

**Adult.** Large brownish species. Proboscis dark, sprinkled with white scales. Scutum with yellowish-white to light-brown scales, a broad median longitudinal stripe of brown scales, or with a varying pattern of brown and paler scales. Abdominal segments with broad basal bands of white to pale-yellow scales. Hind tarsal segments each with a broad basal white ring. Male clasper simple. Basal and apical lobes of sidepiece distinct; basal lobe low, bluntly rounded, bearing small setae and a stout curved dorsal spine; apical lobe prominent, thumb-shaped, bearing a few short setae (fig. 44).

**Egg.** (fig. 92). Described and figured by Horsfall and Craig (1956).

**Larva.** 1st Instar. Head hairs single; hairs 4, 5, and 6 in straight line on each side. Antennal tuft triple; antennal hair 4 about two-thirds as long as hairs 2 and 3. Simple siphon hair inserted at ventral midline of siphon and beyond distal pecten tooth.

**Larva.** 4th Instar. Head hair 5 usually double (occasionally 1, 3, or 4-branched) and 6 single (rarely double). Lateral abdominal hair 6 double or triple on 1, usually double on 11-V, single on VI. Comb with about 25-35 scales in a patch, individual scale with the apical spine about 1½ times longer than subapical spines. Siphon index 3.0-3.5; pecten of about 18-25 evenly spaced teeth on basal third of siphon. Saddle incomplete; anal gills usually a little longer than saddle, each tapering to a blunt point.

**Pupa.** Described and figured by Darsie (1951).

**DISTRIBUTION**
Canada, Alaska, and the northern United States to as far south as Mississippi. In Iowa, it is predominately central and eastern.

**BIOLOGY**
Univoltine. A woodland species. Adults commonly encountered in the wooded areas along creeks and rivers. Daytime biters. Temporary woodland pools constitute the principal larval habitat.

**IMPORTANCE**
This is a rather important spring and early summer pest in the wooded areas of eastern Iowa. Brody (1936) showed that *A. stimulans* may harbor the virus of fowl pox for about 2 days after an infective meal and may spread the disease by intermittent feeding on healthy birds. Its relationship to the incidence of this disease in Iowa is not known.

**Aedes (Finlaya) triseriatus** (Say)

**SYSTEMATICS**
The closely related form, *A. hendersoni* Cockerell, occurs in Illinois (Hedeen 1963) and undoubtedly will be found in Iowa.

**RECOGNITION**
**Adult.** Small dark mosquito with unbanded legs and the sides of the scutum white. Proboscis black. Wing scales black. Hind femur yellowish-white on basal half to two-thirds, dark apically (fig. 29); front and middle femora black, posterior surface pale. Scutal median stripe of fine dark-brown scales, widened posteriorly to surround prescutellar space. Sides of scutum and margins of the prescutellar space with silvery scales. Male clasper is simple. Sidepiece with only the basal lobe distinct and with a tuft of long hairs near the middle of the ventro-mesal surface (fig. 45). Claspette filament longer than stern, ligulate, gradually tapered to a point.
**Egg.** (fig. 92). Figured by Horsfall and Craig (1956).

**Larva.** 1st Instar (figs. 121, 133). Head hair 4 with 2-4 branches; other head hairs single; head hairs 4, 5, and 6 on a side in straight line. Antennal hair tuft single; antennal hairs 2, 3, and 4 relatively short, with 3 and 4 being considerably shorter than 2. Comb scales 4-7, each scale tapered basally, bluntly rounded apically, with only slightest indication of fringe at tip.

**Larva.** 4th Instar. Head hair 5 single (rarely double), longer than hair 6; hair 6 with 2-4 branches. Lateral abdominal hair 6 triple or sometimes double on I and II, double on III-VI. Comb with 6-15 scales in a single or partly double row, individual scale long, gradually tapered, evenly fringed with short spines. Siphon index about 2.5-3.0; pecten of about 17-22 evenly spaced teeth. Saddle incomplete. Gills stout, bluntly rounded.

**Pupa.** Described and figured by Darsie (1951).

**DISTRIBUTION**

Southern Canada. United States south to Florida Keys and west to The Great Plains (precise western limits of this species not known). Mexico. Found in Iowa wherever wooded areas occur.

**BIOLOGY**

Multivoltine. Adults are most commonly encountered in wooded areas. The larvae develop in holes in many kinds of deciduous trees and occasionally in artificial containers, such as wooden tubs, barrels, and watering troughs. The eggs are laid upon the sides of such containers just above the water line, singly or in small groups, and hatch only when covered with water at a favorable temperature. Adults are crepuscular.

**IMPORTANCE**

*Anopheles triseriatus* is a vicious biter, but fortunately does not occur in large numbers. It is occasionally a serious pest in residential areas in or near woodlands.

**Aedes (Ochlerotatus) trivittatus** (Coquillett)

**RECOGNITION**

**Adult.** Small dark species. Proboscis and legs dark. Scutum with a pair of conspicuous submedian stripes of narrow white to yellowish-white scales separated by a median brown stripe of about equal width; sides with bronze-brown scales; anterior margin and prescutellar space with yellowish-white scales (fig. 20). First abdominal segment dorsally dark, remaining dark with basolateral patches of white scales, often with small median basal patches of white or some of the tergites. Wing dark scaled. Male clasper simple. Sidepiece with basal lobe prominent, bluntly conical, bearing numerous short setae apically and a large curved dorsal spine associated with a group of long fine setae near base; apical lobe short, rounded, bearing a few short setae. Claspette filament nearly as long as the stem, expanded bladelike at basal third and bearing a large sharp retrorse projection, occasionally one or more minute accessory retrorse spines present, tapered and curved apically (fig. 50).

**Egg.** (fig. 94). Described and figured by Horsfall and Craig (1956).

**Larva.** 1st Instar (figs. 122, 134). Head hair single, with insertion of hair 5 lying almost directly posterior to that of hair 6 and that of hair 4 lying directly medial to 6; lines through these insertions on each side virtually form right angle. Antennal tuft double; antennal hairs 3 and 4 distinctly shorter than hair 2. Siphon hair single, inserted beyond pecten.

**Larva.** 4th Instar (fig. 146). Head hairs 5 and 6 single. Lateral abdominal hair 6 usually double on I and II, single on III-V. Comb with about 17-26 scales in a patch; individual scale with median spine about one and one-third times as long as the sub-apical spines. Siphon index about 2.0-2.5; pecten of about 14-19 evenly spaced teeth. Anal segment ringed by the saddle; gills about 2.5-3.0 times length of saddle.

**Pupa.** (fig. 161). Described and figured by Darsie (1951).

**DISTRIBUTION**

Southern Canada and eastern United States, west to Idaho and New Mexico. Mexico. Occurring throughout Iowa.

**BIOLOGY**

Multivoltine. For Iowa the earliest adult records are for May 12, and the latest Sept. 25. The adults are encountered in open places as well as wooded areas, biting when disturbed in the shade and in full sunlight. However, this species is particularly active during the crepuscular periods (Wright and Knight 1966; Knight and Henderson 1967). Larvae were found from May 10 until Sept. 13, but were more common in June and July. They are found in a wide variety of temporary and semipermanent flood pools.

**IMPORTANCE**

With the exception of some of the *Psorophora*, the bite of this species is much more painful than that of any other Iowa species. Its vicious nature, general distribution, and abundance make it a very important Iowa pest. *Trivittatus* virus was first isolated from this species in 1948 in North Dakota. This virus is a member of the California group of arboviruses, but is not known to cause an illness in man. Nonetheless, antibodies to this virus have been found in man, as well as in horses. An isolation of this virus was made from a pool of *A. trivittatus* mosquitoes collected at Ames, Iowa, in 1964 (Jenney 1965).
Aedes (Aedimorphus) vexans (Meigen)

RECOGNITION

Adult. Medium-sized brownish mosquito with very narrow basal white bands on the tarsi (fig. 30). Proboscis usually dark above, below usually pale over median three-fifths. Scutum covered with narrow reddish-brown scales, lighter in color along anterior margin, over wing base, and on the prescutellar space. Abdominal segments dark-scaled, each with a conspicuous basal white band and separate basolateral white patches. Wings dark-scaled. Male clasper forked distally (fig. 46). Sidepiece with basal and apical lobes absent. Claspette stem stout, pilose; filament absent.

Egg. (figs. 80, 94). Described and figured by Horsfall and Craig (1956).

Larva. 1st Instar (figs. 123, 135). Head hairs 4 and 7 often double, with hairs 5 and 6 single; hairs 4, 5, and 6 on a side forming more or less a straight line with hair 4 sometimes situated slightly posterior to this line. Antennal tuft double or triple; hairs 2, 3, and 4 of virtually same length. Comb scales 5-6 in number; individual scale pointed at both ends with weak terminal spine and few very short lateral spines basally.

Larva. 4th Instar (figs. 105, 147). Head hair 5 with 2-7 branches, 6 with 1-4. Lateral abdominal hair 6 with 1-6 branches on I-V. Comb with about 6-16 scales in an irregular single or double row; individual scale thorn-shaped with a long apical spine and short lateral spinules on basal part. Siphon index 2.6-4.3; pecten of about 13-25 teeth, distal 1-3 more widely separated. Saddle incomplete. Anal gills about 2.0-2.5 times as long as the saddle, pointed.

Pupa. Described and figured by Darsie (1951).

DISTRIBUTION

Holarctic and Oriental Regions, Pacific Islands, Transvaal. Common throughout southern Canada and most of the United States. Abundant throughout Iowa.

BIOLOGY

Multivoltine. The eggs are deposited in a great variety of floodwater sites, principally in the open. Not all the eggs hatch at one flooding. The adults enter buildings. The adults are capable of dispersing long distances from their larval habitats.

IMPORTANCE

A. vexans is a very important Iowa mosquito. Not only is it the major pest species in the state, but it has been shown by Tenbroeck and Merrill (1935) and by Davis (1940), respectively, to be able to transmit experimentally the virus of western and eastern encephalitis. Flight and biting periodicities have been studied in Iowa for this species by Wright and Knight (1966) and Knight and Henderson (1967).

GENUS ANOPHELES

Recognition

ADULT. Palpi long in both sexes (figs. 1, 2). Scutellum rather evenly rounded posteriorly (fig. 8). Thorax and abdomen bare of scales, or largely so. Legs long and slender, uniformly covered with closely applied scales, without distinct tibial bristles, without pulvilli. Wings often with distinct markings due to presence of patches of lighter or darker scales. When in resting position, proboscis, thorax, and abdomen held in a nearly straight line.

EGG. (figs. 67, 68). The anopheline egg is boat-shaped and is equipped with dorsolateral or lateral floats. Both ends of the egg are tapered, the end corresponding to the head of the larva being somewhat broader and blunter than the other.

LARVA. (figs. 100-101). While feeding, the head can be rotated through an arc of 180° until the ventral side is uppermost. Abdomen with a series of palmate float hairs occurring in pairs on some or all the first seven abdominal segments (hair 1-III, fig. 102). Eighth abdominal segment without a dorsal respiratory siphon. A lateral chitinous plate with a posterior row of strong teeth (pecten) present posterodorsally on eighth abdominal segment.

PUPA. (figs. 162, 165, 166). Respiratory trumpets short and with a wide apical opening. Hair 9-III-VII spinner-like, placed at or near the posterolateral corners of each segment; hair 9-VIII stout and plumose. Paddles with hair 1 at tip of midrib and a smaller hair 2 on midrib anterior to tip.

Biology

In areas subjected to winter freezing, anophelines overwinter as adults in a variety of protected hibernation sites. Where prolonged freezing does not occur, some species overwinter in the egg stage. The eggs are laid singly on water surfaces. Since they hatch as soon as embryonic development is completed, development is continuous wherever temperatures permit.

Keys to the Species of Anopheles (adapted from Stojanovich 1961)

ADULT: FEMALE

1. Wing with areas of white or yellow scales ........................................ 2
   Wing entirely dark scaled .................................................. 3

2. Two pale areas on front margin of wing;
   palpus unbanded .................................................. punctipennis
   One pale area on front margin of wing;
   palpus banded .................................................. crucians

3. Wing entirely dark scaled; scutum brown, shiny, clothed with dark setae that are at least half as long as width of scutum; small species ........................................ 3
   Wing with areas of light or dark scales ........................................ 4

4. Apical wing fringe coppery .................................................. earlei
   Apical wing fringe not coppery ........................................ 5
ADULT: MALE

1. Wing with 1 or more areas of white or yellowish-white scales along anterior margin and anal vein. ...................................................... 2
   Wing without any pale patches, all scales dark except sometimes apical fringe scales. ........................................................... 3

2. Anal vein with 3 short dark bars separated by white bars; costa with a white bar only at apex of wing; palpus dark but with white bands. ............................................................................ crucians
   Anal vein with extreme base and most of apical half black and with a single white area between; costa with an apical white bar and usually also a preapical bar; palpus black, unbounded. ................................................. punctipennis

3. Tip of wing with a patch of silvery or golden fringe scales; dark wing spots very pronounced. ................................................... earlei
   Tip of wing with fringe not different from remainder; dark wing spots either pronounced or obscure. ................................................... 4

4. Palpus black but with rings of white scales at joints. .................................................. walkeri
   Palpus entirely black and without white rings. .................................................. 5

5. Phalloosome without leaflets at apex (fig. 51); wing length under 3.5 mm. .................................................. barberi
   Phallosome with a cluster of leaflets at apex (fig. 52); wing length over 3.5 mm. .................................................. quadriraculatus

LARVA: 1ST INSTAR (ADAPTED FROM DODGE 1946, 1966)

1. Head hairs 5-7 simple (rarely one is bifurcate). .................................................. barberi
   Head hairs 5-7 each with 2-9 branches (fig. 124), sometimes one or more is simple. .................................................. 2

2. Head hair 11 equally pinnate, with branches on both sides to near its base (fig. 124). .................................................. 3
   Head hair 11 unequally pinnate, with branches few or none on inner side. .................................................. 4

3. Lanceolate hairs on abdominal segments 1-7; antennal hair nearly attains apex of antenna (fig. 124). .................................................. quadriraculatus
   Lanceolate hairs on abdominal segments 2-6; antennal hair much shorter. .................................................. crucians

4. Head hair 11 with more than 12 branches, the apical ones fine and numerous. .................................................. walkeri
   Head hair 11 with less than 12 branches; lanceolate hairs on abdominal segments 2-7. .................................................. 5

5. Head hairs 5-7 simple, rarely one or more bifurcate. .................................................. earlei
   Head hairs 5-7 usually with 2-4 branches. .................................................. 6

6. Head hair 11 with 5-9 branches; head hair 7 usually unbranched. .................................................. punctipennis
   Head hair 11 with 7-11 branches; head hair 7 with 2-4 branches, rarely unbranched. .................................................. freebomi

LARVA: 4TH INSTAR

1. Abdomen with plumose lateral hairs on first 6 segments; all head hairs small and single (fig. 106); tree hole breeder. .................................................. barberi
   Abdomen with hair 6 plumose on first 3 segments (fig. 102); head hairs 5, 6 and 7 large plumose (fig. 107). .................................................. 2

2. Hairs 0 and 2 on abdominal segments IV and V both large and multiple (fig. 102). .................................................. crucians
   Fourth and fifth abdominal segments either with hair 0 inconspicuous or with hair 2 only single or double. .................................................. 3

3. Head hair 2 separated by at least width of a basal tubercle (fig. 108). .................................................. quadriraculatus
   Head hair 2 separated by less than width of a basal tubercle (fig. 109). .................................................. 4

4. Hair 2 on abdominal segment IV single; head hair 2 sometimes with sparse minute feathering toward tip (fig. 109). .................................................. earlei
   Hair 2 on abdominal segment IV with 2 or more branches (fig. 102); head hair 2 without minute feathering toward tip (fig. 107). .................................................. 5

5. At least one head hair 2 branched beyond middle; hair 2 on abdominal segment IV multiple (fig. 100). .................................................. earlei
   Head hair 2 bare (fig. 107); hair 2 on abdominal segment IV usually double. .................................................. punctipennis

PUPA (ADAPTED FROM DARSIE 1949; USE FIG. 162 FOR SETAL LOCATIONS)

1. Hair 9-VIII single or with a few coarse branches (1-5) apically; hair 9-VII fifteen or more times as long as wide; hair 9-IV-VIII long and slender; other abdominal setae reduced in size. .................................................. barberi
   Hair 9-VII with many branches (7-20) laterally as well as apically (fig. 162); hair 9-VII not more than 9 times as long as wide. .................................................. 2

2. Outer margin of paddle with stout short blunt teeth along most of its length (fig. 166); accessory paddle seta (2) usually as long as, or longer than, the terminal seta (1). .................................................. walkeri
   Outer margin of paddle with no teeth or at most minute ones (fig. 165); paddle seta 2 seldom as long as paddle seta 1 (fig. 165). .................................................. 3

3. Hair 3-V generally with 4-6 branches (3-8); hair 0-V with 2-8 branches, sometimes single; metanotal hair 11 usually with 6 or more branches (4-10); hair 9-VII generally 4-5 times as long as wide. .................................................. crucians
   Hair 3-V generally with 1-3 branches; hair 0-V single, seldom double; metanotal hair 11 usually with 3-5 branches (2-7); hair 9-VII mostly 6-7 times as long as wide. .................................................. 4
4. Hair 3-IV usually trifid (2-5); hair 4-I with 4-5 branches, seldom with 6; hair 4-V with 2-3 branches; hair 6-VII with 3-4 branches, rarely double; hair 9-VI rarely more than 5 times as long as wide.

Hair 3-IV usually with 5-6 branches (3-8); hair 4-I mostly more than 6-branched (5-11); hair 4-V usually with 4 or more branches (2-7); hair 6-VII single or double, sometimes triple; hair 9-VI rarely less than 6 times as long as wide.

5. Hair 9-I generally single, sometimes double and split in outer half only; hair 6-V single, rarely double; hair 7-I usually triple (2-5); hair 9-VII usually 7 times as long as wide. Hair 9-I usually double or triple (1-6); split almost to base; hair 6-V double or triple, seldom single; hair 7-I mostly with 5 branches (3-9); hair 9-VII usually 6 times as long as wide.

**Anopheles (Anopheles) barberi** Coquillett

**RECOGNITION**


Egg. Described by Vargas (1942).

**Larva.** 1st Instar. Distinct because of the minute head hairs and glabrous small antennae. No other species has lanceolate hairs on abdominal segments 3-6 only. Head hairs 5, 6, and 7 (especially hair 5) are posterior to the position of these hairs in other species.

**Larva.** 4th Instar (fig. 106). Head hairs 5-7 small, simple. Lateral abdominal hair 6 long, plumose on segments I-VI.

Pupa. Described by Penn (1949) and Darsie (1949). Distinctive because hair 9-VIII is single or little branched, the abdominal setae are reduced in both size and number of branches, and hairs 9-III-VII are relatively long and thin.

**DISTRIBUTION**

Eastern United States, north to New York and west through New Mexico and Arizona. Northern Mexico.

**BIOLOGY**

Relatively rare or at least a rarely observed species. The larvae are found in rot cavities of trees, in stumpholes, and occasionally in artificial containers in or near wooded areas. In the North, the winter is passed as larvae frozen in the ice in tree holes. Development is continuous during the remainder of the year. The adults are occasionally found resting underneath bridges, in culverts, and in buildings in or near wooded areas. The adults come to lights.

**IMPORTANCE**

This species will bite man and has been demonstrated to experimentally transmit *Plasmodium vivax* malaria (Stratman-Thomas and Baker 1936), but is entirely too uncommon to be important to man.

**Anopheles (Anopheles) crucians** Wiedemann

**RECOGNITION**

**Adult.** Medium sized. Female palpus with a few white scales basally on segment 3, segment 4 white-ringed basally and apically, segment 5 entirely white. Integument of scutum mottled gray, brown, and black, a pair of dark gray submedian longitudinal stripes present; clothed with numerous short yellowish hairs. Integument of abdomen dark brown to black, clothed with numerous yellow to dark-brown hairs. Wing with white to yellowish-white scales, arranged on the veins in contrasting lines and spots. Halter knob black-scaled. Male phallosome with 3-4 pairs of ligulate leaflets apically on the phallosome, the apical pair longer, one or more pairs with coarse basal teeth. Claspspete with the dorsal and ventral lobes fused to form a single conical lobe on each side.

**Egg.** Described and figured by Bellamy and Repass (1950).

**Larva.** 1st Instar. Lancilolate hairs on abdominal segments II-VI, five pairs of lanceolate hairs on thorax; head hairs 5, 6, and 7 branched; head hair 11 pinnate with branches on both sides to near base.

**Larva.** 4th Instar (fig. 102). Head hairs 5-7 large, plumose. Abdominal hairs 0-IV-V well developed (4-9 branched); hair 1 (a palamate hair) rudimentary on abdominal segments I-II, well developed and nearly equal in size on III-VII. Lateral abdominal hair 6 long, plumose on segments I-III.

**Pupa.** Described and figured by Darsie (1949).

**DISTRIBUTION**

Southern United States, north to Massachusetts and west to Kansas and New Mexico. Middle Americas and Caribbean Islands. Recorded from Page County, Iowa, by the Public Health Service’s program of malaria control in war areas, 1941-45 (Anonymous 1951).

**BIOLOGY**

The larvae are found in semipermanent and permanent aquatic habitats. They are generally associated with aquatic vegetation, either surface or emergent types, usually under partly shaded conditions, and usually in acid waters. The adults occasionally enter houses but are principally outdoor biters, attacking mostly at night. The adults are readily attracted to light traps.
Anopheles (Anopheles) earlei Vargas

SYNONYMY

Before the naming of this species in 1943, it was considered a part of the more western species, A. occidentalis Dyar and Knab.

RECOGNITION

Adult. Readily recognized by the possession of a yellowish or coppery spot in the fringe at the apex of the wing, which is otherwise dark scaled. The scales of the wing are arranged in distinct darker spots. The scales of vein Rs (radial sector) between the fork and dark spot are erected. In the closely related A. occidentalis, the scales in this area are rather closely appressed. Phallosome of male genitalia with 3-4 pairs of apical smooth ligulate leaflets, the distal ones longer. Claspette broad, consisting of a dorsal lobe bearing 2-3 spines and a large pilose ventral lobe bearing a long pointed apical spine and a short and a long slender spine subapically; the claspette lobes more or less distinct apically. Lobes of ninth tergite about 3 times as long as broad, often slightly constricted medially, rounded apically. Egg. Described by Rozeboom (1952).


Larva. 4th Instar (figs. 100-101). Head hair 3 densely dichotomously branched. Head hair 2 simple, sometimes forked beyond middle. Prothoracic hair 1 short, usually simple. Hair 0 absent or rudimentary on abdominal segments III-IV. Head hairs 5-7 large, plumose. Hair 1 (palmate hair) rudimentary on abdominal segments I and II. Hair 1 (palmate hair) on abdominal segments III-VII well developed, of about equal size, leaflets with serrations beyond middle.

Pupa. (fig. 165). Described and figured by Penn (1949) and Darsie (1949).

DISTRIBUTION

Northern United States, Canada, and Alaska. Rare in Iowa, occurring principally in the northern portion.

BIOLOGY

Overwintering by female hibernation. The females invade houses and are nocturnal feeders. The larvae are found in cold clear water in the shallow margins of semipermanent and permanent ponds overgrown with emergent and floating vegetation.

IMPORTANCE

This species occurs north of the endemic zone of malaria in North America and is not known to be a vector of this disease in nature. It feeds readily on man.

Anopheles (Anopheles) punctipennis (Say)

RECOGNITION

Adult. The adults are easily recognized by the spots of white scales on the wing veins. Two large spots of white scales are present on the costal margin, one at about two-thirds the distance to the apex and one at the apex. Spots of white scales are usually present on all veins except Rs and cubitus (Cu1, Cu2, and Cu3), which are black scaled. Phallosome of male genitalia with 3-4 pairs of apical ligulate leaflets, the more distal pairs longer; one or more pairs with a few coarse basal teeth. Claspette broad, consisting of a dorsal lobe bearing 1-2 stout acuminate spines and a ventral lobe bearing a long stout acuminate apical spine and a slender short and slender long spine subapically; the lobes are fused basally, but are more or less distinct apically. Lobes of ninth tergite about 3 times as long as broad, often slightly constricted medially, rounded apically. Egg. Descriptive notes recorded by Herms and Frost (1932) and Lawlor (1940).


Larva. 4th Instar (fig. 107). Head hair 2 simple, head hair 3 densely dichotomously branched, head hairs 5-7 large and plumose. Prothoracic hair 1 short, with several weak branches beyond base. Hair 0 obsolete on abdominal segments IV and V. Hair 1 (palmate) rudimentary on abdominal segments I-II, well developed and of about equal size on III-VII, leaflets with serrations on apical half.

Pupa. Described and figured by Penn (1949) and Darsie (1949).

DISTRIBUTION

Throughout most of the United States and southern Canada, south into the tablelands of Mexico. Common throughout Iowa.

BIOLOGY

Overwinters in hibernation as an inseminated female. It is active during the summer, with the peak of abundance in September. Although the adults are primarily crepuscular and nocturnal, females are not uncommonly found biting in the daytime. The adults do not readily enter houses. The larvae utilize almost all types of aquatic habitats. In addition to more suitable habitats, the larvae have been taken in artificial receptacles, foul ponds, and along the grassy borders of swiftly running streams. Slow, grass-bor­dered pasture streams and rocky or sandy stream bed pools seem preferred.

IMPORTANCE

This species is readily infected with malarial parasites in the laboratory, but does not appear an important natural vector of the disease.
**Anopheles (Anopheles) quadrimaculatus Say**

**RECOGNITION**

**Adult.** Females of this species can be separated from other anophelines of this area by the indistinct dark spots on the wings, the absence of white scales on the wing veins, the dark-colored fringe on the wing, and the lack of a white ring on the apex of the palpus. Ninth tergite of male genitalia with lobes about 2.3 times as long as broad, usually somewhat constricted medially, rounded at apex. Phallosome apex with 3-4 pairs of ligulate subequal leaflets, the apical pair longer; one or more pairs with a few coarse basal teeth (fig. 52). Claspette broad, consisting of a dorsal lobe bearing 1-5 stout bluntly rounded or capitate spines and a ventral lobe bearing 1-3 large pointed apical spines of unequal length; lobes fused basally but more or less distinct apically.

**Egg.** Figured by Barr (1958).

**Larva.** 1st Instar (fig. 124). This species, with *A. crucians*, is distinguished by head hair 11 having a moderately slender shaft and being branched on both sides to near the base. The branches are more or less in a vertical plane, whereas the branches in species with an "unequally pinnate" hair 11 lie nearly in a horizontal plane. It is distinct from *A. crucians* in having lanceolate hairs on abdominal segments I and VII, a longer antennal hair, and head hairs 8, 9, and 10 being usually branched.

**Larva.** 4th Instar. Head hair 2 simple, hair 3 densely branched dichotomously, hairs 5-7 large, plumose (fig. 108). Prothoracic hair 1 short, simple or weakly branched at tip. Hair 0 obsolete on abdominal segments IV-V. Hair 1 (palmate) well developed on segments III-VII, rudimentary on I-II; leaflets with serrations on apical half.

**Pupa.** Described and figured by Penn (1949) and Darsie (1949). Penn and Coleman (1949) give an analysis of the pupal chaetotaxy.

**DISTRIBUTION**

Eastern United States from the Gulf of Mexico to southern Canada and west to North Dakota, Nebraska, and Texas. Mexico. Occurs in all sections of Iowa, except that it has not yet been collected in the southwestern part of the state. It is fairly abundant in northern Iowa.

**BIOLOGY**

Overwinters in hibernation as an inseminated female. The adults may be taken throughout the year but are more abundant in August and September. They are active principally at night. The larvae are found in permanent fresh water in sluggish streams and marginally in ponds and lakes containing emergent or floating vegetation.

**IMPORTANCE**

This species is regarded as the principal malaria vector in the United States east of the Rocky Mountains.

**Anopheles (Anopheles) walkeri Theobald**

**RECOGNITION**

**Adult.** Palpus dark-scaled except for a narrow white ring at apex of each segment. Wing scales entirely dark; some of the scales forming four darker spots, more or less distinct. Halter knob usually pale scaled. Lobes of male ninth tergite slender, tapered, pointed, or rounded at tip. Phallosome with 3-5 pairs of ligulate leaflets serially arranged at apex, the antepical pair more than half as long as the apical pair; none of the leaflets with coarse basal teeth. Claspette broad; consisting of a dorsal lobe bearing 1-2 large, blunt or slightly capitate apical spines, and a ventral lobe bearing a large pointed apical spine and a long slender subapical spine.

**Egg.** Described and figured by Barr (1958).

**Larva.** 1st Instar. This species is distinctive in having extremely long basal branches on head hair 11. The chaetotaxy in all instars is minutely described by Hurlbut (1938).

**Larva.** 4th Instar (fig. 109). Head hair 2 sometimes with sparse minute feathering toward tip; hair 3 densely branched dichotomously; hairs 5-7 large, plumose. Prothoracic hair 1 usually single. Hair 0 comparatively well developed on abdominal segments IV-V, with 3-7 branches; hair 1 (palmate) rudimentary on 1-11, well developed and nearly equal in size on segments III-VII, leaflets serrated on apical half.

**Pupa.** (fig. 166). Described and figured by Penn (1949) and Darsie (1949).

**DISTRIBUTION**

Eastern United States from the Gulf of Mexico to southern Canada and west to North Dakota, Nebraska, and Texas. Mexico. Occurs in all sections of Iowa, except that it has not yet been collected in the southwestern part of the state. It is fairly abundant in northern Iowa.

**BIOLOGY**

It is probable that this species overwinters in Iowa in the egg stage. The females will penetrate houses to bite humans at night. Daytime biting has been observed. They are readily collected in light traps. The larvae occur principally in freshwater marshes containing emergent (usually cattails) and floating vegetation or debris. A comprehensive study was made of the biology of this species in Minnesota by Peters (1943).

**IMPORTANCE**

This mosquito is a potential vector of malaria because it has been shown to successfully transmit malaria in the laboratory. Bang, Quinby, and Simpson (1940) found a wild-caught female containing oocysts and a gland infection.
GENUS *CULEX*

**Recognition**

**ADULT.** Palpus of female rarely more than one-fifth as long as the proboscis. Spiracular and postspiracular bristles absent. Pleuron usually with a few small patches of scales, sometimes bare. Abdomen of female with tip bluntly rounded (when viewed dorsally), segment VIII not retracted (fig. 34). A pair of padlike pulvilli at the bases of the tarsal claws; tarsal claws of female without teeth.  

**EGG.** (figs. 69, 70). Usually long, narrowed at the upper end, without prominent markings on integument, a saucer-shaped corolla attached to the larger lower end. Laid in rafts.  

**LARVA.** Siphon usually long or very long; pecten and several pairs of siphon hairs or hair tufts present. Anal segment completely ringed by the saddle.  

**PUPA.** Respiratory trumpet usually of moderate length, opening small, tracheoid always present. Hair 1 (dendritic tuft) of abdominal segment I well developed. Paddle with smooth margin, without fringe; usually two very short apical hairs placed side by side or a subapical hair in addition to the apical hair.

**Systematics**

Three subgenera are represented in Iowa: *Culex*, *Neoculex*, and *Melanoconion*. These three subgenera are easily separated only on the basis of male genitalia; although members of the subgenus *Melanoconion* are distinct in having the wing scales of veins R₂ and R₃ slightly or distinctly broadened, and the occiput usually with broad appressed scales dorsally (sometimes limited to a narrow border behind the eyes). Concerning the larva, Bram (1964) reported that New World *Melanoconion* are distinct in having a strongly curved or hooked apical bristle dorsally on the siphon (hair 2-S) and that *Neoculex* differs in possessing a ventral brush with one or more hairs proximad of the grid on the saddle or between the saddle and the grid.  

**Biology**

In the North, the members of this genus overwinter as adults in protected spaces such as burrows, caves, building foundations, and hollow trees. The eggs are laid in rafts on the surface of water. They hatch as soon as embryonic development is completed. Consequently, development is continuous wherever temperatures permit. The adults feed on plant nectars, and the females additionally take vertebrate blood meals. Although many species commonly feed on mammals, they appear more adapted to utilizing avian blood than mammal blood.

**Key to the Species of *Culex* (adapted from Stojanovich 1961)**

**ADULT: FEMALE**

1. Proboscis and tarsi banded with white scales; scutum with white longitudinal lines. *sarsalis*

2. Dorsum of abdomen with white bands at apex of segments, or apico-lateral patches; scutal scales pale brown; slender species. *tarsalis*

When present, dorsal abdominal white bands at base of segments, or baso-lateral patches; scutal scales dark, reddish, or golden brown.  

3. Wing scales on veins R₂ and R₃ short and wide, contrasting with long slender scales on R₄ (fig. 28); eyes bordered by appressed dingy, broad scales with blue tinge; abdominal sterna with broad basal pale bands. *erraticus*

Wing scales of veins R₂ and R₃ very long and slender, similar to scales on stem of R₄ (fig. 27); eyes not bordered by appressed broad scales; abdominal sterna uniformly pale. *salinarius*

4. Abdominal segments dorsally with dingy and often inconspicuous basal bands of yellowish or bronzey scales, the bands usually irregular and narrow, sometimes entirely absent (VII and VIII often entirely covered with dingy-yellow scales); tibial knee spots usually absent; scutal scales dark brown. *salinarius*  

Abdominal segments dorsally with bright and conspicuous basal bands of white scales, the bands of the middle segments wide; tibial knee spots usually present; scutal scales reddish or golden brown. *salinarius*  

5. Scutal scales reddish brown, mostly fine, hairlike, usually with a pair of pale spots near middle (fig. 9); central upright fork scales of occiput dark and not differing from the remainder; tibial knee spots usually prominent. *rusticus*

Scutal scales golden brown, coarse, not forming a pair of pale spots laterally at middle (fig. 10); central upright fork scales of occiput pale, remainder dark; tibial knee spots usually moderate. *rusticus*  

6. Pale basal bands on abdominal segments III-IV generally broadly joined to the lateral white patches; wing cell R₂ 4-5 times length of R₂+R₃ (fig. 24). *pipiens*

Pale basal bands on abdominal segments III-IV only narrowly joined to or even disconnected from the lateral white patches; wing cell R₂ 2½-3 times as long as R₂+R₃. *quinquefasciatus*

**ADULT: MALE (ADAPTED FROM ROSS AND HORSFALL 1965)**

1. Subapical lobe of sidepiece divided into 2-3 individual long stalks (fig. 53). *erraticus*

Subapical lobe of sidepiece only slightly, if at all, subdivided (fig. 54). *sarsalis*

2. Middle phallosomal plate armed with a cluster of stout sclerotized teeth (fig. 58). *sarsalis*

3. Middle phallosomal plate without teeth. *sarsalis*
Lateral arm of inner phallosomal plate
with apical half expanded; middle
phallosomal plate with basal projection
curved back and up under teeth
(fig. 58) and without a ventral
blade paralleling inner plate. .......................... \textit{salinarius}

Lateral arm of inner phallosomal plate
narrow and bladelike, apex curved laterad
and paralleled by a ventral blade of
middle phallosomal plate; middle
phallosomal plate with basal projection
projecting only laterad (fig. 59). ......................... \textit{tarsalis}

4. Inner and middle phallosomal plates not
separate from each other, together
represented by a single structure (fig. 57). ........ \textit{restuans}

Inner phallosomal plate forming a V- or
U-shaped structure; middle phallosomal
plate well developed, each arm terminating
in a sickle-shaped process (b) (fig. 55). ............ \textit{pipiens}

5. Rods of inner phallosomal plate divergent,
together forming a V-shaped structure
(fig. 55) ................................................................. \textit{pipiens}

Rods of inner phallosomal plate convergent,
together forming a U-shaped structure
(fig. 56) ................................................................. \textit{quinquefasciatus}

ADULT: MALE (KEYED WITHOUT USE OF MALE GENITALIA) (ADAPTED FROM DODGE 1946a)

1. Penultimate segment of palpus with conspicuous
ventral spots or stripes of white scales .......... 2
Penultimate segment of palpus with spots
inconspicuous, soiled white, or absent ........ 5

2. Penultimate segment of palpus with a
ventral white stripe extending for more than
half its length ..................................................... \textit{quinquefasciatus} and \textit{pipiens}
Penultimate segment of palpus with two
ventral spots, one basal, the other beyond
its middle. ................................................................. \textit{salinarius}

3. Tarsi banded with white; thorax variegated with
bright brown and white scaling .................... \textit{tarsalis}
Tarsi unicolorous, brown; thorax unicolorous,
brown or faintly marked with white. ........... 4

4. Abdominal dorsal bands of brownish-yellow
scales; thorax with uniform dark brown
vestiture ............................................................... \textit{salinarius}
Abdominal dorsal bands of white scales;
thorax with reddish-brown scales, faint
streaks of whitish scales at base and
often with two median dots of whitish scales. .... \textit{restuans}

5. Apical two segments of palpus not
scaled below; abdomen dorsally with
a narrow band of white scales on the
apical margin of each segment or
apico-lateral patches. ................................. \textit{tarsalis}

Apical two segments of palpus with
continuous dark scaling with bronzy
luster ventrally; abdominal dorsal
white scales basal, if present. ....................... \textit{erraticus}

LARVA: 1ST INSTAR (ADAPTED FROM DODGE 1946)

1. Siphon with 2 pairs of small lateral
hairs in addition to the usual ventro-lateral
hairs; maxilla with spine situated
upon the ventral surface, large; prothoracic
hair 3 much shorter than hairs 1 and 2. .... \textit{erraticus}
Siphon without lateral hairs; maxillary
spine small, situated subapically on
the outer margin ...................................................... 2

2. Prothoracic hair 3 much shorter than
hairs 1 and 2; siphon with zone of
primary sclerotization constituting
over half its length ................................................. \textit{terrantis}
Prothoracic hair 3 nearly as long as
hairs 1 and 2; siphon with zone of
primary sclerotization making up less
than half its length (fig. 136) ......................... \textit{restuans}

3. Head hairs 5, 6 and 7 in a straight
transverse row; egg burster preceded
by an oval pale area; antennal hair
usually bifid .......................................................... \textit{restuans}
Head hairs 5, 6 and 7 not in a transverse
row; egg burster not usually preceded
by a pale area; antennal hair many-branched. .... 4

4. Terminal spines of the antennae much
shorter than the shaft; siphon index
about 3:1, with secondary zone of
sclerotization extending less than
two-thirds to base. ................................. \textit{pipiens} and \textit{quinquefasciatus}
Terminal spines approximately equal in
length to the shaft of the antenna;
siphon index about 3:1, with primary
sclerotization only on about apical two-fifths. \textit{tarsalis}
Terminal spines slightly longer than the
length of the shaft of antenna; siphon
index usually over 4:1, with primary
sclerotization about two-fifths its length
and secondary sclerotization nearly
reaching the base of the siphon. ................ \textit{salinarius}

LARVA: 4TH INSTAR (ADAPTED FROM STOJANOVICH 1961)

1. Antenna nearly uniform in shape, antennal
hair tuft inserted near middle (fig. 111); siphon with three pairs of long single
hairs and one pair of 2-3 branched hairs
beyond the pecten. ................................. \textit{restuans}
Antenna constricted beyond antennal tuft,
tuft inserted at outer third (fig. 110);
siphon with 4-5 pairs of multiple hair
tufts beyond the pecten (fig. 148) ......... \textit{restuans}

2. Head hairs 5 and 6 multiple (as in Fig. 111) .... 3
Head hair 6 single, occasionally double (fig. 110) .... 6

3. All siphonal hair tufts inserted in a
straight line (fig. 149) ................................. \textit{tarsalis}
One or more pairs of siphonal hair tufts
dorsally out of line (fig. 148) .......... \textit{erraticus}

33
4. Siphon long and slender, at least 6 times as long as wide; head hairs 5 and 6 usually with 3-4 branches (3-6). \textit{salinarius}

Siphon shorter, about 3 to 5 times as long as greatest width (fig. 148); head hairs 5 and 6 usually with 5 or more branches (4-6). \textit{Pupa} 5

5. Siphon index about 4.0-5.0; 2 basal pairs of siphonal hair tufts usually with a maximum of 3-5 branches each (fig. 148). \textit{pipiens}

Siphon index less than 4.0; 2 basal hair tufts usually with 5-10 branches each. \textit{quinquefasciatus}

6. Pecten teeth with 1-4 coarse side teeth; comb scales in a patch with 3 or more rows. \textit{tertians}

Pecten teeth fringed on one side nearly to tip; comb scales in a single irregular row. \textit{erraticus}

\textbf{Pupa}\textsuperscript{15} (Adapted from Darsie 1951; use figs. 163 and 167 for setal locations)

1. Hair 2-II with about 40 branches. \textit{erraticus}

Hair 2-II with less than 30 branches. \textit{pipiens} 2

2. Hair 2-VII mediad to hair 1-VII; accessory paddle seta (2-P) usually absent; hair 6-VI usually double (1-4); hair 1-VI generally double, rarely triple. \textit{restuans}

Hair 2-VII laterad to hair 1-VII; accessory paddle seta (2-P) rarely absent; hair 6-VI usually with 3 or more branches (2-7); hair 1-VI with 3 or more branches, very rarely double (2-7). \textit{quinquefasciatus} 3

3. Respiratory trumpet 6 or more times as long as its pinna; setal socket of segment IV usually distinctly anterior to hair 4; hair 1-VI with 3 or more branches (2-5); hair 5-I usually double or triple (1-6). \textit{restuans} 4

Respiratory trumpet rarely more than 5 times as long as its pinna; setal socket of IV on a transverse line with, or posterior to, hair 4; hair 1-VII generally with 4 or more branches (3-6); hair 5-I usually with 4 or more branches (2-9). \textit{tertians} 5

4. Hair 9-VII double, rarely triple; hair 9-VIII generally 4-branched (3-6); hair 6-VII usually with fewer than 4 branches (1-7); hair 1-III usually with more than 8 branches (8-14). \textit{tertians}

Hair 9-VII usually 4-branched (4-6); hair 9-VIII generally 7-branched (6-8); hair 6-VII usually with 5 or more branches (4-9); hair 1-III usually with 8 or fewer branches (6-9). \textit{salinarius} 6

5. Respiratory trumpet usually 4-5 times as long as its pinna; hair 5-II generally more than 4-branched (4-8); hair 6-IV double or triple (2-4); hair 1-V generally 5-branched or more (4-8); hair 5-III usually with more than 5 branches (4-9). \textit{pipiens}

\textit{Culex (Melanoconion) erraticus} (Dyar and Knab)

\textbf{RECOGNITION}

\textbf{Adult.} Small, dark brown mosquito. Most of outstanding wing scales distinctly broadened, especially those on the branches of the radial sector (fig. 28). Scutum dark brown, scales yellowish-brown to dark brown. Abdominal segments dorsally covered with dark bronzey scales; small basal spots of white scales may be present along the median line of some segments. Occiput with central triangular area of narrow yellow scales, flanked on either side by area of broad dusky to white appressed scales. Subapical lobe of male basistyle deeply divided into 2 distinct divisions (fig. 53).

\textbf{Egg.} Figured by Howard, Dyar, and Knab (1912).


\textbf{Larva.} 4th Instar (fig. 110). Head hair 5 short, weak, 4-8 branched; hair 6 long, single, barbed. Lateral abdominal hair 6 usually 2-3 branched on segments I-II, usually triple on III-VI. Comb with many scales in an irregular single or double row. Siphon index 6.0-7.0; pecten of about 11-17 teeth, on basal third of siphon. Gill varying in length from about two-thirds to 1 ½ times as long as the saddle, tapering to a blunt point.

\textbf{Pupa.} Described and figured by Foote (1954).

\textbf{DISTRIBUTION}

Eastern and central United States, Central and South America, Caribbean Islands. Generally distributed over the southern half of Iowa.

\textbf{BIOLOGY}

Overwinters as hibernating fertilized female. Larvae occur in permanent ponds containing abundant growths of floating aquatic plants, occasionally in permanent marshes and in the narrow marshy borders around lakes in or near wooded areas.

\textbf{IMPORTANCE}

The females may attack man at night, but seem to prefer bird blood. They are not troublesome to man.

\textit{Culex (Culex) pipiens Linnaeus}

\textbf{RECOGNITION}

\textbf{Adult.} The females of \textit{C. pipiens} are often very difficult to separate from those of \textit{C. quinquefasciatus} and \textit{C. restuans}, especially if the specimens are not typically marked. Most specimens, however, can be separated by the characters given in the key to females.

\textsuperscript{15} Pupa of \textit{C. tarsalis} undescribed.
Egg. Christophers (1945) gives many details on the egg raft.


Larva. 4th Instar (fig. 148). Head hairs 5 and 6 long, usually with 4-6 branches. Lateral abdominal hair 6 usually triple on I-II, double on III-VI, triple on VII. Comb with about 35-50 scales in a triangular patch. Siphon index about 4.0-4.5; pecten of about 12-13 teeth, on basal third of siphon; 4 pairs of siphon hair tufts beyond pecten, penultimate pair dorsally out of line from remainder. Gill tufts represented by 3 pairs of long single hairs irregularly placed and a pair of small subapical tufts of 2-3 branches each, inserted beyond the pecten. Gill tufts of 2-3 times as long as the saddle, pointed.


DISTRIBUTION

Holarctic Region, eastern and southern Africa, southern South America. Generally distributed in Iowa.

BIOLOGY

Overwinters in hibernation as a fertilized female. Larval habitats include rain barrels, tubs, piles of used tires, and similar artificial water collections, and intermittent or permanent water of ponds, pools, and drains where some measure of organic pollution is occurring.

IMPORTANCE

The importance of this species as a man biter has not been fully evaluated in Iowa. At least in the middle portion of the state, however, it apparently does not feed on man (Wright and Knight 1968). Rowe (1942a) reports it as an annoying pest in some of the larger cities along the Mississippi River. Ross (1947) states that, in Illinois, it is a persistent but wary biter, especially annoying at night in gardens or houses. It is a known intermediate host of heartworm of dogs (Dirofilaria immitis), western encephalitis, and St. Louis encephalitis. It also transmits the organisms of bird malaria and fowl pox (Carpenter and LaCasse 1955, 286).

Culex (Culex) quinquefasciatus Say

SYNONYMY

Commonly known outside of the United States as C. fatigans Wiedemann.

RECOGNITION

Adult. Similar to C. pipiens, but usually having the pale basal bands of the abdomen narrowly joining or entirely disconnected from the lateral patches (instead of being broadly joined to them). The male genitalia are sharply distinct in details of the inner phallosomal plate (fig. 56). Where the species overlap in distribution, however, male phallosomal plates are found that are intermediate, indicating that hybridization occurs readily.


Larva. 4th Instar. The larva is similar to that of C. pipiens, except that the siphon is rather stouter and that the basal two siphonal hair tufts usually have more branches (5-10 each). Siphon index about 3.5.

Pupa. Described and figured by Darsie (1951).

DISTRIBUTION

Occurs throughout the tropics and subtropics. It is included here on the basis of records from Clarinda (Page County) and Sioux City (Woodbury County) by Olson and Keegan (1944). No mention is made of the sex of the specimens identified as C. quinquefasciatus. Because of current knowledge of the distribution of this species, these records may be in error.

BIOLOGY

Essentially similar to that of C. pipiens. Unlike that species, however, it is a troublesome biter of man wherever it occurs.

IMPORTANCE

This species is an important vector of human filariasis in several areas of the world. It is also a vector of avian malaria and of western and St. Louis encephalitis (Chamberlain, Sudia, and Gillett 1959). It is an important pest species also.

Culex (Culex) restuans Theobald

RECOGNITION

Adult. The adults of this species are easily confused with those of C. pipiens, C. quinquefasciatus, and C. salinarius. Typical specimens may usually be recognized by the presence of the following characters: scutum reddish-brown with small reddish-brown scales and somewhat longer yellowish ones. The yellowish scales are usually along the anterior margin, along the sides, on the prescutellar space and on 2 round spots (sometimes missing) near the middle of the mesonotum. Basal white bands of abdominal segments somewhat irregular on posterior margins, usually equally as wide laterally as medially. Male phallosome distinctive (fig. 57).

Egg. Raft figured by Howard, Dyar, and Knab (1912).


Larva. 4th Instar (fig. 111). Head hairs 5 and 6 with 4-8 branches. Lateral abdominal hair 6 double on segments I-II, long and single on III-VI. Comb with many scales in a patch. Siphon index 4.0-4.5; pecten of about 12-20 teeth on basal third of siphon; siphonal tufts represented by 3 pairs of long single hairs irregularly placed and a pair of small subapical tufts of 2-3 branches each, inserted beyond the pecten. Gill tufts about 2-3 times as long as saddle, tapered.

Pupa. Described and figured by Darsie (1951).
DI STRIBUTION
Southern Canada, United States, Mexico. Distributed generally in Iowa.

BIOLOGY
Overwinters as hibernating fertilized females. The larval habitats are in part similar to those of C. pipiens. Larvae are found in streambed pools, intermittent and permanent ponds, marshes, and woodland pools.

IMPORTANCE
There is disagreement as to the importance of this species as a human biter (however, see table 4). It has been found biting man in Iowa, but does not do so commonly enough to be of importance (Wright and Knight 1968). Norris (1946) recovered a virus believed to be western encephalitis from wild-caught C. restuans in Manitoba during the summer of 1944.

Culex (Culex) salinarius Coquillett
RECOGNITION
Adult. In general appearance the females of C. salinarius resemble those of C. pipiens, C. quinquefasciatus, and C. restuans. The scutum of C. salinarius, however, is reddish and quite evenly covered with very small, uniformly sized, reddish scales. Usually only a few larger yellowish scales on the prescutellar space and above the wing break the uniformity of the mesonotal scaling. The abdominal segments may be unband ed or with narrow to moderately broad basal bands of dingy-yellow scales contiguous with basolateral patches of pale scales, seventh and eighth tergites often entirely covered with dingy-yellow scales. Phallosome of male genitalia distinctive (fig. 58).

Egg. Raft figured by Howard, Dyar, and Knab (1912).

Larva. 1st Instar (fig. 136). Described and figured by Dodge (1966).

Larva. 4th Instar. Head hair 5 usually with 3-6 branches, hair 6 usually with 4-5. Lateral abdominal hair 6 usually triple on segments I-V, double or triple on VI. Comb with many scales in a patch. Siphonal index about 4.5-5.5; pecten of about 10-15 teeth on basal third of siphon; five pairs of multiple ventro-lateral siphonal tufts present, irregularly arranged but all near ventral margin. Gills varying in length, usually 1-1½ times as long as the saddle, tapered.

Pupa. Undescribed.

DISTRIBUTION
Eastern United States and southeastern Canada, west to Colorado. Mexico. Distributed generally in Iowa.

BIOLOGY
The larvae are found in a wide variety of aquatic habitats. In Iowa the intermittent ponds produced by heavy summer rains are probably the most preferred habitat. Such ponds occur everywhere in the state and may last from 3 to 6 weeks.

IMPORTANCE
C. tarsalis is one of the most important Iowa mosquitoes because of its widespread distribution and because it is a primary vector of western and St. Louis encephalitis. The females are painful, and usually persistent, biters, attacking at dusk and after dark, and readily entering dwellings for blood meals. Both birds and mammals are commonly fed upon.

Culex (Neoculex) territans Walker
SYNONYMY
Culex apicalis (of Dyar and many subsequent authors, not of Adams).

RECOGNITION
Adult. This is a small brownish mosquito. Both males and females may be easily recognized by the apical bands of white scales on the dorsum of the abdominal segments. These bands are sometimes rep-
represented by only a few white scales dorsally and apical white spots laterally. Apex of basistyle as figured (fig. 54). Phallosome formed of a pair of stout columnar lateral plates strongly joined at base and with a narrow transverse sclerotized bridge near apical fourth; apex of each column broad and blunt, crowned with numerous small denticles.

Egg. Raft figured by Howard, Dyar, and Knab (1912).

Larva. 1st Instar (fig. 125). Described and figured by Dodge (1966).

Larva. 4th Instar. Head hair 5 single (occasionally double, rarely triple), about 1/2 to 2/3 as long as hair 6; hair 6 long, single, rarely double. Lateral abdominal hair 6 usually multiple on segments I-11, double on III-VI. Comb with numerous scales in a patch. Siphon index about 6.0-7.0; pecten of about 12-16 teeth on basal third of siphon; 4-5 pairs of siphonal hair tufts, inserted beyond the pecten, some apical tufts inserted somewhat out of line dorsally. Gills variable in length, but usually as long as or a little longer than the saddle, tapered.

Pupa. Described and figured by Darsie (1951).

DISTRIBUTION
United States, Canada, Alaska, Europe, western USSR, Turkey, northern Africa. Generally distributed in Iowa.

BIOLOGY
Most Iowa collections were from permanent or intermittent ponds and marshes, but in a few instances, the larvae were found in streambed pools and along the grassy borders of slow pasture streams. A cold-water form, the species practically disappears during hot summer weeks, but reappears during the cooler weeks of late summer and early autumn.

IMPORTANCE
The females normally feed only on cold-blooded vertebrates, particularly frogs and snakes, but Means (1965) reported a female C. territans biting man in New York.

GENUS CULISETA FELT
Synonymy
This genus has been commonly referred to in the literature under the name of Theobaldia Neveu-Lemaire.

Recognition
ADULT. Female palpus short. Spiracular bristles present; postspiraculars absent. Tip of female abdomen bluntly rounded (when viewed dorsally), segment VIII not retractile. Pulvilli absent. A tuft of setae present on under side of wing at base of subcostal (Sc) vein.

Egg. (fig. 71). In most species, the eggs are rounded at one end and somewhat pointed at the opposite end. They are usually laid on the surface of the water in boat-shaped masses, but some species deposit them singly on moist surfaces.

LARVA. (fig. 150). Siphon present; pecten various; siphonal hair tuft single and inserted near base of siphon. Saddle complete.

PUPA. Respiratory trumpets short. Dendritic tufts on abdominal segment I large; hair 1-IV-VI equal or surpassing 5-IV-VI in length; seta 1-IX present. Paddles finely serrate and with one hair, at outside tip of midrib.

Systematics
Three subgenera, Culiseta, Culicella, and Climacura, are represented in this area. They are very distinct in the larval form, but less readily defined on adult characters.

Biology
C. impatiens and C. inornata overwinter as adults, whereas C. morsitans dyari and C. melanura pass the winter as larvae.

Key to the Species of Culiseta

ADULT
1. Tarsi conspicuously banded with white scales .............................................. morsitans dyari
   Tarsi entirely dark, or with scattered pale scales ........................................... 2

2. Wing scales broad; spiracular bristles dark; abdomen usually uniformly dark; cross veins widely separated (fig. 25) ......................................... melanura
   Wing scales narrow; spiracular bristles yellow; abdomen distinctly banded; cross veins not widely separated (fig. 26) ........................................... 3

3. Wing scales entirely dark; abdominal bands straight .............................................................. impatiens
   Wing scales mixed dark and white on subcosta and costa; abdominal bands widened laterally .............................................. inornata

ADULT: MALE
1. Lobes of 9th tergite bluntly rounded, very dark and bearing many short stout spines (fig. 61); phallosome heavily sclerotized, narrow .............................................. inornata
   Lobes of 9th tergite slightly elevated, lightly sclerotized, and bearing long slender setae; phallosome lightly sclerotized, bulbous .............................................. 2

2. Sidepiece with a small apical lobe (8th tergite with a long even row of about 30-40 short stout spines on median apical margin) ............................................................. impatiens
   Sidepiece without an apical lobe ................................................................................... 3

3. Eighth tergite with a broadly rounded median apical lobe bearing a group of about 8-10 long slender setae .............................................. morsitans dyari
   Eighth tergite without such a lobe ............................................................. melanura
2. Comb with a patch of 17-24 scales from median patches of yellowish scales; prescutellar pattern; two fine yellowish lines extending posteriorly

Comb a row of 8-13 scales of nearly equal size.

LARVA. 1ST INSTAR.\textsuperscript{16} (ADAPTED FROM DODGE, 1946)

1. Siphon stout, less than three times longer than wide (fig. 137). \textit{melanura}
Siphon elongate, over four times longer than wide. \textit{inornata}

2. Comb with a patch of 17-24 scales. \textit{morsitans dyari}
Comb a row of 8-13 scales of nearly equal size. \textit{impatiens}

LARVA. 4TH INSTAR.

1. Siphon with a median row of 8-16 multiple tufts along the ventral side. \textit{melanura}
Siphon without a row of median ventral tufts (fig. 150). \textit{inornata}

2. Outer pecten teeth not hairlike. \textit{morsitans dyari}
Outer pecten teeth hairlike. \textit{impatiens}

3. Lateral hair of saddle stout, usually with 2-3 branches, as long as saddle (fig. 150). \textit{inornata}
Lateral hair of saddle fine, usually 3-4 branched, shorter than saddle. \textit{impatiens}

PUPA (ADAPTED FROM BARR 1963; USE FIG. 164 FOR SETAL LOCATIONS)

1. Accessory paddle seta (2-P) present; respiratory trumpet split almost to base, not over \(\frac{1}{2}\) times as long as its pinna; hair 2-II much longer than hair 4-II. \textit{(Climacura). melanura}
Accessory paddle seta usually absent; respiratory trumpet two or more times as long as its pinna (fig. 158); hair 2-II no longer than hair 4-II, usually much shorter. \textit{inornata}

2. Hair 9-VIII single; respiratory trumpet four or more times as long as its pinna (fig. 158); hair 9-VII usually single, occasionally double. \textit{morsitans dyari}
Hair 9-VIII with 3 or more branches; respiratory trumpet not four times as long as its pinna, usually three or less; hair 9-VII frequently with 3 or more branches. \textit{impatiens}

3. Hair 3-VI lateral of hair 1-VI; hair 1-VI usually with 4 or more branches; hair 4-III usually with 4 or more branches. \textit{impatiens}
Hair 3-VI medial of hair 1-VI; hair 1-VI usually with 3 or fewer branches; hair 4-III usually with 3 or fewer branches. \textit{inornata}

Culiseta (Culiseta) impatiens Walker

RECOGNITION

Adult. A large brown species. The female has dark legs, with the femora somewhat pale and tipped with light scales; tarsi unbandied. Scutum clothed with narrow reddish-brown and yellowish scales in a variable pattern; two fine yellowish lines extending posteriorly from median patches of yellowish scales; prescutellar space margined with yellowish scales. Scutellum with narrow scales; remaining terga bronze-brown, with basal white bands.

Eighth tergite of male terminalia with an even row of 20-50 short stout spines on median apical margin. Lobes of ninth tergite slightly elevated, separated by less than width of one lobe, each bearing several long slender setae. Apical lobe of sidepiece represented by a small prominence, bearing a few moderately long setae, one or more of which are longer and stronger.

Egg. Apparently undescribed.

Larva. 1st Instar. Not described.

Larva. 4th Instar. Head hair 5 and 6 multiple, similar in size. Lateral abdominal hair 6 usually multiple on segments I-II, double on III-VI. Siphon index 2.5-2.8; pecten of numerous teeth on basal fifth or fourth of siphon, followed by an even row of hairs extended to near apical fourth of siphon; siphon tuft large, multiple, inserted within the pecten near the base of siphon. Lateral hair of saddle usually with 3-4 branches. Gill longer than the saddle, pointed.


DISTRIBUTION

Northern United States, Canada, Alaska. It has been taken at one northwestern Iowa locality.

BIOLOGY

Little is known of the biology of this species in Iowa. The larvae occur in a variety of aquatic habitats.

IMPORTANCE

Where this species is abundant, it is an annoying biter of man.

Culiseta (Culiseta) inornata (Williston)

RECOGNITION

Adult. This is a large grayish-brown mosquito. The proboscis of the female is long and has evenly intermingled dark and white scales. Tarsi with dark scales, unbandied. Tibiae and femora with dark and light scales intermingled. Scutum with two small bare areas on the anterior margin, and a longer one each side of the prescutellar space; otherwise covered with irregularly intermixed small, narrow golden scales and larger yellowish ones. Wing with costa and vein R\textsubscript{1} sprinkled with broadened white scales. The males are much smaller and more delicate than the females. The palpus differs from those of most male culicines in lacking long hairs and in having the terminal segment broad and flattened. Lobe of ninth tergite sclerotized, bluntly rounded, bearing numerous short stout spines. Sidepiece with apical lobe absent (fig. 61).

Egg. Raft and individual eggs figured by Mitchell (1907) and Howard, Dyar, and Knab (1912).

Larva. 1st Instar (fig. 137). Described and figured by Dodge (1966).

\textsuperscript{16} 1st instar larva of Culiseta impatiens not described.
Larva. 4th Instar (fig. 150). Head hairs 5 and 6 multiple, 5 a little shorter than 6. Lateral abdominal hair 6 multiple on segments I-II, double on III-VI. Siphon index about 3.5; pecten of about 12-20 teeth on basal fourth or fifth of siphon, closely followed by an even row of long hairs extending to near apical fourth of siphon; siphonal hair large, multiple, inserted within the pecten near base of siphon. Lateral hair of saddle usually with 2-3 branches. Gills as long as or longer than the saddle, bluntly pointed.

Pupa. (fig. 164). Described and figured by Darsie (1951) and by Barr and Myers (1962). Keyed by Barr (1963).

**DISTRIBUTION**
United States, southern Canada, northern Mexico. Generally distributed in Iowa.

**BIOLOGY**
Hibernation is by fertilized females. The females leave their hibernating quarters in the early spring and are among the earliest mosquitoes on the wing. The eggs are laid as rafts on the surface of the water. The larvae live in a variety of habitats. In the spring they are commonly found in small bodies of water. In June and September, they occur more often in marshes and in semipermanent and permanent ponds. The larvae are common in spring and fall and rare during the summer. The females are seldom persistent biters, but do occasionally attack man. They more commonly feed on larger domestic mammals such as cattle (see table 4). The adults are readily attracted to artificial light and are often captured in light traps during cold weather when few other night-flying insects are active.

**IMPORTANCE**
Not an important pest. Western equine encephalitis has been isolated from wild-caught *C. inornata* in the Yakima Valley, Washington (Hammon et al. 1945).

*Culiseta (Climacura) melanura* (Coquillett)

**RECOGNITION**
**Adult.** Slender, dark species. Scutum clothed with fine dark bronze-brown scales, paler on prescutellar space. Scutellum with narrow golden-brown scales. Abdominal terga dark brown to black-scaled, with bronze to purplish reflections, and with small yellowish-white basal patches laterally (not visible from above); faint narrow yellowish-white bands sometimes present on some segments. Legs and wings dark-scaled. Male terminalia with lobes of ninth tergite slightly elevated, each bearing several long weak setae. Sidepiece without an apical lobe.

**Egg.** The egg raft was described and figured by Chamberlain, Sudia, and Nelson (1955).

**Larva. 1st Instar.** Described and figured by Dodge (1966).

Larva. 4th Instar. Head hair 5 multiple, nearly half as long as hair 6; hair 6 long, single. Lateral abdominal hair 6 multiple on segments I-II, double on III-V, usually single on VI. Comb of eighth segment of about 25 barlike scales in a single row; individual scale long, slender, pointed basally, rounded, and fringed apically with spinules. Siphon index about 6-7; pecten of numerous teeth on basal third of siphon; a small 2- or 3-branched siphonal tuft at base of siphon; a median row of about 10-16 short multiple ventral tufts beginning within the pecten and extending to outer fourth of siphon; a row of 5-6 minute 2-branched (rarely 3) dorsolateral tufts present.

Pupa. Described by Darsie, Tindall, and Barr (1962) and Barr (1963).

**DISTRIBUTION**
Eastern and central United States. Reported from Polk and Webster counties, Iowa (Anonymous 1951, table 5).

**BIOLOGY**
The larvae are found most commonly in small permanent bodies of water in woodlands and swamps. This species possibly overwinters in the larval stage beneath the ice, although this point has not been definitely settled. The female routinely feeds on avian blood.

**IMPORTANCE**
This is believed one of the principal bird-to-bird vectors of eastern encephalitis.

*Culiseta (Culicella) morsitans dyari* (Coquillett)

**RECOGNITION**
**Adult.** Proboscis dark-scaled. Scutum clothed with narrow fine golden-brown scales except for coarser narrow white scales medially, along anterior and lateral margins, on either side of posterior bare stripes, around the prescutellar space, and in front of wing bases. Scutellum with narrow white scales. First abdominal tergite dark, remaining dark with broad appressed bronze-brown scales and rather narrow basal bands of yellowish-white scales. Tarsi dark except for rather faint pale rings involving both ends of segments, more pronounced on basal segments, indistinct or absent on distal segments. Eighth tergite of male terminalia with a group of about 8-10 long slender spines on a broadly rounded lobe on median apical margin. Lobes of ninth tergite only slightly elevated, each bearing many long weak setae. Sidepiece without an apical lobe.

**Egg.** Unknown in the United States.

**Larva. 1st Instar.** Described and keyed by Dodge (1966).

**Larva. 4th Instar.** Head hair 5 usually 4- to 6-branched, shorter than hair 6; head hair 6 very long,
double. Lateral abdominal hair 6 usually multiple on segments I-II, single on III-VI. Siphon index about 6.0-7.0; pecten of a few teeth on basal fifth or fourth of siphon, distal teeth more widely separated; siphonal tuft large, usually 4- or 5-branched, inserted within the pecten near base of siphon.

**Pupa.** Described by Darsie (1951), Price (1958), and Barr (1963).

**DISTRIBUTION**
Northern North America. This species is known from two northwestern Iowa localities—4 miles west of Rush Lake, Osceola County, and 6 miles northwest of Ruthven, near Dickens in Clay County. *C. morsitans* (Theobald) is confined to Europe, Asia, and northern Africa according to Maslov (1964).

**BIOLOGY**
Larvae were collected in Iowa from cattail marshes in open country. They apparently require a cool water temperature of about 60° F. for successful development (Ross 1947, 40). The habits of the adults in this area are unknown. The life history of this species in Minnesota is discussed by Price (1961). Prior to Maslov (1964), this species was known as *C. morsitans*.

**IMPORTANCE**
This species does not normally feed on man.

**GENUS MANSONIA**

**Recognition**

**ADULT.** Palpus of female about one-fourth to a little more than one-third as long as the proboscis. Spiracular and postspiracular bristles absent. Pleura usually with small patches of scales. Pulvilli absent. Wings with the scales broad.

**EGG.** (fig. 72). Elongate, usually with a long process. In the single Iowa species, the eggs occur as rafts similar to those of *Culex*.

**LARVA.** (figs. 138, 151). Antenna long, with a large multiple tuft inserted before middle and 2 long filaments inserted before tip. Anal segment long, completely ringed by the saddle. Comb of eighth segment of a few scales in a single row. Siphon short, attenuated and modified to form a saw-like apparatus for piercing underwater stems and roots of aquatic plants; with a pair of siphonal tufts inserted near middle; pecten absent.

**PUPA.** Respiratory trumpets long, the tip of each in the form of a chitinized spine for piercing the roots of plants. Abdominal segment I without dendritic tufts. Paddles long, narrow, tip emarginate, without a terminal seta, margins with small serrations.

**Biology**
The eggs are laid in rafts on the surface of water in areas of heavy emergent vegetation. After hatching, the small larvae attach themselves with the modified siphon to the roots or submerged stems of plants where they remain throughout their development. The pupae also attach themselves to the underwater portions of aquatic plants with their modified trumpets. Just before the adult is ready to emerge, the pupae disconnect and rise to the surface. The winter is passed as larvae, and the adults emerge in the spring.

*Mansonia (Coquillettidia) perturbans* (Walker)

**RECOGNITION**

**Adult.** Proboscis dark, sprinkled with white scales basally and with a broad median ring of pale scales. Scutum clothed with dark-brown scales intermixed with pale-golden scales, the golden scales more numerous anteriorly, laterally, and on the prescutellar space. Scutellum with pale-golden scales. First abdominal tergite dark-scaled; remaining tergites dark-scaled, with white or pale-yellow baso-lateral patches and occasionally with narrow basal segmental bands of pale scales. Legs speckled with pale scales. First tarsal segment of all legs with a narrow white ring basally and broader white ring a little beyond middle; remaining tarsal segments each with basal half white, apical half dark. Wing scales broad, mixed dark and white. Male sidepiece (fig. 62) with basal lobe flat, triangular, fused to sidepiece, bearing a thick, blunt dark rod and a smaller stout spine at apex, no apical lobe. Clasper curved, enlarged at base, constricted and slender before middle, rounded and expanded on outer surface beyond middle, and then tapered to a point.

**Egg.** Figured by Mitchell (1907). The egg raft is figured by Hagmann (1952).

**Larva.** 1st Instar (fig. 138). Described and figured by Dodge (1966).

**Larva.** 4th Instar (fig. 151). Antenna more than twice as long as the head, whiplike, antennal tuft multiple, arising from a notch on basal third of shaft, a pair of short setae inserted at middle of shaft, a short spine, a seta, and a membranous papilla at tip. Siphon short, strongly attenuated and heavily sclerotized beyond middle; attenuated part of siphon bearing saw-like projections dorsally and stout hooks apically; arising before the heavily sclerotized part of the siphon are a long stout recurved dorsal spine, a single stout dorsal-lateral hair, and a multiple siphonal tuft; pecten absent.

**Pupa.** Described and figured by Darsie (1951).

**DISTRIBUTION**
United States, Canada, and Mexico. It probably occurs in all parts of Iowa where permanent cattail marshes are found.

**BIOLOGY**
The winter is spent as larvae attached to the roots of aquatic plants on the mucky bottoms of permanent
marshes. The adults emerge in late spring or early summer and are present throughout most of the summer. Blood-seeking females readily enter houses.

**IMPORTANCE**

The females are aggressive biters. They are very important pests in some parts of the country, but in Iowa, this species is of only minor importance in certain localized areas. Howitt et al. (1949) have recovered the virus of eastern encephalitis from wild-caught females in Georgia.

**GENUS ORTHOPODOMYIA THEOBALD**

**Recognition**

**ADULT.** Palpus of female about one-third as long as the proboscis. Spiracular and postspiracular bristles absent. Abdomen of female blunt-tipped, eighth segment not retractile. Fork of wing vein R₉ much longer than its petiole.

**EGG.** (fig. 73). The eggs of this genus have prominent longitudinal flanges and a coarse pattern of irregular polygons. Each egg is covered with a gelatinous brown wrinkled membrane resembling a veil.

**LARVA.** (figs. 139, 152). The body is sometimes pink or reddish. Siphon without a pecten; a single pair of siphonal tufts present, inserted a little before or near middle of siphon. Comb of eighth segment usually consisting of two rows of thornlike scales, those of the posterior row much longer. Anal segment completely ringed by the saddle in the fourth instar.

**PUPA.** Respiratory trumpets short, widening gradually from the base, opening large (fig. 159). Dendritic tufts on abdominal segment I large; hairs 9-VII-VIII multiple. Paddles with smooth margins, with a small hair at tip of midrib.

**Biology**

The larvae are found in natural container type habitats such as tree holes. The eggs are laid singly on the sides of the tree hole at the waterline. In some instances, the eggs are apparently laid directly on the water surface. The winter is passed in the egg stage, some species even surviving being frozen in the ice. The larvae develop very slowly. The adults are probably avian feeders.

**Orthopodomyia signifera** (Coquillett)

**RECOGNITION**

**Adult.** Proboscis long, dark, with numerous white scales forming narrow longitudinal lines dorsally. Scutum clothed with numerous long dark setae and small reddish-brown scales, except for three paired narrow longitudinal lines of silver-white scales. Scutellum with long narrow silver-white scales. First abdominal tergum with a median patch of broad pale scales; second tergum with the pale basal band wide and often projecting medially nearly to the apical margin of the segment; remaining terga dark bronze-brown, scaled dorsally, with more or less distinct narrow basal bands of pale scales. Hind tarsi with all segments broadly ringed with white apically and basally, segment 5 entirely white on one side. Wings with intermixed dark brown and white scales. Male side-piece (fig. 63) with 1-2 large curved spines arising from inner face near middle; basal lobe bearing a few large apical spines and numerous smaller subapical setae; no apical lobe. Apical spine of clasper short, split distally into numerous comlike teeth.

**Egg.** Described and figured by Howard, Dyar, and Knab (1917 and 1912, respectively).

**Larva.** 1st Instar (fig. 139). Described and figured by Dodge (1966).

**Larva.** 4th Instar (fig. 152). Head hairs 5 and 6 multiple. Lateral abdominal hair 6 short, multiple on segments I-II. A large sclerotized dorsal plate present on segment VIII, often also present on VI and VII. Comb of two rows of scales, the anterior row with about 17-23 short scales, the posterior row with about 6-10 long scales. Siphonal index about 3.0-3.5; pecten absent; siphonal tuft 5- to 12-branched, inserted a little beyond basal third of siphon. Saddle complete on anal segment.

**Pupa.** (fig. 159). Described by Darsie (1951).

**DISTRIBUTION**

Oregon, Utah, New Mexico, North Dakota, and Massachusetts, south to California, Tamaulipas, Cuba, and the Virgin Islands (Zavortink 1968). Reported from Muscatine, Iowa, as O. alba Baker by Rowe (1942a).

**BIOLOGY**

The larvae, which grow quite slowly, occur in water-filled rot cavities in trees of many types and occasionally in artificial, particularly wooden, containers. The adult is known to take avian blood and is occasionally taken in light traps.

**IMPORTANCE**

This species does not bite man.

**GENUS PSOROPHORA ROBINEAU-DESOVYD**

**Recognition**

**ADULT.** Generally similar to species of the genus *Aedes*. Spiracular and postspiracular bristles present. Abdomen of female tapered; eighth segment retractile; cerci long, prominent.

**EGG.** (figs. 81, 82). Similar to those of *Aedes* but with the surface finely spinose.

**LARVA.** (figs. 112, 153). Siphon moderate or short in length, usually inflated; with a single pair of siphonal hair tufts, never inserted basally, much smaller in some species. Anal segment completely ringed by the saddle, the saddle pierced on the mid-
ventral line for nearly its entire length by tufts of the ventral brush.

**PUPA.** Respiratory trumpet variable, long, tubular, slender in some species, moderately and broadly funnel-shaped in others. Paddles large, broadly rounded, with 1-2 small terminal setae. A pupal key is not available.

**Biology**

As with *Aedes*, the eggs are laid singly on the ground in depressions where water collects after rains or by overflow from streams. In general, the eggs are able to withstand long periods of drying. The eggs hatch very shortly after being flooded, provided that temperatures are suitable. The larvae develop very rapidly. Overwintering is accomplished in the egg stage.

**Keys to the Species of Psorophora**

**ADULT: FEMALE**

1. Wing with mixed dark and white scales; hind femur with a narrow ring of white scales at apex. ........................................... 2

   Wing uniformly dark or with only a few white scales on costa and subcosta; hind femur without a narrow ring of white scales at apex. ........................................... 4

2. Wing uniformly speckled with dark and white scales; first segment of hind tarsus with a definite white ring at the middle; anterior surface of tibia dark, with row of irregular pale spots. .................. *confinnis*

   Wing with definite areas of white and dark scales; first segment of hind tarsus largely white scaled; anterior surface of tibia with mixed pale and dark scales. .................. *discolor*

3. Front margin of wing with two black spots separated by an area of white scales; wing fringe with groups of dark and pale scales; anal vein (1A) apically pale; tibia with pale and dark scales evenly mixed. .................. *signipennis*

   Front margin of wing without black spots; wing fringe uniform in color; anal vein apically dark; tibia predominantly pale scaled. .................. *horrida*

4. Hind leg shaggy, with conspicuous tufts of long erect scales; large yellowish species. .................. *ciliata*

   Hind leg not markedly shaggy; medium-sized purplish species. .................. 5

5. Scutum with mixed dark and pale scales; first abdominal tergum purplish; occipital scales uniformly yellowish. .................. *ferox*

   Scutum with a broad median stripe of dark scales; first abdominal tergum pale; occiput with purplish spots. .................. *horrida*

**ADULT: MALE (ADAPTED FROM ROSS AND HORSFALL 1965)**

1. Clasper narrow and sinuate, with a mesal row of bristles (fig. 65) .................. *ciliata*

   Clasper expanded near or beyond middle, without mesal row of bristles (fig. 66). .................. 2

2. Apex of claspette with a series of simple setae or hairs and two flattened contorted leaflets at lateral corner (fig. 66). .................. 3

   Apex of claspette without contorted leaflets, at most with scales and (or) thickened hairs (fig. 64). .................. 4

3. Scutum golden scaled over its entire area. .................. *ferox*

   Scutum with mesal half black scaled, lateral portions white scaled. .................. *horrida*

4. Claspette with about 5-6 setalike filaments on crown. .................. *signipennis*

   Claspette with 5-7 long pointed apically feathered blades and a single apically feathered (finely frayed) seta (fig. 64). .................. 5

5. Apex of claspette with 6-7 blades and a single apically feathered seta (fig. 64). .................. *confinnis*

**EGG (ADAPTED FROM ROSS AND HORSFALL 1965; SIGNIPENNIS NOT INCLUDED)**

1. Dorsoventral profile of egg strongly biconvex, ratio of diameter to length less than 1:2 (fig. 81). .................. *ciliata*

   Dorsal profile of egg only strongly convex (fig. 82); ratio of diameter to length more than 1:2. .................. 2

2. Eggshell without distinct reticulations but studded with distinct elongate spots; egg elongate; in savanna depressions. .................. *discolor*

   Eggshell with distinct reticulations, especially noticeable at ends. .................. 3

3. Eggshell having margins of cells of reticulation forming sharp ridges with branches radiating onto discs of cells; egg banana-shaped; in savanna depressions. .................. *confinnis*

   Eggshell having margins of cells of reticulation not sharply ridged, the reticulations sometimes indistinct in midsection of egg; in woodland depressions. .................. 4

4. Egg having shell with reticulations pronounced on anterior one-fifth. .................. *ferox*

   Egg having shell with reticulations not pronounced on anterior one-fifth. .................. *horrida*

**LARVA. 1ST INSTAR. (ADAPTED FROM DODGE 1946)**

1. Pecten teeth 21-29 in number, minute; comb scales 7-9; antennal hair situated beyond the middle. .................. *ciliata*
Psorophora (Psorophora) ciliata (Fabricius)

RECOGNITION

**Adult.** This is the largest mosquito in Iowa, sometimes attaining a wingspread of 15 mm. The females have broad basal white bands on the tarsi. Scales of the hind tibiae and tarsi long, erect. Scutum with a median stripe of golden scales; two submedian nude polished stripes bordered on the side by narrow stripes of dark-brown scales; sides with broader white scales. Male clasper somewhat bowed inward mediadly, tapering at outer third, with short stout setae arising from inner surface; a dorsal angular projection present at outer fifth; tip curved and terminating in a short strong claw. Sidepiece without lobes (fig. 65). Claspette with stem curved, slender, expanded apically into a triangular crown; apical portion free and bearing a row of 6-7 long pointed apically feathered blades and a single apically feathered seta (fig. 64).

**Psorophora (Grabhamia) confiniss (Lynch Arribalzaga)**

**RECOGNITION**

**Adult.** A fairly large black mosquito with banded legs and a wide white band on the proboscis. Femora black and white scaled, each with a narrow ring of white scales on the outer half. Tibiae black with row of white spots on the anterior surface. Tarsal segments with basal white bands, the first with a broad band of white scales at the middle. Abdominal segments black; white scales present as a broad apical band on the second, large apical lateral spots on the succeeding segments. Male claspers broadly expanded mediaally. Sidepiece without lobes. Claspette with stem curved, slender, expanded apically into a triangular crown; apical portion free and bearing a row of 6-7 long pointed apically feathered blades and a single apically feathered seta (fig. 64).
**Egg.** Keyed and figured by Horsfall, Miles, and Sokatch (1952).

**Larva. 1st Instar.** Described and figured by Dodge (1966).

**Larva. 4th Instar.** Head hairs 5 and 6 multiple, with hair 7 inserted in a single oblique line. Lateral abdominal hair 6 multiple on segments I-II, double on III-V. Comb of 6 thorn-shaped scales. Siphon slightly inflated, about 3 times as long as basal width; pecten of 3-6 widely spaced teeth; hair tuft small, multiple, inserted at outer third of siphon.

**Pupa.** Undescribed.

**DISTRIBUTION**
South and Central America, United States, Mexico, Antilles. Taken in Boone, Polk, and Scott counties in Iowa.

**BIOLOGY**
Little is known of its biology in Iowa. Adults seem rare and have been taken in light traps only. Larvae were found once in an overflow pool from a small pasture stream.

**IMPORTANCE**
Not important in Iowa. Elsewhere, it is known as an exceedingly important pest.

**Psorophora (Janthinosoma) ferox (Humboldt)**

**RECOGNITION**
**Adult.** Proboscis dark scaled. Scutum covered by rather broad dark-brown and golden-yellow scales, intermingled and in no definite pattern, the dark scales more abundant. All abdominal tergites dark scaled with purplish reflections, except for prominent apico-lateral triangular patches of whitish-yellow to golden-yellow scales. The hind tarsus covered with erect purplish scales except on the tip of the third segment and all the fourth and fifth, which are white. Male clasper strongly inflated medially. Claspette slender, cylindrical, about three-fourths as long as basistyle, becoming abruptly broader at apical fourth, then tapering to tip, apical fourth with numerous slender feathered filaments on inner margin, a large leaf-like contorted pointed filament at apex, a similar one and a shorter straight blunt filament subapically.

**Egg.** (fig. 82). Keyed and figured by Horsfall, Miles, and Sokatch (1952).

**Larva. 1st Instar.** Described and figured by Dodge (1966).

**Larva. 4th Instar.** Head hairs 5 and 6 long, 2-branched. Lateral abdominal hair 6 multiple on segments I and II, usually triple on III, single or double on IV-VI. Comb of 6-8 scales. Siphon strongly inflated, about four times as long as basal width; pecten of 3-5 widely spaced teeth on basal fourth of siphon; hair tuft minute, multiple, inserted laterally beyond middle of siphon.

**Pupa.** Undescribed.

**DISTRIBUTION**
Southern Canada; eastern United States westward to Nebraska and Texas; Mexico; West Indies; Central and South America. In Iowa, this species has been about 3 times as long as basal width; pecten of about 4-8 long teeth on basal half of siphon, hair tuft multiple, as long as siphon. Gills three or four times as long as the anal segment, each conspicuously tracheate.
taken from 8 widely separated localities south of a line between Page, Story, and Dubuque counties.

BIOLOGY

Larvae are found in temporary rain-filled pools in thickets and woodlands and occasionally in pot holes in stream beds. The adults are usually encountered in or near thickets or forests following rainy periods during the summer.

IMPORTANCE

Where abundant, this is a serious pest species. It is a persistent and painful biter.

Psorophora (Janthinosoma) horrida (Dyar and Knab)

RECOGNITION

Adult. Proboscis dark. Scutum with broad longitudinal median stripe of dark scales, margined laterally with whitish to pale yellow scales, prescutellar space margined with broad pale scales. First abdominal tergite entirely or primarily pale scaled; remaining tergites dark purplish scaled dorsally, with apical patches of pale yellow scales laterally. Hind femur with basal half to two-thirds pale on all aspects, tibia and tarsus dark except that tarsal segments 4 and 5 and occasionally the apex of 3 white scaled; scales of segments 1 and 2 of hind tarsus and of apical portion of hind tibia somewhat shaggy in appearance. Wing scales dark. Male terminalia (fig. 66) very similar to that of P. ferox.

Egg. Described and figured by Howard, Dyar, and Knab (1912, 1917) and Horsfall, Miles, and Sokatch (1952).


Larva. 4th Instar (fig. 112). Head hairs 5 double; hair 6 triple, sometimes double. Lateral abdominal hair 6 multiple and longer on segments I-II, 3- to 4-branched on III, usually double or triple on IV-VII. Comb of 6-8 scales in a row. Siphon strongly inflated, about four times as long as basal width; pecten of about 3-5 widely spaced teeth on basal fourth of siphon; hair tuft minute; multiple, about as long as apical pecten tooth, inserted laterally at apical third of siphon.

Pupa. Undescribed.

DISTRIBUTION

Maryland west to Iowa and south. It has been taken from 10 widely scattered localities south of a line between Woodbury, Story, and Dubuque counties.

BIOLOGY

The larvae are found in temporary rain and overflow pools in wooded areas. Females attack any time during the day in shady areas.

IMPORTANCE

The females are very aggressive. Large numbers have been encountered in the woods near the mouth of the Wapsipinicon River and on Credit Island at Davenport. The bite is probably the most severe of any Iowa species, causing an intense itching that may linger for 2-3 hours.

Psorophora (Grabhamia) signipennis (Coquillett)

RECOGNITION

Adult. This is a medium-sized grayish mosquito with banded legs. Easily recognized by the alternating spots of dark and light scales and hairs along the borders of the wing. These spots begin about the middle of the costa, extend distally around the tip of the wing and backward through the fringe. The proboscis has a white wide band, and there is a narrow band of white scales on the outer half of the femur. Male clasper moderately inflated medially. Claspette with stem curved, slender, expanded apically; expanded portion attached to basal third of sidepiece and bearing about five setalike filaments on crown.

Egg. Not described.


Larva. 4th Instar. Head hairs 5 and 6 single, elongate. Comb of about 6 thorn-shaped scales. Siphon somewhat inflated medially, about 3 times as long as basal width; pecten of 4-6 progressively longer teeth on basal third of siphon; hair tuft minute, multiple, inserted at apical third of siphon.

Pupa. Undescribed.

DISTRIBUTION

Western and west central United States, south to Mexico. It has been taken frequently in Iowa along the Missouri River and as far east as Ames. It is probable that Iowa lies along the eastern distributional limits of this species.

BIOLOGY

The larvae are found in temporary and intermittent water of rain pools, flooded farm land, and roadside borrow pits, all in open country. The adults are commonly encountered in open pastures and marshy areas.

IMPORTANCE

The females are quite aggressive and will bite in full sunlight or in shaded areas; they have been caught while biting from early morning hours until midnight.

GENUS URANOTAENIA LYNCH ARRIBALZAGA

Recognition

Adult. Palpi very short in both sexes (fig. 5). Spiracular bristles few in number; postspiracular bristles
absent. Pleuron with scales usually limited to 1-2 patches or stripes. Abdomen of female blunt. Pulvilli absent. Wing squama without fringe. Fork of vein R₂₃ much shorter than its stem (fig. 23).

**EGG.** (fig. 74). Eggs elongate. Deposited in boat-shaped masses on the surface of the water.

**LARVA.** (fig. 113). Head usually longer than broad, darkly sclerotized. Head hairs 5 and 6 stout and spinelike in many species. Comb of eighth segment consisting of a single row of scales on the posterior margin of a sclerotized plate. Siphon short or of medium length, with a pecten and a single pair of siphonal tufts inserted beyond the pecten near the middle of siphon.

**PUPA.** Respiratory trumpets variable (fig. 160). Dendritic tufts large on abdominal segment I. Paddles ovate, serrate.

**Biology**

The larvae are found mostly in ground pools, swamps, and grassy margins of lakes; some occur in cavities in trees, potholes, and other small containers. The larvae are often with those of *Anopheles* and may be confused with them since they rest nearly horizontal to the water's surface.

**Uranotaenia sapphirina** (Osten Sacken)

**RECOGNITION**

**Adult.** This is a small, delicate, brownish mosquito. Easily recognized by the bright sapphire-colored scales on the occiput, prothoracic lobes, sternopleura, a median stripe on the scutum, and a stripe on the sides in front of the wings and on the basal part of vein Cu. The abdomen is dark-scaled except for an apical median patch of white scales on the third and fifth segments. Legs dark, except for a white scale patch at apices of femora and tibiae. Male clasper about three-fourths as long as sidepiece, 4 or 5 times as long as broad, apical third tapered and bearing several very short stout setae. Sidepiece short and broad, with a basal lobe, which is crowned with 2-3 long strong setae and several smaller ones. Claspete absent.

**Egg.** Described and figured by Dyar (1901).

**Larva.** 1st Instar. Described and figured by Dodge (1966).

**Larva.** 4th Instar. Head hairs 5 and 6 stout, spine-like, darkly pigmented, barbed, as long as or longer than antenna (fig. 113). Lateral abdominal hair 6 of segments I-II triple. Comb consisting of a row of 7-10 scales on the distal margin of a large transverse sclerotized plate (fig. 155). Siphon about 4-5 times as long as basal width, slightly upcurved; pecten of numerous evenly spaced teeth, not reaching middle of siphon; hair tuft multiple, inserted at or slightly beyond end of pecten.

**Pupa.** Described and figured by Darsie (1951).

**DISTRIBUTION**

Eastern United States, Mexico, West Indies, and Central America. This species occurs in all sections of Iowa; more common over the eastern two-thirds.

**BIOLOGY**

This species probably overwinters as an adult. Eggs are laid in rafts in permanent pools, ponds, and lakes containing emergent or floating vegetation. In these situations, the larvae seem more abundant in the thick surface mats of *Lemna* leaves. They are very much like anopheline larvae in peculiarities of movement when diving or coming to the surface.

**IMPORTANCE**

The females of this species rarely, if ever, bite humans.

**ACKNOWLEDGMENTS**

Grateful appreciation is extended to the Illinois Natural History Survey for permission to redraw a large number of illustrations from the comprehensive treatment on the mosquitoes of Illinois by Ross and Horsfall (1965). Sources for other figures redrawn for use here are credited in the explanations of figures.

We are grateful to Dr. J. L. Laffoon for making the Iowa State University insect collection available for this study. All the illustrations were prepared by Mrs. Judith Guenther, and we are indebted to Miss Charlotte Jones for long and painstaking assistance with the manuscript.
2. Anopheles sp. (♀)

1. Anopheles sp. (♂)

3. Toxorhynchites rutulus septentrionalis (♂)

2. Anopheles sp. (♀)

4. T. r. septentrionalis (♀)

5. Uranotaenia sapphirina (♂)

6. Culicine ♂

Figs. 1 to 6. Lateral aspect of adult head and head appendages (figs. 1 and 3-5 redrawn from Ross and Horsfall 1965; 2 from Carpenter and LaCasse 1955; and 6 from Belkin 1962).
Figs. 7 to 11. Dorsal aspect of adult mesonotum (figs. 7, 8, and 11 redrawn from Ross and Horsfall 1965; 9 and 10 from Stojanovich 1961).
Figs. 12 to 20. Dorsal aspect of adult mesoscutum (redrawn from Ross and Horsfall 1965).
Figs. 21 to 22. Lateral aspect of adult thorax (fig. 21, pleural chaetotaxy, redrawn from Carpenter and LaCasse 1955; 22, pleural scaling, redrawn from Belkin 1962).
Figs. 23 to 28. Wings and wing scaling (figs. 23, 24, 27, and 28 redrawn from Ross and Horsfall 1965; 25 and 26 from Stojanovich 1961).
Figs. 29 to 35. Anterior aspect of hind legs (figs. 29-31 redrawn from Ross and Horsfall 1965). Female tarsal claw (figs. 32 and 33 redrawn from Stojanovich 1961). Dorsal aspect of terminal female abdominal segments (figs. 34 and 35 redrawn from Stojanovich 1961).
Figs. 36 to 39. Dorsal aspect (before rotation) of left side of male genitalia (figs. 36, 38, and 39 redrawn from Ross and Horsfall 1965; 37 from Carpenter and LaCasse 1955).
Figs. 40 to 43. Left side of male genitalia, dorsal aspect (before rotation) except for 42, which illustrates dorso-mesal surface of sidepiece (redrawn from Ross and Horsfall 1965).
Figs. 44 to 50. Dorsal aspect (before rotation) of left side of male genitalia (figs. 44, 45, and 46 redrawn from Ross and Horsfall 1965). Lateral aspect of claspette (figs. 47 and 48 redrawn from Carpenter and LaCasse 1955; 49 and 50 redrawn from Ross and Horsfall 1965).
Figs. 51 to 56. Dorsal aspect (before rotation) of male genitalia, left sidepiece omitted, figs. 51 and 52. Sidepiece apices of male genitalia, figs. 53 and 54. Ventral aspect (before rotation) of male phallosomal structures, figs. 55 and 56 (all redrawn from Ross and Horsfall 1965).
Figs. 57 to 61. Ventral aspect (before rotation) of male phallosomal structures, figs. 57-60. Dorsal aspect (before rotation) of male genitalia, right sidepiece omitted, fig. 61 (all redrawn from Ross and Horsfall 1965).
Figs. 62 to 66. Dorsal aspect (before rotation) of male genitalia, right sidepiece omitted, figs. 62, 63, 65, and 66. Apex of claspette of male genitalia, fig. 64 (figs. 62, 63, and 66 redrawn from Ross and Horsfall 1965; 64 and 65 from Carpenter and LaCasse 1955).
Figs. 67 to 82. Eggs. Dorsal (fig. 67) and lateral (fig. 68) aspects (redrawn from Hurlbut 1938). Egg raft (fig. 69). Lateral aspect, ventral side is to right (figs. 75-82) (redrawn from Ross and Horsfall 1965).
Figs. 83 to 94. Reticulations of eggshell of *Aedes* (drawn from photographs by Ross and Horsfall 1965).
Figs. 95 to 99. Fourth instar larva (redrawn from Knight 1964). Dorsal aspect right side, ventral aspect left.
Figs. 100 to 105. Fourth instar larva, dorsal aspect right side, ventral left (fig. 100); lateral aspect of terminal segments (fig. 101). Right dorsal aspect of first four abdominal segments of fourth instar larva (fig. 102). Dorsal aspect of fourth instar larval head (figs. 103-105) (figs. 100-101 redrawn from Barr 1958; 102 from Ross and Roberts 1943; 103-105 from Ross and Horsfall 1965).
Figs. 106 to 111. Fourth instar larval head, dorsal aspect (redrawn from Ross and Horsfall 1965).
Figs. 112 to 117. Fourth instar larval head, dorsal aspect (figs. 112-113). First instar larval head, dorsal aspect, and enlargement of apex of antenna (figs. 114-117) (fig. 112 redrawn from Carpenter and LaCasse 1955; 113-117 from Price 1960).
Figs. 118 to 125. First instar larval head, dorsal aspect, and enlargement of apex of antenna (figs. 118, 120-123 redrawn from Price 1960; 119 from Knight 1964; 124 and 125 from Dodge 1945).
Figs. 126 to 131. A. Lateral aspect of terminal abdominal segments of 1st instar larva. B. Pecten tooth. C. Comb scale (figs. 126-130 redrawn from Price 1960; 131 redrawn from Knight 1964).
Figs. 132 to 137. A. Lateral aspect of terminal abdominal segments of 1st instar larva. B. Pecten tooth.
C. Comb scale (figs. 132-135 redrawn from Price 1960; 136 and 137 redrawn from Dodge 1945).
Figs. 138 to 142. A. Lateral aspect of terminal abdominal segments of larva (figs. 138-141 of 1st instar; 142 of 4th instar). B. Comb scale (figs. 138-141 redrawn from Dodge 1945; 142 redrawn from Barr 1958).
Figs. 143 to 145. A. Lateral aspect of terminal abdominal segments of 4th instar larva. B. Comb scale (figs. 143 redrawn from Ross and Horsfall 1965; 144-145 redrawn from Barr 1958).
Figs. 146 to 149. A. Lateral aspect of terminal abdominal segments of 4th instar larva. B. Comb scale. C. Pecten tooth (redrawn from Ross and Horsfall 1965).
Figs. 150 to 155. A. Lateral aspect of terminal abdominal segments of 4th instar larva (fig. 151 shows only the siphon). B. Comb scale. C. Pecten tooth (fig. 150 redrawn from Carpenter and LaCasse 1955; 151-155 redrawn from Ross and Horsfall 1965).
Figs. 156 to 160. Outer surface of cephalothoracic exuvia of pupa (fig. 156 redrawn from Belkin 1962). Pupal trumpets (fig. 157 redrawn from Belkin 1962; figs. 158-160 redrawn from Darsie 1951).
Figs. 161 to 164. Dorsal aspect of pupal abdomen (figs. 161 and 163 redrawn from Darsie 1951; 162 redrawn from Darsie 1949; and 164 redrawn from Barr and Myers 1962).
Figs. 165 to 167. Dorsal aspect of right paddle (figs. 165-166 redrawn from Darsie 1949; 167 redrawn from Darsie 1951).


### APPENDIX. IOWA DISTRIBUTION OF CULICIDAE BY COUNTY

**Aedes**

- *aurifer*, Clayton.
- *campestris*, Jackson, Monona, Osceola, Palo Alto, Plymouth.
- *dorsalis*, Allamakee, Boone, Buena Vista, Calhoun, Clarke, Dickenson, Dubuque, Harrison, Jackson, Lyon, Monona, Muscatine, Palo Alto, Polk, Pottawattamie, Scott, Story, Winnebago, Woodbury.
- *dupreei*, Polk.
- *fitchii*, Black Hawk, Boone, Clay, Clinton, Jackson, O’Brien, Polk, Story, Winnebago.
- *flavescens*, Monona, Story, Winnebago, Wright.
- *implicatus*, Boone, Buena Vista, Linn, Pocahontas.
- *riparius*, Clinton, Grundy, Hamilton.
- *spencerii*, Dickenson, Guthrie, Jackson, Monona, Scott, Story.
- *stimulans*, Allamakee, Boone, Cedar, Clayton, Clinton, Fremont, Jackson, Jones, Linn, Louisa, Polk, Pottawattamie, Sac, Scott, Shelby, Sioux, Story, Webster.
- *triseriatus*, Boone, Clay, Clinton, Des Moines, Dickenson, Emmet, Fayette, Floyd, Franklin, Hamilton, Hancock, Hardin, Iowa, Jackson, Muscatine, Page, Palo Alto, Polk, Scott, Story, Woodbury.

**Anopheles**

- *barberi*, Boone, Mahaska, Page, Story.
- *crucians*, Page.

**Culex**

- *pipiens*, Allamakee, Black Hawk, Boone, Butler, Cass, Clay, Clayton, Crawford, Davis, Delaware, Des Moines, Dubuque, Greene, Guthrie, Iowa, Jackson, Johnson, Keokuk, Lee, Louisa,
Lyon, Marion, Monona, Muscatine, Page, Palo Alto, Polk, Pottawattamie, Sac, Scott, Story, Wapello, Washington, Woodbury, Worth.

*quinquemaculatus*, Page, Woodbury.


*salinarus*, Allamakee, Black Hawk, Boone, Bremer, Buena Vista, Butler, Calhoun, Carroll, Cerro Gordo, Clarke, Clay, Clayton, Clinton, Crawford, Davis, Delaware, Des Moines, Dickinson, Dubuque, Fremont, Greene, Hancock, Hardin, Henry, Jackson, Johnson, Jones, Keokuk, Kossuth, Lee, Louisa, Mahaska, Marion, Monona, Muscatine, Osceola, Page, Palo Alto, Plymouth, Polk, Pottawattamie, Poweshiek, Sac, Scott, Shelby, Story, Wapello, Warren, Woodbury, Wright.


*Culiceta*

*impatiens*, Palo Alto.


*melanura*, Polk, Webster.

*morsitans dyari*, Clay, Osceola.

*Mansonia*

*perturbans*, Clinton, Des Moines, Dickinson, Dubuque, Emmet, Jackson, Muscatine, Palo Alto, Scott, Story.

*Orthopodomyia*

*signifera*, Boone, Muscatine, Story.

*Psorophora*


*confinis*, Boone, Monona, Polk, Scott, Story.

*discolor*, Guthrie, Page, Pottawattamie, Story.

*ferox*, Clinton, Dubuque, Kossuth, Louisa, Page, Polk, Scott, Story, Wapello.


*Uranotaenia*