

AN ANNOTATED LIST OF MOSQUITOES REPORTED FROM MICHIGAN¹

JOHN R. CASSANI² AND H. D. NEWSON³

ABSTRACT. The known distribution of mosquito species in Michigan is reported, by county, as is the recorded seasonal occurrence of their immature and adult stages. This is a compilation of information generated over a period of approximately 76 years and includes

data from all known publications and the unpublished reports, theses and records of a number of investigators. Five species represent previously unpublished records for the state.

INTRODUCTION

The species composition and distribution of mosquitoes in Michigan is incompletely known and the information that is now available is scattered in numerous publications and unpublished reports, theses, and data records of a number of investigators. This publication is an effort to consolidate this information, generated over a period of approximately 76 years, into one comprehensive reference source. In most cases the specimens involved are not available for examination so it has not been possible to verify what appear to be misidentifications. These questionable reports, however, are noted in the text. The species names used and the arrangement of subgenera follow those of Knight and Stone (1977) except in two cases where more recent changes in nomenclature have been used (Wood 1977). When original reports used species names not now accepted the synonyms then used are given under the currently used species names, e.g., *Anopheles maculipennis* Meigen and *An. occidentalis* Dyar and Knab reported by several early workers in Michigan here is reported as the eastern form of the *maculipennis* complex now known as *An. earlei* Vargas. Following the larvae and adult captions for each listed species are the counties from

which these species have been collected. The location of each county in the state is shown in Fig. 1. The numbers listed in the references section for each species refer to the literature citations that pertain to that species. The numbers in parentheses following the species synonyms, also refer to reference citations. Species not previously reported from Michigan are so noted in the text.

Aedes (Aedes)

cinereus (Meigen)

LARVAE: Cheboygan, Clare, Gogebic, Ingham, Iosco, Keweenaw (Isle Royale), Keweenaw, Lake, Midland, Missaukee,

ADULTS: Alcona, Allegan, Antrim, Arenac, Baraga, Barry, Bay, Branch, Calhoun, Clare, Charlevoix, Cheboygan, Chippewa, Crawford, Delta, Emmet, Genesee, Gladwin, Gogebic, Grand Traverse, Huron, Ingham, Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Keweenaw, Keewenaw (Isle Royale), Lake Livingston, Mackinac, Macomb, Manistee, Mason, Midland, Missaukee, Montcalm, Montmorency, Muskegon, Oakland, Oceana, Ontonagon, Osceola, Otsego, Presque Isle, Roscommon, Saginaw, Sanilac, Shiawassee, St. Clair, St. Joseph, Tuscola, Washtenaw, Wayne, Wexford.

STAGE NOT STATED: Cass.

SEASONAL RECORD: Larvae—IV—15 to IX—4; Adults V—9 to VIII—29.

REFERENCES:⁴ 3, 6, 13—15, 17, 22, 24, 25, 27—29, 37, 38, 42.

¹ Michigan Agricultural Experiment Station Journal Article No. 9198.

² Lee County Hyacinth Control District, P.O. Box 06005, Fort Myers, FL 33906.

³ Departments of Entomology; Microbiology and Public Health, Michigan State University, East Lansing, MI 48824.

⁴ Editor's Note: Because of the nature of this article the usual *Mosquito News* format for citations has not been followed.

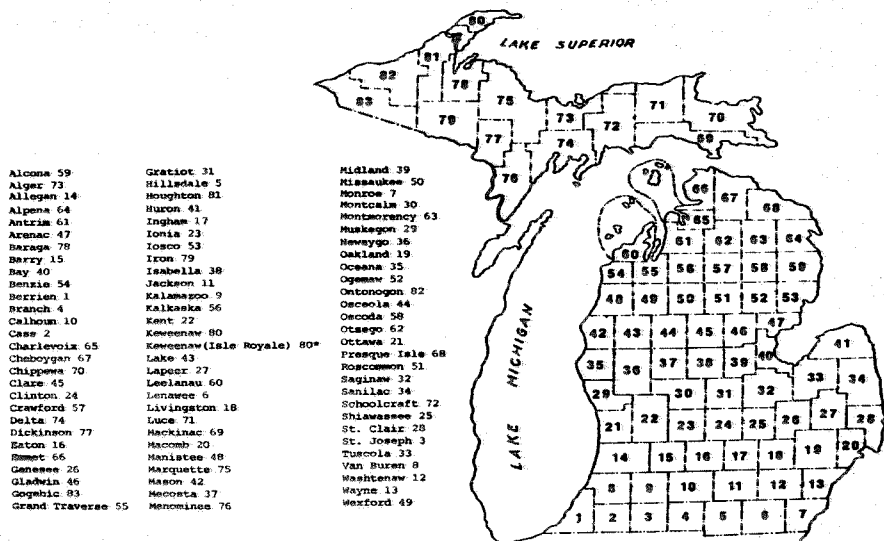


Fig. 1. Location of Michigan Counties.

Aedes (Aedimorphus)

vexans (Meigen)

LARVAE: Alger, Allegan, Alpena, Baraga, Bay, Calhoun, Cass, Cheboygan, Clare, Crawford, Dickinson, Genesee, Gogebic, Houghton, Huron, Ingham, Ionia, Iosco, Jackson, Kalamazoo, Keweenaw, Keweenaw (Isle Royale), Lake, Lenawee, Macomb, Manistee, Marquette, Mason, Menominee, Midland, Missaukee, Muskegon, Oakland, Roscommon, Saginaw, Schoolcraft, Shiawassee, St. Clair, Tuscola, Van Buren, Washtenaw, Wayne, Wexford.

ADULTS: Alger, Allegan, Alpena, Arenac, Baraga, Barry, Bay, Berrien, Branch, Calhoun, Cass, Charlevoix, Cheboygan, Chippewa, Clare, Clinton, Crawford, Dickinson, Eaton, Emmet, Genesee, Gladwin, Gogebic, Grand Traverse, Gratiot, Hillsdale, Huron, Ingham, Ionia, Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Keweenaw, Lake, Lapeer, Lenawee, Livingston, Mac-

kinac, Macomb, Manistee, Mason, Midland, Missaukee, Monroe, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Oceana, Ogemaw, Ontonogon, Osceola, Ottawa, Roscommon, Saginaw, Sanilac, Shiawassee, St. Clair, St. Joseph, Tuscola, Van Buren, Washtenaw, Wayne, Wexford.

SEASONAL RECORD: Larvae V-8 to IX-10; Adults V-16 to X-4.

REFERENCES: 3, 6-8, 10, 13-15, 20, 22, 24, 25, 27, 29, 37, 38, 42, 45.

Aedes (Ochlerotatus)

aboriginis Dyar (questionable record-Michigan is far east of its known distribution. Adult female cannot be distinguished with certainty from *punctor*).

ADULTS: Cheboygan
SEASONAL RECORD: Adults V-28 to late VIII.

REFERENCES: 13-15, 29.

abserratus (Felt and Young) = *Aedes implacabilis* Walker (13-15, 29)

LARVAE: Oakland, Cheboygan, Keweenaw (Isle Royale).

ADULTS: Cheboygan, Keweenaw (Isle Royale), Washtenaw. (No associated larval rearings were made so these could not have been separated with certainty from *punctor*).

SEASONAL RECORD: larvae IV-30 to V-22, adults mid-V to end IX.

REFERENCES: 3, 13-15, 28, 29.

abserratus-*punctor* complex = *Aedes implacabilis*-*punctor* complex (29).

ADULTS: Alcona, Alger, Arenac, Baraga, Cheboygan, Chippewa, Clare, Crawford, Delta, Dickinson, Emmet, Gladwin, Gogebic, Grand Traverse, Iosco, Iron, Isabella, Keweenaw, Leelanau, Newago, Mackinac, Manistee, Marquette, Mason, Menominee, Missaukee, Ogema, Ontonogon, Osceola, Roscommon, Schoolcraft.

SEASONAL RECORD: Adults V-12-18.

REFERENCES: 6, 7, 29.

atropalpus (Coquillett)

LARVAE: Keweenaw

ADULTS: Marquette, Keweenaw, Keweenaw (Isle Royale)

REFERENCES: 3, 29.

aurifer (Coquillett)

LARVAE: Cheboygan

ADULTS: Bay, Cheboygan, Chippewa, Emmet, Genesee, Gogebic, Isabella, Keweenaw, Keweenaw (Isle Royale), Marquette, Menominee, Muskegon, Oakland, Ontonogon.

SEASONAL RECORD: Larvae-mid V; Adults V-12 to end VIII.

REFERENCES: 3, 6, 7, 13-15, 27-29.

campestris Dyar and Knab

ADULTS: Clinton, Kent, Midland, Tuscola.

REFERENCES: 13, 29.

canadensis (Theobald)

LARVAE: Allegan, Alger, Bay, Cass, Cheboygan, Chippewa, Clare, Crawford, Emmet, Genesee, Gogebic, Huron, Iosco, Keweenaw, Keweenaw (Isle Royale), Lake, Marquette, Ogema, Ontonogon, Roscommon, Wayne.

ADULTS: Alcona, Alger, Antrim, Arenac, Baraga, Barry, Bay, Branch, Calhoun, Cass, Cheboygan, Chippewa, Clare, Crawford, Delta, Dickinson, Eaton, Genesee, Gladwin, Gogebic, Grand Traverse, Huron, Ingham, Ionia, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Keweenaw, Keweenaw (Isle Royale), Lake, Lapeer, Leelanau, Livingston, Mackinac, Manistee, Marquette, Mason, Midland, Missaukee, Montcalm, Montmorency, Newago, Oakland, Oceana, Ogema, Ontonogon, Osceola, Otsego, Ottawa, Presque Isle, Roscommon, Saginaw, Shiawassee, St. Clair, St. Joseph, Tuscola, Washtenaw, Wayne, Wexford.

STAGE NOT STATED: Alger, Antrim, Delta, Emmet, Cheboygan, Genesee, Luce, Midland, Oakland, Ontonogon, Washtenaw, Wayne, Wexford.

SEASONAL RECORD: Larvae—IV-30 to VIII-6; Adults—late IV to VIII-21.

REFERENCES: 3, 7, 10, 13-15, 20, 22, 24, 27-29, 38, 43, 45.

canadensis mathesoni Middlekauf. (Questionable record—Michigan is far north of its known range).

ADULTS: Marquette

SEASONAL RECORD: Adults—VII 9-12.

REFERENCES: 40.

communis (DeGeer)

LARVAE: Cheboygan, Keweenaw (Isle Royale).

ADULTS: Alger, Arenac, Baraga, Cheboygan, Chippewa, Clare, Crawford, Delta, Iosco, Iron, Kent, Keweenaw, Keweenaw (Isle Royale), Lake, Leelanau, Lenawee, Mackinac, Marquette,

Menominee, Ontonogon, Presque Isle, Roscommon, Tuscola.

STAGE NOT STATED: Alger, Cheboygan, Emmet, Luce, Washtenaw.

SEASONAL RECORD: Larvae—IV-30 to VI-29; Adults V-14 to VIII-3.

REFERENCES: 3, 13-15, 29, 38.

decticus Howard, Dyar and Knab

LARVAE: Cheboygan, Keweenaw (Isle Royale).

ADULTS: Keweenaw (Isle Royale).

REFERENCES: 3, 15.

diantaus Howard, Dyar and Knab

LARVAE: Cheboygan, Keweenaw (Isle Royale).

ADULTS: Cheboygan, Keweenaw (Isle Royale).

SEASONAL RECORD: Larvae IV-30 to V-28; Adults VI-12 to end VIII.

REFERENCES: 3, 13-15, 29.

dorsalis (Meigen)

LARVAE: Bay, Macomb, Midland, St. Clair, Wayne.

ADULTS: Allegan, Genesee, Isabella, Keweenaw (Isle Royale), Midland, St. Clair, Wayne.

SEASONAL RECORD: Larvae VII-15 to VIII-28; Adults V-8 to IX-15.

REFERENCES: 3, 7, 8, 22, 24, 28.

dupreii (Coquillett) (New State Record)

ADULTS: Washtenaw

REFERENCE: 35.

euedes Howard, Dyar and Knab = *Aedes barri* Rueger (3, 26).

ADULTS: Keweenaw (Isle Royale), Ogema.

SEASONAL RECORD: Adults early VII.

REFERENCES: 3, 26.

excrucians (Walker)

LARVAE: Cheboygan, Isabella, Keweenaw (Isle Royale).

ADULTS: Allegan, Arenac, Bay, Benzie, Berrien, Calhoun, Charlevoix, Cheboygan, Chippewa, Clare, Delta, Emmet, Genesee, Gladwin, Gogebic,

Grand Traverse, Houghton, Huron, Ingham, Iosco, Iron, Isabella, Jackson, Kent, Keweenaw, Keweenaw (Isle Royale), Lapeer, Leelanau, Mackinac, Marquette, Mecosta, Menominee, Midland, Missaukee, Monroe, Montcalm, Oakland, Ogema, Osceola, Presque Isle, Roscommon, Saginaw, Sanilac, Schoolcraft, Shiawassee, Tuscola, Washtenaw, Wayne.

STAGE NOT STATED: Alpena, Berrien, Calhoun, Cheboygan, Eaton, Emmet, Ingham, Isabella, Gogebic, Kent, Lapeer, Leelanau, Livingston, Luce, Midland, Oakland, Tuscola, Washtenaw.

SEASONAL RECORD: Larvae III-30 to V-29; Adults V-5 to VIII-21.

REFERENCES: 3, 6, 7, 13-15, 20, 27-29, 37.

fitchii (Felt and Young)

LARVAE: Alger, Barry, Cheboygan, Chippewa, Clare, Emmet, Genesee, Isabella, Keweenaw (Isle Royale), Lake, Washtenaw.

ADULTS: Alger, Allegan, Arenac, Bay, Berrien, Calhoun, Cass, Cheboygan, Chippewa, Clare, Crawford, Delta, Dickinson, Eaton, Emmet, Genesee, Gladwin, Gogebic, Grand Traverse, Huron, Ingham, Ionia, Iosco, Isabella, Kalamazoo, Kalkaska, Kent, Keweenaw, Keweenaw (Isle Royale), Lake, Lapeer, Leelanau, Livingston, Mackinac, Macomb, Manistee, Marquette, Mason, Midland, Misaukee, Monroe, Montcalm, Montmorency, Oakland, Ogema, Ontonogon, Presque Isle, Roscommon, Saginaw, Schoolcraft, Shiawassee, St. Clair, Tuscola, Washtenaw, Wayne.

STAGE NOT STATED: Ingham, Isabella, Livingston, Midland, Montcalm, Oakland, Oceana, Tuscola, Washtenaw, Wayne.

SEASONAL RECORD: Larvae III-20 to V-12; Adults IV-25 to IX-17.

REFERENCES: 3, 6, 7, 10, 13-15, 24, 25, 27-29, 37, 39.

flavescens (Mueller)

LARVAE: Cheboygan

ADULTS: Genesee, Kent

STAGE NOT STATED: Cheboygan, Ingham, Midland.

SEASONAL RECORD: Adults V-12-29.

REFERENCES: 13, 15, 27, 29.

grossbecki Dyar and Knab (**New state record**)

ADULTS: Bay, Macomb, Wayne

SEASONAL RECORD: Adults VI-5 to VII-1.

REFERENCES: 22, 33, 36.

impiger (Walker) = *Culex impiger* Walker (30)

LARVAE: Cheboygan, Clare, Ingham

ADULTS: Cheboygan

STAGE NOT STATED: Alger, Cheboygan, Washtenaw

SEASONAL RECORD: Larvae V-11-29; Adults V-14 to VI-12.

REFERENCES: 13-15, 29, 30.

implicatus Vockeroth

LARVAE: Keweenaw (Isle Royale).

ADULTS: Keweenaw (Isle Royale)

REFERENCE: 3

intrudens Dyar

LARVAE: Cheboygan, Keweenaw (Isle Royale).

ADULTS: Berrien, Cheboygan, Chippewa, Crawford, Genesee, Houghton, Ingham, Iosco, Isabella, Livingston, Mackinac, Ogemaw, Osceola, Roscommon.

STAGE NOT STATED: Alger, Cheboygan, Emmet, Ingham, Keweenaw (Isle Royale), Mackinac, Midland, Presque Isle, Roscommon, Washtenaw, Wayne, Wexford.

SEASONAL RECORD: Larvae IV-3 to V-12; Adults V-12 to VIII-10.

REFERENCES: 3, 13-15, 20, 27, 29, 37.

pionips Dyar

LARVAE: Keweenaw (Isle Royale)

ADULTS: Keweenaw (Isle Royale)

REFERENCE: 3

provocans (Walker) = *Aedes trichurus* (Dyar) (3, 6, 7, 13-15, 28, 29) = *Aedes cinereoborealis* Felt and Young (20).

LARVAE: Cheboygan, Emmet, Gogebic, Isabella, Keweenaw (Isle Royale), Ontonogon.

ADULTS: Cheboygan, Gogebic, Keweenaw (Isle Royale).

STAGE NOT STATED: Cheboygan, Crawford, Emmet, Lake, Midland, Oakland, Osceola, Roscommon.

REFERENCES: 3, 6, 7, 13-15, 20, 28, 29.

pullatus (Coquillett) (Michigan is east of the normal range of this species, but collections also have been reported from Quebec).

LARVAE: Cheboygan

ADULTS: Alger, Crawford, Cheboygan, Chippewa, Emmet, Roscommon.

SEASONAL RECORD: Larvae V-5; Adults V-14 to end VIII.

REFERENCES: 13-15, 29, 37

punctor (Kirby)

LARVAE: Cheboygan, Clare, Keweenaw (Isle Royale).

ADULTS: Cheboygan, Chippewa, Crawford, Emmet, Genesee, Keweenaw, Keweenaw (Isle Royale), Ontonogon.

STAGE NOT STATED: Alger, Cheboygan, Emmet, Luce.

SEASONAL RECORD: Larvae IV-30 to VII-2, Adults V-14 to VIII-2.

REFERENCES: 3, 13-15, 20, 28, 29, 37.

riparius Dyar and Knab

LARVAE: Cheboygan

ADULTS: Arenac, Cheboygan, Genesee, Gladwin, Keweenaw (Isle Royale),

Oakland, Ontonogon, Presque Isle.

STAGE NOT STATED: Cheboygan, Emmet.

SEASONAL RECORDS: Adults early V to end VIII.

REFERENCES: 3, 13-15, 27-29.

solicitans (Walker) (**New State Record**)

LARVAE: Midland, St. Clair, Wayne

ADULTS: Bay, Ingham, Midland, St. Clair

SEASONAL RECORD: Larvae VII-22 to VIII-25; adults VI-20 to VIII-25.

REFERENCES: 19, 22, 25.

spenceri (Theobald)

LARVAE: Cheboygan

ADULTS: Cheboygan, Ingham

STAGE NOT STATED: Cheboygan, Ingham

SEASONAL RECORD: Larvae V-14-22; Adults VII-30 to end VIII.

REFERENCES: 13-15, 29.

sticticus (Meigen) = *Aedes lateralis* (Meigen) (13-15, 29)

LARVAE: Cheboygan, Ingham, Iosco, Midland, Roscommon.

ADULTS: Alcona, Alger, Allegan, Alpena, Antrim, Arenac, Baraga, Bay, Berrien, Branch, Cass, Charlevoix, Cheboygan, Clare, Crawford, Delta, Dickinson, Eaton, Emmet, Genesee, Gladwin, Gogebic, Gratiot, Ingham, Ionia, Iosco, Iron, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Keweenaw, Keweenaw (Isle royale), Lake, Lapeer, Leelanau, Lenawee, Livingston, Luce, Manistee, Marquette, Mason, Menominee, Midland, Missaukee, Montcalm, Montmorency, Muskegon, Newago, Oakland, Ogema, Ontonogon, Osceola, Oscoda, Otsego, Ottawa, Presque Isle, Saginaw, Sanilac, Schoolcraft, Shiawassee, St. Clair, St. Joseph, Tuscola, Van Buren, Wayne, Washtenaw.

STAGE NOT STATED: Allegan, Alger, Arenac, Cass, Cheboygan, Delta, Eaton, Emmet, Genesee, Gogebic, Isabella, Keweenaw, Livingston, Luce, Oakland, Ontonogon, Van Buren, Wayne.

SEASONAL RECORD: Larvae IV-15 to IX-4; Adults V-14 to IX-13.

REFERENCES: 3, 6, 7, 13-15, 22, 25, 27-29, 37, 43.

stimulans (Walker) = *Culex stimulans* Walker (29)

LARVAE: Antrim, Cheboygan, Emmet, Ingham, Isabella, Keweenaw (Isle Royale).

ADULTS: Alger, Allegan, Alpena, Antrim, Arenac, Barry, Bay, Benzie, Ber-

rien, Branch, Calhoun, Cass, Charlevoix, Cheboygan, Chippewa, Clare, Delta, Eaton, Emmet, Genesee, Gladwin, Gogebic, Grand Traverse, Gratiot, Huron, Ingham, Ionia, Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Keweenaw, Lake, Lapeer, Leelanau, Lenawee, Livingston, Mackinac, Macomb, Manistee, Marquette, Mason, Mecosta, Menominee, Midland, Missaukee, Monroe, Montcalm, Muskegon, Newago, Oakland, Oceana, Ogema, Ontonogon, Osceola, Presque Isle, Roscommon, Saginaw, Sanilac, Schoolcraft, Shiawassee, St. Clair, St. Joseph, Tuscola, Washtenaw, Wayne, Wexford.

STAGE NOT STATED: Alger, Antrim, Calhoun, Cass, Emmet, Ingham, Isabella, Kent, Keweenaw (Isle Royale), Lapeer, Livingston, Midland, Oakland, Ontonogon, Washtenaw, Wayne.

SEASONAL RECORD: Larvae III-12 to late V; Adults IV-25 to VIII-26.

REFERENCES: 3, 6-10, 13-15, 20, 22, 25, 27-30, 37, 38, 42, 45.

trivittatus (Coquillett)

LARVAE: Bay, Kalamazoo, Wayne.

ADULTS: Allegan, Antrim, Arenac, Baraga, Bay, Berrien, Calhoun, Cass, Crawford, Eaton, Gogebic, Grand Traverse, Ingham, Ionia, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lenawee, Livingston, Mackinac, Macomb, Manistee, Mason, Midland, Monroe, Montmorency, Oakland, Oceana, Ontonogon, Ottawa, Saginaw, St. Clair, St. Joseph, Washtenaw, Wayne, Wexford.

STAGE NOT STATED: Calhoun, Gogebic, Midland, Oceana.

SEASONAL RECORD: Adults VI-7 to IX-18.

REFERENCES: 6-8; 22, 24, 25, 28, 29, 37, 38, 42.

Aedes (Protomacleaya)

hendersoni Cockerell

LARVAE: Cass, Ingham

ADULTS: Ingham

SEASONAL RECORD: Adults VI-19 to VIII-1.

REFERENCES: 23, 31, 34, 44.

triseriatus (Say) = *Culex triseriatus* (30)

LARVAE: Berrien, Cheboygan, Genesee, Ingham, Kalamazoo, Macomb, Ontonogon, Roscommon, St. Clair, St. Joseph, Washtenaw, Wayne.

ADULTS: Allegan, Antrim, Barry, Berrien, Branch, Cass, Charlevoix, Cheboygan, Chippewa, Clare, Eaton, Emmet, Genesee, Gogebic, Grand Traverse, Huron, Ingham, Ionia, Iosco, Isabella, Kalamazoo, Keweenaw (Isle Royale), Lake, Lapeer, Livingston, Macomb, Manistee, Marquette, Mecosta, Menominee, Midland, Monroe, Montcalm, Newago, Oakland, Ontonogon, Saginaw, Sanilac, Shiawassee, St. Clair, St. Joseph, Tuscola, Washtenaw, Wayne.

STAGE NOT STATED: Emmet, Oakland.

SEASONAL RECORDS: Larvae mid-V to mid VII; Adults V-23 to IX-18.

REFERENCES: 3, 6, 7, 10, 13, 22, 25, 27-30, 37, 38, 42, 44, 45.

Anopheles (Anopheles)

barberi Coquillett

ADULTS: Ionia, Newago, Oceana

REFERENCE: 29.

crucians Wiedemann (New State Record)

LARVAE: Midland

SEASONAL RECORD: Larvae VII-22-27.

REFERENCE: 25.

earlei Vargas = *Anopheles maculipennis* Meigen (13-15, 20, 30)
= *An. occidentalis* Dyar and Knab (27, 29)
= *An. maculipennis occidentalis* (20)

LARVAE: Alcona, Alger, Alpena, Antrim, Arenac, Baraga, Barry, Bay, Benzie, Cheboygan, Chippewa, Clinton, Crawford, Delta, Emmet, Gogebic, Grand Traverse, Gratiot, Houghton, Huron, Ingham, Iosco, Isabella, Kalamazoo, Kalkaska, Kent, Keweenaw, Keweenaw (Isle Royale), Leelanau, Luce, Mackinac,

Macomb, Manistee, Mason, Marquette, Mecosta, Menominee, Midland, Missaukee, Montcalm, Montmorency, Newago, Ogema, Oscoda, Otsego, Presque Isle, Roscommon, Saginaw, Sanilac, Schoolcraft, Shiawassee, Wexford.

ADULTS: Alcona, Alger, Alpena, Antrim, Arenac, Bay, Benzie, Charlevoix, Cheboygan, Chippewa, Clare, Crawford, Emmet, Genesee, Gladwin, Gogebic, Grand Traverse, Houghton, Huron, Ingham, Iosco, Isabella, Keweenaw, Keweenaw (Isle Royale), Lake, Lapeer, Marquette, Mason, Mecosta, Menominee, Midland, Missaukee, Montcalm, Montmorency, Newago, Oceana, Ogema, Osceola, Oscoda, Presque Isle, Roscommon, Sanilac, St. Clair, Tuscola, Wexford.

STAGE NOT STATED: Cheboygan, Emmet, Genesee, Ingham, Kent, Midland, Muskegon, Presque Isle, Schoolcraft, Washtenaw, Wayne, Wexford.

SEASONAL RECORD: Larvae late-V to IX-29; Adults IV-11 to IX-20.

REFERENCES: 2, 3, 6, 7, 13-15, 20, 21, 25, 27, 30, 37.

punctipennis Say

LARVAE: All counties (also includes Isle Royale) except Crawford, Dickinson, Gogebic, Iron, Mecosta.

ADULTS: All counties (also includes Isle Royale) except Baraga, Delta, Dickinson, Gogebic, Houghton, Iron, Luce, Mackinac, Macomb, Marquette, Mecosta, Schoolcraft.

STAGE NOT STATED: Calhoun, Cheboygan, Emmet, Genesee, Ingham, Midland, Montcalm, Muskegon, Oakland, Oceana, Shiawassee, Washtenaw.

SEASONAL RECORD: Larvae V-28 to X-6; Adults IV-4 to X-12.

REFERENCES: 3, 6-8, 13-15, 20-22, 24, 25, 27-30, 32, 37, 42, 45.

quadrinaculatus (Say)

LARVAE: Allegan, Alpena, Antrim, Arenac, Barry, Bay, Berrien, Calhoun, Cass, Cheboygan, Clare, Clinton, Eaton, Genesee, Gladwin, Grand Traverse, Gratiot, Hillsdale, Huron, Ingham, Ionia,

Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Lenawee, Livingston, Macomb, Manistee, Mason, Mecosta, Midland, Missaukee, Monroe, Montcalm, Montmorency, Muskegon, Newago, Oakland, Oceana, Ogema, Osceola, Ottawa, Presque Isle, Roscommon, Saginaw, Sanilac, Shiawassee, St. Clair, St. Joseph, Tuscola, Van Buren, Washtenaw, Wayne, Wexford.

ADULTS: Alcona, Allegan, Antrim, Arenac, Bay, Barry, Berrien, Branch, Cass, Calhoun, Cheboygan, Clare, Clinton, Eaton, Gladwin, Genesee, Grand Traverse, Gratiot, Hillsdale, Huron, Ingham, Ionia, Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Lenawee, Livingston, Macomb, Mason, Mecosta, Midland, Missaukee, Montcalm, Montmorency, Monroe, Muskegon, Newago, Oakland, Oceana, Ogema, Osceola, Ottawa, Presque Isle, Roscommon, Saginaw, Sanilac, Shiawassee, St. Clair, St. Joseph, Tuscola, Van Buren, Washtenaw, Wayne, Wexford.

STAGE NOT STATED: Calhoun, Cheboygan, Emmet, Genesee, Ingham, Midland, Montcalm, Muskegon, Oakland, Oceana, Shiawassee, Washtenaw.

SEASONAL RECORD: Larvae VII-9 to X-2; Adults IV-25 to late-X.

REFERENCES: 6-8, 13, 17, 22, 24, 25, 27-29, 32, 37, 38, 42.

walkeri Theobald

LARVAE: Allegan, Antrim, Bay, Barry, Berrien, Branch, Cass, Calhoun, Charlevoix, Crawford, Delta, Dickinson, Eaton, Emmet, Genesee, Gladwin, Grand Traverse, Hillsdale, Huron, Ionia, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Leelanau, Livingston, Macomb, Manistee, Mecosta, Missaukee, Monroe, Montmorency, Muskegon, Newago, Oakland, Ogema, Oscoda, Otsego, Ottawa, Presque Isle, Roscommon, Schoolcraft, St. Clair, St. Joseph, Tuscola, Van Buren, Washtenaw, Wayne.

ADULTS: Antrim, Arenac, Bay, Berrien, Cass, Cheboygan, Emmet, Genesee, Gladwin, Huron, Ingham, Isabella, Jackson, Kalamazoo, Keweenaw (Isle

Royale), Lake, Livingston, Macomb, Mason, Monroe, Sanilac, St. Clair, St. Joseph, Wayne.

STAGE NOT STATED: Cheboygan, Emmet, Genesee, Ingham, Kalamazoo, Kent, Midland, Ottawa, St. Joseph, Washtenaw.

SEASONAL RECORD: Larvae VIII-4-18; Adults V-16 to IX-20.

REFERENCES: 3, 6-9, 13, 15, 17, 22, 25, 27, 29, 32.

Coquillettidia (*Coquillettidia*)

perturbans (Walker) = *Culex perturbans* Walker (30)
= *Culex testaceus* Vander Wulp (20)
= *Mansonia perturbans* (Walker) (3, 7, 13-15, 22, 27-29)

LARVAE: Cheboygan, Ingham

ADULTS: Alger, Allegan, Antrim, Arenac, Baraga, Barry, Bay, Benzie, Berrien, Branch, Calhoun, Cass, Cheboygan, Chippewa, Crawford, Delta, Dickinson, Eaton, Emmet, Genesee, Gladwin, Gogebic, Grand Traverse, Hillsdale, Huron, Ingham, Ionia, Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Keweenaw, Keweenaw (Isle Royale), Lapeer, Livingston, Mackinac, Macomb, Marquette, Mason, Mecosta, Menominee, Missaukee, Monroe, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Ontonagon, Osceola, Ottawa, Presque Isle, Roscommon, Saginaw, Schoolcraft, Shiawassee, St. Clair, St. Joseph, Tuscola, Van Buren, Washtenaw, Wayne.

STAGE NOT STATED: Calhoun, Cheboygan, Emmet, Gogebic, Huron, Isabella, Jackson, Mackinac, Midland, Oakland, Oceana, Roscommon, Wexford.

SEASONAL RECORD: Adults VI-15 to IX-11.

REFERENCES: 3, 6-8, 10, 13-15, 20, 22, 24, 25, 27-30, 38, 42.

Culex (*Culex*)

pipiens Linnaeus

LARVAE: Allegan, Bay, Berrien,

Branch, Calhoun, Cass, Cheboygan, Chippewa, Eaton, Emmet, Genesee, Ingham, Ionia, Isabella, Jackson, Hillsdale, Huron, Kalamazoo, Kent, Lenawee, Livingston, Macomb, Midland, Monroe, Muskegon, Oakland, Ontonogon, Ot-tawa, Saginaw, St. Clair, St. Joseph, Tuscola, Van Buren, Washtenaw, Wayne.

ADULTS: Allegan, Arenac, Barry, Bay, Berrien, Branch, Calhoun, Cass, Cheboygan, Clinton, Emmet, Genesee, Hillsdale, Ingham, Iosco, Isabella, Jackson, Kalamazoo, Kent, Lapeer, Macomb, Midland, Monroe, Muskegon, Newaygo, Oakland, Ogema, Ontonogon, Ottawa, Roscommon, Saginaw, Shiawassee, Tuscola, Washtenaw, Wayne.

STAGE NOT STATED: Cass, Cheboygan, Crawford, Emmet, Genesee, Ingham, Midland, Oakland, Washtenaw, Wayne, Wexford.

SEASONAL RECORD: Larvae VI-26 to X-2; Adults IV-4 to X-15.

REFERENCES: 6-8, 10, 13-15, 22, 25, 28-30, 37, 38, 42.

quinquefasciatus (Say) (This almost certainly is an erroneous identification. Michigan is far north of its known range).

LARVAE: Ingham

REFERENCE: 30.

restuans Theobald

LARVAE: All counties (also includes Isle Royale) but Alcona, Arenac, Baraga, Barry, Branch, Delta, Gogebic, Houghton, Iron, Luce, Oceana, Oscoda, Shiawassee.

ADULTS: Alcona, Allegan, Arenac, Bay, Benzie, Berrien, Calhoun, Cass, Cheboygan, Clare, Clinton, Crawford, Emmet, Gladwin, Grand Traverse, Gratiot, Huron, Ingham, Ionia, Iosco, Isabella, Kalamazoo, Kent, Keweenaw (Isle Royale), Lake, Leelanau, Livingston, Mason, Mecosta, Midland, Missaukee, Montcalm, Montmorency, Muskegon, Newaygo, Oceana, Osceola, Otsego, Ot-tawa, Roscommon, Saginaw, St. Joseph, Tuscola, Van Buren, Wayne, Wexford.

STAGE NOT STATED: Cass, Crawford, Genesee, Oakland, Wayne.

SEASONAL RECORD: Larvae late V to VIII-27; Adults V-2 to X-1.

REFERENCES: 3, 6, 7, 14, 15, 22, 24, 25, 27-29, 37, 42.

salinarius Coquillett

LARVAE: Bay, Cheboygan, Huron, Ionia.

ADULTS: Cass, Ionia, Keweenaw (Isle Royale), Washtenaw, Wayne.

STAGE NOT STATED: Cheboygan, Genesee, Ingham, Midland.

SEASONAL RECORD: Larvae VII-20-X-1; Adults VII-29 to VIII-12.

REFERENCES: 3, 13, 15, 22, 24, 27, 37.

tarsalis Coquillett

LARVAE: Emmet, Genesee, Manistee, St. Clair, Wayne.

ADULTS: Bay, Keweenaw (Isle Royale), Saginaw.

SEASONAL RECORDS: Adults VII-11-24.

REFERENCES: 3, 13, 23, 25, 29.

Culex (Melanocomion)

erraticus (Dyar and Knab)

LARVAE: Bay, Van Buren

ADULTS: Cass, Isabella

REFERENCES: 6, 7, 25, 27, 29.

SEASONAL RECORDS: Larvae VIII-28, Adults VIII-13-23.

peccator Dyar and Knab

STAGE NOT STATED: Ingham.

REFERENCE: 13.

Culex (Neoculex)

territans Walker = *Culex apicalis* Adams
(13, 14, 27, 29)

= *Culex saxatilis* Gross-
beck (20).

LARVAE: All counties (also includes Isle Royale) except Houghton, Newaygo, Oceana, Sanilac, Schoolcraft.

ADULTS: Allegan, Barry, Berrien, Branch, Calhoun, Cheboygan, Eaton, Emmet, Genesee, Grand Traverse, Gratiot, Hillsdale, Huron, Ingham, Ionia, Isabella, Jackson, Kalamazoo, Keweenaw,

Keweenaw (Isle Royale), Lake, Mason, Missaukee, Montcalm, Muskegon, Newaygo, Oakland, Oceana, Osceola, Ottawa, Saginaw, Shiawassee, St. Joseph, Washtenaw, Wayne.

STAGE NOT STATED: Allegan, Calhoun, Cheboygan, Emmet, Genesee, Gogebic, Ingham, Oakland, Oceana, St. Joseph, Van Buren, Washtenaw, Wayne, Wexford.

SEASONAL RECORD: Larvae mid-V to X-2; Adults III-29 to X-14.

REFERENCES: 2, 4, 6, 7, 13, 14, 16, 20, 22, 24, 25, 27, 29, 37, 42.

Culiseta (Climacura)

melanura (Coquillett) = *Theobaldia melanura* (Coq.) (13)

ADULTS: Allegan Arenac, Branch, Calhoun, Jackson, Ottawa.

STAGE NOT STATED: Wexford.

REFERENCES: 13, 29.

Culiseta (Culicella)

morsitans dyari (Coquillett) =
Theobaldia dyari Coq. 20)

= *Theobaldiamorsitans* (Theobald) (13-15)

LARVAE: Bay, Cheboygan, Genesee, Keweenaw (Isle Royale), Mason, Osceola,

ADULTS: Alcona, Alger, Alpena, Antrim, Arenac, Cheboygan, Clare, Crawford, Dickinson, Gladwin, Grand Traverse, Ionia, Iosco, Isabella, Kent, Keweenaw, Keweenaw (Isle Royale), Livingston, Menominee, Midland, Montcalm, Montmorency, Muskegon, Newaygo, Ogema, Osceola, Presque Isle, Roscommon, Saginaw, Tuscola, Wexford.

STAGE NOT STATED: Cheboygan, Emmet, Washtenaw.

SEASONAL RECORD: Larvae V-12 to VIII-6; Adults IV-4 to IX-17.

REFERENCES: 3, 6, 7, 13-15, 20, 25, 27, 29, 37.

silvestris minnesotae Barr

ADULTS: Keweenaw (Isle Royal).

REFERENCES: 3

Culiseta (Culiseta)

impatiens (Walker)

LARVAE: Cheboygan, Keweenaw (Isle Royale)

ADULTS: Cheboygan, Isabella, Keweenaw (Isle Royale).

STAGE NOT STATED: Cheboygan.

SEASONAL RECORD: Larvae mid-V; Adults V-2 to VIII-21.

REFERENCES: 3, 7, 13-16, 29.

incidens (Thompson) = *Theobaldia incidens* (Thompson) (13) (A questionable record, Michigan is far east of its known range).

STAGE NOT STATED: Cheboygan, Emmet.

REFERENCE: 13.

inornata (Williston) = *Theobaldia inornata* Williston (13, 14, 20)

LARVAE: Cheboygan, Clare, Genesee, Grand Traverse, Ionia, Iosco, Isabella, Lake, Mason, Ontonogon, Osceola, Saginaw, Wayne.

ADULTS: Bay, Berrien, Cass, Charlevoix, Cheboygan, Grand Traverse, Ingham, Iosco, Isabella, Kent, Keweenaw (Isle Royale), Lenawee, Mason, Monroe, Montcalm, Muskegon, Roscommon, Saginaw, St. Clair, Wayne.

STAGE NOT STATED: Cheboygan, Emmet, Genesee, Midland.

SEASONAL RECORD: Larvae late V to X-2; Adults IV-4 to IX-9.

REFERENCES: 3, 6-8, 13, 14, 20, 22, 24, 29, 37, 42.

Orthopodomyia

alba Baker

LARVAE: Berrien

SEASONAL RECORD: Larvae V-1 to IX-11.

REFERENCE: 11.

signifera (Coquillett)

LARVAE: Berrien

SEASONAL RECORD: Larvae VII-16 to IX-11.

REFERENCE: 11.

species not identified.

ADULTS: Calhoun, Isabella

SEASONAL RECORD: Adult VIII-27.

REFERENCES: 6, 7, 29.

Psorophora (Janthinosoma)

ferox (Von Humbolt) = *Conchyliaestes musicus* Say (30)

LARVAE: Ingham

ADULTS: Eaton, Ingham, St. Clair

STAGE NOT STATED: Ingham.

SEASONAL RECORD: Adult VII-15 to VIII-31.

REFERENCES: 13, 29, 30, 42, 45.

horrida (Dyar and Knab)

ADULTS: Ingham

SEASONAL RECORD: Adults VIII-8-31.

REFERENCE: 43.

varipes (Coquillett) (**New State Record**) (May be *Ps. dyari* Belkin and Heineman. Lack of study specimens has precluded verification of this possibility).

ADULTS: Washtenaw

REFERENCE: 35

Psorophora (Psorophora)

ciliata (Fabricius) = *Culex ciliata* Fabricius (9)

LARVAE: Ingham, St. Clair

ADULTS: Berrien, Cass, Genesee, Ingham, Isabella, Jackson, Kalamazoo, Oceana, Ottawa, St. Joseph.

STAGE NOT STATED: Ingham, Livingston, Shiawassee, Wayne.

SEASONAL RECORD: Adults VIII-5.

REFERENCES: 7, 9, 13, 22, 27-30.

Uranotaenia (Uranotaenia)

sapphirina (Osten Sacken)

LARVAE: Allegan, Arenac, Barry, Benzie, Berrien, Calhoun, Cass, Cheboygan, Clare, Clinton, Crawford, Eaton, Emmet, Genesee, Gladwin, Grand Traverse, Hillsdale, Houghton, Huron, Ingham, Iosco,

Iron, Jackson, Kalamazoo, Kalkaska, Kent, Lapeer, Lenawee, Livingston, Mackinac, Manistee, Menominee, Midland, Missaukee, Montcalm, Muskegon, Newago, Oakland, Oceana, Ogema, Osceola, Presque Isle, Roscommon, Shiawassee, St. Joseph, Washtenaw, Wayne, Wexford.

ADULTS: Benzie, Genesee, Grand Traverse, Hillsdale, Huron, Ingham, Isabella, Livingston, Montcalm, Muskegon, Newago, Van Buren.

STAGE NOT STATED: Berrien, Cheboygan, Ingham.

SEASONAL RECORD: Larvae IX-4, Adults VIII-31 to IX-14.

References: 6, 7, 12, 13, 22, 25, 27-30, 37.

Wyeomyia (Wyeomyia)

smithii (Coquillett)

LARVAE: Cheboygan, Ingham, Oakland.

ADULTS: Cheboygan

STAGE NOT STATED: Cheboygan

SEASONAL RECORDS: Larvae early IV to end VIII; Adults mid-V to end VIII.

REFERENCES: 13-15, 20, 23, 28, 29.

Literature Cited

1. Aitken, T. H. G. 1945. Studies on the anopheline complex of western America. Univ. Calif. Publ. Entomol. 7: 273-364.
2. Arnell, J. H. 1976. Mosquito studies (Diptera: Culicidae) XXXIII. A revision of the *scapularis* group of *Aedes* (*Ochlerotatus*). Contr. Amer. Entomol. Inst. 13(3): 1-91.
3. Beadle, L. D. 1963. The mosquitoes of Isle Royale, Michigan. Proc. New Jersey Mosquito Extermination Assoc. 50: 133-139.
4. Bohart, R. M. 1948. The subgenus *Neoculex* in America north of Mexico (Diptera, Culicidae). Ann. Entomol. Soc. Amer. 41: 330-345.
5. Carpenter, S. J. and W. J. LaCasse. 1955. Mosquitoes of North America (north of Mexico). Univ. Calif. Press, VI + 360 pp.
6. Cassani, J. R. 1977. A survey of mosquitoes (Diptera: Culicidae) of Mt. Pleas-

- ant and environs, Isabella County, Michigan. M.S. Thesis, Central Michigan University.
7. Cassani, J. R. and R. G. Bland. 1978. New distribution records for mosquitoes in Michigan (Diptera: Culicidae). Great Lakes Entomol. 11: 51-52.
 8. Detwiler, R. K. 1975. Annual Report, Midland, Michigan Mosquito Control District. (1974). 14 pp.
 9. Dyar, H. G. 1922. The mosquitoes of the United States. Proc. U. S. Nat. Mus. 62: 1-119.
 10. Gorton, R. J. 1973. An epidemiological study of mosquito-borne California encephalitis in a southern Michigan subdivision. M. S. Thesis, Michigan State University.
 11. Grimstad, P. R. 1977. Occurrence of *Orthopodomyia alba* Baker and *Orthopodomyia signifera* (Coquillett) in Michigan. Mosquito News 37: 129-130.
 12. Hinman, E. H. 1935. Biological notes on *Uranotaenia* spp. in Louisiana (Culicidae, Diptera). Ann. Entomol. Soc. Amer. 28: 404-407.
 13. Irwin, W. H. 1941. A preliminary list of the Culicidae of Michigan. Part I Culicinae (Diptera). Entomol. News. 52: 101-105.
 14. ———. 1942a. The role of certain northern Michigan bog mats in mosquito production. Ecology 23: 466-477.
 15. ———. 1942b. The mosquitoes of three selected areas in Cheboygan County. Mich. Acad. Sci. Arts and Letts. 28: 379-396.
 16. Jewell, M. E. and H. W. Brown. 1929. Studies on northern Michigan bog lakes. Ecology 10: 427-475.
 17. King, W. V. and G. H. Bradley. 1941. Distribution of the nearctic species of *Anopheles*. Amer. Assoc. Adv. Sci. Publ. 15: 71-78.
 18. Knight, K. L. and A. Stone. 1977. A catalog of the mosquitoes of the world (Diptera: Culicidae). Thomas Say Foundation, Vol. 6, Entomol. Soc. Amer. 611 pp.
 19. Lewandowski, H. B. 1977. Determination of the important potential vectors of dog heartworm in Michigan. Ph.D. Thesis, Mich. State Univ.
 20. Matheson, R. 1924. The Culicidae of the Douglas Lake region (Michigan). Can. Entomol. 56: 289-290.
 21. Matheson, R. and R. C. Shannon. 1923. The anophelines of northeastern America. Ins. Insc. Mens. 11: 57-64.
 22. McGroarty, D. L., H. D. Newson and G. D. Dennis. 1976. St. Louis Encephalitis surveillance in Michigan: Technical Report. Entomol. Dept. Mich. State Univ. 91 pp.
 23. Newson, H. D. and J. S. Rogers. 1979. Unpublished data.
 24. Newson, H. D. and J. H. Zimmerman. 1974. Unpublished data.
 25. Newson, H. D., D. L. McGroarty and V. E. Wagner. 1975. Mosquito survey in three Michigan counties (Bay, Midland and Saginaw). Technical Report, Entomol. Dept., Mich. State Univ. 91 pp.
 26. Nielsen, L. T. and W. R. Horsfall. 1973. The occurrence of *Aedes barri* Rueger in Alaska with notes on its distribution. Mosquito News 33: 243.
 27. Obrecht, C. B. 1949. Notes on the distribution of Michigan mosquitoes (Diptera, Nematocera). Amer. Midland Naturalist 41: 168-173.
 28. Obrecht, C. B. 1967. New distribution records of Michigan mosquitoes, 1948-1963. Mich. Entomol. 1:153-158.
 29. Pederson, C. E. 1947. The distribution of Michigan mosquitoes. M. S. Thesis, Dept. of Entomol., Mich. State Univ.
 30. Pettit, R. H. 1903. Mosquitoes and other insects of the year 1902. Mich. State College of Ag. Exp. Stn. Entomol. Dept., Spec. Bull. 17, pp. 1-12.
 31. Rogers, J. S. and H. D. Newson. 1979. Comparisons of *Aedes hendersoni* and *Aedes triseriatus* as potential vectors of *Dirofilaria immitis*. Mosquito News 39:463-466.
 32. Sabrosky, C. W. 1946. The occurrence of malaria mosquitoes in southern Michigan. Tech. Bull. 202, Mich. State College Agric. Exp. Stn. 50 pp.
 33. Schultz, J. H. 1979. Personal communication.
 34. Truman, J. W. and G. B. Craig. 1968. Hybridization between *Aedes hendersoni* and *Aedes triseriatus*. Ann. Entomol. Soc. Amer. 61: 1020-1025.
 35. Waffle, E. 1979. Personal communication.
 36. Wagner, V. E. 1979. Personal communication.
 37. Wagner, V. E. and H. D. Newson. 1971. Unpublished data.
 38. Wagner, V. E. and H. D. Newson. 1975a. Mosquito biting activity in Michigan State Parks. Mosquito News 35: 217-222.
 39. Wagner, V. E. and H. D. Newson. 1975b. Field investigations on *Aedes fitchii* mosquito populations in a woodland pool ecosystem. Mosquito News. 35:518-522.
 40. Wallace, R. C. 1960. Mosquitoes collected

- in the vicinity of Marquette, Michigan during the summer of 1959. Ill. State Acad. Sci. Trans. 53: 46-47.
41. Wood, D. M. 1977. Notes on the identities of some common nearctic *Aedes* species. Mosquito News. 37: 71-82.
 42. Zaim, M. 1978. Impact of wastewater irrigation on the population of the tree-hole breeding mosquito, *Aedes triseriatus*. Ph.D. Thesis, Mich. State Univ.
 43. Zaim, M., H. D. Newson and G. D. Dennis. 1977. *Psorophora horrida* in Michigan. Mosquito News. 37:763.
 44. Zavortink, T. H. 1972. Mosquito studies (Diptera: Culicidae) XXVII. The New World species formerly placed in *Aedes* (*Finlaya*). Contr. Amer. Entomol. Inst. 8(3):1-206.
 45. Zorka, T. J. 1975. Seasonal distribution of human feeding mosquitoes in a sewage spray irrigation complex. M. S. Thesis, Mich. State Univ.

ACKNOWLEDGMENTS

The authors thank Ms. Mary Kay Casani for her assistance in reviewing the literature and Mrs. Susan Andrews and Mrs. Ruth Filter for their aid in preparing the manuscript.

EFFECT OF *BACILLUS THURINGIENSIS* VAR. *ISRAELENSIS* ON NON-TARGET INSECTS IN STREAM TRIALS FOR CONTROL OF SIMULIIDAE

M. H. COLBO AND A. H. UNDEEN

Research Unit on Vector Pathology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada A1C 5S7

ABSTRACT. The mortality of non-target organisms during efficacy tests of *Bacillus thuringiensis* var. *israelensis* against simuliid larvae was evaluated in a small stream in Newfoundland. Three applications of about 1×10^5 cells/ml were made during the spring and summer of 1979. Non-target insects occurring on stones with simuliids were sampled within

24 hr prior to treatment and from 3 to 7 days post treatment. The results indicated there were no significant decreases in the major groups of non-target insects that could be directly accounted for by the treatments. On the other hand the simuliids in the last 2 treatments had an overall mortality of more than 93% in the zone sampled.

INTRODUCTION

Recently, Undeen and Nagel (1978), and Undeen and Berl (1979) showed that *Bacillus thuringiensis* var. *israelensis* de Barjac was an effective larvicide against Simuliidae in the laboratory. Preliminary laboratory trials against Hydropsychidae and *Leptophlebia cupida* indicated these were not affected by the dosage required to kill simuliid larvae. In addition previous studies with *B.t.* strains have indicated that they are relatively specific, and one would not expect a broad spectrum effect. Therefore permission was obtained from the Newfoundland Government for a field test in a section of a small stream below a lake outflow. The results of these tests on the simuliid spe-

cies have been reported by Undeen and Colbo (1980), and this paper reports the findings with regard to other stream insects.

MATERIAL AND METHODS

The application point for the bacterial suspension was 30 m below a lake outflow, at the head of a rubble riffle which constituted the treatment zone. A single 1 min application, calculated to provide a concentration of 1×10^5 bacterial spores/ml, was made using a pre-calibrated 4 liter sprinkling can (Undeen and Colbo 1980).

Due to the difficulties of stream sampling it was decided to use an arbitrary method and examine only the fauna asso-