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ABSTRACT

A TAXONOMIC, ECOLOGIC AND ZOOGEOGRAPHIC STUDY  
OF THE ASILIDAE OF MICHIGAN

by  
Norman T. Baker

Eighty-eight species of Asilidae have been recorded from Michigan. An additional seven which may occur here are included. Keys to subfamilies, genera and species are given. Four subfamilies and thirty genera are represented. A discussion of specific identification, habitat, and distribution is given where possible. Six faunal regions are defined and discussed.

The Laphria canis complex, index complex, and aeatus complex are discussed. One new species, Laphria calvescenta is described. Laphria disparella has been raised from synonymy. Tolmerus virginicus was removed from Asilus sensu-latu and placed in the genus Tolmerus.



A TAXONOMIC AND ECOLOGIC STUDY OF THE  
ASILIDAE OF MICHIGAN

by

Norman Thomas Baker

A THESIS

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NORMAN THOMAS BAKER

1970

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## INTRODUCTION

This study is a review of the robber flies which occur within Michigan. Specimens for the study were collected during the summers of 1967 and 1968. Habitat information was recorded as specimens were collected. Additional specimens were borrowed from other institutions. Approximately 4500 specimens were examined during the course of this study.

Eighty-eight species of Asilidae have been recorded from Michigan, and an additional seven might occur here. These species represent four subfamilies and thirty genera.

A discussion of the identification, habitat preference and distribution are given where possible for each species. Distributional data is given in summary form for well known species and complete data is given for species which are poorly known. Keys for specific identification are given. Six faunal regions and the species included in each are defined and discussed.



## SYSTEMATICS

Linnaeus erected the genus Asilus in the tenth edition of "Systema Naturae" in 1758. Asilus crabroniformis is the type species of the genus Asilus. Asilus is the type genus of the family Asilidae. In 1803 Meigen separated Asilus into Dasypogon, Leptogaster, Laphria, and Asilus. These four genera now form the basis of the four subfamilies currently recognized. Leach (1819) raised the genus Asilus to family level. Loew in a series of papers raised three genera of Asilidae into two subfamilies using Leptogaster and Dasypogon to form Dasypogoninae, and Asilus to form Asilinae. Macquart (1838) recognized Laphria as the subfamily Laphriinae. Schiner (1868) erected the subfamily Leptogastrinae. Martin (1968) raised the subfamily Leptogastrinae to the family Leptogastridae and Oldroyd (1969) promptly chose to preserve the subfamily rank of Leptogastrinae. Nearly all modern authors recognize these four subfamilies.

Hardy (1934) has proposed only two subfamilies and synonymizes Laphriinae with the Dasypogoninae and the Leptogastrinae with the Asilinae. The limits of the

subfamilies break down when applied to the Australian fauna. Carrera (1949) has followed Hardy in recognizing only two subfamilies. Karl's (1959) excellent work on asilid genitalia likewise leads him to believe there are only two subfamilies. Hull (1962) has erected a fifth subfamily, the Megapodinae, and entirely neotropical group of flies closely related to the Dasypogoninae. The systematic treatment followed in this study recognizes four subfamilies as was done by Martin and Wilcox (1965).

In North America, Hine, Williston, and Back were the first to contribute significant taxonomic papers on Asilidae. Since then, Bromley, Curran, Martin and Wilcox have industriously contributed a wealth of taxonomic papers. Several annotated lists of species have been published; notably by Bromley (1931, 1933, 1934b, 1937 and 1946), James (1941), Johnson (1909, 1913, 1925), McAtee and Banks (1920).

#### ZOOGEOGRAPHY

An analysis of the continental distribution of the asilids endemic to Michigan show six distinct macrogeographic faunal regions. These faunal regions

are illustrated in Figures 1 through 4.

Voous (1955, 1963) has advocated the faunal analysis used here on Michigan Asilidae. He stresses that by using the analytic approach of superimposing distribution maps of single species to detect faunal regions, distinct faunas are demonstrable. However, distinct zoogeographic regions applicable to all animals are not demonstrable.

Uvarov (1938) uses the term ecofauna to designate the lowest zoogeographical unit or area which a species inhabits. According to his definition, a species may locally belong to only a single ecofauna. Members of a single faunal region are not necessarily related phylogenetically and may also have belonged to historically different faunal regions due to the very dynamic nature of zoogeography. Uvarov's ecofauna is very similar to Clements (1916) biocoenosis or biotic community but is different in that the organisms involved are not presumed to be interdependent in their lives. The term ecofauna was not applied to the Asilidae because of the very strict definition of local populations and not the continentally distributed ranges of species. Any single

species of robberfly would belong to many different local ecofaunae over the extent of its range.

Nikolsky (1947) defined the term faunal complex as a group of species connected by a common geographical origin, that is, by the development in the same geographical zones within which the several species of the complex are adapted. This definition does not account for the importance of the entire continental distribution of any single species. Also, no mention is made of the importance of phylogeny amongst the groups or species under consideration. For these reasons the term faunal complex was not applied to the Asilidae.

The term faunal region is used and defined as any geographic region where a number of phylogenetically related animals have a similar continental distribution. This includes the entire geographical distribution of any species under consideration. Plainly the definition applies to more than a single species and may also be applied to a taxon higher than the species level. The exact limits of such a faunal region are somewhat arbitrary due to the fact that not all of the species concerned will have exactly co-extensive ranges.

The faunal regions defined here for the Asilidae do not correspond to life zones or biotic provinces as conceived by Dice (1943) or Merriam (1892, 1894). Nor do these faunal regions conform to potential natural vegetation areas (Kuchler, 1961). Approximately 70% of the species endemic to Michigan occupy faunal regions. The remaining 30% may occupy undefined faunal regions or possibly not belong to any defined faunal region. All of the faunal regions overlap to some extent within Michigan. The species of asilids involved in each faunal region are not closely related phylogenetically as almost every group contains species from all four subfamilies. The several species of Asilidae occupying each faunal region are distributed over most of the entire range indicated for each faunal region. Since all of the species do not have co-extensive ranges, this alone necessitates the limits of the faunal regions being somewhat arbitrarily delineated on the maps.

Each faunal region is part of a large flora and fauna occupying generalized areas and climates. A detailed analysis for faunal regions of other terrestrial groups of arthropods apparently has not been done for

eastern North America. Undoubtedly, each taxon examined areogeographically would have considerable similarity to the faunal regions defined here but would exhibit their own singularity just as was shown for the Tabanidae (Hays, 1956) and Odonata (Kormondy, 1958).

The Northwestern Faunal Region extends from the Norton Sound, Alaska, through Canada, closely skirting the southwest tip of Hudson Bay, to include all of Michigan and then extends directly across the United States to Vancouver Island, British Columbia. Two asilid species inhabit this area: Echthodopa pubera and Lasiopogon terricola. The extent of the region compares with the same faunal region shown for Tabanidae (Hays, 1956).

The Boreal Faunal Region corresponds in extent with the boreal forests of North America. This region extends from Cape Cod, Massachusetts, to a line directly across the middle of the lower peninsula of Michigan through to the center of Wyoming and south along the Rocky Mountains to New Mexico, and north and westward to Vancouver Island, British Columbia. These species inhabit this faunal region: Cyrtopogon bimacula,

Laphria gilva, L. janus, and L. sadales. The limits of the Boreal Faunal Region for the Odonata and Tabanidae and Asilidae agree except for the western most range. The Asilidae apparently do not have the southward extension into California present in other groups.

The Transcontinental Faunal Region extends from the Gaspe Peninsula across the continent to Vancouver Island, British Columbia and covers the entire conterminous United States. The southern limits are somewhat vague due to the poorly collected areas in Mexico and is shown as a dotted line in Figure 2. The species inhabiting this faunal region are: Andrenosoma fulvicauda, Efferia albibarbis and Proctacanthus milbertii. The Tabanidae do not exhibit a Transcontinental Faunal Region. The Odonata have a comparable faunal region (Kormondy, 1958).

The Eastern Faunal Region extends from the Gaspe Peninsula westward through Canada to the 100th meridian and southward through the United States into Mexico as far south as Tropic of Cancer. Due to the poorly collected areas of Mexico, the southern most limits are not clear and for this reason the lines on the map are dotted. The western limits of the Eastern Faunal Region

border on the Great Plains. These species inhabit this region: Leptogaster incisuralis, Tipulogaster glabrata, Ceraturgus cruciatus, Holcocephala abdominalis, Holopogon phaeonotus, Laphria flavicollis, L. thoracica, Efferia poqonias, Promachus bastardii, Tolmerus notatus and T. snowii.

A significant subelement of the Eastern Faunal Region is the lower Eastern Faunal Region. This region extends from the eastern-most tip of Maine southwestward bisecting the lower peninsula of Michigan and continuing to north Texas where the south limits are coincident with the Eastern Faunal Region. This region seems to be coincident for the most part with the broadleaf and hardwood forests of Kuchler (1961). These following species inhabit this faunal region: Leptogaster brevicornis, Psilonyx annulatus, Diogmites misellus, Holcocephala calva, Atomosia puella, Lampria bicolor, and Ommatius tibialis.

The Atlantic Coastal Plain Faunal Region is probably the most unique faunal region. It extends from the Gaspe Peninsula southwestward to the eastern half of the upper peninsula of Michigan and south into northern



Illinois. From this point it extends eastward to the easternmost tip of West Virginia and southward along the eastern slope of the Appalachian Mountains straight into Florida. This faunal region is inhabited by these species: Leptoqaster atridorsalis, Ceraturgus aurulentus, Cyrtopogon falto, Taracticus octopunctata, Laphria canis, L. cinerea, L. sacrator, L. sericea, Pogonosoma dorsatum, and Tolmerus novaescotiae.

A distinct subelement of the Atlantic Coastal Plain Region is the Middle and Northern Atlantic Coastal Plain Faunal Region. This region extends from the eastern tip of Maine to include the eastern third of the upper peninsula of Michigan and eastern shore of Wisconsin, eastward to the northern tip of Virginia and south to include North Carolina. Beameromyia disfacia, Cyrtopogon lutatius, C. marginalis, Lasiopogon opaculus, Laphria aktis, L. disparella, L. winnemana, Asilus auricomus, Neoitamus flavfemoratus, N. orphne, Tolmerus maneei, T. sadyates, and T. virgincus. All occupy this region. Both the Tanidae and Odonata exhibit the Atlantic Coastal Plain Faunal Region but apparently without subelements and with very different southern limits.

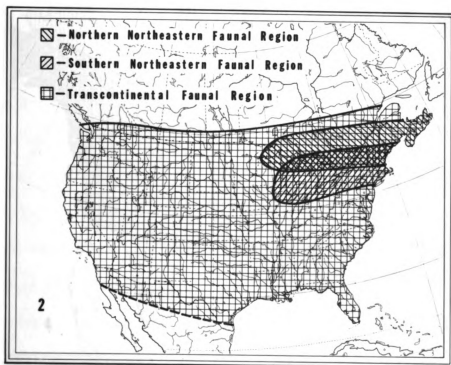
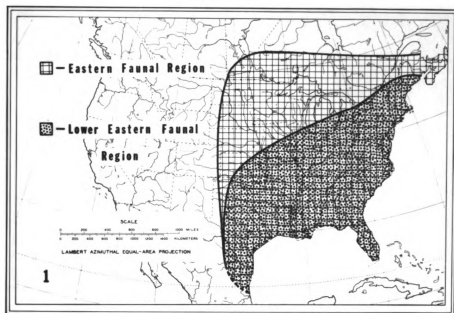
The Northeastern Faunal Region is divided into two subelements. A northern and a southern. The northern element extends from northernmost Nova Scotia westward to include all of the western shore of Lake Superior and eastward through the northern half of the lower peninsula of Michigan to the southern limit of New Hampshire. These species inhabit this region: Dioctria propinqua, Laphria altitudinum, L. huron, and L. insignis. The southern element extends from southernmost Nova Scotia to include all of Michigan's Lower Peninsula and western shore of Lake Michigan and eastward to New York. These species inhabit this region: Diogmites basalis, D. discolor, Lasiopogon tetragrammus, Laphria scorio, Asilus latipennis and A. piceus. The entire Northeastern Faunal Region seems to be associated with the Saint Lawrence Seaway and the Great Lakes drainage systems. Apparently however, the northern element is more closely associated with the boreal forests and the southern element more closely associated with deciduous forests as seen on Kuchler's (1961) Potential Natural Vegetation Map. The Tabanidae exhibit a very similar Northeastern Faunal Region while the

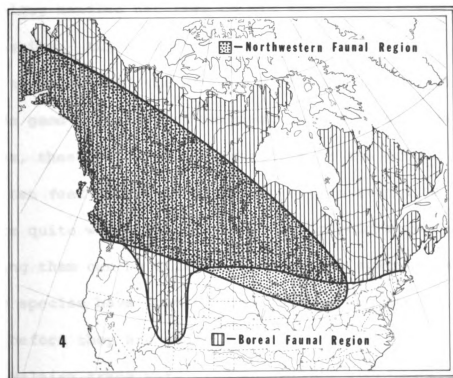
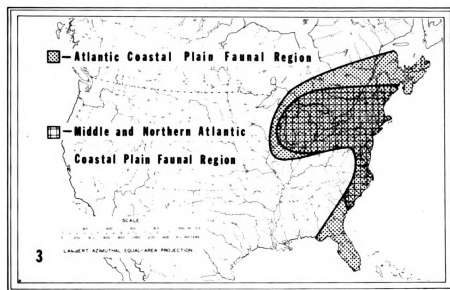
Odonata do not.

Not all species endemic to Michigan occupy faunal regions for various reasons. The distributions of some species are very poorly known and consequently these species cannot be included. Species in this category may very well belong to one of the above described faunal regions. Interspecific displacement of one species by another may occur and prevent dispersal of a species into a potential area. Some species with well known geographic ranges may possibly fit as yet undefined faunal regions. Certain species and especially introduced species may have drastically changing distributions due to environmental changes by man, e.g., destruction of prairies, forests, plantation planting. Certain species may be dependent on particular species of plants for food or some stage of the life cycle and thus not occupy the entire potential faunal region.

#### TECHNIQUES

Most species of robberflies are found in relatively restricted habitats which can present problems collecting





and observing uncommon species. The most productive collection method is to quietly walk through a habitat stalking and netting the flies as they are seen. Nearly all asilids are easily alarmed and being excellent fliers, fly great distances when alarmed. A few species of Laphria take stations and will return to the original site within a short time. All specimens should be captured as quickly as possible since unnecessary stalking usually results in no specimen. A large long handled net five to six feet long is almost a necessity. All specimens should be pinned in the field to help avoid the problem of "greasing" and to provide good material for examination. Depending on the species, these flies may sit directly on the ground or up to ten feet above the ground on a tree trunk. A few are quite well camouflaged by their coloration and spotting them can be difficult unless the specimen moves. Larger species have loud buzzing flights and are often heard before they are seen.

Malaise traps were used to collect specimens during this study. Successful collection of asilids is dependent upon careful placement of the trap. The best

location is along an ecotonal area such as a forest edge. For the most part smaller species are captured whereas larger species of the genera Proctacanthus and Efferia use the trap as a lookout station and are seldom captured. Ethylene glycol should not be used in the trap because of the resulting poor condition of the specimens. Seventy percent alcohol is far superior as a killing agent. The trap should be emptied daily and the specimens mounted immediately following the instructions of Vockeroth (1966). Window pane traps are especially effective for those species found in forests. Pitfall traps are useful for collection of a large number of certain species. Some species of Tolmerus and "Asilus" have behavior patterns that make them especially susceptible to pitfall trap capture. These species continually land on light colored sunlit objects on the ground in the proper habitat.

The single greatest problem in species identification of the Asilidae is the tendency for specimens to "grease." Greasing obliterates the pattern and coloration of the pollinose condition and ground color characters which are very important in determination of many species.

Recently pinned specimens showing signs of greasing can be restored by soaking the specimen in xylene or benzene about one week. Older specimens will "degrease" but will be considerably faded after restoration. If specimens have to be relaxed, they should always be degreased first. Otherwise the specimens will deteriorate badly. Relaxing is best done by a short soaking in a solution of 3% aqueous ammonia.

Certain people have collected large numbers of specimens and where complete information has been given for rare species collector's initials have been used rather than using the entire name. These people are: NTB - Norman T. Baker, RRD - Robert R. Driesbach, RLF - Roland L. Fischer, CWS - Curtis W. Sabrosky.

#### MORPHOLOGICAL TERMINOLOGY

Morphological terms which need explanation in the Asilidae are not very extensive. Figures 5 through 12 demonstrate these structures. Wing venation terminology follows that of Comstock and Needham from Crampton's "Guide to the Insects of Connecticut" (1942). Genitalic terminology follows that of Karl (1959).



1. Alula - This is the expanded axillary membrane of the wing; also known as alulet, squama, calypter, or axillary lobe of some authors.
2. Antenna - The antennae of asilids may have three or five segments. Microsegments may or may not be present between second and third segments and the third segment and style. The style may be quite long or reduced to a recessed pit on the apex or side of the third segment or it may be lacking.
3. Beard - This refers to the thick patch of long, fine hair on each side of the face below the eyes on the gena and on the base of the proboscis.
4. Epandrium - This is derived from the ninth abdominal tergum of the male dipteran and usually forms the dorsum of the hypopygium. This sclerite is usually split longitudinally and when strongly developed, functions as a clasping organ. This sclerite corresponds to the "superior forceps" and "gonoforceps" and includes the surstyli of other authors (Emden,

1956; Karl 1959). Various dorsal or apical processes on the epandria may be present.

5. Frons - The frons is actually that sclerite between the eyes which extends from the oral margin up to the median ocellus and surrounds the antennae. For taxonomic purposes, however, the frons refers to the area between the bases of the antennae and the dorsal border of the gibbosity. (Fig. 6.)
6. Front - This is the area between the antennal bases to the median ocellus and is actually a part of the frons. (Fig. 6.)
7. Gibbosity - The lower portion of the frons; usually covered by the mystax. (Fig. 6.)
8. Ground Color - The integumental color of the specimen, not the color of the pollen.
9. Ground Color Bands - The integumental color bands of the abdominal segments, designated as anterior or posterior.
10. Humeral Callus - The anterior angles of the prescutum of the mesothorax, usually a more or less rounded tubercle; also called humeri. (Fig. 6.)

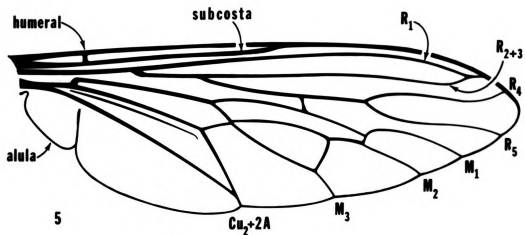
11. Hypandrium - Derived from the ninth abdominal sternum of the male dipteran and usually forms the venter of the hypopygium (except in the Laphriinae); usually a simple sclerite without protruberances or appendages and usually not split longitudinally. This structure is synonymous with the "subgenital plate" of other authors. (Emden, 1956; Karl, 1959).
12. Hypopleura - the sclerite between the just above the meso- and metacoxae. See Figure 6.
13. Hypopygium - this term is synonymous with the entire male external genitalia, including all of the ninth and succeeding abdominal segments.
14. Legs - with the legs stretched out laterally, the anterior surface is that surface facing toward the head.
15. Microtrichia - these are minute hair-like or bristle-like structures covering the wings.
16. Mystax - the patch of hair or bristles above the mouth on the facial gibbosity.
17. Ocellar tubercle - the swelling on which the ocelli are placed.

18. Occiput - in Diptera the whole posterior of the head.
19. Pleura - the lateral areas of the thorax between the mesonotum, scutellum and the sterna.
20. Pollen - the dusty or pruinose surface covering which under very high magnification (216X) is composed of extremely fine, short, dense recumbent hair. Unless referred to as ground color the general body color is attributable to these fine hairs.
21. Postmetacoxal arch - the unusual sclerotization of the membranous area between the metacoxae and abdomen of all species in the tribe Ommatini.
22. Pronotal bristles - the bristles present on the dorsum of the collar-like pronotum. See Figure 6.
23. Pteropleuron - the sclerite immediately below and just anterad of the base of the wing.
24. Sectorial vein - the crossvein (Fig. 5) which extends from the stem of  $R_{2+3}$  to  $R_{4+5}$  or from  $R_3$  to  $R_4$ .

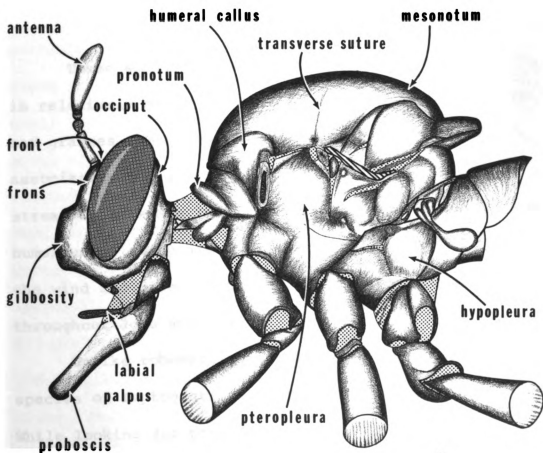
25. Tomentum - this is a matted, woolly pubescence  
usually composed of short flattened recumbent  
feather-like hair. This pubescence is clearly  
visible at about 60X magnification.

#### Key to Subfamilies of Asilidae

1.  $R_1$  cell open.....2  
 $R_1$  cell closed.....3
2. Palpi one segmented; small, slender species;  
antennae with slender terminal arista  
.....Leptogastrinae  
Palpi two segmented; antennae without terminal  
arista but may bear a thickened style  
.....Dasypogoninae
3. Palpi two segmented; antennae never aristate  
(except for extremely rare Dasylechia atrox  
(Williston).....Laphriinae  
Palpi one segmented; antennae with a slender  
terminal arista.....Asilinae



Asilus sericeus



Laphria sp.

## LEPTOGASTRINAE

This subfamily is characterized by: antennae with three segments and a slender terminal style; one segmented labial palpus;  $R_1$  cell open; complete absence of alulae; lack of pulvilli; empodia rudimentary or absent; long, slender, somewhat clubbed or clavate abdomen, never clothed with dense pile; hypopygium generally large and well developed.

## Biology of Leptogastrinae

These small, slender, delicate flies are found in relatively mesic habitats supporting dense vegetation and grasses. Meadows, swales and the edges of forests associated with a nearby source of water such as a stream or lake are ideal habitats. These flies are most numerous in sandy areas that are well protected from the wind and direct sunshine. They generally occur throughout June and July.

Unlike robberflies of other subfamilies, all species of Leptogastrinae pursue prey that is not flying. While looking for prey they fly slowly through the vegetation turning and hovering and even backing up.

The wings vibrate so rapidly that they are not seen and the little flies often seem to be gracefully floating through the air. During flight the abdomen is held parallel to the ground, the first two pairs of legs folded and tucked beneath the thorax, with the metalegs dragged along behind. Occasionally these flies will swoop downward and clutch a stem or twig to rest. Their position is more akin to hanging with their head pointed upward than to a sitting position as other asilids.

Leptogastrinae prey upon almost any arthropod of suitable size which happens to be seen sitting on the stems or leaves of a nearby plant. Aphids, leafhoppers, small Diptera, Hymenoptera and spiders are the usual prey, although hymenopterans often escape presumably because the asilid cannot penetrate the exoskeleton. When prey is sighted, the "grass fly" as named by Martin (1968) will turn slowly toward it and begin an approach. When relatively close it darts in and captures its prey. Using the tarsi of the pro- and mesolegs and then kills the prey with its hypopharynx. These flies are not particularly adept hunters and will often attack any inanimate object which resembles prey, such



as seed pods. Consuming the prey takes place on a nearby stem where the fly dangles by either one or two tarsi, the other legs being used to support the prey.

Details of the courtship behavior in the Leptogastrinae have never been recorded except to say that the male "attacks" the female until the genitalia are joined. The male genitalia are not rotate (Karl, 1959). Once the sexes are coupled, the male hangs head down and inverted 180 degrees from the female. The female usually sits in a typical resting position on a twig or grass stem. The male may support himself on the stem or twig below the female. If disturbed the copulating pair will fly away with the female leading and dragging the male behind. The male may or may not beat his wings.

Females of Leptogastrinae have no specialized ovipositor and no specialized behavior is known to be involved in egg laying. The females settle onto a stem or twig and after some contortions of the abdomen extrude a single egg which falls to the ground. Some species expel eggs while in flight. The eggs hatch in ten to eleven days (Melin, 1923).

The larvae of Leptogastrinae can be distinguished from other subfamilies by: having broad mandibles untoothed at the apex with the palpus placed in an incision on the dorsal side; abdominal segments with one pair of ventral fleshy protruberances; second joint of mandibles widely separated; maxillae lacking. Compared to other asilid larvae, they have a rather poorly developed but relatively broad head capsule. All known larvae of Leptogasterinae live in sandy soil beneath dense herbaceous vegetation where they feed on the dense fine matted roots of bushes or trees (Melin, 1923).

Pupation occurs just beneath the surface of the soil in a slightly hollowed chamber. The pupa is a brownish to tan creature with numerous long hairs and bristles, with small cube-like antennal processes and only two spine-like processes on last segment of abdomen. The duration of pupation is known to vary from two to six weeks, with emergence of laboratory specimens nearly always occurring in the early morning (Melin, 1923).

## Key to Genera of LEPTOGASTRINAE

1. Third antennal segment three and one-half to four times as long as second segment; style one-half length of third antennal segment; dorsal and ventral arms of epandria of equal width throughout their length  
.....Tipulogaster Coquillett
- Third antennal segment no more than two to three times as long as second segment; style longer than three-fourths length of third segment; dorsal arm of epandria lacking or dorsal arm much thinner than ventral arm.....2
2. With median circlet of hair on second abdominal segment; M<sub>2</sub> vein sharply angulate.....3
- Without median circlet of hair on second abdominal segment; M<sub>2</sub> straight (angulate in L. atridorsalis).....Leptogaster Meigen
3. Without empodia; epandria deeply bifid, dorsal arm very slender, ventral arm broad.....Psilonyx Aldrich

With empodia; epandria taper to point and

dorsal arm absent.....Beameromyia Martin

#### Genus BEAMEROMYIA Martin

Beameromyia Martin, 1957, Bull. Amer. Mus. Nat. Hist.

111: 355

Generic Characteristics - Antennae much like Leptogaster

with a short style; labial palpi exceptionally small;

M<sub>2</sub> sharply angulate; empodia present; median circlet

of long, fine hair present on abdominal segment 2;

epandria taper to point; length 6 mm to 10 mm.

#### Key to Species of Beameromyia

##### 1. Epandria dark brown, terminal projection

truncate; upper occiput at base of ocellar

tubercle gray; base of third antennal

segment orange becoming brown distally

.....B. pictipes Loew

##### Epandria testaceous, terminal projection

acuminate; upper occiput at base of

ocellar tubercle brown; third antennal

segment brown.....2

2. Abdominal segments two and three with

yellow posterior ground color bands,

segment four with red posterior ground

color band; ground color of scutellum

red.....B. vulgaris Martin

Posterior bands of abdomen absent or very

dark red; ground color of scutellum

black.....B. disfascia Martin

Beameromyia disfascia Martin

Beameromyia disfascia Martin, 1957. Bull. of Amer.

Mus. Nat. Hist. 111: 357.

Description - Third antennal segment brown; occiput

brownish, at least at base of ocellar tubercle; radial

cell stippled with microtrichia becoming sparse basally;

apical two-thirds of hind tibiae reddish-brown; abdomen

black and brown pollinose; segments 2, 3 and 4 with white

pollinose posterior bands; epandria dark brown, terminal

projection truncate. Length 7 mm.

Habitat Preference - Unknown.

Michigan Distribution - A single specimen has been collected from Wexford Co., T23N, R9W, S?, 14 August 1965, J.H. Shaddy. Martin (1957) reports the distribution of this species from southern New York south to Virginia and westward from New York to central Ohio.

Flight Range - Martin (1957) reports 16 June to 30 July as flight dates for the entire range of this species.

Beameromyia pictipes (Loew)

Leptogaster pictipes Loew, 1862. Berliner Ent. Zeitschr. 6: 189.

Description - Third antennal segment orange becoming brown distally; occiput gray; radial cell with very few microtrichia; apical two-thirds of hind tibiae dark brown often with testaceous median band; abdomen uniformly light brown with whitish pollen; epandria with terminal projection truncate. Length 5-7 mm.

Habitat Preference - Blanton (1939) and Bromley (1946, 1950c) state the species is found in shady areas in moist forests with sandy soils.

McAtee and Banks (1920) report this species is quite common in Washington, D.C. and is often seen about the flowers of Ceanothus americanus and Tephrosia virginica.

Michigan Distribution - This species is known from only two specimens: Kalamazoo Co., Gull Lake Bio. Sta., 29 July 1969, RLF; Berrien Co., St. Joseph, 13 July 1968, Diana Dee Wilder. Martin (1957) reports the range of this species is a narrow belt from Kansas to Maryland. Bromley (1950a) records this species from Florida although this is doubtful.

Flight Range - Martin (1957) reports flight dates ranging from 5 June to 8 August. McAtee and Banks (1920) report 4 June to 26 September for Washington, D.C.

Beameromyia vulgaris Martin

Beameromyia vulgaris Martin, 1957. Bull. Amer. Mus. Nat. Hist. 111: 363.

Description - Third antennal segment brown; occiput brownish near ocellar tubercle; radial cell partially stippled distally with microtrichia; apical half of hind

tibia dark brown; abdomen dark with yellow posterior bands; epandria bluntly pointed. Length 7 mm.

Habitat Preference - Unknown.

Michigan Distribution - Thirteen specimens from these counties: Lake, Iosco, Kalamazoo, Berrien, Ingham, and Kent Co. Martin (1957) reports this species occurs from New Jersey down the Atlantic seaboard to Florida and west to Indiana and Alabama.

Flight Range - 22 June to 11 August. Martin (1957) reports 20 May to 25 August for the known range. The majority of dates are in June.

#### Genus LEPTOGASTER Meigen

Leptogaster Meigen, 1803. Illiger's Magazine 2: 269.

Generic Characteristics - Third antennal segment ovate, style short; palpi of normal size with blunt apex;  $M_2$  nearly straight (except in L. atridorsalis); empodia present; no median circlet of hair on abdominal segment two; epandria taper to point or are nearly truncate. Length 10-20 mm.



Identification of many of the females is difficult because of the variability of markings and coloration, and are thus not included in the key. The structure of the male genitalia is the most accurate means of specific identification.

Key to the Males of Leptogaster

1. Hypandrium with a raised median triangular area.....3  
Hypandrium without a raised median triangular area.....2
2. Epandria truncate apically; M<sub>3</sub> cell sessile or sub-sessile; mesonotum without polished areas.....L. brevicornis Loew  
Epandria deeply cleft apically; M<sub>3</sub> cell petiolate; mesonotum with one median and two lateral longitudinal polished stripes.....L. virgatus Coquillett
3. Thoracic dorsum highly polished; M<sub>2</sub> sharply angulate.....L. atridorsalis Back  
Thoracic dorsum pollinose; M<sub>2</sub> nearly straight.....4

## 4. Six to ten bristles in the mystax;

microtrichia in discal cell sparse

to moderately dense.....5

Nine to twenty bristles in mystax arranged

in a single row; discal cell densely

stippled with microtrichia

.....L. murinus Loew

## 5. Width of base of triangular midsection

of hypandrium is subequal to its length

and tapers to a blunt point with a small

nipple-like process (Figure 7)

.....L. flavipes Loew

Width of base of midsection of hypandrium

is distinctly less than length, with

a slight constriction one-third the

length from the apex (Figure 8)

.....L. incisuralis Loew

Leptogaster atridorsalis Back

Leptogaster atridorsalis Back, 1909. Trans. Amer. Ent. Soc. 35: 159-160.

Description - Six to ten bristles in mystax; discal cell sparsely stippled with microtrichia; M<sub>2</sub> sharply angulate; anterior two-thirds of mesonotum polished; abdomen semipolished dorsally with yellow ground color bands near incisures; triangular area of hypandrium long and narrow, not well differentiated, with a brush of white hair at apex. Length 8-9 mm.

Habitat Preference - Unknown.

Michigan Distribution - Only four specimens have been collected: Wexford Co., 11 June 1944, RRD; Washtenaw Co., Ypsilanti, 24 July 1935, R. Steere; Tuscola Co., 4 August 1946, RRD; Crawford Co., 1 July 1939, Bullock and RRD. Martin (1957) states this species is distributed only from southern Pennsylvania to North Carolina and westward to Indiana. Bromley, however (1950a) reported this species from Florida.

Leptogaster brevicornis Loew

Leptogaster brevicornis Loew, 1872. Berliner Ent.

Zeitschr. 16: 62.

Description - Six to eight bristles in mystax; discal cell lightly stippled with microtrichia;  $M_2$  straight,  $M_3$  cell sessile or subsessile; thoracic nota brownish-gray pollinose; abdomen with yellow posterior ground color bands on segments two to four, anterior ground color bands on segments three to five interrupted medially; hypandria without median raised triangular area; epandria truncate. Length 10 mm.

Habitat Preference - Unknown.

Michigan Distribution - This species has not been collected in Michigan but might occur in the southwestern part of the state. Martin (1957) states this species occurs over most of the southeastern United States from Maryland to Florida and westward to Kansas and Texas. This species has been collected in central Indiana from Spencer, 27 June 1925 (Martin, 1957).

Flight Range - Martin (1957) gives the flight dates 8 June to 25 July for the known range of this species.

Leptogaster flavipes Loew

Leptogaster flavipes Loew, 1862. Berliner Ent.

Zeitschr. 6: 193.

Description - This species is closely related to L. incisuralis. Both flavipes and incisuralis have: six to ten bristles in mystax; discal cell moderately stippled with microthrichia;  $M_2$  is straight; hypandrium with a raised median triangular area.

L. flavipes and incisuralis can be distinguished only with difficulty. Because of the variability in the markings of flavipes the thoraces and abdomens of these two species frequently have almost identical coloration.

The ground color of the mesonotum of flavipes is usually entirely black while incisuralis is black medially but fades to a more reddish ground color along the postero-lateral margins. An occasional specimen of flavipes will also have the reddish postero-lateral margins of the mesonotum. Both flavipes and incisuralis have the lateral margins of the thoracic nota gray pollinose.

The ground color of the abdomen of the majority of specimens of flavipes is usually brown dorsally with gray pollen laterally. The abdominal coloration may occasionally be completely gray pollinose on segment two and the last three segments. At times there are narrow yellow or reddish posterior ground color bands on segments two to four and rarely on segments two or two and three. An occasional specimen will have the first two or three segments entirely yellow, as in incisuralis, but with narrow black ground color bands at the incisures.

By contrast, the ground color of the abdomen of incisuralis is fairly constant having blackish ground color bands around the incisures and orange ground color between the black bands, and is thinly gray pollinose overall.

L. flavipes and incisuralis are most reliably separated by the structure of the male hypopygium. In flavipes the epandria are more symmetrically pointed and narrowed in lateral view. The width of the base of the median triangular area of the hypandrium is subequal to its length and tapers to a blunt point with a small

nipple-like process on the apex. The epandria of incisuralis are more truncate apically and less symmetrical, with a very short apical triangular point. The width of the base of the median triangular area of the hypandrium is less than the length and has a slight constriction at about one-third the length from the apex. Length of flavipes - 8-12.5 mm., incisuralis - 10-12.5 mm.

Habitat Preference - This species is characteristically found along edges of forests, often associated with grassy areas within conifer forests (Bromley, 1946). I have found this common species in similar habitats but usually associated with sandy soil. The flies are always in shady areas and usually quite close to the ground. They have been most abundant when the proper habitat was relatively close to water, a swamp, or bog. Occasionally this species is taken at light.

Michigan Distribution - Seventy-nine specimens are recorded from these counties: Gogebic, Schoolcraft, Charlevoix, Antrim, Benzie, Grand Traverse, Kalkaska, Crawford, Manistee, Wexford, Missaukee, Roscommon, Mason,

Lake, Clare, Newaygo, Midland, Muskegon, Montcalm, Saginaw, Kent, Ingham, Livingston, Oakland, Van Buren, Kalamazoo, Washtenaw, Wayne and Berrien. Martin (1957) reports this species is distributed from Maine to Minnesota southward to southern Kansas and Georgia.

Flight Range - 5 June to 19 September with the majority of specimens taken in July.

Leptogaster incisuralis Loew

Leptogaster incisuralis Loew, 1862. Berliner Ent.

Zeitschr. 6: 190.

Description - Refer to L. flavipes.

Habitat Preference - Bromley (1946) reports collecting this species in pitch pine plains in Connecticut.

Michigan Distribution - Sixty-eight specimens were examined from these counties: Cheboygan, Benzie, Grand Traverse, Manistee, Wexford, Iosco, Mason, Lake, Arenac, Oceana, Midland, Muskegon, Huron, Livingston, Kalamazoo, Washtenaw and Berrien. Martin (1957) states this species is distributed over the entire eastern United States as far west as Minnesota and central Texas.



Flight Range - 28 June to 21 August with the majority of specimens taken in mid-July.

Leptogaster murinus Loew

Leptogaster murinus Loew, 1862. Berliner Ent. Zeitschr., 6: 190.

Description - This is a dark brownish-black species; nine to twenty bristles in mystax in a single row; discal cell densely stippled with microtrichia;  $M_2$  is straight; thoracic nota brown pollinose, pleurae whitish; abdomen entirely brown with no ground color bands; hypandria with median triangular area distinct. Length 12-14.5 mm.

Habitat Preference - Unknown.

Michigan Distribution - Examination of ten specimens showed this distribution by counties: Huron, Midland, Muskegon, Kent, Shiawassee, Clinton, Ingham, Oakland and Kalamazoo. Martin (1957) reports this species from Michigan and Ohio south to Arkansas and westward to South Dakota and Texas.

Flight Range - 8 June to 10 August. Nearly all dates are in July. Martin (1957) reported 7 June to 8 July for

the known range with nearly all dates in June.

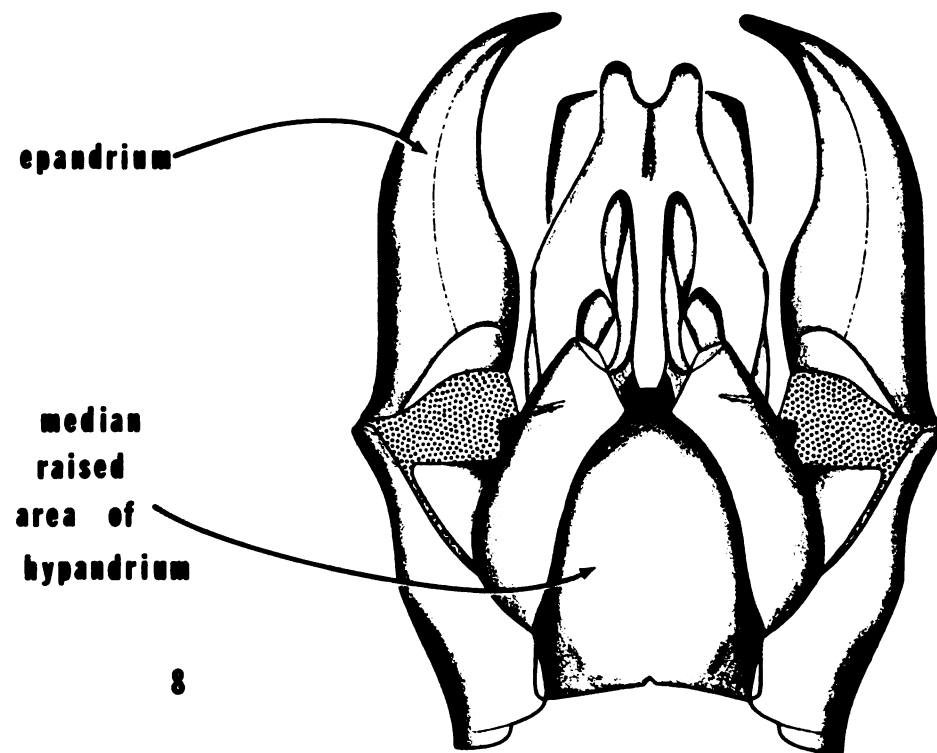
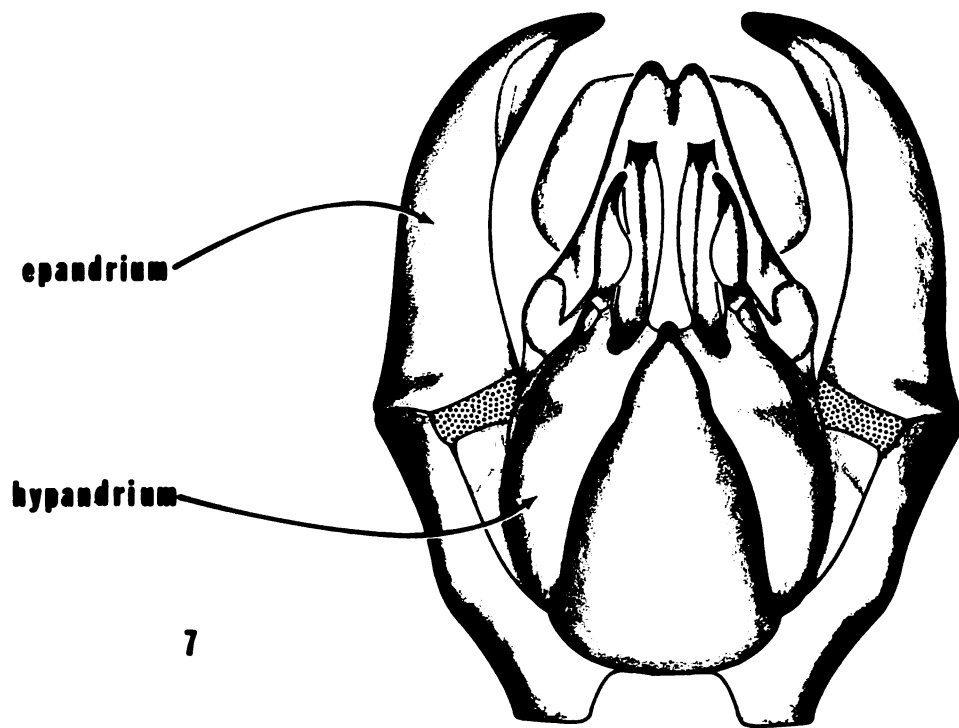
Leptogaster virgatus Coquillet

Leptogaster virgatus Coquillet, 1904. Proc. Ent. Soc.,  
Wash. 6: 177.

Description - Six to ten bristles in mystax; discal cell lightly stippled with microtrichia;  $M_2$  straight,  $M_3$  cell petiolate; mesonotum with median and lateral longitudinal polished stripes; abdomen black and brownish pollinose with grayish pollen at incisures; hypandrium without a raised median area; epandria deeply cleft with dorsal and ventral arms bent dorsally. Length 9-13 mm.

Habitat Preference - Blanton (1939) reports this species found in grassy areas.

Michigan Distribution - This species has not been collected in Michigan but might occur in the southeastern part of the state. Martin (1957) states that this species is distributed from Texas and Oklahoma eastward and northward to Pennsylvania and New York. Bromley (1947) reports this species taken in Ross Co., Ohio.



Flight Range - For the northern part of its range, Martin (1957) and Bromley (1947) give 21 June to 25 July as flight dates.

Genus PSILONYX Aldrich

Psilonyx Aldrich, 1923. Proc. U. S. Natl. Mus. 62: 5.

Generic Characteristics - Antennae much like Leptogaster, style shorter; palpi of normal size;  $M_2$  sharply angulate; empodia completely lacking; median circlet of long, fine hair on abdominal segment 2; epandria deeply bifid with dorsal arm very slender. Length 10 mm to 15 mm.

Psilonyx annulatus (Say)

Leptogaster annulatus Say, 1823. Jour. Acad. Nat.

Sci. Phil. 3: 75.

Description - Four or five bristles in mystax; discal cell moderately stippled with microtrichia becoming more sparse basally;  $M_2$  sharply angulate; thoracic nota brownish-gray pollinose becoming more whitish posteriorly, and laterally brown to yellowish, with posterior yellow ground color bands covered with whitish pollen; hypandria extremely bulbous. Length 9-13 mm.

Habitat Preference - This species is usually found in shaded areas of moist sandy forests (Bromley, 1950c). Newkirk (1963) presents an interesting paper on the behavior of this species. Unfortunately little information is given on its habitat. Small Diptera and Homoptera make up about 70-80% of the prey. However, any arthropod of suitable size may be seized. When not hunting, the fly will rest on anything that supports them. At night P. annulatus rests or perches solely on dead twigs and usually in a hanging position. This species has a peculiar habit of grouping together at or just after dusk. There is almost always a single female and a few males in a group. At dusk, the males will attempt to mate with the female but almost never succeed. With the approach of dawn, however, the females readily mate with the males.

Michigan Distribution - This species has not been collected in Michigan but might be in the southern part of the state. Newkirk has collected this species in large numbers in Ashland, Ohio. Martin (1965) reports this species from New England westward to Ohio and south to Oklahoma and Florida.

Flight Range - Newkirk (1963) reports the flight range at Ashland, Ohio as 30 June to 1 October. McAtee and Banks (1920) give 7 July to 19 September for Washington, D.C.

#### Genus TIPULOGASTER Cockerell

Tipulogaster Cockerell, 1913. Entomologist 46: 214.

Generic Characteristics - Third antennal segment long and slender, style equal in length; palpi of normal size;  $M_2$  nearly straight; empodia present; no median circlet of long fine hair present on segment two; epandria of male deeply bifid, arms of subequal width. Length 14-16 mm.

#### Tipulogaster glabrata (Wiedemann)

Tipulogaster glabrata (Wiedemann), 1828. Aussereuropaische zweifflugelige Insekten, 2: 534.

Description - Four to seven bristles in mystax; discal cell very sparsely stippled with microtrichia;  $M_2$  slightly angulate; anterior two-thirds of thoracic mesonotum highly polished abdomen semi-polished dorsally, ground color brownish fading anteriorly; epandria deeply bifid, arms

of subequal width, dorsal arm usually dark in color.

Length 14-16 mm.

Habitat Preference - This species is usually taken in shady areas with grass or low conifers associated with sandy soil. (Bromley, 1946)

Michigan Distribution - Examination of seventy-three specimens reveals this distribution: Delta, Wexford, Roscommon, Ogemaw, Iosco, Osceola, Gladwin, Oceana, Mecosta, Isabella, Midland, Bay, Huron, Muskegon, Gratiot, Saginaw, Ottawa, Clinton, Shiawassee, Genessee, Allegan, Ingham, Livingston, Oakland, Jackson, and Washtenaw. Martin (1957) states this species occurs from the Atlantic seaboard nearly to the Rockies and southward to Texas and Florida. It has also been taken in southern Canada.

Flight Range - 7 June to 18 August with the greatest majority of specimens in middle July. Martin (1957) reports 11 April to 14 July for known range.

## DASYPOGONINAE

This subfamily has these characteristics: antennae with or without an apical thickened style which may be divided into two apparent antennal segments; labial palpi are two segmented;  $R_2$  cell is open; alulae present; pulvilli are well developed; empodia well developed; abdomen is of many various forms but never clothed with dense pile; male genitalia small and usually not strongly developed; species range in size from 6 mm to 50 mm.

## Biology of Dasypogoninae

This subfamily is remarkably heterogeneous in size, coloration, behavior, and habitat. The smallest species measure no more than 8 mm, while the largest measure almost 60 mm. The habitus will vary from a camouflaging gray to a distinctive black and orange to surprisingly good mimics of aculeate Hymenoptera. Because of this heterogeneity, any discussion of this subfamily must necessarily be made on a generic level.

Species of Ceraturgus, Dioctria, Cyrtopogon and Holopogon prefer ecotonal areas of luxuriant dense



vegetation along the edges of forests. Ceraturgus and Holopogon tend to prefer small open areas where the habitat is more shady, more mesic and protected from the wind. Species of Ceraturgus are excellent mimics of aculeate Hymenoptera and their habitats and behavior are often very similar to their aculeate models. Generally, Holopogon and Ceraturgus fly closer to the ground and in a more restricted area than Dioctria and Cyrtopogon. Dioctria and Cyrtopogon are found in a more open habitat and fly over larger areas. Cyrtopogon is often in full sunshine. The species of these genera sit directly on the foliage while Ceraturgus and Holopogon will sit or hang, respectively, on twigs.

Holcocephala is the most unusual among the Michigan Dasypogoninae for its habitat is restricted to very mesic swales or lake borders where sedges and grasses predominate. Local populations may number several hundred. These "gnat-ogres" (Hull, 1962) sit on the tips of sedges and apparently conduct their entire adult life cycle from the sedge tips or the immediate area.

Diogmites, Stichopogon and Lasiopogon all occur in sandy habitats. Diogmites inhabit fields with more

dense grassy to shrubby habitats with some shade. These flies alight on twigs or grasses relatively close to the ground. Several species are often found in flower gardens. By contrast Stichopogon and Lasiopogon occur in habitats of open sunshine with only a low herbaceous cover or sparse grasses. Species of these genera are remarkably well camouflaged by their coloration. They alight directly on the substrate and seldom fly more than a few inches above the substrate. Species of Stichopogon are generally associated with dry habitats with light colored soil. Species of Lasiopogon occur in more mesic habitats with darker colored substrates and are usually found in closer proximity to water.

Most species of Dasypogoninae are relatively restricted in their choice of possible insects for prey. The slow flying species of Ceraturgus, Dioctria, Holcocephala and Stichopogon have a distinct preference for small insects and especially small Diptera. Species of Diogmites prey on aculeate Hymenoptera almost exclusively. Prey records are relatively scant for Holopogon except for one record of preying on aphids.

Prey is captured and killed four different ways:  
(1) attacking and killing the prey in the air as most

species do; (2) attacking prey on the ground and killing it in the air as Stichopogon trifasciatus alone does or; (3) attacking the prey on vegetation and killing it in the air as Diogmites misellus occasionally does or as Lavigne and Holland (1969) report by (4) attacking the prey in the air and killing on the ground as Diogmites angustipennis.

Lavigne and Holland (1969) reported that some species of Diogmites, Stenopogon, Heteropogon and Lasiopogon show some discriminatory behavior in selecting prey before attempting to capture it. Discrimination usually involved turning the head or the whole body to evaluate its desirability. Stichopogon trifasciatus flips its wings and turns the whole body when prey is sighted. Because of the discriminatory behavior, the Dasypogoninae reportedly make fewer unsuccessful attacks on prey than species of other subfamilies. This discriminatory behavior was not observed among Michigan Dasypogoninae.

The prey is manipulated in three different ways:  
 (1) the protarsi remove the prey from the hypopharynx (actually the fused mandibles) and reposition it while

the asilid rests on the substrate, as most species do, or (2) the asilid suspends itself with a front or middle tarsus and uses the other tarsi to hold and manipulate the prey. Diogmites misellus and Ceraturgus cruciatus have this unique behavior; (3) Stichopogon trifasciatus is the most unique among Dasypogoninae in that it hovers in the air and uses all its tarsi to manipulate the prey. If the prey is quite small, it is usually not manipulated at all except to discard it.

Lavigne and Holland (1969) analyzed the prey of asilids by comparing the area ( $\text{mm}^2$ ) of the prey, as seen by the asilid, to the area ( $\text{mm}^2$ ) of the predator. For each species analyzed, the ratio of prey area to predator area was found to be relatively constant.

Courtship and copulation in Dasypogoninae has rarely been observed but exhibits the heterogeneity typical of this subfamily. Courtship exists in some genera but not all. Species of Cyrtopogon, Dioctria, Heteropogon, Stichopogon, Holcocephala, and Diogmites do have courtship behaviors. Other genera have for the most part not been adequately observed.

The sequence of events of courtship is: the male recognizes the female and approaches her; the female

faces the approaching male; the male hovers in front of the female; the female remains stationary and the male rushes in to attempt copulation. If the female is not receptive she will turn away or fly away in which case the male may repeat the courtship or fly away. The males hover in front of the females in all known genera except Holcocephala. Males of Holcocephala abdominalis hover in a small arc behind the female. Males of the species of Stichopogon, Heteropogon and Cyrtopogon may use a touching or waving and kicking of the protarsi as part of the courtship.

Wilcox and Martin (1936) report that some species of Cyrtopogon also involve lashing of the abdomen and movements and buzzing of the wings as well as waving of the protarsi. It is interesting to note that the species of Cyrtopogon clearly divide into two groups, distinguished easily by the shape and pollinose condition of the scutellum. One group generally has the male sex ornamentation discussed above and the other group does not. Those species with the ornamentation have courtship behaviors and those without the ornamentation do not.

Lavigne and Holland (1969) report that Diogmites angustipennis have the basic courtship outlined above

but that the female flies out to meet the male while he is hovering. The pair meet venter to venter and coupling is accomplished in the air. They then settle onto the vegetation.

Lavigne and Holland (1969) report that male asilids have distinctly different and identifiable wingbeat sound frequencies when foraging and when in copulation. Closely related species could be easily distinguished by their wingbeat frequencies during copulation. They state that movement of the male attracted the attention of the female and that although sound accompanies the hovering flight, there was no indication of it performing a useful or necessary function to the process.

The males of Holcocephala abdominalis court the females from behind and although the females do not always see the males, they are certainly aware of their presence. Occasionally the females would see the males and turn their head slightly as the male flew to the rear of the female to start courtship. Often, however the males initially approached the females from the rear and the females could not see the males. Also the female does not respond to the presence of the male until he has started hovering. In the case of this species at

least, perhaps the hovering flight sounds reinforce the sequence of courtship behavior and may be functionally important.

Copulation occurs after courtship and involves the male which courted the female in all known cases except Stichopogon trifasciatus. If a third male sees the courtship in progress he may rush in and immediately copulate with the female.

Four major copulatory positions occur in the Dasypogoninae. Melin (1923) and Lavigne and Holland (1969) reported the tail to tail position of Dioctria, Lasiopogon, Stenopogon, Cryptopogon and Diogmites. Stichopogon argenteus and trifasciatus have the unusual copulatory position of male over female. Species of Heteropogon have the most unique copulatory position of the male and female in a side by side position (Bromley, 1933; Lavigne and Holland, 1969). Holcocephala abdominalis mate in a position where the male is inverted from the female. Mating occurs on the tips of sedges with the female in a head upward position. The male hangs below the female attached only by the genitalia.

Lavigne and Holland (1969) state that copulation amongst known species of Dasypogoninae usually lasted

for relatively long periods of time, and varies from 10-20 minutes for Lasiopogon polensis to over three hours for Diogmites angustipennis. Stichopogon trifasciatus is unique in having copulation last about one minute.

Karl (1959) states there is no universally common characteristic in the structure of the hypopygium of the Dasypogoninae. There is considerable structural heterogeneity throughout the subfamily. The amount of hypopygial inversion varies from 0° up to 180°. The presence or absence of hypopygial inversion corresponds with the mating position characteristically used for the species within a genus. The more common tail to tail position has been reported from all tribes within Dasypogoninae except Damalini. The tribe Stichopogonini includes the genus Stichopogon with the male over female position. The courtship and mating of Holcocephala abdominalis is unlike any other reported for the subfamily and is reported here for the first time for any species in the tribe Damalini.

There appears to be two types of ovipositional behavior in the Dasypogoninae. Those species with a



relatively undeveloped, simple ovipositor which oviposits while resting on vegetation or while flying and those species with semicirculars of heavy spines oviposit in the soil.

Melin (1923) reports that species of Dioctria oviposit single eggs while resting on vegetation. After oviposition at one site, the female flies to another site to repeat the process. The egg does not stick to the vegetation but falls to the ground. Presumably, Taracticus and Echthodopa have similar ovipositional behavior patterns. Although Holcocephala was not observed to oviposit anywhere, the eggs are probably dropped from the sedges into the moist substrate.

Melin (1923) and Lavigne and Holland (1969) report that Dioqmites, Stenopogon, Heteropogon, Cyrtopogon and Lasiopogon have ovipositors equipped with heavy spines. The spines are used to dig the ovipositor into the soil where the eggs are laid. Those species associated with habitats with firm somewhat bare soil often use the ovipositor to smooth over the hole. These include species of Cyrtopogon, Stenopogon and Dioqmites. Lavigne and Holland (1969) report that Dioqmites angustipennis

also vibrates the abdomen while withdrawing it from the soil. Melin (1923) reports the eggs of Dioctria sp. hatch in about 18 days.

The larvae of Dasypogoninae are distinguished from other subfamilies by: mandibles broad and provided with a lateral incision containing the palpus; mandibles untoothed at the apex; abdominal segments with one ventral pair of fleshy protuberances. The head capsule is relatively well developed (Melin, 1923).

The larvae of all known Dasypogoninae occur in the soil. Melin (1923) reported the larval habitat of some species of Dioctria, Lasiopogon, and Cyrtopogon. Nearly all larvae occur within a few inches of the soil surface although under very dry conditions they may be as much as two feet below the surface.

Larvae have been reported to be carnivorous by most of the early writers. There is however little proof for a carnivorous way of life since most reports have been made from superficial observations. The mouthparts are not morphologically like those of a predator. The mandibles are more ideally suited to a vegetarian mode of nutrition. Melin (1923) has examined this question

in detail.

Pupation occurs very close to the surface of the soil. Melin (1923) reported pupation to take from 17 to 30 days depending on the species.

#### Key to Genera of Dasypogoninae

1. Protibia with a terminal claw-like spur on  
inner side at apex (which may be very  
small.....2
- Protibia without a terminal claw-like  
spur at apex.....3
2. Apex of third antennal segment indented  
and bearing a spine; bristles on  
oral margin; orange or reddish brown  
species with black markings on  
mesonotum.....Diogmites
- Spine on mid-dorsum of flattened third  
segment; hairs on oral margin; black  
species with orange legs  
.....Taracticus

## 3. Antennae elongate and apparently composed

of five segments; the first two segments  
short and subequal in length, third  
segment elongate; fifth segment pubescent

.....Ceraturgus

## Antennae less elongate or short and composed

of three segments, with a short or  
slender style.....4

## 4. Style of antennae short, thick obtuse,

not easily distinguishable from the  
third segment; black bare species

.....5

## Style of antennae small, more slender

than the third segment, usually  
elongate and attenuate.....6

## 5. Hind femora with short strong bristles;

lower one-third of the face is convex  
and bears a dense mystax

.....Ecthodopa

## Hind femora without bristles; lower one-

third of face is weakly convex; mystax con-  
fined to oral margin.....Dioctria



Mystax moderately dense and extending  
 to base of antennae; legs black; wings  
 not usually extending beyond tip of  
 abdomen.....Holopogon

Genus CERATURGUS Wiedemann

Ceraturgus Wiedemann, 1824. Analecta Ent. p. 12.

Generic Characteristics - Antennae porrect, apparently  
 five segmented, first and second subequal in length,  
 third elongate, fourth short, fifth elongate and/or  
 fusiform and densely pubescent; frons slightly and  
 evenly convex to base of antennae; mystax of female is  
 sparse and weak haired, male mystax is abundant and  
 silky, hairs on oral margin longer; ocellar tubercle  
 well developed and tufted with three or four pairs of  
 hairs; mesonotum rather bare with pale pollinose areas  
 on lateral margins, humeri and part of scutellum;  
 protibia without a claw-like spur; pulvilli well  
 developed, empodia blade-like and pubescent; wing cells  
 open except anal which is closed at the margin or very  
 narrowly open; abdomen convex and subcylindrical, pile  
 extremely fine. Length 8-20 mm.

## Key to Species of Ceraturgus

1. Legs entirely yellow; body extensively  
 golden yellow pollinose, black triangular  
 spots on abdominal segments  
 .....C. aurulentus Fabricius  
 Femora completely brown, tibia yellowish;  
 body black; abdominal segments black  
 with posterior whitish pollinose  
 bands.....C. cruciatus Say

Ceraturgus aurulentus (Fabricius)

Dasypogon aurulentus Fabricius, 1805. Syst. Antl.,  
 p. 166.

Description - Ground color black, golden pollinose  
 everywhere except stripes of thoracic dorsum and proximal  
 portions of abdominal segments; last antennal segment  
 fusiform and densely pubescent; wings hyaline; legs  
 bright yellow, apical third of front and middle femora  
 and apical fourth of posterior femora black; abdominal  
 segments with black triangular spots; last two segments  
 completely black. Length 8-9 mm.

Habitat Preference - Bromley (1946, 1950c) collected this species on a freshly cut black birch stump in a clearing. A single specimen has been taken by light trap in Ohio. This species is extremely rare and less than a dozen specimens have been recorded.

Bromley (1950c) notes that this species is a mimic of a worker yellow jacket, Vespa maculifrons (Buysson) or Vespa arenaria Fabricius.

Michigan Distribution - Only one specimen has been collected: Washtenaw Co., 17 August 1925, W.W. Newcomb. Back (1909) and Bromley (1950c) record the known range of this species from New York westward to Jackson Co., Ohio and southward to Georgia.

Flight Range - 11 July to 17 September with the majority of dates in July for the entire range of the species. (Back, 1909 and Bromley, 1950c)

Ceraturgus cruciatus (Say)

Dasypogon cruciatus Say, 1823. Jour. Acad. Sci. Phila. 111: 52.

Description - Ground color black, polished thorax margined and spotted with yellow, abdomen with apical



yellow annuli; last antennal segment elongate and densely black pubescent; wings vary from deep yellow and blackish to nearly hyaline; legs vary from pale to dark rusty reddish-brown; tibia and tarsi sometimes very pale; abdomen polished black, each segment with a brown golden cross band on its posterior portion. Length 16-20 mm.

Habitat Preference - Cockerell (1894, 1913), reports this species from areas of oak and mixed mesophytic forests. Usually it is taken in brushy pastures or edges of forests in very thick brush. This species flies slowly and with a loud buzz. Prey are usually slow flying beetles. Feeding is accomplished by hanging from a twig by a proleg and grasping the prey with the other legs and sucking on the prey.

Bromley (1950c) states this species is a mimic of yellow jackets Vespa maculifrons (Buysson) or Vespa arenaria Fabricius.

Michigan Distribution - Only one specimen has been collected: Iosco Co., State Game Refuge, 24 July 1935, Olson and Gloyd. Back (1909) reports this species is very common in Massachusetts and is found from New York

southward to Florida and Arkansas and westward from New England to South Dakota. Bromley (1931) reported this species in Ohio from Ashland Co. and Waterloo.

Flight Range - Back (1909) reports 23 June to 7 August for Massachusetts. Bromley (1931) reports three specimens all taken in early June in central Ohio.

#### Genus CYRTOPOGON Loew

Cryptopogon Loew, 1847. Linnaea Ent., 2: 516.

Generic Characteristics - Antennae three segmented with a distinct, two-segmented, stout style one-half the length of third segment; frons swollen and protuberant from antennae to oral margin; mystax densely pubescent with long stiff hairs and bristles covering entire frons, bristles stouter on oral margin; ocellar tubercle low, ocelli large, two to three pairs of long slender bristles; thorax is either dully pollinose or shining with variable patterns of dense fine hair or pollen, pile varies from dense, fine and erect to scanty, short and appressed; protibia without claw-like spur; all tibia with long stiff hair, femora usually with dense erect or suberect fine pile dorsally and few bristles; pulvilli normal,

empodia thickened at base; all wing cells open, anal cell narrowly, wings sometimes maculated; abdomen normally slender or attenuate and often nearly bare. Length 9-14 mm.

# Key to Species of Cyrtopogon

1. Scutellum more or less flattened, rugose  
and pollinose except for two lateral  
polished spots.....C. lutatius Walker  
Scutellum convex and entirely shining or  
with narrow transverse band of pollen  
at base.....2
2. Abdominal segments of males conspicuously  
yellow pollinose, females usually  
pollinose laterally.....3  
Without conspicuous yellow pollinose  
areas in both sexes, but with narrow  
caudal pollinose margins.....4
3. Third antennal segment yellowish-red  
.....C. varans Curran  
Third antennal segment black  
.....C. vulneratus Melander

## 4. Third antennal segment yellowish-red

.....C. marginalis Loew

Third antennal segment black.....5

## 5. Wings bimaculate, at apex of wing and

apex of anal cell, dark in males,

faint to almost lacking in female;

proximal two-thirds of tibia brown

.....C. bimacula Walker

Wings not maculated; proximal one-half

of tibia yellow.....C. falto WalkerCyrtopogon bimacula (Walker)Euarmostus bimacula Walker, 1851. Dipt. Saund.,

Pt.2: 102.

Description - Antennae black, first two segments with black hair; frons and front densely yellow-brown pollinose; mystax dense, pale yellow mesally black on outer margins; thoracic dorsum with yellow-gray pollinose pattern except on humeri and notopleural suture; scutellum pollinose only at the base; thoracic dorsum with black pile which is longer on the scutellum; ground color of tibiae and tarsi dark brown and black distally; pile of

legs black except for pale yellow hairs on femora and dense short appressed golden hair on inner side of tibia and tarsi of proleg and metaleg; wings hyaline with two dark brown spots in male, and less pronounced to almost lacking in female; abdomen blue-black and polished; posterior lateral margins of segments two through five white pollinose; sides of segments with pale yellow to white tufts of long hair.

Habitat Preference - Unknown.

Michigan Distribution - This species has been collected from only two localities: Chippewa Co., 25 July 1960, RRD; Marquette Co., 20 July 1955, RRD. Back (1909), Curran (1923, 1924), Melander (1923a) and Wilcox and Martin (1936) have recorded this species from New Hampshire westward through Ontario and Minnesota to British Columbia and southward into New Mexico. This species is apparently a boreal species judging from the known distribution and from the fact that Wilcox and Martin (1936) record a number of more southern localities restricted to elevations above 6,400 feet.

Flight Range - Wilcox and Martin (1936) report 22 June to 18 August for the known range of this species.

Cyrtopogon falto (Walker)

Dasypogon falto Walker, 1849. List., Pt.2: 355.

Description - Antennae black; frons silvery pollinose at sides; front brownish pollinose; mystax dense in male, golden above and black on oral margin, mystax much thinner in female, golden in center and black on outer margin; thoracic dorsum yellowish-brown pollinose with median and lateral subpolished stripes; scutellum convex, polished black and pollinose only at base; dorsum of thorax and scutellum with black pile of equal length; legs black and polished, except the basal half or third of tibiae and distal portion of tarsal segments yellowish; white pile on femora except at apex; tibiae, tarsi, and apex of femora with black pile; mesal side of protarsi in male with white hair; wings hyaline with posterior margin and apex grayish; veins black but yellowish at base, some veins infuscated; abdomen wholly black, polished, white pilose, apex of abdomen in male with more black pile than female; lateral

margins of segments two to five white pollinose.

Habitat Preference - Bromley (1946) reports this common species is usually collected near oak and mixed mesophytic woods and in areas of white pine. It is most common alighting on shrubbery or other low plants along sunny edges of woods. I have taken this species in similar situations and always associated with areas with sandy soils and plants generally less than one foot tall.

Bromley (1946) records this species feeding on Aedes (Culicidae), Chrysogaster (Syrphidae), Pipunculidae and Dioctria (Asilidae).

Michigan Distribution - This species is the most common in the genus and is collected quite often. Eighty-six specimens have been collected from these counties: Keweenaw, Marquette, Dickinson, Schoolcraft, Mackinac, Chippewa, Cheboygan, Presque Isle, Grand Traverse, Kalkaska, Crawford, Oscoda, Manistee, Wexford, Arenac, Lake, Osceola, Clare, Gladwin, Iosco, Oceana, Isabella, Midland, Bay, Saginaw, Sanilac, Livingston, Oakland, and Wayne.

Wilcox and Martin (1936) report this species occurs throughout Canada from Nova Scotia to Alberta and in the United States from Wisconsin, Illinois and the New England states south along the Atlantic seaboard to Florida. Bromley (1931) reported this species from Ohio.

Flight Range - 18 May to 4 August with the majority of dates in early June.

Cyrtopogon lutatius (Walker)

Dasypogon lutatius Walker, 1849. List. Pt.2: 357.

Description - Antennae completely black; frons and front grayish pollinose; mystax white and reaches to antennal base; thoracic dorsum with brown pollinose pattern, humeral callosities and lateral margins of dorsum covered with yellowish-gray pollen; scutellum flat and finely wrinkled, with little hair, gray pollinose over median and with polished black spots laterally; legs black; tarsi reddish-brown; femora with white hairs; tibiae with white bristles beneath; wings hyaline with a faint grayish tinge on distal half; abdomen convex, black and subpolished, first segment with pollinose spots laterally, segments two to seven with white pollinose



bands on caudal margin, bands interrupted on segments two to five and nearly entire on segments six and seven. Length 7.5-10 mm.

Habitat Preference - Blanton (1939) reports this species as always in open sunshine and alighting on tree trunks and stumps of conifers. McAtee and Banks (1920) state this species is usually collected about piles of cordwood.

Michigan Distribution - Nine specimens were examined from these counties: Midland, Lapeer and Cheboygan. Wilcox and Martin (1936) report this species is distributed from New York westward through Ontario and Michigan. McAtee and Banks (1920) have found this species in Virginia and Maryland. Bromley (1931) reports this species from central Ohio.

Flight Range - 30 May to 11 July. Wilcox and Martin (1936) report nearly the same dates for the known range with the majority of dates in middle June.

Cyrtopogon marginalis Loew

Cyrtopogon marginalis Loew, 1866. Cent., 7: 60.

Description - First two antennal segments black, apex of second and third reddish-yellow, apex of third and style blackish; fine white pile on antennal segments one and two; frons and front with fine white pile; mystax laterally and oral margin black, mesally with fine white hair; thoracic dorsum with grayish to brownish pollinose pattern except posterior part from humeri to scutellum which is polished black; pile on polished area black, otherwise short and whitish; scutellum polished black and with white pile; femora black, reddish at apices; with long white pile, yellowish ventrally and black apically; tibiae reddish and darker apically, black pile on inner side and white pile on outer side; tarsi reddish; basitarsus often yellowish; protarsi of male more slender than female and wholly bright yellow with yellow bristles and pile; bristles of tibiae and tarsi of mesoleg and metaleg black; wings hyaline, yellowish basally, grayish apically; abdomen black and polished; segments two to five with an interrupted white pollinose band on posterior portion nearly

touching caudal margin mesally; posterior margins of segments with white pile, remainder is black pilose and tufted on segments two to four. Length 11-12 mm.

Habitat Preference - Bromley (1946) reports this species from white pine woodlands. It alights on stones, fences, tree trunk bases or dried logs in open sunny situations. Blanton (1939) reports similar habits for this species.

Michigan Distribution - Eight specimens show this distribution for Michigan: Keweenaw Co., Isle Royale, 27 June to 8 August, D.E. Bixler, R.W. Hodges; Baraga Co., "Sand Plains," 6 June 1959, Wayne Yoder; Midland Co., 20 May 1942, RRD.

Wilcox and Martin (1936) report this species occurs from New York and New Hampshire southward to Virginia. Curran (1924) reports it occurs westward to Lake Nipigon, Ontario. Bromley (1931) tentatively recorded marginalis as occurring in Ohio but it has never been taken.

Flight Range - 15 May to 1 September with majority of dates in June for the known range of the species (Wilcox and Martin, 1936).

Cyrtopogon varans Curran

Cyrtopogon varans Curran, 1923. Can. Ent. 55: 141

Cyrtopogon varans Curran, 1924. Can. Ent. 56: 279

Description - First two antennal segments black with black hair; third segment yellow, darker basally; style dark; frons whitish pollinose with fine golden to pale yellow bristles above and black bristles on oral margin and a few under base of antennae; front nearly bare in female, polished black; front whitish pollinose or tomentose in male; thoracic dorsum with gray and brown pollinose pattern; lateral areas of mesonotum polished black; scutellum quite convex, smooth, and covered with long fine black hair, middle of base narrowly pollinose; proximal two-thirds of protibia and three-fourths of meso- and metatibia and base of tarsal segments reddish, remainder of all legs black except yellow apical tip of femora; all bristles and hair black; venter of all tarsi, protibia and apex of metatibia with very dense golden pile; wings hyaline and infuscated at crossveins and furcations in center of wing; male abdomen black and subpolished with long fine golden bristles on lateral areas of segment one, most of segments

two to four and caudal margin of segments five to seven; extensive yellow pollinose areas on dorsum of segments two to four, median pollinose spot on segment five; segments five to seven with lateral spots of pollen; female abdomen black and subpolished, with scattered short pale yellow hair, fine pale yellow hairs laterally on segments one to four, pollinose areas limited to large lateral triangular spots of pale yellow pollen. Length 15 mm.

Habitat Preference - Unknown.

Michigan Distribution - This rare species is known only from Keweenaw Co., Isle Royale, 3-7 August 1936, RRD.

(six specimens) and Daisy Farm, 1-3 July 1965, D.E.

Bixler (four specimens). Wilcox and Martin (1936) record only two other specimens known; Gaspé, Quebec, 4 September 1914, C.H. Young; Macdiarmid, Ontario, 21 June 1923, N.K. Bigelow.

Cyrtopogon vulneratus Melander

Cyrtopogon vulneratus Melander, 1923. Psyche 30: 118-119.

Description - Antennae completely black; frons and front covered with dense golden tomentum, a bare spot between

antennae and anterior ocellus; mystax black with yellow facial hair; thoracic dorsum tomentose except at caudal margin; anterior portion of mesonotum golden gray and median caudal portion blackish-gray; notal hairs are black and sparse; scutellum black, convex and shining with a trace of yellow pollen at base, black marginal hairs present but sparse; femora black; tibiae and tarsi reddish except apex, hairs on legs are largely whitish, bristles black; two strong yellow bristles near middle of anterior side of hind femora, inner side of pro- and metatibia with dense deep golden pubescence; wings broad and hyaline, yellowish toward base, slight infuscation about the crossveins; abdomen slender and shining, first and second segment tufted with white pile, second segment less dense; third and fourth segment with short brownish yellow hair; segments five to seven and hypopygium with black hair golden pollen laterally on posterior margins of segments two to five.

Habitat Preference - Unknown.

Michigan Distribution - This species has not been collected in Michigan but may occur in the eastern part of the Upper Peninsula. This uncommon species has been collected in Coniston, Ontario, 27 July by H.S. Parish and in Kearney, Ontario, 26 July 1911, by M.C. Van Duzee.

Genus DIOCTRIA Meigen

Dioctria Meigen, 1803. Illig. Mag., Pt.2: 270.

Generic Characteristics - Antennae elongate and slender with spoon-shaped apical microsegment enclosing a spine, medio-ventral surface of third segment bears an oval patch of pubescence; frons always protruberant at or below base of antennae, otherwise flattened to oral margin; mystax consists of rounded cluster of bristles confined to oral margin; ocellar tubercle high and steep-sided with very small bristles directed anteriorly or with four or five pairs of long bristles; thorax low and shining and often with, longitudinal pubescent vittae, pleuron shining and with patterns of appressed pubescence; pile of mesonotum rather scanty, erect and bristly; legs with dense, short appressed setae dorsally, femora and tibiae with a dense, erect fringe of moderately long

pile, beneath protibia without spur at apex; pulvilli half as long as claws, or well developed; empodium well developed; cells of wings all widely open; abdomen elongate, slender and polished with short, fine, suberect, scanty hair. Length 7-13 mm.

The genera Taracticus and Ecthodopa superficially resemble Dioctria and specimens are often labeled as such in collections. Taracticus has a small, curved apical protibial spur on medial side. Ecthodopa and Dioctria lack protibial spurs. These two genera are separable by characters given in the key.

#### Key to Species of Dioctria

1.  $R_{2+3}$  wing vein reaching wing margin at  
or below apex of wing; second anal  
cell and alulae reduced

.....D. baumbaueri Meigen

- $R_{2+3}$  wing vein reaching wing margin  
before apex of wing; second anal  
cell and alulae well developed.....2



2. Mesonotum entirely pollinose; posterior

margin of mesopleura pollinose

.....D. propinqua Bromley

Mesonotum with a shining black spot on

each side; posterior margin of

mesopleura bare.....D. albius Walker

Dioctria albius Walker

Dioctria albius Walker, 1849. List. Pt.2: 301.

Description - Antennae black with black hair, segment three subequal in length to segments one and two; frons golden yellow pollinose; mystax black haired; scutellum flattened, polished, bare, with long erect marginal hair; femora with denticles and white pile beneath;  $R_{2+3}$  reaches anterior margin of wing before apex; second anal vein and alulae well developed; wings dark. Length 9-11 mm.

Habitat Preference - This species usually occurs within forests or the edges of forests. Usually it alights on large shrubs or low trees (Cockerell, 1894).

Michigan Distribution - Only two specimens have been taken in Michigan: Marquette Co., Huron Mountains, 2 July 1919, A.W. Andrews. Wilcox and Martin (1941) record specimens from New York and Ontario westward to Wisconsin. Bromley (1932, 1950a) reported the species from central Ohio and Florida.

Flight Range - Wilcox and Martin (1941) record 4 June to 28 July as flight dates for this species.

Dioctria baumhaueri Meigen

Dioctria baumhaueri Meigen, 1820. Sys. Besch. bek.

eur. zweifl. Insekten. 2: 245.

Description - Antennae black with black hair, segment three subequal to segments one and two; frons silvery white; mystax sordid white; palpi with pale yellow hair; scutellum convex with short recumbent pile over entire scutellum; femora without denticles and with white pile;  $R_{2+3}$  reaching margin at or below apex; second anal vein and alulae reduced. Length 12-14 mm.

Habitat Preference - This species is an introduced species from Europe. It was first found in Boston, Mass. in 1916. Since then it has spread over much of northeastern North

America.

Blanton (1939) reports this species is often found along fence rows and in old fields with "large bushes such as wild cherry."

I have collected this species associated with Prunus, Philadelphus and Hamamelis. The habitat is usually mesic and usually close to a forest or several large trees. Often this species is taken in nurseries. The flies are often very abundant in particular areas and as many as one hundred may be collected in a single day.

The flies rest on twig tips or leaves three to seven feet above the ground. Prey are small Diptera and Hymenoptera. This species will congregate about flowering bushes and feed on insects attracted to the flowers.

This species was observed on two occasions on flowering mock orange (Philadelphus). Several hundred baumhaueri were observed on a bush approximately ten feet tall which contained several hundred blossoms.

D. baumhaueri was seen everywhere over the bush, darting out after small flies and hymenopterans. No cannibalism

or mating was observed at any time. Over a two day period, nearly all of the blossoms fell from the bush and less than ten specimens of baumhaueri could be found indicating that they will disperse if prey is not readily available.

Michigan Distribution - One hundred and twenty-three specimens show this county distribution: Houghton, Schoolcraft, Clinton, Eaton, Ingham, Oakland, Kalamazoo, and Monroe.

Flight Range - 30 May to 5 August with the majority of dates in June.

Dioctria propinqua Bromley

Dioctria propinqua Bromley, 1924. Occ. Papers Boston Soc. Nat. Hist. 5: 125.

Description - Antennae black with golden hair; third antennal segment longer than segments one and two; frons golden yellow pollinose; mystax in male golden yellow, black in female; palpi with yellow hair; scutellum flattened and bare; femora without denticles, with scattered golden hair;  $R_{2+3}$  reaches anterior wing margin

before apex of wing; male wings yellowish on basal portion. Length 9-11 mm.

Habitat Preference - Unknown.

Michigan Distribution - Only a single specimen is known from Michigan: Baraga Co., T12N R35S S31, 30 July 1935, C. Steinback. Wilcox and Martin (1941) report this uncommon species from Nova Scotia, New York, and Massachusetts. All specimens were taken from 12 to 30 July.

#### Genus DIOGMITES Loew

Diogmites Loew, 1866. Berliner Ent. Zeitschr. 10: 21.

Generic Characteristics - Antennae three segmented with apical microsegment, second segment with two stout ventroapical bristles, microsegment with large, oblique open pit with a spine; frons flattened except for slightly convex oral margin; ocellar tubercle large and squat with one pair long stout bristles; mesonotum pollinose, with scattered setae; legs bristly, protibia with strong apical spine, basitarsi with numerous denticles; well developed slender pulvilli, bladelike empodium; all cells open except  $M_3$ , alulae large; abdomen

elongate, cylindrical, attenuate or slightly clavate,  
pile reduced to scant, fine appressed setae. Length  
16-25 mm.

Key to Species of Diogmites

1. Mesonotum with three velvety black lines  
     distinctly contrasting with the surrounding  
     light yellowish orange pollen.....2  
     Mesonotal lines not distinct and not  
     contrasting (may be only a single  
     median black line), more uniformly  
     brown or reddish brown.....3
2. Palpi entirely yellow haired; sides of  
     abdominal segment one with stout,  
     pale yellow bristles.....D. misellis Loew  
     Palpi with black hair apically; sides  
     of abdominal segment one with black  
     bristles.....D. neoternatus (Bromley)
3. Hairs and bristles of coxae pale; palpi  
     black haired with some dark brown  
     bristles apically.....D. discolor Loew

Hairs and bristles of coxae black;

palpi black haired with some yellow

hair apically.....D. basalis (Walker)

Diogmites basalis (Walker)

Dasypogon basalis Walker, 1851. Diptera, 1: 95.

Description - Antennae yellow with stout black bristles, second segment with two large bristles longer than the segment, third segment with five or more black bristles laterally; mystax pale yellow; palpi with black hair, some yellow hair apically; mesonotum without strongly contrasting black lines, dorsum more concolorous; hairs and bristles of coxae partly or wholly black, abdominal tergum one with seven lateral bristles and long fine hair. Length 17-29 mm.

Habitat Preference - Bromley (1931, 1950c) reports this species is usually found in fields and meadows where tall weeds are especially abundant. Usually these areas are moist. In some areas, this species is quite common in gardens. Prey is usually any aculeate hymenoptera or occasionally Eristalis (Syrphidae). McAtee and Banks

(1920) also record it feeding on a spider. This species commonly alights on twigs or grasses very close to the ground. Occasionally this species is a pest at apiaries.

Bromley (1950c) states that this species is becoming increasingly scarce. At one time it was especially common in the flower and vegetable gardens of New England but now is very seldom found.

Michigan Distribution - Only a single specimen has been collected: Ingham Co., East Lansing, 9 August 1935, C.W. Sabrosky. Bromley (1931, 1936b, 1950c) records this species from New England westward to Iowa and south to North Carolina and Kentucky. This species is commonly collected in southern Ohio and especially in the Ohio River valley.

Flight Range - Bromley (1931) records 3 July to 2 Sept. as flight dates for this species in southern Ohio. McAtee and Banks (1920) report July to 19 Sept. for Washington and in copulo on 1 Sept.



Diogmites discolor Loew

Diogmites discolor Loew, 1866. Cent., 7: 37.

Description - Antennae orange with stout black bristles, second segment with two large bristles, one subequal in length to the segment, third segment with three to six black bristles on outer side; mystax sordid light yellow to pale orange; palpi with black hair, dark brown apically and some brownish yellow on the base; mesonotum with narrow median black stripe, split and fading to reddish brown anteriorly, tapering acutely and fading posteriorly, lateral stripes indistinct and dark brown; hairs and bristles of coxae pale; abdominal tergum one with lateral orange brown bristles and fine black hair. Length 17-22 mm.

Habitat Preference - Bromley (1946, 1947, 1950c) states that this species is found in swales and brushy pastures near the edges of woods. Sometimes this species is common in flower gardens and is occasionally a pest in apiaries. It feeds almost exclusively on aculeate Hymenoptera. McAtee and Banks (1920) list these insects as prey; Leptalea sp. (Formicidae), Vespula vulgaris Linn,

V. maculifrons (Buysson) (Vespidae) and Anthophora furcata terminalis Cresson (Apidae).

Ritcher (1940) found that larvae of this species were a significant predator on Phyllophaga (Scarabeidae) larvae. He estimated that twelve percent of the available Phyllophaga pupae were destroyed by this asilid. He states that over 40 (asilid) larvae were found in the soil attacking pupae in the pupal cells over a two year period. The evidence presented is extremely circumstantial and there is room for considerable doubt about whether these larvae are truly carnivorous or not.

Michigan Distribution - This species has not been collected within Michigan but undoubtedly occurs in the southeastern part of the state for the species has been collected in Henry Co., Ohio. Bromley (1936b) gives the distribution of this species as southern Connecticut westward to Missouri and south to North and South Carolina.

Flight Range - Within Ohio, Bromley (1931) lists 18 July to 31 August with the majority of collection dates in late July. For Washington, McAtee and Banks (1920) record

24 June to 16 September with copulation dates in late July and August.

Diogmites misellus Loew

Diogmites misellus Loew, 1866. Berliner Ent. Zeitschr.

10: 22.

Description - Antennae with black bristles; second segment with one large bristle subequal to the segment; third segment with two bristles on lateral margin; mystax sordid white; palpi with yellow hair; mesonotum with contrasting black lines, median line fades into red anteriorly; hairs and bristles of coxae pale; first abdominal tergum with five, lateral, pale yellow, bristles. Length 14-17 mm.

Habitat Preference - Blanton (1939) reports this species found along fence rows sitting on the ground or green foliage. Bromley (1946) reports this species common to dry fields and pastures. I have found this species in dry sandy areas and nearly always associated with grasses. It flies about six to seven inches above the ground. Generally this fly either lands on the ground or on grass stems, usually within twenty feet of the edge of a tree

line or forest edge.

This species has the unique habit of picking worker ants off grass stems. Its prey is mostly small Diptera and Hymenoptera.

Michigan Distribution - Eleven specimens show this distribution: Newaygo Co., T12N R12W S2, 25 August 1967, NTB; Newaygo Co., 30 June 1944, RRD; Kalamazoo Co., Gull Lake Bio. Sta. 28 July - 27 August, RLF. Bromley (1931, 1936b, 1950c) gives the distribution of this species as New England west to Ohio and southward to Texas and Florida.

Flight Range - For Connecticut, Bromley (1946) gives 22 July to 27 August with the majority of dates in early August.

Dioqmites neoternatus (Bromley)

Deromyia neoternatus Bromley, 1931. Ent. Soc. Amer.

Ann. 24: 433.

Description - Antennae with black bristles; second segment with one pair large bristles less than length of the segment; third segment lacking bristles on lateral margin;

mystax white; palpi with all black hair apically and some yellow basally; mesonotum with strongly contrasting black lines, median line is split anteriorly; hairs and bristles of coxae pale; sides of first abdominal tergite with four large stout bristles. Length 18-29 mm.

Habitat Preference - Bromley (1931, 1950c) reports this species from moist bushy woods or fields, frequently in partial shade. When disturbed, it will fly directly through blackberry thickets to escape. It has been taken at light.

Michigan Distribution - Only one specimen has been collected in Michigan: Van Buren Co., Paw Paw Lake, 5 August 1906, E. Liljeblad. Bromley (1936b) states that this species occurs from Ohio westward to Nebraska and southward to Florida and Texas. Martin and Wilcox (1965) and Bromley (1950a) gives the distribution as Indiana to Colorado and southward to Texas and Florida. Martin (1965) gives the same distribution.

Flight Range - Bromley (1931) gives 22 July to 18 August for Ohio.

## Genus ECTHODOPA Loew

Ecthodopa Loew, 1866. Berliner Ent. Zeitschr. 10: 16.

Generic Characteristics - Antennae elongate and slender, third segment subequal in length to first two and with two microsegments, apical microsegment is spoon-shaped and has a dorsally exposed spine; frons flattened but gently convex on lower one-third; mystax densely pubescent and confined to lower third of face, consisting of a broad patch of long, slender bristles or bristly hairs; ocellar tubercle prominent with vertical sides, anterior ocellus enlarged, stiff pile present; thorax shining, without pollen except on posterior margin of mesonotum and on upper half of pleuron, mesonotum with dense suberect pile and poorly differentiated weak bristles; numerous strong bristles on anterior surface of mesofemora and lateral surface of metafemora, long fine erect pile on all femora, no spur on protibia, pulvilli well developed, empodia short and swollen; all wing cells open; abdomen is narrow, cylindrical and hairy. Length 11-17 mm.

Ecthodopa pubera Loew

Ecthodopa pubera Loew, 1866. Cent. 7, 27: 15.

Description - Antennae black, elongate; segment three longer than segments one plus two; style distinct and about one-fourth as long as segment three; frons and occiput pale golden pubescent; front polished black; male mystax golden; female mystax and often pile of entire body pale white; palpi yellow haired; coxae with long pale hair; pile and bristles of legs are pale; all wing veins are infuscated. Length 11.5-13 mm.

Habitat Preference - Hull (1962) reports this species from low growing foliage at the edge of woodlands.

Michigan Distribution - Only one specimen has been collected in Michigan: Monroe Co., Monroe, 12 June 1949, G. Steyskal. Martin and Wilcox (1965) gives the distribution as South Dakota to Washington and southward to Wyoming and Nebraska. I have however examined several specimens from Dane Co., Wisconsin. I would expect this species to be collected either in the western part of the upper peninsula or in lower part of the lower peninsula of the state.

## Genus HOLCOCEPHALA Jaennicke

Holcocephala Jaennicke, 1867. Senckenb. Naturf. Gesell.

Abhandl. 6: 359.

Generic Characteristics - Antennae three-segmented with a conical microsegment at tip, third segment long; frons reduced and plane, face densely micropubescent with few fine scattered hairs, oral margin differentiated by a crease and bears a mystax of four to six slender bristles; ocellar tubercle pubescent, large, and all ocelli are enlarged; thorax with a high prominent mesonotum, densely micropubescent and pollinose with no bristles and few hairs; protibiae without spur, metatibiae swollen toward apex, basitarsus greatly swollen to about twice diameter of mesotarsus; pulvilli well developed, empodia short and slender; wings usually brown at least basally and very broad, all cells open except anal; abdomen densely pollinose with scanty short pile. Length 5-9 mm.



Key to Species of Holcocephala

1. Scutellum gray pollinose; frons brown

below to white pollinose above

.....H. calva (Loew)

Scutellum pale yellow or golden yellow

pollinose; frons completely brown or

yellow pollinose, without white

pollen.....2

2. Abdomen bright yellow pollinose;

occipital hairs pale golden

.....H. abdominalis (Say)

Abdomen dark brown pollinose with paler

incisures; occipital hairs white

.....H. fusca BromleyHolcocephala abdominalis (Say)Dasypogon abdominalis Say, 1823. Jour. Acad. Sci. Phil.,

3: 50.

Description - Frons golden yellow pollinose; occiput  
is gray pollinose; mystax and occipital hairs are pale  
golden; thorax with dark brownish-black pollinose median

stripe and lateral spots, giving way to golden yellow pollen on lateral areas; scutellum is golden yellow pollinose; legs are reddish-brown, with sparse golden pile; apices of tibiae and tarsal segments more or less blackened; femora often black on dorsal side; abdomen bright yellow pollinose. Length 9 mm.

Habitat Preference - Bromley (1946) reports this species from "meadows or moist areas where herbage is rank." It usually alights on the tips of twigs, sedges, grasses and several hundred individuals may be present in a small area.

McAtee and Banks (1920) and Bromley (1950c) state abdominalis is usually seen perched on grass blade tips in damp situations. Ants, Solenopsis molesta Say and Iasius sp. and a Ceratopogonid (Culicoides) are listed as prey.

I have collected this species inhabiting sedges and grasses on the edge of a lake. Several hundred individuals could have been collected quite easily in a short time. The adults sit with their heads up on the tips of sedges and capture Chironomidae and small Tipulidae when they fly near. This robberfly, the "gnat

ogre" as dubbed by Hull (1962) then settles on a nearby sedge and consumes its prey. They are readily approached for observation.

Males tend to sit with their heads above the sedge tip while females generally sit 8-10 millimeters below the sedge tip. Perhaps the males recognize females by their position on the sedge. Courtship occurs anytime a more active male came upon a female sitting on a sedge. In the beginning phases of courtship the male flies in a short arc behind the female at a distance of three to four inches. A receptive female immediately raises her wings and metalegs over her thoracic dorsum. In a semihovering flight the male extends the metalegs, curls his abdomen beneath, and continues his approach to the female from the rear. Her wings remain raised but her metalegs move in a downward arc to the normal resting position. Often her legs will move in this fashion two or three times. While her legs are moving downward the male rushes in and attempts to couple with the female by touching the tip of his abdomen to hers. Upon contact the metalegs of both sexes grapple for each other, offering a moment of physical

stability while the still-hovering male attempts to couple with the female. If coupling is not successful, the male and female will repeat the ritual until they had coupled or the male departs. This precoupling activity lasts but 5-10 seconds. If coupling is successful, the legs of both sexes release their hold, the metalegs of the female again grasping the sedge and all the legs of the male folded and tucked beneath the thorax. As copulation ensues the male hangs head down, remaining quiescent and extending back with the venter up in contrast to the female. Copulation lasts three to four minutes and may occur at any time during the day. To break the coupling the male begins flight in an upward arc, which places him in the same position prior to coupling. Simultaneously the male pushes downward with his legs on the abdomen of the female and the female curls her abdomen downward. With these combined actions the male genitalia are released and he immediately takes flight to a nearby sedge and remains quiet.

Michigan Distribution - This species has been collected from these counties: Otsego, Manistee, Wexford, Clare, Arenac, Oceana, Muskegon, Montcalm, Huron, Tuscola,

Ottawa, Kent, Clinton, Shiawassee, Genesee, Ingham, Livingston, Calhoun, Washtenaw, Berrien, and St. Joseph. Over three hundred specimens were examined.

This species occurs over most of the United States and southern Canada east of the 100th meridian. (Back, 1909; Pritchard, 1938; Bromley, 1950c)

Flight Range - 2 July to 4 September with the greatest majority in late July and early August. McAtee and Banks (1920) report 20 June to 30 October for Washington, D.C.

Holcocephala calva (Loew)

Discocephala calva Loew, 1872. Cent. 10: 35.

Description - Frons brown below to white pollinose above; occiput is gray pollinose; mystax white; occiput hairs white; thorax with dark brown pollinose median and lateral stripes on mesonotum giving way to silvery gray pollen on lateral areas; scutellum gray pollinose; dark brown legs with sparse white hairs; all femora and tibiae darker on apices; protarsi usually darker than others; abdomen dark brown pollinose and noticeably constricted basally. Length 8-9 mm.

Habitat Preference - This species is commonly found in association with H. abdominalis but is usually found in fewer numbers. Nothing is known of the behavior of this species.

Michigan Distribution - Seventeen specimens were examined from Clare, Oceana, Shiawassee, Barry, Ingham, Kalamazoo, Cass, St. Joseph and Monroe counties.

Back (1909) records this species from New England south to Florida and west to Texas. Pritchard (1938) also recorded Kansas and Oklahoma. Bromley (1931) recorded Ohio.

Flight Range - 8 June to 30 August with majority of dates in late July and early August.

Holcocephala fusca Bromley

Holcocephala fusca Bromley, 1951. Amer. Mus. Novitates  
No. 1532 p. 10.

Description - Frons brown pollinose to light tan above; occiput hairs white; thorax with light brown pollinose median and lateral stripes giving way to yellow-gray pollen on lateral areas; scutellum pale yellow pollinose;

legs reddish-brown with sparse white hairs; apices of tibiae, upper surface of femora, and tarsal segments blackened; abdomen dark brown pollinose with paler pollen at incisures. Length 5.5-7 mm.

Habitat Preference - Unknown.

Michigan Distribution - This species has not been taken in Michigan but probably occurs in the southern part of the state. Bromley (1951) records it from Erie Co., Ohio, Texas and Tennessee.

Flight Range - Bromley (1951) reports 11 July to 15 September as flight dates for this species in Ohio.

#### Genus HOLOPOGON Loew

Holopogon Loew, 1847. Linnaea Ent., 2: 473.

Generic Characteristics - Antennae three-segmented, elongate and slender with two microsegments; frons short, gently convex and retreating to a nearly concave oral margin; mystax densely pubescent with long hair, ocular margins apilose; ocellar tubercle prominent with two or three pairs of long slender hairs, anterior ocellus set at bottom of tubercle; thorax always pollinose, mesonotum

high and prominent, pile is scattered, long, fine and erect; protibia without spur, metatibia and metatarsus distinctly swollen to about twice the diameter of mesoleg; pulvilli well developed; empodia short and swollen basally; all wing cells open except anal which may be closed; abdomen with parallel or tapering sides, generally convex, pile is short, fine and subappressed along middle of abdomen, long and prominent on lateral edges. Length 6-8 mm.

#### Key to Species of Holopogon

1. Viewed dorsolaterally, the mesonotum with

tomentous, median, germinate stripe outlined by broad lateral subpolished stripes, small amount of pale tomentum on lateral areas of mesonotum before transverse suture

.....H. vockerothi Martin

The mesonotum with median tomentose stripe

outlined by broad lateral areas of

pale tomentum.....2



2. Diameter of apical three-fifths of  
 metatibia uniform in diameter or  
 slightly tapering, subequal to diameter  
 of femur.....H. oriens Martin  
 Metatibia clavate, greatest diameter at  
 apex, diameter of femur less than  
 that of tibia.....H. phaeonotus Loew

Holopogon oriens Martin

Holopogon oriens Martin, 1959. Amer. Mus. Novitates  
 no. 1980 p. 22.

Description - Frons with reddish-brown tomentum, partially  
 subshining; mystax black; thorax dark brown tomentose,  
 broad median stripe confluent with lateral stripes,  
 outlined by light yellowish-brown tomentum and dark  
 brown tomentum posteriorly; wing hyaline and apically  
 broad; distal three-fifths of metatibia about same  
 diameter as femur; dense short hair on venter of tibia  
 bright coppery to yellow; lateral margins of abdominal  
 tergites one to seven brown pollinose, dorsum without  
 tomentose pattern. Length 6 mm.

Habitat Preference - Holopogon oriens, H. phaeonotus, and H. vockerothi have recently been recognized as distinct species from H. guttula (Martin, 1959). The confusion arose from an incomplete original description by Wiedemann and the variability of guttula and phaeonotus. Collections will have these species all labeled as H. guttula. Habitat information on these species is therefore confused and no distinctions of habitat or behavior between these species can be made.

Martin (1959) reports that most species of Holopogon are usually found perching on the tips of dead twigs several feet above the ground. He also states that oriens, phaeonotus and vockerothi are often collected together. Melin (1923) states species of this genus are usually found near water. Bromley (1946) reports that "guttula" is a fairly common species in sunny openings or edges of forests or brushy pastures where it alights on the tips of twigs. He also recorded this species feeding on winged aphids.

Michigan Distribution - Thirty-four specimens were examined from these counties: Oscoda, Wexford, Roscommon, Iosco, Clare, Newaygo, Midland, Kent, Allegan, Ingham,

Van Buren, Washtenaw, Wayne, Berrien, Cass, and Hillsdale.

Martin (1959) reports the range of this species as from New York south to South Carolina and northwestward through Tennessee to Minnesota.

Flight Range - 6 June to 31 August with the majority of dates in late June. Martin (1959) reports 23 April to August with most dates in June for the known range.

Holopogon phaeonotus Loew

Holopogon phaeonotus Loew, 1874. Berlin. Ent. Zeitschr.

18: 366.

Description - Frons with brownish-gray tomentum; mystax completely black or gray with black on oral margin; broad median thoracic stripes not germinate, confluent with lateral stripes, no black subshining stripes, lateral pollen of mesonotum varies in density and from brown to gray; wings of males brownish and narrowed at tip; metatibia of males are clothed ventrally and laterally with dense, dark brown hair; wings of female narrow and light brown; metatibia of female with hair faded reddish brown to bright orange brown; brown pollen on lateral margins of each abdominal tergite of male (of tergites

one to three or four in female), becoming narrower caudally, occasional specimens have dorsal pollinose stripe on anterior margin of tergites four to six (four and five in female). Length 6-7 mm.

Habitat Preference - Refer to H. oriens.

Michigan Distribution - Twenty-four specimens were examined from these counties: Alger, Cheboygan, Grand Traverse, Crawford, Alcona, Manistee, Wexford, Missaukee, Iosco, Osceola, Newaygo, Midland, Montcalm, Gratiot, Saginaw, Kent, Allegan, Livingston, Washtenaw, Wayne and Monroe. Martin and Wilcox (1965) report this species is distributed from Massachusetts westward to Wisconsin and southward to Florida and Texas. Martin (1959) also reports Quebec, and Ontario and New York.

Holopogon vockerothi Martin

Holopogon vockerothi - Martin, 1959. Amer. Mus.

Novitates, No. 1980, p. 31.

Description - Frons densely yellowish brown tomentose, mystax blackish brown with some pale hair; thorax brown tomentose, with median geminate stripe divided by a narrow,

subshining line and outlined by a subshining lateral black stripe, small pale tomentose spots before transverse suture; wings hyaline; metatibia clavate with dense yellow short hair ventrally dark reddish brown hair anteriorly and posteriorly; tergite one laterally broadly brown pollinose, tergite two laterally brown pollinose, tergite seven brown pollinose anteriorly. Length 7 mm.

Habitat Preference - Refer to oriens.

Michigan Distribution - Sixty-eight specimens were examined from Marquette, Cheboygan, Presque Isle, Grand Traverse, Kalkaska, Crawford, Wexford, Missaukee, Iosco, Mason, Osceola, Clare, Newaygo, Midland, Bay, Kent, Ionia, Allegan, Oakland, Van Buren, Kalamazoo, Jackson, Wayne, Berrien, Cass, Hillsdale and Monroe counties.

Martin (1959) records this species from Ontario, Quebec and Manitoba southward through New England Illinois to Georgia.

Flight Range - 24 May to 25 July with the majority of records in middle June.

## Genus LASIOPOGON Loew

Generic Characteristics - Antennae three-segmented and with a single microsegment tapering apically to a long sharp spine; frons abruptly convex below, small flat area just below antennae; mystax of dense, long, stiff bristles on gibbous frons except at ocular margin; ocellar tubercle large with two to three pairs of long, stiff bristles and three to five pairs of long fine hairs; mesonotum low and pollinose with some bristles; pleuron with fine, appressed pubescence, protibia without spur at apex, femora abundantly pilose, decumbent dorsally and laterally, and fine, erect ventrally; long, spatulate pulvilli; blade-like empodium; all cells open except anal which has a slight stalk; abdomen slightly tapered, much of surface is pollinose with fine decumbent pile or bristles in middle of tergites, lateral margins with bristles; male genitalia are large, prominent and obtuse, unlike most other genera in this subfamily. Length 5-9 mm.

Key to Species of Lasiopogon

1. Ground color of legs reddish-brown,  
     femora with blackened medial area;  
     mystax white.....L. terricola Johnson  
     Ground color of legs black; mystax black  
     with some pale hairs.....2
2. Hypopleural bristles and lateral bristles  
     on abdominal segment one mostly  
     black.....L. tetragrammus Loew  
     Hypopleural and lateral bristles mostly  
     white.....L. opaculus Loew

Lasiopogon opaculus Loew

Lasiopogon opaculus Loew, 1874. Berl. Ent. Zeitschr.,  
 18: 367.

Description - Mystax black, occasionally with few pale  
 hairs below; legs black, tibia with long, fine, erect,  
 blackish-brown hair, protibia with ventral, dense, short,  
 bright yellow pile; thoracic dorsum brownish pollinose  
 with median and lateral stripes surrounded by lighter  
 pollen, median stripe occasionally geminate; abdomen black,

entirely gray pollinose on segment one, remainder of segments except last gray with broad brown pollinose areas on anterior dorsum of each segment, last segment black polished with black pile and no pollen. Length 8-9 mm.

Habitat Preference - Bromley (1946) states that this species is usually found alighting on stones along edges of gravelly woods.

Michigan Distribution - Ten specimens were examined from these counties: Oakland, Ionia, Genesee and Midland. Cole and Wilcox (1938) report the known distribution of this species is from Maryland westward to Illinois and south to North Carolina. Bromley (1931) reported this species from Ohio.

Flight Range - 15 May to 11 June with the majority of dates in late May.



Lasiopogon tetragrammus Loew

Lasiopogon tetragrammus Loew, 1874. Berl. Ent. Zeitschr.,  
18: 368.

Description - Mystax black, occasionally with some pale hairs below; legs black, tibia with fine, black, suberect hair, protibia with dense, ventral, short, yellow pile; thoracic dorsum with a distinct brown, median, geminate stripe, lateral stripes shorter and of same color, semi-polished between the median and lateral stripes, black stripe extending forward to humeri; abdomen black, the entire first segment caudal, and lateral margins of remaining segments gray pollinose, except last segment which is highly polished and without pile or pollen.  
Length 9 mm.

Habitat Preference - Bromley (1946) states this species occurs on sandy beaches of large rivers and usually on bare sandy areas. I have found this species associated with grassy fields at the edges of floodings and lakes where the plant growth was generally no taller than two to three inches. Most specimens were within a few feet of the waters edge and generally had landed on small

sticks or litter washed up on shore by wave action.

Michigan Distribution - Twelve specimens were examined from these counties: Presque Isle, Oscoda, Iosco, Gladwin, Midland, and Wayne. Cole and Wilcox (1938) record the New England states as the known distribution of this species. Bromley (1931, 1934b, 1936a, 1947, 1950c) did not record this species from Ohio and did not regard its presence there as a possibility.

Flight Range - 7 May to 20 June with most specimens collected in middle May.

Lasiopogon terricola Johnson

Lasiopogon terricola Johnson, 1900. Ent. News 11: 326.

Description - Mystax of fine, white hair; legs reddish-brown, tibiae with fine, white, recumbent hair, femora with wide, median, blackened area; protibia lacking ventral dense short yellow pile; thoracic dorsum yellowish-brown pollinose fading to grayish-yellow posteriorly, darker brown pollen around the humeral areas; abdomen polished black, thinly, white pilose, finely punctate, excluding the first, all segments with caudal

margins and lateral areas with a brown ground color.

Length 5-7 mm.

Habitat Preference - Back (1909) reports this is an early spring species found on low damp ground. Bromley (1946) reports it from gravelly or sandy areas along streams, alighting on small stones and pebbles.

Michigan Distribution - Only one specimen has been collected in Michigan: Kent Co., 17 May 1959, RRD. Cole and Wilcox (1938) report this species from New Jersey and Virginia and westward to Indiana and North Dakota and northward to Alberta, Canada. Bromley (1931) reported this species from Hocking Co., Ohio.

Flight Range - Cole and Wilcox (1938) report 28 April to 17 June as the flight dates for this species over its known range. The majority of specimens are collected in early and middle May. Bromley (1931) reports three specimens collected on 17 June in Central Ohio.

## Genus STICHOPOGON Loew

Stichopogon Loew, 1847. Linnaea Ent., 2: 499.

Generic Characteristics - Three-segmented antennae, small and slender with spine-tipped style half as long as the third segment, first two segments subequal, third segment twice as long as first two; frons extremely short, flat and distinctly pollinose; mystax of stout, matted bristles only on oral margin; ocellar tubercle variable in shape, with either a few divergent hairs or weak bristles; mesonotum low, often shining in part or wholly pollinose, pile scanty and stiff, usually with only two or three pairs of bristles protibia without apical spur; femora usually with weak and short bristles, bristles are better developed on tarsi and tibiae than on femora; pulvilli slender and well developed; empodia half as long as claws; all cells open except anal; base of  $R_{2+3}$  strongly arched; abdomen is robust and flattened toward the base and pollinose with fine appressed pile; bristles absent on first tergite. Length 6-15 mm.

## Key to Species of *Stichopogon*

1. Abdomen uniformly silvery white pollinose;  
length 6-8 mm.....S. argenteus Say  
Abdomen trifasciate with gray, black and  
brown pollinose areas; length 9.5-14 mm.  
.....S. trifasciatus Say

*Stichopogon argenteus* (Say)

Dasypogon argenteus Say, 1822. Jour. Acad. Sci. Phil.,  
3: 51.

Description - Completely covered with silvery white pollen; mystax extends upward on face; abdomen moderately covered with silvery white pollen and fine white, recumbent hair. Length 6-8 mm.

Habitat Preference - Back (1909), Blanton (1939) and Bromley (1946, 1950a) state this species is found in abundance on sand dunes and beaches of the coast and large inland lakes. This species almost always alights on the sand.

I have taken this species in abundance on the sandy shores and sand dunes of the Great Lakes. They are

usually not found on actively moving sand dunes but on beaches or dunes where vegetation has stabilized the sand and are usually taken in reasonably close proximity to water. On occasion they will be found close to the shoreline but only when there is very little wind and prey is available. In these situations, this species has been found associated with the following species of plants: Lithospermum croceum, Populus tremuloides, Artemesia absinthium, Ammophila breveligulata, Andropogon gerardi, Rhus radicans, Juniperus virginiana, J. communis, Arctostaphylos uva-ursae and Coreopsis lanceolata.

They fly about two to three inches above the sand and always alight directly on the sand and not on vegetation or stones. Mating occurs throughout the day in areas protected from wind. The male mounts the female dorsally during copulation and when disturbed they will fly together and land two to three feet away. They have been observed to feed on Chloropidae and small Chironomidae and attempt to capture small Pompilidae.

This species is often found in a habitat similar to that inhabited by S. trifasciatus but with denser vegetation. They do not usually occur together but will

if there is protection from the wind and prey is available to both. I have never observed trifasciatus preying upon argenteus.

Michigan Distribution - Forty-four specimens were examined from these counties: Leelanau, Grand Traverse, Oceana, Oakland, Van Buren and Berrien. Wilcox (1936) records this species from the Atlantic States westward through Illinois, to Kansas and Colorado and possibly California. Bromley (1950a) did not record it from Florida.

Flight Range - 17 June to 6 August with the majority of specimens taken in middle July.

Stichopogon trifasciatus (Say)

Dasypogon trifasciatus Say, 1822. Jour. Acad. Sci.

Phila. 3: 51.

Description - Covered with gray pollen but with trifasciate abdomen; mystax confined to single dense row of bristles on oral margin; abdomen trifasciate with gray, brown and black pollinose areas and with fine white or brown recumbent bristles. Length 9.5-14.5 mm.

Habitat Preference - Blanton (1939) and Bromley (1946, 1950c) state that this species is always found in sandy habitats such as beaches near lakes or gravel pits or sand plains. Lavigne and Holland (1969) report this species from very rocky pebbly areas or sandy areas both of which support very different types of vegetation. His data show that this species has nearly always been found near natural drainages and he suggests that perhaps a relatively moist habitat is needed for larval development.

I have collected this common species in large numbers from sandy or gravelly areas but only occasionally associated with natural drainages such as streams or gullies. The substrate is usually moist and in full sunlight. In these situations, the following species of plants have been associated: Ammophila sp., Juniperus communis, J. virginiana, Arenaria stricta, Pinus strobus, Arctostaphyllum uva-ursae, Quercus alba, and Acer rubrum.

Lavigne and Holland (1969) state that this species always rests on sand, rocks or other objects resting on the sand. I have never found this species resting on anything except light colored sand.



Lavigne and Holland (1969) state this species appears to be quite "nervous" when foraging and frequently changes position, especially when prey is sighted. Pursuit and capture occurs when prey flies by and lands upon the ground. Capture occurs almost as soon as prey lands. The robberfly then returns to its original foraging site to consume its prey. The prey is manipulated with all six tarsi while the asilid is hovering above its forage site. My observations on this species' behavior agree completely with those of Lavigne and Holland.

Lavigne and Holland (1969) state that courtship and mating occurs in the morning or late afternoon. The males search for females by flying from individual to individual pouncing upon individuals of either sex. When males encounter other males they simply fly away, but when males encounter females they immediately fly to the front of the female. There he hovers back and forth in an arc very close to the female. The males tarsi touch the eyes of the females while hovering. If the female is not receptive she will raise the tip of her abdomen and the male will repeat the hovering process.

If the female is receptive, the male mounts on top and copulation takes place for approximately a minute. If, a second male attempts to mount the female while the first is hovering, the female may couple immediately with the second male. Separation occurs when the male flies off leaving the female.

Bromley (1946) reports this species commonly feeds on small grasshoppers and on small spiders. Lavigne and Holland (1969) recorded that the largest numbers of prey were dipteran, but Hymenoptera, Arachnids and Homoptera were also recorded as occasional prey.

Michigan Distribution - Nearly 200 specimens were examined from these counties: Luce, Chippewa, Mackinac, Emmet, Cheboygan, Charlevoix, Leelanau, Benzie, Grand Traverse, Kalkaska, Crawford, Manistee, Roscommon, Iosco, Osceola, Clare, Isabella, Midland, Oceana, Muskegon, Montcalm, Saginaw, Clinton, Ottawa, Genesee, Allegan, Livingston, Van Buren, Kalamazoo, and Berrien.

Back (1909) Wilcox (1936), and Bromley (1950c), report this species covers the United States but do not include any part of Canada.

Flight Range - 17 June to 15 August with the majority of collections made in middle July.

Genus TARACTICUS Loew

Taracticus Loew, 1872. Berliner Ent. Zeitschr. 16: 64.

Generic Characteristics - Antennae three segmented with third segment two and one-half times as long as first two and dorso-ventrally compressed apically, middle of dorsum of third segment indented and bearing a spine; frons short and flattened, micropubescent; mystax confined to a single row of bristles on the oral margin; ocellar tubercle exceptionally large, a single pair of bristles and three or four pair fine short hairs are posterad of ocelli; thorax with dense coarse appressed pubescence over pleuron and in stripes or spots on the mesonotum; protibia with subapical bristles and an apical ventrolateral stout curved spur or spine (this spur is concolorous with the rest of the leg and is quite small and difficult to see); basitarsus has no denticles; pulvilli are large; empodia swollen basally; all cells open except anal which may be closed; abdomen as wide as the mesonotum, convex but flattened on top,

gently tapered apically. Length 6-8.5 mm.

Taracticus octopunctatus (Say)

Dioctria 8-punctata Say, 1823. Jour. Acad. Sci. Phil.,  
3: 49.

Description - Black; halteres, femora, tibiae except apices of metatibia and bases of tarsal segments yellow; all bristles and pile are pale white or yellow; antennal segment three more than twice the length of segments one and two together; frons whitish to goldish pollinose; mesonotum with three golden pollinose stripes; abdomen black, polished, punctate, with a silvery white spot on postero-lateral margins of segments two to five; tip of male abdomen and genitalia red.

Habitat Preference - Bromley (1931, 1946) states that this species occurs in mixed mesophytic woodlands and brushy pastures. It usually alights on shrubbery and herbage in sunny openings or margins of forests.

Michigan Distribution - Monroe Co., Petersburg, 15 June 1959, G.C. Eickwort; Monroe Co., T7S, R6E, S2, 24 July - 14 August, James B. Truchan; Ionia Co., 14 June 1957,

RRD; Monroe Co., 8 June 1962, RRD. Back (1909) reports this species from New Hampshire south to Florida and westward to Ohio.

Flight Range - Bromley (1931, 1936a) reports 24 June to 1 August for central Ohio. McAtee and Banks (1920) report the species as being fairly common and occurring from 30 May to 4 August for Washington, D.C.

#### LAPHRIINAE

This interesting subfamily has these characteristics: antennae never stylate (except for extremely rare Dasylechia atrox Will.); labial palpi are two segmented, the second segment may be spatulate and concave;  $R_1$  cell is closed; alulae, pulvilli, and empodia well developed; abdomen always ovate and often clothed with dense pile; male genitalia large and strongly developed except in Atomosiini; species range in size from 5 mm. to 25 mm.

#### Biology of Laphriinae

Species of this interesting subfamily are always associated with forests and wooded regions. The species

of the largest genus, Laphria, are usually taken in deeper and more mesic habitats than other species of the subfamily. All other genera except Dasylechia are primarily tropical in origin and those species which occur in Michigan inhabit drier, more open habitats.

These flies are active and very fast fliers. Some species of Laphria station themselves on objects in the habitat and do not ordinarily leave the object even when threatened. Other species of Laphria, especially those species which mimic bumblebees, do not take stations but quickly fly through the proper habitat landing on the vegetation to watch for prey. The small species of the genera Atomosia and Cerotainia are known to also take stations to watch for prey.

This subfamily is unique in possessing a large number of species which mimic aculeate Hymenoptera. Bombus and Vespa are most often the models for the species of this subfamily. The best known mimic, Laphria saffrana, is remarkably like Vespa sp. (Vespidae) and even flies like this hymenopteran. Laphria thoracica is a good mimic of Bombus impatiens Cressen and Bombus vagans Smith. L. thoracica actually seems to vary between

B. impatiens and B. vagans in the amount of yellow pile present on the abdomen. Laphria grossa, L. lata and L. macquartii all mimic Bombus pennsylvanicus (Degeer). It is of interest to note that the geographical ranges of the aculeate model and these asilid mimics are largely co-extensive. Laphria grossa shows a north to south clinal variation in the amount of yellow pile present on the abdomen. The more southern specimens have much more yellow pile and undoubtedly mimic the more southerly abundant B. pennsylvanicus. The more northern specimens tend to mimic another species.

Poulton (1924) defines "aggressive mimicry" where the mimic is protected from potential natural enemies by the resemblance to the model and the mimic also preys upon the model. Species of Laphria, for the most part, feed upon beetles. Those species which mimic bumblebees will rarely feed upon their models. Bromley (1934c) hypothesizes that this tendency of the mimetic asilid to prey on its model may have arisen "as a confusion of sexual and feeding instincts." Mimicry originally protected the asilid. Bromley states that attraction of the sexes may have led to cannibalism which is known throughout

the family. Subsequently, the model would also be preyed upon. Since cannibalism would be genocidal the activity of feeding on the model would probably become more extensive.

The species of Cerotainia and Atomosia feed primarily on small Diptera. The larger species of Laphriinae feed for the most part on slow-flying beetles and on some aculeate Hymenoptera. Capture of the prey is accomplished in the same manner as most asilids, by pouncing on the prey from behind while in flight and killing it immediately before the asilid lands.

Courtship has never been observed in any species of Laphriinae. Copulation has been reported for some Swedish asilids but not for species found in North American except the holarctic Laphria gilva. Melin (1923) and Schmid (1969) state that all species of Laphria observed copulate in a tail to tail position. If mating occurs on a perpendicular object, the female is in the upper position. Those species which mimic aculeate Hymenoptera have been reported to copulate tail to tail on horizontal objects and have the wings spread slightly. The males of some species have an unusual modification



of the posterior margin of the sixth and seventh terga. These modifications are either posteriorly developed processes or a deflection of the hypopygium. Both serve to aid the female in guiding the ovipositor into the male genital complex.

Oviposition is accomplished in two ways. Those species in the tribe Atomosiini have simple unspecialized ovipositors and probably drop their eggs while at rest. The Laphriini all have ovipositors suitable for depositing eggs in crevices in dead wood and bark. Andrenosoma and Pogonosoma have longer, more cylindrical ovipositors more suited to deeper egg deposition. Laphria gilva is known to oviposit in the duff or litter layer at the base of dead conifers. The time required for the eggs to hatch is unknown.

All known larvae occur in dead wood. No larvae are known from the tribe Atomosiini. Some species of Laphria have been reared. Laphria thoracica was reared from pine stumps. Laphria posticata has been reared from tulip tree stumps, apple trees and cherry trees (Bromley 1934c). Melin (1923) reported the species of trees from which several Laphria species larvae have been

taken and that no asilids are specific to certain trees. All species discussed were taken from two or three species of unrelated trees. Melin (1923) states that most species probably require three years for larval development.

Larvae of Laphriinae are generally believed to be carnivorous, but this is probably not so. Most workers reporting carnivorous asilid larvae have used extremely circumstantial evidence to support their statements. Laphriinae larvae are often taken from logs or stumps in association with coleopterous larvae, but I have never found any evidence of them preying on other insects. The mouthparts are not particularly suited for attacking other insect larvae but are adapted to boring through wood. Melin (1923) has analyzed this aspect in some detail.

The larvae of Laphriinae can be distinguished from other subfamilies by: mandibles with a dorsal incision containing the palpus; apex of mandibles toothed; abdominal segments one to six each with four fleshy protuberances; the last segment usually has a terminal plate with spine like processes. Melin (1923) states

that the larvae of species in the genus Laphria are all remarkably alike in morphology and present some problem in species identification.

Pupation occurs for the most part in early spring. The larva bore a hole to the surface of the wood. Instead of boring their way out, they leave a paper-thin covering over the hole and then pupates. Melin (1923) reports pupation required 23 to 50 days. When ready to emerge, the pupa wriggles part way out of the hole after breaking the covering. The adult emerges and leaves the pupal skin sticking half-way out of the hole. The actual process of emergence has never been observed.

#### Key to Genera of Laphriinae

1.  $M_2$  and  $M_3$  veins parallel; rather small  
species with small partially concealed  
genitalia (tribe Atomosiini).....2
- $M_2$  and  $M_3$  veins divergent; male genitalia  
usually large and prominent (Tribe  
Laphriinae).....3

2. First antennal joint three times or more  
the length of the second; vertex is  
divergent.....Cerotainia Schiner
- First antennal joint subequal or only  
slightly longer in length to the  
second; vertex is more parallel-sided  
.....Atomosia Macquart
3. Antennae with a distinct terminal style;  
second palpal segment is swollen and  
clavate; genitalia very small; face  
coarsely pilose.....Dasylechia Williston
- Antennae without a distinct terminal  
style; palpus of normal size.....4
4. Distal segment of the palpus spatulate,  
thin and leaf-like; proboscis pointed  
or slightly up-turned in profile,  
thickened at base; facial gibbosity  
very prominent.....5
- Distal segment of the palpus bluntly  
rounded; proboscis usually more  
cylindrical, longer and not up-turned  
at tip.....6

## 5. Sectoral cross vein present, connecting

$R_{2+3}$  to  $R_4$ .....Pogonosoma Rondani

Sectoral cross vein not present

.....Andrenosoma Rondani

## 6. Body nearly or completely bare; ground

color of abdomen entirely orange; hind

tibia arcuate; hind femora with spinous

tubercles below.....Lampria Macquart

Body nearly always hairy; ground color of

abdomen largely black, occasional

specimens may have median or caudal

reddish area; many species are bumble-

bee-like in appearance.....Laphria Meigen

Genus ANDRENOSOMA Rondani

Andrenosoma Rondani, 1856. Dipterologiae Italicae

Prodromus, 1: 160.

Generic Characteristics - Antennae same length as head, third antennal segment dilated mesally bearing a small apical pit with concealed spine; frons strongly gibbous and highly convex; second palpal segment thin, flattened and scoop-like with bristly hairs; mystax with numerous,

long, curved bristles and/or with less numerous spike-like bristles; femora stout and swollen distally, femora and tibia covered with numerous, long bristles; abdomen broad, shining with fine appressed pile becoming longer, coarser, and more erect laterally; male genitalia large, rotate, basistyli moderately long and uncleft. Length 16 to 25 mm.

Andrenosoma fulvicauda (Say)

Laphria fulvicauda Say, 1823. Journal Acad. Nat. Sci.

Phil., 3: 53.

Description - Head black; frons gray pollinose laterally with black shining triangle mesally; vertex and occiput gray pollinose; mystax of stiff black bristles and long white hairs; beard white; pronotal bristles black; thorax ground color blue-black, extensively gray pollinose with fine black hair and bristles on dorsum; white hair and bristles on pleurae; erect white hair on femora and tibiae, black bristles on tibiae and tarsi, protibiae with dense, short, dark brown pile ventrally; abdominal ground color blue-black, last three segments largely brownish red; genitalia brownish red with reddish gold

hair. Length 18-20 mm.

Habitat Preference - Bromley (1934c) states this species is never very abundant anywhere and is very infrequently collected. It is usually collected in dry, sandy, situations where it rests on logs, stumps or tree trunks in full sunlight. Occasionally it is taken in numbers on freshly cut pitch pine logs or stumps. It usually rests closely appressed to the tree bark and if disturbed usually flies a short distance. Bromley further states that this species has behavior much like Erax aestuans. Prey is usually small Hymenoptera.

Bromley (1934c) records the following as prey:

Osmia sp. (Megachilidae), Halictidae, Vespa maculifrons (Buysson) (Vespidae), Trypoxylon rubrocinctum, Packard (Sphecidae), Evania sp. (Evaniidae) and Phasgonoghora sp. (Chalcididae).

Champlain and Knull (1923) have reared fulvicauda from the pupal cells of Chrysobothris femorata Oliv. (Buprestidae) taken from an oak log. The evidence presented is extremely circumstantial and there is considerable doubt about the asilid larvae being carnivorous.

Michigan Distribution - Only four specimens have been taken in Michigan: Emmet Co., Conley, 5 July 1919, A.W. Andrews; Saginaw Co., 8 August 1942 and 11 September 1942, RRD; Kalamazoo Co., Gull Lake Bio Sta., 26 July 1969, RLF. Martin (1965) reports this species distribution covers the United States and part of Ontario. It does not extend into Mexico.

Flight Range - Bromley (1931, 1934c) reports 9 June to 22 August with majority of dates in July for Ohio.

#### Genus ATOMOSIA Macquart

Atomosia Macquart, 1838. *Dipteres exotiques*, 1: 73.

Generic Characteristics - Antennae much longer than head, occasionally nearly twice as long; third antennal segment with a dorsal incision containing a spine; frons short, lower fourth slightly convex; palpi minute, slender and cylindrical with a few ventral and lateral, apical bristles; mystax of coarse, scattered bristly hairs; femora stout and not swollen except for metafemora, pile is scant, fine and subappressed on dorsum; abdomen robust, strongly convex, deeply punctate, with abundant subappressed fine hair; male genitalia rotate 180° and



concealed. Length 5 to 12 mm.

Atomosia puella (Wiedemann)

Laphria puella Wiedemann, 1828. Auszereuropaische

Zweifflugelige Insekten, 1: 531.

Description - Head black; frons, vertex and occiput silvery pollinose; mystax, beard and facial hair white; ocellar, antennal, occipital and pronotal bristles dark brown; thorax black with scattered appressed minute pale yellow hairs; pleurae whitish pollinose; legs brownish black, base of femora and tibiae yellowish; pile of tibiae and femora white; metatibia with dense ventral white pile; tarsi with black and yellow bristles and hair; abdomen black, highly convex, brownish at apex, covered with fine appressed yellow hair. Length 5-8 mm.

Habitat Preference - Blanton (1939), Bromley (1934c, 1946), McAtee and Banks (1920) report this species usually rests on exposed tree trunks, posts, buildings and stones in full sunlight. It usually lands in a head downward position. This species is often taken in large numbers on woodpiles. I have taken this species by malaise trap

in areas of sandy soil with thick plantings of conifers.

Bromley (1934c) reports that this species preys on small Diptera, including Drosophila sp. (Drosophilidae), Hippelates sp. (Chloropidae), and Holopogon snowi. McAtee and Banks (1920) also record Simulium sp. (Simuliidae).

Michigan Distribution - Examination of 44 specimens revealed this distribution: Mecosta, Midland, Huron, Saginaw, Shiawassee, Ingham, Ottawa, Van Buren and Wayne. Bromley (1934c, 1950a) reports this species from New York southward to Florida and westward to Illinois, Kansas and Texas.

Flight Range - 20 May to 8 August with the majority of dates in early July.

#### Genus CEROTAINIA Schiner

Cerotainia Schiner, 1866. Verh. zool.- bot. Ges. Wien, 16: 673.

Generic Description - Antennae one and one-half to three times the length of the head, third segment with dense short pubescence on outer side and near the apex with a narrow, elongate inconspicuous incision with a concealed

spine; frons pollinose, short and flattened; palpus bluntly pointed with a few long ventral hairs; mystax variable, lower third often with several slender bristles; legs stout, especially the profemora, all femora with abundant ventromedial and ventral fringe of pile, metatibial fringe well developed; abdomen is short, robust, coarsely punctate, pile coarse, subappressed and erect laterally; genitalia withdrawn into abdomen. Length 8-14 mm.

#### Key to Species of Cerotainia

1. Vestiture silvery white; frons grayish  
     white pollinose.....C. albipilosa Curran
- Vestiture brownish; frons yellow brown  
     pollinose.....C. macrocera (Say)

#### Cerotainia albipilosa Curran

Cerotainia albipilosa Curran, 1930. Amer. Mus. Novitates,

No. 425, p. 13.

Description - Frons and vertex grayish white pollinose, often with narrow yellow pollinose stripes at ocular margin; mystax occupying less than lower half of frons,

scant sordid white hair; beard of fine white hair; thorax black, pleurae silvery white pollinose, dorsum black and shining with white recumbent hair; femora brownish black with fine white hair; appressed dorsally, erect ventrally and laterally; tibiae and tarsi yellowish brown, with dense fine silvery white decumbent hair especially dense and short ventrally, with white erect bristles; abdomen polished, black dorsally fading to brownish yellow on lateral margins. Length 7-8 mm.

Habitat Preference - Bromley (1934c) states that this species has been observed to alight on the tips of grass or weed leaves.

Michigan Distribution - Only six specimens have been collected in Michigan: Mecosta Co., 14 July 1942, RRD; Midland Co., 12 July 1960, RRD; Ingham Co., Stockbridge, 6 July 1939, CWS; St. Joseph Co., 2 July 1942, CWS; St. Joseph Co., Constantine, 13 June 1959, G.C. Eickwort. Branch Co., Bronson, 14 June 1959, A.L. Borgatti. Bromley (1934c, 1947) records this species from numerous localities in Ohio and Indiana, and also from Tennessee, and Mississippi. Curran (1930) recorded the type specimens

from North Carolina.

Flight Range - Bromley (1934c) records 11 June to 11 September as flight dates for this species over its known range.

Cerotainia macrocera (Say)

Laphria macrocera Say, 1823. Jour. Acad. Nat. Sci.

Phil. 3: 73.

Description - Frons and vertex brownish-yellow pollinose; mystax confined to lower third of frons, scant yellow brown hairs; beard of very fine gray or white hair; thorax black, grayish sometimes yellow pollinose on pleurae, dorsum black and shining with recumbent pale yellow to brownish hair; femora black, with fine appressed brown hair dorsally, laterally and ventrally with fine white erect hair; tibiae reddish brown, with fine white erect hair especially dense and short ventrally, large pale brown bristles; tarsi brownish black with concolorous hair and bristles, especially dense ventrally; abdomen semi-polished black with yellowish brown lateral margins. Length 5-9 mm.

Habitat Preference - Bromley (1931, 1946, 1950c) states this species is usually found alighting on the tips of twigs and leaves in open fields or forests edges.

Michigan Distribution - Nine specimens were examined from these counties: Oceana, Midland, Muskegon, Barry, Ingham, Van Buren, Kalamazoo, Calhoun and Branch. Bromley (1931, 1936a, 1950a) gives the known distribution of this species as Maryland and Pennsylvania westward to Indiana, and south to Florida.

Flight Range - 14 June to 17 August with majority of dates in late June. McAtee and Banks (1920) give 5 June to 22 August and state that it is known to come to light.

#### Genus DASYLECHIA Williston

Dasylechia Williston, 1907. Jour. New York Ent. Soc.,

15: 1.

Generic Description - Antennae shorter than head, apex with style and microsegment; frons long, prominent mesally and ventrally, receding to antennal base; second segment of palp greatly swollen, short and rounded, with dense, long slender bristles; mystax of long, slender,

dense, bristles; pro- and mesofemora exceptionally swollen, tibiae almost as wide as femora; abdomen exceptionally broad, and robust and covered with very dense pile; male genitalia quite small and elongate. Length 27 mm.

This genus contains a single species, D. atrox. This species differs from all other North American Laphriinae in having an antennal style, enlarged second palpal segment and a short tuncate proboscis. Hull (1962) considers this species a phylygeront.

Dasylechia atrox (Williston)

Hyperechia atrox Williston, 1884. Trans. Amer. Ent. Soc. 11: 28.

Description - Large robust very densely yellow pilose; species mystax, occipal hairs, vertex, mesonotum, scutellum, coxae, meso- and metafemora are all yellow pilose.

Habitat Preference - This species is extremely rare. Only twelve specimens have been collected in all North America. Bromley (1936a) recorded the observations of C.F. Walker who had collected two specimens. Both flies

were collected while they circled Mr. Walker's head. These flies were extremely sluggish and unwary and were easily captured. The location was an open pasture with oak, hickory and maples on gravelly morainic soil. An additional specimen in the Charles Dury collection at Ohio State University has Melissodes bimaculata (Lepeletier) (Apidae) as prey and an attached note "In an open grove, resting on an exposed branch, in rather low ground."

Michigan Distribution - This species has been collected only once in Michigan: Ingham Co., Lansing, 27 August 1888, collector unknown, male. This fly was recorded as having a small beetle as prey. Unfortunately nothing is known of the beetle.

This species has been collected from New York, New Jersey, Pennsylvania, Ohio, Kansas and Utah. Most of the specimens have been collected in Ohio.

Flight Range - Bromley (1931, 1934c, 1936a, 1947) records 7 June to 29 August as flight dates within Ohio. The greatest number of specimens have been taken in July.



Genus LAMPRIA Macquart

Lampria Macquart, 1838. Dipteres exotiques 1: 60.

Generic Description - Antennae one to two times the length of the head, apex bluntly pointed with a small dorsal pit and spine; frons moderately gibbous below and slightly convex at base of antennae, middle is concave; palpi long, slender and cylindrical with apical and ventral hairs; mystax confined to double row of seven or eight stiff bristles on oral margin; femora all stout, especially the metafemora; metafemora flat below and arched above, tuberculate, many acicular; abdomen robust and bare; male genitalia large and conspicuous, rotate 180°, hypandrium uncleft. Length 10-20 mm.

Lampria bicolor (Wiedemann)

Laphria bicolor Wiedemann, 1828. Aussereuropaische Zweifflugelige Insekten 1: 522.

Description - Head black with black pile, except for tuft of appressed white hair on frons at ocular margin; beard black with few pale white hairs; thorax black, pleurae subshining and covered with very small fine black hairs dorsally; legs black, hind femora thickened

and with double row of acicular tubercles; coxae white haired; abdomen red except for black base of tergite one; genitalia small, reddish, with yellow hair. Length 9-16 mm.

Habitat Preference - Bromley (1934a, 1950c) reports this species is usually found resting on logs or stumps in open dry woods. This species apparently has a preference for oak trees.

Bromley (1934c) has recorded one specimen with an ichneumonid as prey.

Michigan Distribution - Only six specimens are known from Michigan: Kalkaska Co., ? June 1966, L.F. Wilson; Wexford Co., T24N, R9W, S22, 10 August 1965, J.H. Shaddy; Midland Co., 8 July 1944, RRD; Kalamazoo Co., Augusta, 1 July 1948; Washtenaw Co., Ann Arbor, 31 July 1929, coll. ?, Hillsdale Co., Pittsford, 15 June 1959, G.C. Eickwort.

Bromley (1934a, 1950a) records this species from New York westward to Illinois and southward to Florida and Texas.

Flight Range - Bromley (1931, 1934c) records June to 20 July for this species in Ohio. For the known range of this species Bromley reports June to 14 September.

Genus LAPHRIA Meigen

Laphria Meigen, 1803. Mag. Insectenkunde, 2: 270.

Generic Description - Antennae shorter than length of head, apex with a small pit and minute spine and often with a sensory groove; frons very convex and gibbous especially on lower two-thirds, tends to be nearly concave on upper third; palpi normal, first segment excavated, second cylindrical and bristly; mystax dense with long coarse hairs or bristles and sometimes restricted to median of frons; femora stout and moderately swollen; tibiae swollen, curved, robust pile of legs variable; abdomen varies from broad, ovate forms to narrow cylindrical forms, pile if present, usually dense and erect, but may be scant or densely appressed into swirls; male genitalia rotate 180°, large, elongate, the undivided epandrium forms a long ventral bowl or scoop shaped structure. Length 10 to 27 mm.

Certain species are recognizable only by male genitalic characters, and modifications of the posterior

margins of abdominal tergites six and seven. Females of the species of the canis-complex, index complex, aeatus complex are indistinguishable from one another.

Most species of the genus Laphria have abdominal segments one to seven unmodified. Segment eight in all species of Laphria is remarkably reduced to a simple ring of narrow sclerotized plates. The hypopygium is made up of the ninth, tenth and eleventh segments.

(Karl, 1959)

The males of certain species have the apical margin of the sixth and seventh tergite extensively modified. These species belong to three species complexes: aeatus complex including L. aeatus; L. disparella and L. scorpio; canis complex including L. canis, L. sicula and L. winnemana; and the index complex including L. index and L. ithypyga. Other species of Laphria not examined during the course of this study may belong to one of these complexes.

Males of these species complexes have two lines of development of the sixth and seventh abdominal tergites. The sixth tergite in most species has two posterior processes on the caudal margin. In the first group this

tergite may be highly convex toward the posterior portion and consequently deflects the hypopygium downward. These species have posterior processes which are heavy, stout and short. The seventh tergite has no protruding processes but is tripartite and minutely rugose. Laphria canis and L. disparella are examples of this type of development.

Those species with a normally shaped sixth tergum have long narrow finger-like processes on the posterior margin. Usually the posterior processes are slightly upturned. The seventh tergite has a single median process which is pointed or slightly bilobate apically.

All known species of Laphria copulate tail to tail facing in opposite directions. These processes on the sixth and seventh abdominal tergites probably function to guide the female's ovipositor into the male's hypopygium. Unfortunately the actual sequence of events involved in coupling has not been observed for any species of Laphria.

Key to Species of Laphria

1. Abdomen always with considerable amounts  
of erect black pile; pile of mesonotum  
always dense and erect; abdomen broadened  
beyond the middle and generally ovate in  
males.....2
- Abdomen devoid of pile or with yellow or  
golden pile and very little or no black  
pile, frequently appressed; mesonotum  
naked or with more or less appressed  
pile; abdomen almost always nearly  
parallel sided in males.....14
2. Hair on sides of first abdominal segment  
largely black.....3
- Hair on sides of first abdominal segment  
largely yellow.....10
3. Front and middle legs and joint of  
metafemora and tibiae densely covered  
with yellow hair.....4
- Legs largely black haired or profemora alone  
with dense yellow hair.....5

## 4. Pteropleural tuft of hair yellow

.....L. huron Bromley

## Pteropteural tuft of hair black

.....F. flavicollis Say

## 5. Beard entirely black.....6

Beard largely yellow.....7

## 6. Mystax entirely yellow.....12

Mystax all or largely black

.....L. thoracica Fabricius

## 7. Marginal scutellar bristles largely pale;

disc of scutellum with black hair or

entirely yellow hair.....8

Scutellar bristles and hair largely

black.....9

## 8. Pile of mesonotum uniformly reddish brown;

scutellar disc with black hair

.....L. royalensis Bromley

Pile of mesonotum distinctly yellow;

scutellar disc with yellow hair

.....12

9. Mesonotal pile yellow anteriorly and  
reddish orange posteriorly  
.....L. insignis (Banks)  
Mesonotal pile uniformly concolorous  
.....L. posticata (Say)
10. Scutellar vestiture black; pile on sixth  
tergite grayish to pale yellow  
.....L. cinerea (Back)  
Scutellar vestiture yellow; pile of sixth  
tergite always black.....11
11. Dorsal abdominal pile uniformly black  
on first three tergites.....L. flavicollis Say  
Dorsal abdominal pile yellow on first  
three tergites.....L. sacrator (Walker)
12. Dorsum of abdomen with entirely black  
pile.....L. flavicollis Say  
Dorsum of abdomen with black and yellow  
pile.....13
13. Pronotal bristles black.....L. divisor Banks  
Pronotal bristles yellow.....L. posticata (Say)



14. Legs distinctively reddish, tibiae  
 somewhat brownish at apex  
 .....L. sadales Walker  
 Legs entirely black.....15
15. Ground color of abdomen with a  
 distinct median reddish area  
 superimposed with appressed golden  
 pile which is parted mesally  
 .....L. gilva Linnaeus  
 Ground color of abdomen black or entire  
 caudal end may be reddish brown  
 .....16
16. Abdomen largely covered with reddish  
 or yellowish pile.....17  
 Abdomen nearly bare or with only  
 scattered fine whitish pile.....27
17. Mesonotum uniformly covered with  
 uniform yellow or golden pile (may  
 be shorter anteriorly).....18  
 Mesonotum with extensive black pile either  
 covering dorsum or anteriorly at the  
 sides.....21

18. Mesonotal pile yellow, contrasting with  
golden or reddish orange pile of  
abdomen.....19
- Mesonotal pile golden or reddish orange,  
concolorous with abdominal pile  
.....20
19. With some black bristles on sides of  
first abdominal segment.....L. altitudinum Bromley
- Bristles on sides of first abdominal  
segment entirely yellow or golden  
.....L. janus McAtee
20. Humeral callosity black haired; beard and  
coxal hair usually white; seventh  
abdominal tergite of female mostly  
black haired.....L. aktis McAtee
- Humeral callosity with golden hair;  
beard and coxal hair yellow; seventh  
abdominal tergite of female mostly  
golden haired.....L. sericea Say

21. Lighter colored pile of thorax contrasting strongly in color with that of abdomen; yellowish pile on mesonotum becoming denser posteriorly, pile of abdomen brassy golden distally  
 .....L. janus McAtee  
 Light pile of thorax concolorous with abdominal pile.....22
22. Pale golden pile of mesonotum and abdomen forming a lateral fringe, pile of median areas shorter, sparser and largely black.....L. calvescenta n. sp.  
 Pale pile covering mesonotum and abdomen at least posteriorly, pile becoming more dense posteriorly.....23
23. Pale pile on posterior portion of mesonotum forming a narrow triangle, extending at least to middle; first abdominal segment with fine abundant white hair.....24

Pale pile lacking or forming a narrow

fringe or spot on posterior mesonotum

never reaching middle; first abdominal

segment with yellow or golden hair

.....25

24. Sixth tergite with two well defined

blunt apical processes; apical

processes of the hypandrium

convergent.....L. index McAtee

Sixth tergite with a single minute

median apical process; apical

processes of hypandrium

divergent.....L. ithypyga McAtee

25. Processes of sixth tergite of male

hooklike or upturned.....L. aeatus Walker

Processes of sixth tergite straight and

not hooklike.....26

26. Seventh abdominal tergite with single

median process upturned at the tip;

sixth tergite with two blunt points;

mystax yellow haired.....L. scorpio McAtee

Seventh abdominal tergite tripartite

and rugose; sixth tergite with two

heavily sclerotized slightly upturned

processes; mystax white haired

.....L. disparella Banks

27. Hypopygium wider than abdomen when viewed

from above; seventh tergite tripartite

and rugose.....L. canis Williston

Hypopygium not wider than abdomen;

seventh tergite not tripartite.....28

28. Tip of hypandrium tapering and bluntly

pointed; seventh tergite distinctly

keeled (often nearly hidden from

view).....L. sricula McAtee

Tip of hypandrium expanded and leaflike;

seventh tergite with small bilobate

process.....L. winnemana McAtee

*Laphria aeatus* Walker

Laphria aeatus Walker, 1849. List of Diptera in the British Museum, 2: 381.

This species is closely related to L. disparella Banks and to L. scorpio McAtee. These three species have the following in common: mystax of black bristles on lower half of frons, with yellow or white erect hair on inner part and decumbent yellow or white hair on ocular margin; beard white; occiput gray pollinose with black bristles; vertex and palpi shining black with black bristles; thorax black with predominately black vestiture, with sparse golden pile on median of mesonotum; pleurae grayish to yellowish pollinose; tuft of bristles before halteres yellow with a few black bristles dorsally; halteres usually light brown; scutellum with fine appressed golden pile; coxae silvery white pollinose with long white hair; legs black with black bristles and white hair on first two pair of legs and on base of third; abdomen black with reddish golden pile becoming denser laterally and caudally, golden bristles on sides of segment one; genitalia of male black with black hair.

Distinction between aeatus, disparella and scorpio can be difficult because of the similarity in morphology and vestiture. Comparison of the patterns of vestiture of the mystax, mesonotum, scutellum and abdomen will separate these species.

In aeatus the lateral decumbent pile of the mystax is golden yellow. The mesonotum is covered mostly with fine black hair but golden hair is sparsely scattered about the entire mesonotum and becomes much more numerous before the scutellar margin. The entire humeral callus is brown pollinose. The scutellum has fine appressed golden hair with black and golden brown marginal bristles. The abdomen is uniformly covered with reddish gold appressed pile combed into a diverging pattern. The male has a pair of hooklike processes projecting from the caudal margin of the sixth tergite. The seventh tergite has a median pointed process.

In disparella the lateral decumbent hair of the mystax is dull yellow and somewhat lighter in the female. The mesonotum is black haired and with a distinctly denser tuft of long black bristles on the humeral callosity. Golden hair is scant on the mesonotum except

for a narrow fringe on the scutellar margin. The humeral callosity has a median shining spot without pollen. The scutellum is finely golden haired with more black marginal bristles than aeatus or scorpio. Abdominal pile is brownish yellow or orange and erect and most dense on the apical and lateral portion of each segment. Apical segments are almost completely covered with pile. Females are generally more densely haired than males. The posterior processes of the sixth tergite of the male are relatively small compared to scorpio and aeatus. The seventh tergite is not pointed or hooked but relatively unmodified.

In scorpio the mystax of the male has decumbent golden pile laterally, while the entire mystax of the female is white to very pale yellow. The mesonotum is scantily haired with mostly black hair and with the golden hair becoming more decumbent posteriorly and forming a somewhat indistinct triangle just above the scutellar margin. The black hair of the humeral callosities is not as dense or as strong as in aeatus and disparella. The humeral callosities are without pollen in the center. Margin of scutellum with brassy golden bristles. The



abdomen is covered with erect golden pile becoming more decumbent and more dense on the posterior portions of each segment and the abdomen as a whole. The mesonotal and abdominal pile of scorpio is lighter in color than that of aeatus. Males of scorpio have the posterior processes of the sixth tergite relatively short and strong. The seventh tergite has a strong, hooked median process. Length of aeatus 12-15 mm., disparella 13-16 mm., scorpio 14-17 mm.

Habitat Preference - Unknown.

Michigan Distribution - A single specimen has been collected in Kalkaska Co., 29 June 1946, RRD. Bromley (1934c) records this uncommon species from Macdiarmid, Ontario, flying from 12 June to 29 of June. Martin and Wilcox (1965) also give Hudson Bay and Alberta.

Laphria aktis McAtee

Laphria aktis McAtee, 1918. Ohio Jour. Sci. 19: 152.

Description - Mystax of fine white bristles in male and mostly black in female; beard whitish; bristles of vertex, occiput and palpi black; pronotum with black bristles; mesonotum with fine thick decumbent yellowish

golden pile and fine black bristles on anterior and lateral margins; pleurae brownish pollinose with fine white hair and occasionally a few black hairs toward dorsum; halteres yellowish brown; scutellum with fine yellow or golden hair and many yellow marginal bristles; coxae grayish pollinose, with white hair; legs black with black and white hairs intermixed, white hair is more prevalent on first two pair of legs; abdomen with thick golden erect pile; female with black hairs and bristles on seventh segment to apex; genitalia black with black hair. Length 17-21 mm.

Habitat Preference - Unknown.

Michigan Distribution - A single specimen has been collected from Wayne Co., 30 May 1959, RRD. Bromley (1934c) records this species from Ohio in Cashocton and Summit counties. McAtee (1918) reports this species from Pennsylvania to Ohio and southward from Pennsylvania to North Carolina.

Flight Range - McAtee (1918) reports 25 May to 27 June as flight dates for the known range of this species.

Laphria altitudinum Bromley

Laphria altitudinum Bromley, 1924. Ocs. Papers Boston

Soc. Nat. Hist. 5: 126.

Description - Mystax black, especially below, with golden bristles medially, smaller paler yellow hairs dorsally and laterally; beard black, occasionally entirely yellow hairs of occiput and vertex black with some yellow; palpi black haired, yellow hair at base; pronotal bristles black; mesonotum covered with pale yellow pile, with black hairs on humeral callus; scutellum with pale hair and bristles; pleurae brown pollinose; black hair and yellow bristles in front of wings; long yellow tuft of hair in front of haltere; coxae tan pollinose with long pale yellow bristles and some black hair; legs black with black hair, with some light hair on protibia; abdomen with reddish yellow hair, black hair on all of tergites one and eight and on sides of tergite two and sometimes three; genitalia black with black and some yellow hair. Length 16-24 mm.

Habitat Preference - Unknown.

Michigan Distribution - This species has been collected only twice: Mackinaw Co., Cut River, 19 July 1921, Sherman Moore; Schoolcraft Co., Manistique, 2 August 1915, A.W. Andrews. Bromley (1934c) reports this beautiful but uncommon species from Maine, New Hampshire and New York.

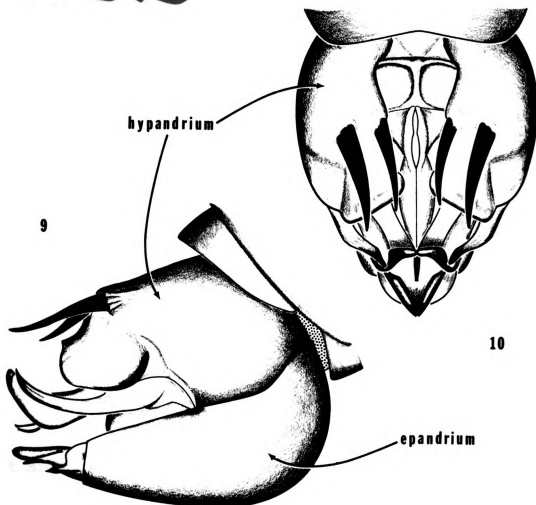
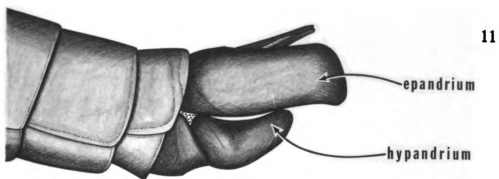
Flight Range - Bromley (1934c) reports 16 June to 30 July for the known range of this species.

Laphria calvescenta n. sp.

(Figs. 9 and 10)

This beautiful species is black with golden pile on sides of thorax and abdomen giving specimens a bald appearance. This species is described from a single male specimen. It is however, considered distinct enough to warrant description.

Description of Male: Mystax of dense black bristles with some shorter yellow bristles at top of mystax and longer yellow bristles just under antennae, white decumbent featherlike hair in concavity of frons; vertex brown pollinose with black and yellow hairs; occiput gray



pollinose with dense black bristles; palpi black with black and gold bristles; thorax black with dense golden vestiture except on pronotum and shining dorsum of mesonotum which are densely black haired, brown pollinose anteriorly between humeri, along notopleural suture and margin of scutellum; pleurae brown pollinose; legs black, with some black pile and with dense golden pile becoming less dense on rear legs; coxae gray pollinose; coxae, femora and basal half of tibiae golden pilose, rest of leg with black pile; venter of protibia with very dense, short golden pubescence; wing fumose in apical half, venation normal with small vestige of setoral vein present; abdomen with golden pile laterally around perimeter, dorsum with short black pile except for two narrow golden spots anteriorly on each segment; genitalia black basally, brown on apex of hypandria, with golden and some black hair. Length 18 mm.

Holotype: Male, Isle Royale, Keweenaw Co., 8 August 1957, Ronald W. Hodges. Female unknown.

Habitat - Unknown.

The holotype is deposited in the Entomology Museum at Michigan State University.

**(Λαφρία)**

The Greek name Laphria (**Λαφρία**) was proposed by Meigen (1803). Laphria was the name applied to Artemis, the Greek Goddess of chase. Later the name came to mean spoils of war. The specific name of calvescent is derived from a latin adverb calvescentis which is translated "becoming bald," referring to the bald appearance of the mesonotum and abdomen.

Laphria canis Williston

Laphria canis Williston, 1884. Trans. Amer. Ent. Soc.

11: 59.

Description - This species is closely related to L. sicula McAtee and L. winnemana McAtee. These three species have: mystax black with small white bristles medially and decumbent white hair at ocular margin; beard white or grayish white; occiput and vertex with black pile, occasionally white hair will be present at ocular margin of vertex; palpi black haired; pronotal bristles black; mesonotum with scattered small fine white or pale yellow hairs, black hair sparse and slightly longer; scutellum with fine white hair and black marginal bristles; pleurae grayish white pollinose; tufts of hair in front

of wings and halteres black; coxae whitish pollinose with white hair; legs black with fine white and black hair and black bristles, first two pair of legs with white hair more dense; abdomen black with a fringe of white hair on each segment; genitalia black with black and some white hair. Length of L. canis 7-12 mm., L. sicula 12-16 mm., L. winnemana 8-13 mm.

These three species are very closely related and separation can be quite difficult and are often labeled Laphria canis Williston or L. sicula and L. winnemana are confused in museum collections. The structure of the male genitalia and of the sixth and seventh tergite will reliably distinguish the males. The females of this species complex are presently not distinguishable.

The sixth tergite of L. canis is highly convex posteriorly and has two heavy stout posterior 'knuckle-like' processes. The seventh tergite is tripartite and always visible in dorsal view. The posterior processes on tergite six apparently articulate with tergite seven and both are minutely rugose.

The sixth tergite of sicula is likewise highly convex posteriorly but has smaller, narrower smooth



posterior processes. The seventh is keeled mesally and ends in a distinct point. Often the hypopygium is strongly turned dorsad and hides the seventh tergite. It may be necessary to relax the specimen and pull the genitalia down in order to observe the seventh tergite.

The sixth tergite of winnemana is not convex and has two small, smooth processes which are longer than wide. The seventh tergite is keeled medially and ends in a small bilobate point which apparently articulates with the processes on the sixth tergite. The hypopygium is usually held more horizontal than in canis or sicula.

Habitat Preference - Blanton (1939) and Bromley (1931, 1934c, 1946) report ~~these~~ species common in mesic forests alighting on shrubs in sunny openings. I have collected this species in dense, wet forests with very thick shrub and herbaceous undergrowth. Often a lake or stream is in close proximity.

Michigan Distribution - Fifteen specimens were examined from these counties: Alger, Cheboygan, Kalkaska, Gladwin, Isabella, Midland, Saginaw, Ingham and Washtenaw. Bromley

(1934c) reported L. canis also from Wayne and Huron counties. Bromley (1934c) reported this species from New York, Pennsylvania, Ohio Illinois and Georgia. McAtee (1918) also reported Maryland and Virginia.

Flight Range - 4 June to 31 August with majority of dates in early July.

Laphria cinerea (Back)

Dasyllis cinerea Back, 1904, Can. Ent. 36: 289.

Description - Mystax mostly grayish-yellow with black on oral margin; beard grayish pilose; occiput and vertex with gray and some black hair; palpi with black hair; thorax light grayish yellow pilose except for fine black hair and bristles on lateral margins of mesonotum and scutellum; coxae grayish yellow pilose; legs black with short black hair and bristles apically, predominately grayish yellow long pile on femora and tibiae; abdomen shining black and nearly bare on dorsum of segments one to four, laterally with grayish yellow pile and some shorter black hair, segments five to seven completely grayish yellow pilose; genitalia black with grayish-yellow pile. Length 10-16 mm.

Habitat Preference - Bromley (1931, 1934c) reports this species from hot dry sandy locations alighting on stumps and logs of conifers. Frequently it is attracted to freshly cut pitch pine and other hard pines.

Michigan Distribution - Only two specimens were taken in Schoolcraft Co., Doyle Township, 13 July 1915, W.S. McAlpine. Bromley (1934c) reports it from Mackinac Co., Naubinway, 7 June 1922, S. Moore. Bromley (1934c, 1950a) reports this species to be a species of the Atlantic seaboard and occurs from New York and Massachusetts southward to Florida and Mississippi. Bromley (1931) recorded this species as possibly occurring in Ohio, but it never appeared in subsequent additions.

Flight Range - Bromley (1934c) reports 7 June to 16 July as flight dates for this species in the northern part of its range.

Laphria disparella Banks NEW STATUS

Laphria dispar Banks, 1911. Can. Ent. 43: 130 (preocc. Coquillett, 1898).

Laphria disparella Banks, 1913. Proc. Ent. Soc. Washington

18: 52 (n. name for dispar Banks).

Laphria canis var. disparella McAtee, 1918. Ohio Jour.

Sci. 19: 167.

Laphria canis Martin and Wilcox, 1965. In Stone,

A., et al., A Catalog of the Diptera of America North of Mexico. Agr. Res. Serv., Agric. Handbk No. 276.

Washington, D.C. p. 389 In pars.

Martin and Wilcox (1965) give disparella as a synonym of Laphria canis due to the fact that these species are very similar in morphology and especially genitalic morphology. These species belong to different species complexes and are easily separable on the basis referred to previously under L. aeatus.

Habitat Preference - Unknown.

Michigan Distribution - This uncommon species has been collected only twice: Chippewa Co., 27 August 1941, RRD; Keweenaw Co., Isle Royale, 3 August 1936, RRD. McAtee (1918) and Bromley (1934c) report the range of this species as Pennsylvania and New York.

Flight Range- McAtee (1918) and Bromley (1934c) report 6 June to 10 August as flight dates for this species.

Laphria divisor (Banks)

Dasyllis divisor Banks, 1917, Bull. Brooklyn Ent. Soc.

12: 54.

Description - Mystax densely yellow with the lower portion black haired; beard yellow; vertex, upper occiput and palpi with black hair; occiput of female with a few yellow hairs; pronotal bristles black; mesonotum and scutellum with yellow hair; pleurae with fine brown pollen, tuft in front of wings with long fine black hair, tuft in front of halteres yellow; halteres usually yellow but may be blackish brown; coxae yellow haired; legs black with black hair, femora and first two pair of tibia usually with some yellowish pile on outer side; legs of female with sparse yellow hair; abdomen with black hair, posterior portion of the fourth tergite (sometimes), fifth and sixth yellow pilose, female abdomen with denser yellow pile on fourth tergite, hair on sides of first tergite mostly black but with a tuft of yellow hairs; genitalia black with black hair. Length 11-18 mm.

Habitat Preference - Unknown.

Michigan Distribution - Twelve specimens were examined from these counties: Keweenaw, Alger, Chippewa, Midland, Livingston, Oakland, Washtenaw, Wayne, St. Joseph and Monroe.

Banks (1917) and Bromley (1934c) report this species from New England westward to Ohio and Illinois and southward from New England to North Carolina.

Flight Range - 30 May to 3 August with majority of dates in mid-June.

Laphria flavicollis (Say)

Laphria flavicollis Say, 1824. Long's Expedition to

the St. Peter's River, vol. II, Appendix No. 374, p. 2.

Description - Mystax of dense yellow hair with the lower portion black; beard yellow in male, black in female; vertex, upper occiput and palpi with black hair; pronotal bristles black with a few yellow bristles; mesonotum and scutellum with light yellow hair; pleurae brown pollinose; tuft of hair in front of wings fine and black, tuft of hair in front of halteres yellow; coxae with yellow hair

in male, black hair in female; legs black, femora and first two pair of tibiae usually with a variable amount of yellow hair intermingled with the black, female legs usually entirely black pilose; abdomen shining black with long fine scattered black hair, side of first tergite black haired but often with considerable yellow hair and bristles; genitalia black with black hair, may have yellow hair intermingled. Length 11-20 mm.

Habitat Preference - Bromley (1931, 1934c, 1946, 1950c) reports this species is usually found in sunny places resting on foliage in or at the edge of a forest. Often it alights on stumps or logs or woodpiles.

I have collected this species in sunny openings along roads or at the edges of forests where undergrowth is luxuriant and thick. It is most numerous in fairly mesic situations and found near water such as a swamp, stream, bog or lake.

I have never taken this species on logs or stumps but always on foliage three to four feet above the ground. This species flies very fast and does not remain in any one area very long. Its flight is remarkably like that of a bumblebee. It nearly always alights on leaves in

areas of dappled sunlight.

Bromley (1934c) lists several medium sized beetles and these insects as prey: Apis mellifera Linn. (Apidae), sp. Nephrotoma sp. (Tipulidae), Chrysops sp. (Tabanidae), Eristalis sp. (Syrphidae), Muscina sp. (Muscidae), Lygus sp., Euschistus sp. (Pentatomidae) and Podisus sp. (Pentatomidae).

Michigan Distribution - One hundred thirty-five specimens were examined from these counties: Keweenaw, Houghton, Ontonagon, Marquette, Alger, Schoolcraft, Luce, Mackinac, Cheboygan, Charlevoix, Antrim, Otsego, Benzie, Gd. Traverse, Manistee, Wexford, Alpena, Roscommon, Ogemaw, Iosco, Lake, Oscoda, Clare, Mecosta, Midland, Bay, Huron, Muskegon, Gratiot, Saginaw, Ionia, Clinton, Shiawassee, Lapeer, Ingham, Livingston, Oakland, Kalamazoo, Barry, Washtenaw and Hillsdale.

Bromley (1934c, 1950a) and Martin and Wilcox (1965) give the distribution as New England and Quebec westward to Iowa and southward to Florida and Texas.

Flight Range - 3 May to 10 August with the greatest majority of dates in the latter half of June and early July.



Laphria gilva (Linnaeus)

Asilus gilvus Linnaeus, 1758. Systema Naturae, Edition 10, p. 605.

Description - Mystax black with some short white hairs in dorsal portion; beard white; bristles of occiput and vertex black; palpi black with white hair; pronotum, mesonotum and scutellum with black hair and bristles; usually some white hair at margin of scutellum; pleurae with scattered brown pollen and tufted with fine black hair; coxae with long white hair; legs black with black and some white hair; abdomen black with black hair but with a median reddish brown ground color and a reddish gold appressed pile parted in the center and combed into a divergent pattern on segments three four and five and occasionally on segments two and six; hair of segment one uniformly white; genitalia black with black hair. Length 16-32 mm.

Habitat Preference - Bromley (1946) reports this species is often taken on pine stumps and logs. Andrews (1918) has taken this species resting on maple foliage. Melin (1923) states that L. gilva occurs in sunny clearings of

coniferous forests with Epilobium, Senecio, shrubs and heather. It generally rests on vertical objects like pine trunks, fences, stumps, or large stones. This species will often return to the same station time after time unlike most other species in the genus. In the proper habitat it may become very numerous.

Melin (1923) and Schmid (1969) have both written comprehensively on the behavior of L. gilva. These flies are usually found head down on the south side of trees from two to fifteen feet above the ground. They apparently prefer to sit in direct sunshine, and were found on the shaded side of the tree only when disturbed or feeding upon prey.

Adults mate frequently and apparently without any courtship behavior. When a male spots a female hovering near the ground, he flies downward from the tree and knocks the female to the ground. Coupling occurs in a tail to tail position followed by flight to a nearby tree with the male being dragged behind the female. The female always assumes the uppermost position on the side of the tree, the male in a head down position. Copulation usually lasted one-half hour or more. Separation after

copulation was initiated by either sex. The male usually attempts to fly and the female uses a combination of thoracic push-ups and abdominal flexures to force the female genitalia downward and away from the male genitalia.

Schmid (1969) reports that females deposit their eggs in the litter layer close to the base of a conifer in South Dakota. Six to twelve eggs are deposited in a single site and usually in several sites before resting. A single fly would often make several ovipositing forays in a single hour, resting between forays. The female apparently selects sites for oviposition by hovering about two inches above the ground. After turning 180° and alighting the eggs are laid. This same species in Sweden according to Melin (1923) oviposited only two or three eggs, and often oviposited on the tree trunk as well as the litter layer about the base of the tree.

Cannibalism was never observed by either Schmid (1969) or Melin (1923). Schmid (1969) aptly pointed out that asilids do not necessarily pierce the harder parts of the exoskeleton to subdue their prey but may

penetrate the abdomen or other softer parts of the body.

L. gilva attacks flying Dendroctonus ponderosae Hopkins (Scolytidae) and pierces the softer abdomen rather than the much harder mesonotum.

Michigan Distribution - This species is rather uncommonly collected in Michigan Marquette Co., 20 July 1949, G.D. Gill (six specimens); Chippewa Co., Whitefish Point, 30 June 1913, A.W. Andrews (three specimens); Marquette Co. Huron Mrs., 1 July 1920, A.S. Andrews; Dickinson Co., Mich. Biol. Survey no. 714, 27 July 1909, J. Hine, Gd. Traverse Co., Fife Lake, 28 Aug. 1969, G. Manley. This species is the only holarctic species of asilidae known. McAtee (1918) and Bromley (1934c) report this species from the New England states and Canada across the continent to Washington and southward along the Rockies into Colorado.

Flight Range - Although 5 June to 27 July represent flight dates for this species within Michigan it is undoubtedly incorrect. Schmit (1969) reports that in South Dakota L. gilva was flying from early July to mid-September.

Laphria huron (Bromley)

Bombomima huron Bromley, 1929. Can. Ent. 61: 159.

Description - Myster black with few yellow hairs in middle; beard, palpi, vertex and occiput with black pile; pronotal bristles black; all thoracic pile excluding the legs is yellow; pleurae brownish pollinose; coxae with yellow and some black hair; legs black with black hair, outer side of profemora and tibiae and apex of mesofemora and outer side of mesotibiae densely yellow pilose, some yellow hair on apex of metafemora; abdomen black with black hair except tuft of yellow hair on each side of tergite two; genitalia black with black hair, yellow-brown hair laterally on epandria. Length 16-20 mm.

Habitat Preference - Unknown.

Michigan Distribution - Eight specimens were examined from these counties: Houghton, Gogebic, Marquette, Dickinson, Alger, Mackinac and Barry. Bromley (1934c) also reported this species from Alger, Mackinac and Marquette counties. It is also recorded from several localities in Ontario and the New England states.

Flight Range - 2 June to 12 July.

Laphria index McAtee

Laphria index McAtee, 1918. Ohio Jour. Sci. 19: 164.

This species is very closely related to L. ithypyga. There are no discernible differences between these two species except in the distinct male genitalia and the sixth and seventh tergites. Both L. index and ithypyga have: Mystax black with smaller white hairs intermingled and with decumbent white hair laterally; beard white; occiput and vertex with black and some white hairs; palpi with black bristles; pronotal hair black; mesonotum with blue-black ground color and fine scattered yellow and white hairs and with a distinctive narrow triangle of golden pile on posterior portion reaching more than half the length; tuft in front of wings with few black bristles and long fine white hair; tuft in front of halteres sordid white; pleurae whitish pollinose with fine white hair; coxae with white hair; legs black with black and white hair intermingled, white hair most abundant on first two pair of legs; abdomen with thin white hair on sides, second segment with a triangle of golden-red

pile caudally, remaining segments covered with thick golden red pile combed into a divergent pattern; genitalia black with black hair.

The hypopygium of index is tilted upward toward the dorsum of the abdomen much more than ithypyga and the apex of the basistylus bears two processes which are convergent. The apical processes of ithypyga are not as well developed as index and are divergent.

The seventh tergite of index is drawn to a point medially and the sixth tergite has two fingerlike processes on its caudal margin. The sixth tergite of ithypyga does not have posterior processes and the seventh tergite is only slightly keeled. Length of index 12-20 mm. and ithypyga 11-17 mm.

Habitat Preference - Bromley (1931, 1934c, 1946) states that this species is found in mixed mesophytic woodlands and usually alights in the sunlight on foliage, tree trunks or logs. It flies swiftly and is quite active.

I have collected this species along the edges of roads through rather wet forests. It usually alights with its head down about two to three feet above the undergrowth which may be up to ten feet above the ground.

This species will feed or rest on the same sunlit station on a tree trunk for several hours. Individuals are observed making capture flights after prey and making flights for mates all from the same station.

Michigan Distribution - Examination of twenty-eight specimens showed this distribution: Alger, Delta, Emmet, Cheboygan, Grand Traverse, Alcona, Manistee, Missaukee, Mecosta, Midland, Bay, Huron, Clinton, Livingston, Oakland, Kalamazoo and Washtenaw.

Bromley (1934c) and McAtee (1918) record this species from Quebec and the New England states westward to Iowa and south to central Ohio.

Flight Dates - 29 May to 1 August with the greatest majority of dates in mid-June.

Laphria ithypyga McAtee

Laphria ithypyga McAtee, 1918. Ohio Jour. Sci. 19: 165.

Description - Refer to L. index.

Habitat Preference - I have collected a single male in a Malaise Trap. The trap location was set approximately twenty feet from the edge of a forest.



The soil was very sandy with mosses scattered about on the ground. Plant collected in the area were Pteridium aquilinum, Cassandra calycullata, Quercus velutina, Carya sp., Liatrus spicata, Rumex acetocella, Lespedeza capitata, Lespedeza caroliniana and Helianthus sp. Species closely related to ithypyga are usually found in much more mesic situation. This immediate area was quite close to a generally much more mesic habitat.

Michigan Distribution - This species has been collected only twice within Michigan: Livingston Co., E.S. George Reserve, 1 August 1967, NTB; Midland Co., 30 June 1960, RRD. This rare species has been collected from Pennsylvania, Maryland, New Jersey, Wisconsin, and Tennessee.

Flight Range - McAtee (1918) records 4 June to 4 August for the known range of this species.

Laphria insignis (Banks)

Dasyllis insignis Banks, 1917. Bull. Brooklyn Ent.

Soc. 12: 54.

Description - Mystax with lower portion black, upper portion yellow; beard and occiput yellow haired; vertex

black haired; palpal bristles black; pronotal bristles yellow; mesonotum yellow haired on anterior part, posterior part thickly bright red pilose; scutellum with black hair and bristles, may be yellow in occasional specimen; tuft in front of wings fine and black; tuft in front of halteres yellow; procoxae and mesocoxae yellow haired, metacoxae black haired; legs black with black hair and with more or less yellow hair intermingled especially on proleg and mesoleg; abdomen black with black hair on tergites one and two median anterior portion of third, densely yellow pilose on remainder; genitalia black with black hair. Length 13-18 mm.

Habitat Preference - Unknown.

Michigan Distribution - Twelve specimens were examined from these counties: Keweenaw, Alger, Schoolcraft, Chippewa and Mackinac. Bromley (1934c) also listed this species from Schoolcraft and Mackinac counties.

This uncommon species is reported from Ontario, Labrador and California (Bromley, 1934c; Martin and Wilcox, 1965).

Flight Range - 4 June to 28 July with the majority of dates in early July.

Laphria janus McAtee

Laphria janus McAtee, 1918. Ohio Jour. Sci. 19: 153.

Description - Mystax light yellow with black hairs on lower portion, some decumbent hairs at ocular margin; beard yellow; vertex and occiput with black hair; palpi yellow hair apically and black hair basally; pronotal bristles black; mesonotum with fine black and yellow hairs on anterior half, posterior half with dense gray-yellow pile; tuft in front of wing black; tuft in front of haltere dense, long yellow; coxae with pale yellow hair; legs black with mostly black hair, some yellow hair on caudal side of femora; abdomen black with fine erect bright reddish golden pile becoming denser caudally, the first three tergites less densely and lighter pilose with dorsum nearly bare, sides of first tergite with fine light yellow hair; genitalia black with yellow hair. Length 15-20 mm.

Habitat Preference - Unknown. Bromley (1934c) lists Cicindela longilabris Say as the only recorded prey for

this species.

Michigan Distribution - Thirty-five specimens were examined from these counties: Isle Royale, Keweenaw, Ontonagon, Gogebic, Dickinson, Delta, Mackinac, Grand Traverse, and Wexford.

Bromley (1934c), Johnson (1925) and McAtee (1918) give the distribution of this species as the New England states and Quebec westward across North America to British Columbia and Washington and southward along the Rocky Mountains to Colorado. Bromley states this species is restricted to mountainous areas.

Flight Range - 6 June to 6 August with the majority of dates in early July.

Laphria posticata Say

Laphria posticata Say, 1824. Long's Expedition to Saint Peter's River, vol II, Appendix, p. 374.

Description - Mystax yellow except on oral margin which is black; beard yellow in male, black in female; vertex with yellow and some black bristles; occiput with yellow hair; palpal bristles yellow with some black intermingled;

pronotum and mesonotum with yellow hair; scutellum with black hair, yellow and some black marginal bristles; pleurae with fine black hair; tufts of hair in front of wings and halteres with long, fine yellow bristles; coxae yellow haired; legs black with black hair, femora and tibia more or less yellow haired particularly on first two legs, females usually with much more black hair; abdomen black with first two tergites and median portion of third tergite and sixth to eighth tergite black haired, sides of tergites three to five completely yellow haired; hair at sides of first tergite with black bristles, long yellow hair and many small black hairs; genitalia black and black haired. Length 12-18 mm.

Habitat Preference - Bromley (1934c) reports that this species is almost invariably associated with white pine stumps and logs. It flies with a loud buzz and feeds mostly on small flying beetles such as small Elateridae, Hyperplatys sp. (Cerambycidae), Macroductylus sp. (Scarabaeidae), Aphodius sp. (Scarabaeidae), Anomala sp. (Scarabaeidae), and an ichneumonid, Amblyteles sp.

This species has been reared from larvae found in white pine stumps. Andrews (1918) reports this species

is often taken resting on maple foliage. McAtee and Banks (1920) report this species on Ceanothus flowers.

Michigan Distribution - Sixty-nine specimens were examined from: Isle Royale, Keweenaw, Marquette, Schoolcraft, Menominee, Chippewa, Mackinac, Cheboygan, Alpena, Grand Traverse, Kalkaska, Manistee, Wexford, Missaukee, Roscommon, Lake, Clare, Gladwin, Newaygo, Mecosta, Midland, Allegan, Ingham, Washtenaw. Bromley (1934c) and Johnson (1925) report the known range of this species is from the New England states and Quebec westward to Manitoba and Wisconsin.

Flight Range - 29 May to 15 August with the majority of dates near the end of June.

Laphria royalensis (Bromley)

Bombomima royalensis Bromley, 1950. Occ. Papers Mus.

Zool. Univ. Mich., No. 527, 5pp.

Description - Mystax brownish yellow above, lower portion black; beard yellow; vertex and occiput with reddish pile; palpal hairs black; pronotal bristles yellow or reddish; mesonotum uniformly yellowish or reddish yellow; scutellum

with black hair and pale yellow bristles, female has dark red or black marginal bristles; tuft in front of wings fine and black; tuft in front of halteres sordid yellow; coxae with yellow hairs; legs mostly blackhaired with a few yellow hairs intermingled; abdomen with yellowish red pile from tergite three to apex, sides of first tergite with black hairs and a few yellow hairs; genitalia black with black hair and some pale hair on dorsum of hypandrium. Length 12-15 mm.

Habitat Preference - Unknown.

Michigan Distribution - Three specimens were examined from Michigan: Isle Royale, 3 August 1936, C.W. Sabrosky; Isle Royale, 11 August 1957, R.W. Hodges; Alger Co., 28 July 1916, W.S. McAlpine. Bromley (1950b) recorded this species from Schoolcraft Co., Floodwood, 10 July 1915, J.S. Rogers; Mackinac Co., Naubinway, 27 June 1922, S. Moore; Mackinac Co., Bois Blanc Island, 18 June 1935, C.F. Walker. The type locality of this species is Isle Royale, Keweenaw Co., Michigan.

Laphria sacrator Walker

Laphria sacrator Walker, 1849. List of Diptera in the  
British Museum, 2: 382.

Description - Mystax yellow, black on oral margin; beard black; occiput with black hair and some yellow hair; vertex with long yellow hair; palpal hairs black; pronotal bristles black; mesonotum and scutellum densely yellow pilose; tufts of hair in front of wings and halteres densely yellow; first two pair of coxae densely yellow pilose, third pair with several gold hairs; legs black, first two pair densely yellow pilose, third pair mostly black haired with yellow hair at apices of femora and dorsal side of tibiae, base of dorsum of metafemora usually has fine reddish hair; abdomen densely yellow pilose on segments one to three, remainder black haired, sides of first tergite with fine black hair and larger yellow hair and black bristles; genitalia black, reddish brown basally with mostly black hair and some brown hair laterally and apically. Length 15-20 mm.

Habitat Preference - Bromley (1934c) states this species is usually collected in association with white pine. He



has collected it in sunny openings along brooks flowing through forests of white pine, hemlock, sugar maple and black and white birch. It alights on foliage in full sunlight.

Michigan Distribution - Approximately seventy specimens were examined from these counties: Houghton, Gogebic, Marquette, Dickinson, Alger, Schoolcraft, Chippewa, Cheboygan, Charlevoix, Benzie, Otsego, Kalkaska, Alcona, Iosco, Oscoda, Clare, Midland, Clinton, Oakland and Washtenaw. Bromley (1934c) gives the New England states and Quebec south to North Carolina as the known distribution of this species.

Flight Range - 14 June to 20 August with the largest majority of dates in early July.

Laphria sadales Walker

Laphria sadales Walker, 1849. List of the Diptera in the British Museum, 2: 378.

Description - Mystax black with some yellow hair in center; beard white or very pale yellow; occiput and vertex with black hair; palpi with black and some yellow hair; pronotal

hair black; mesonotum and scutellum with fine, scattered, short golden hair; marginal bristles of scutellum pale gold; tufts of hair on pleurae black and scant; pleurae polished with spots of white pollen; coxae black and white pollinose with white hair; legs reddish for most part, tarsi black, femora with light yellow hair, tibiae with yellow and black hairs and bristles; abdomen black with scattered fine golden pubescence; genitalia small, black, with black and some yellow hair. Length 9-15 mm.

Habitat Preference - Bromley (1934c) states that this species is characteristically found in mountainous regions, and is usually associated with white pine. It usually alights on stones or sticks along paths or roads. Bromley records it feeding on Rhagio mystaceus Macquart (Rhagionidae).

I have collected this species but not in association with white pine. The habitat is usually fairly well established but has some disturbance. These plants are characteristically found: Plantago regale (Salix sp.), Solidago canadensis, Solidago rigida, Erigeron annuus, Quercus nigra, Alnus rugosa, Juncus, sp. Rubus parviflorus, Equisetum sp., Scirpus sp., Acer rubrum, Chrysanthemum leucanthum, Heiracium aurantiacum, Prunella vulgaris,

and Pteridium aquilinum.

Michigan Distribution - Twenty-eight specimens were examined from these counties: Isle Royale, Keweenaw, Baraga, Dickinson, Alger, Schoolcraft, Cheboygan, Montmorency, Grand Traverse, Crawford, Roscommon, Clare, Gladwin, Mecosta and Midland. Bromley (1934c), Johnson (1925) and McAtee (1918) have recorded this species from Quebec and the New England states across the continent to British Columbia and Washington and southward into California.

Flight Range - 12 June to 16 August with majority of dates in early July.

Laphria scorio McAtee

Laphria scorio McAtee, 1918. Ohio Jour. Sci. 19: 163.

Description - Refer to L. aeatus.

Habitat Preference - Unknown.

Michigan Distribution - Only three specimens have been collected in Michigan: Dickinson Co., 12 August 1953, RRD; Kalamazoo Co., Gull Lake Bio Sta. 5 and 25 July 1967, RLF.

Johnson (1925) and Bromley (1934c) have reported this species only from the New England states.

Flight Range - Johnson (1925) lists 3 July to 1 August for the known flight range of this species.

Laphria sericea Say

Laphria sericea Say, 1825. Jour. Acad. Nat. Sci.

Phila., 3: 4.

Description - Mystax black with variable amounts of light yellow hair, some specimens entirely yellow, some decumbent light yellow hair laterally; beard pale yellow; occiput and vertex with black hair and some yellow bristles; palpi with black or yellow hair; pronotal bristles black; mesonotum with thick golden pile except lateral and anterior fringe of black hair; scutellum with thick golden pile and yellow marginal bristles; tuft in front of wings with fine short black hair and longer yellow hair and bristles; tuft in front of halteres with long fine yellow bristles; coxae with pale yellowish hair; legs black with black and pale yellow hairs intermingled, yellow hair most dense on first two pairs of legs; abdomen golden pilose, sides of tergite

one with gold hair and bristles; genitalia black and elongate with black or yellow bristles. Length 17-24 mm.

Habitat Preference - Bromley (1934c) states this species occurs in sunny glades of forests alighting on foliage or stumps or logs.

Dr. Irving Cantrall has taken this species by sweeping close to a pure stand of Pinus strobus. Around the immediate area were Poa sp., Solidago sp., Elymus sp., Carnus sp., Prunus sp., Fraxinus sp., and Populus sp.

I have collected this species in deep mature mesic woods mostly of Pinus strobus, with Quercus alba, Pteridium aquilinum, Morus sp., Prunus sp. and Oryzopsis asperifolia. This was a rather mesic situation with sandy soil and many mature trees. Large stumps and logs were present in various stages of decay.

The flies were alighting on foliage usually less than two feet high in areas of dappled sunlight, never in large patches of direct sunlight. They are very active and fly swiftly when disturbed. One specimen, a male was taken with a small Elaterid, Hemicrepidius sp. (Elateridae), as prey. McAtee and Banks (1920) record this species feeding on Nicagus obscurus Leconte

(Lucanidae). Bromley (1934c) reports sericea feeding on these insects: Nicaqus sp. (Lucanidae), Dichelonyx sp. (Scarabaeidae), Neoitamus orphne, Panorpa sp. (Panorpidae), and a small Pyralid moth.

Michigan Distribution - Thirty-one specimens were examined from these counties: Cheboygan, Benzie, Iosco, Gladwin, Huron, Clinton, Livingston, Oakland, Washtenaw, and Wayne.

It is interesting to note that the most closely related species L. altitudinum has only been collected in the Upper Peninsula while L. sericea is confined to the Lower Peninsula.

McAtee (1918), Bromley (1934c) and Johnson (1925) report this species from the Atlantic seaboard from New York to Florida and westward to Illinois. Bromley (1934c) reports a single isolated record from Colorado.

Flight Range - 28 May to 24 August with the majority of dates in late June and early July. McAtee and Banks (1920) report 23 May to 16 June for Washington, D.C.

Laphria sicula McAtee

Laphria sicula McAtee, 1918. Ohio Jour. Sci. 19: 165.

Description - Refer to L. canis.

Habitat Preference - Unknown.

Michigan Distribution - Thirty-six specimens were examined from Keweenaw, Ontonagon, Alger, Dickinson, Mackinac, Charlevoix, Ogemaw, Clare, Isabella, Midland, Saginaw, Clinton, Shiawassee, Lapeer, Ingham, Oakland and Kalamazoo. Bromley (1934c) and McAtee (1918) report this species distributed from Maryland and Virginia west to Illinois.

Flight Range - 30 May to 14 August with majority of dates throughout July.

Laphria thoracica Fabricius

Laphria thoracica Fabricius, 1805. Systema Antilatorum, 158: 10.

Description - Mystax black with yellow hair medially and dorsally; beard black; hair of vertex varies from black with little yellow to nearly all yellow; occipital hair black with some yellow; palpi with black bristles;

mesonotum densely yellow pilose, often somewhat bald in center; scutellum with black hair and bristles; coxae with yellow hair; legs brownish black with mostly black hair and yellowish or reddish hair intermingled; abdomen black and entirely black haired or with varying amounts of yellow pile on tergites two to four, hair on sides of first tergite mostly black; genitalia black or reddish black with black hair. Length 15-20 mm.

Habitat Preference - Bromley (1931, 1934c) states this species is found along sunny edges of woods or brushy pastures and in the vicinity of logs and stumps. Often it is found resting or flying about logs and stumps or foliage of elm, maple, and birch. It is found most often in mesic situations. It flies slowly with a loud buzz and if the collector moves slowly in the proper habitat this species will fly toward and alight on one's clothing.

Larvae of L. thoracica have been reared from apple, Liriodendron tulipifera and Pinus sp. These logs and stumps were dead and quite moist (Bromley 1934c, Bell, 1921), recorded a large number of specimens at flowering sumac (Rhus sp.) They were feeding on the large numbers of insects attracted to the sumac.



This species is an excellent mimic of Bombus impatiens Cresson and B. vagans Smith but is not known to feed upon them. Usually this species feeds on slow flying beetles, an occasional honeybee and in one instance a seventeen year cicada, Magiccicada septendecim Linn (Cicadidae) (Bromley, 1934c).

Michigan Distribution - Examination of eighty-one specimens showed this distribution: Alger, Cheboygan, Benzie, Manistee, Gladwin, Isabella, Midland, Bay, Oceana, Montcalm, Tuscola, Sanilac, Ionia, Shiawassee, Genesee, Barry, Eaton, Ingham, Livingston, Oakland, Kalamazoo, Calhoun, Washtenaw, Wayne, Berrien, St. Joseph, Branch and Monroe.

Bromley (1934c, 1950b and Johnson (1925) and McAtee (1918)) record this species from New England south to Florida and eastward to Minnesota, Kansas and Mississippi.

Flight Range - 21 May to 23 July with majority of dates in early June.

Laphria winnemana McAtee

Laphria winnemana McAtee, 1918. Ohio Jour. Sci. 19: 168.

Description - Refer to L. canis.

Habitat Preference - Unknown.

Michigan Distribution - Alcona Co., 3 July 1948, RRD;  
Missaukee Co., 8 July 1945, RRD; Gladwin Co., 14 June  
1953, RRD; Ottawa Co., Nottawa, 30 May 1941, RRD;  
Clinton Co., 9 September 1950, RRD; Shiawassee Co.,  
4 July 1951, RRD; Ingham Co., 16 July 1969, NTB; Berrien  
Co., Grand Mere, 13 August 1969, NTB. Bromley (1934c)  
has recorded Alger Co., 30 July 1910, W.S. McAlpine.  
McAtee (1918) records this species from Maryland,  
Pennsylvania, and Virginia. Bromley (1931, 1934c)  
lists Michigan, Pennsylvania and North Carolina.

Flight Range - McAtee and Banks (1920) give 27 June  
to 12 August with most dates in July over the known range.

## Genus POGONOSOMA Rondani

Pogonosoma Rondani, 1856. Dipterologiae italicae

Prodromus, 1: 160.

Generic Characteristics - Antennae shorter than head,  
third segment dilated toward the apex, apex with pit

containing a very small spine; frons, palpi and mystax like Andrenosoma; femora quite stout and somewhat swollen distally, densely covered with long bristly hairs; abdomen broad, robust, densely pilose, pile long and matted or scant and bristly medially; male genitalia large, elongate and rotate 90°, hypandrium uncleft. Length 18-24 mm.

Pogonosoma dorsatum (Say)

Laphria dorsata Say, 1824. Amer. Ent., 1: 13.

Description - Head black with pile mostly black; hairs of beard, lower mystax, vertex, occiput white; frons white pollinose laterally; thorax black and shining with fine black fine hair; lower pleurae, coxae and spot above the humeri white pollinose; legs black with mixed black and white hairs, white hair most abundant on prolegs and mesolegs; halteres black; abdomen metallic blue-black with black hairs; genitalia black with black hair. Length 13-23 mm.

Habitat Preference - Bromley (1934c) states that this species is from the Atlantic Coastal Plain. It occurs in hot dry situations and is usually taken resting on

stumps and logs of conifers. It has also been taken by window pane trap.

Bromley (1946) states this species is mimetic of some Pompilidae when flying and even flits its wings while at rest. The flight of this species produces a light whirring sound unlike the sonorous buzzing of most large Laphriinae.

Michigan Distribution - Only two localities are known; Keweenaw Co., Isle Royale, 15 June 1966, R.B. Willson (three specimens); Chippewa Co., Whitefish Pt. 4 July 1913, A.W. Andrews. Bromley (1931) listed P. dorsatum as possibly occurring in Ohio but in subsequent lists (1934b, 1936a, 1947, 1950c) it remained unrecorded. Bromley (1934c) has recorded this species as part of the Atlantic Coastal Plain fauna. He reports it from New Jersey, Pennsylvania, Virginia, South Carolina, Georgia and Florida.

Flight Range - Bromley (1934c) reports this species has been collected in mid-May in the southern states and in mid-July in northern states.

## ASILINAE

This common subfamily is easily recognized by: antennae always with a slender terminal arista (which is plumose in Ommatini); palpi are one-segmented; R<sub>1</sub> cell closed; alulae, pulvilli and empodia well developed; abdomen generally attenuated and never ovate; male genitalia well developed and of various sizes; species range from 15 mm to 25 mm.

The genus Asilus presently contains many species which are not congeneric with the type species Asilus crabroniformis Linnaeus. Asilus sericeus is the only known species in North America which apparently belongs in the genus Asilus. Most, if not all, of the other species presently in Asilus are awaiting generic reassignment. Hine (1909) based his species groups on recognizable genera but retained all species in the genus Asilus. Later workers subsequently raised some of Hine's species groups to generic rank but left other groups within Asilus. This resulted in a conglomerate of species having no generic limits. The genus Tolmerus is difficult to distinguish from the conglomerate of species, "Asilus." For this reason the key to genera has been constructed

to identify those species whose generic status is known from those in "Asilus." For ease of identification however, all species of "Asilus" and Tolmerus are included together in one key.

### Biology of Asilinae

The Michigan Asilinae are typically associated with open sandy habitats along or relatively near ecotonal areas of forest edges. Most species are usually found resting in sunshine or quite close to large areas of bright sunshine. Larger species such as Promachus, Efferia and Proctacanthus are usually found resting on the soil or on dead vegetation very close to the soil. Species of these genera usually occur in quite dry, more open habitats containing grasses and common weeds with some large shrubs and few trees. Smaller species included in Asilus, Neoitamus and Tolmerus occur in slightly more mesic ecotonal forest edges. Usually these species are found resting in shaded areas in close proximity to open areas of bright sunshine.

None of the species of Asilinae are as accomplished fliers as species of other subfamilies. Most species fly

in a lumbering noisy way without much speed or agility. Larger species usually produce a characteristic low buzzing sound while flying low to the ground and are often heard before they are seen. Their buzzing flight, large size and local abundance has resulted in some species acquiring common names. Proctacanthus milbertii is known as the "Boo Hoo Fly" or "Missouri Bee Killer." Proctacanthus rufus is called the "Red Boo Hoo Fly." Efferia aestuans is the "Common Fly Hawk"; E. interruptus is identified as "The Snorey Joe Fly or Pathfinder Fly" and "Louanner."

Smaller species of Asilinae usually rest on the leaves of the trees and shrubs in the habitat and often make investigative flights after prey or possible mates. They typically fly at higher levels above the ground than larger Asilinae. Some species of Tolmerus are particularly attracted to small patches of sunlight on the vegetation. Tolmerus chase prey and mates from these small patches and often return to the same patch of sunlight but never with the predictability and perseverance of Laphria.

Larger species of Asilinae usually feed on larger slower flying prey. Proctacanthus, Promachus and Efferia

feed on aculeate Hymenoptera, large Diptera, butterflies, and grasshoppers. A few species of Proctacanthus occasionally feed on Bombus. Smaller Asilinae of the genera Asilus, Neoitamus and Tolmerus feed on much smaller prey in relation to their body size. Calyptrate Diptera, Bombyliidae and small flying beetles are the usual prey. Lavigne and Holland (1969) report that species of Efferia and Promachus consistently choose prey of a certain size in relation to the body size of the asilid. This is a unique analysis of prey criteria and is probably true for most asilids.

The Dasypogoninae and Laphriinae have been observed to discriminate between possible prey insects before they pursue and capture it. By contrast, Asilinae investigate possible prey while in flight. Proctacanthus milbertii has been observed to fly along behind prey and not capture it. The Asilinae consequently have a much lower ratio of successful capture flights than Dasypogoninae and Laphriinae.

Prey is manipulated in two ways: by hovering and turning the prey with all the tarsi, or by using just the front tarsi to roll or turn the prey on the ground.



Lavigne and Holland (1969) report that Promachus dimidiatus and some species of Efferia hover above the ground to manipulate their prey. Proctacanthus milbertii manipulates the prey using just the front tarsi and rolls or turns it on the ground. This species may lie on its side and use all of its legs to hold its prey. Very small prey is never manipulated at all except to discard it when consumption is finished. Cannibalism is more frequently observed in the Asilinae than in other subfamilies.

Lavigne and Holland (1969) have identified searching flights by males for the females of one species of Promachus and three species of Efferia. These flights are also known to occur in Proctacanthus milbertii. These are usually long zig-zagging flights close to the ground or through the vegetation of the habitat where females are found. Proctacanthus have longer, more rapid, undulant zig-zagging searching flights. Promachus have erratic zig-zagging flights at variable speeds.

Courtship takes place when a male sees a female. He rushes forward and hovers in front of her, facing her. Usually he is hovering six to eight inches away, up to

45 seconds. The receptive female remains stationary and the male darts forward and mounts her. Both flies face the same direction. The unreceptive female flies away. Lavigne and Holland (1969) reported that males of Promachus dimidiatus will often successfully mount the female without courtship. If a male courts a male, he will be rushed and chased away.

Copulation takes place in two major ways. The sexes may be joined tail to tail facing in opposite directions. Another way is with the male mounted on top of the female with his abdomen bent downward to the side of the female's abdomen, with the hypopygium bent dorsally to connect with the female genitalia more or less from the venter. Melin (1923) reported the first position for species of the European genera Philonicus, Rhadiurgus, and Dysmachus. No Michigan Asilinae are known to copulate in this position.

Melin (1923), Lavigne and Holland (1969), Hull (1942) have reported the second position as much more common. All the species of Asilinae in Michigan are known to copulate in this position. Usually the male protarsi are resting on the head and the mesolegs holding

the abdomen. The metalegs either hold onto the thorax or the abdomen of the female. Lavigne and Holland (1969) report that Promachus dimidiatus uses the metatarsi to stroke the abdomen of the female. The male also forces the female's abdomen up and down rhythmically during copulation. Lavigne and Holland (1969) also report that the male's buzz their wings at some time during copulation, and especially just prior to termination of copulation.

Melin (1923) and Lavigne and Holland (1969) report that males occasionally copulate with females feeding on prey. No special significance or explanation could be attached to this behavior except that males may tend to prefer feeding females and avoid being killed and consumed themselves. This hardly seems plausible.

Just as reported by Melin (1923), the ovipositor morphology correlates well with the oviposition site. Oviposition in the Asilinae is performed by three different methods. In one group the ovipositor is relatively unspecialized. The eggs are simply extruded and dropped to the substrate. The ovipositors of the second group are armed with spines. The ovipositor is forced into the

soil where the eggs are laid in small clumps. These flies often use the ovipositor to rake over the hole, and thus conceal it. The third group has rather specialized ovipositors designed to place eggs into certain materials. The eggs may be placed in the ground or litter or on vegetation or flower heads where the eggs usually stick until the tiny larvae hatches and falls to the substrate.

Melin (1923) has reported on all of the above types of oviposition for swedish asilids. Lavigne and Holland (1969) reported on oviposition of three species of Efferia and one species of Promachus. Efferia have long thin narrow ovipositors and either lay their eggs in the soil or in vegetation. E. pallidula has been observed to oviposit in soil and in the basal leaves of Yucca glauca. Those species which oviposit in the soil have terminal cerci which are used as a brush to conceal the oviposition site. Those species ovipositing in vegetation do not have cerci and may even become specialized to oviposition in a particular type of vegetation.

Promachus vertebratus has been observed to oviposit in the unopened inflorescences of Daucus carota.

Proctacanthus hinei has an ovipositor with a small semicircle of spines at the tip and has been observed to oviposit in beach sand. Melin (1923) reports that Dysmachus forcipula required 5 to 16 days for the eggs to hatch.

All known larvae of Asilinae occur in the soil. Melin (1923) stated that his investigations showed some species to be specific to certain soil habitats and other to be wide ranging in habitat requirements. Most habitats are primarily sandy. Most species live only two to three inches below the surface, apparently dependent on the amount of available moisture. These larvae are almost always found in or relatively near fine matted roots.

Few of the larvae of North American species of asilids have been found and described. The known larvae are associated with agricultural crops. Harris (1862) reports that Asilus sericeus larvae are taken in association with the roots of rhubarb. The pupal skins are found sticking out the soil around the rhubarb. No significant damage has been reported. Promachus vertebratus larvae have been collected from the edges of cornfields.



3.  $R_{4+5}$  vein reaches wing margin before  
apex of wing; remnants of sectoral  
vein never present; large species with  
long attenuate abdomen.....Proctacanthus Macquart  
 $R_{4+5}$  vein reaches wing margin at or well  
beyond apex of wing; remnant of sectoral  
vein present if  $R_{4+5}$  reaches wing margin  
at apex.....4
4. Remnant of sectoral vein present; male  
genitalia large and project upward  
from longitudinal axis of body; female  
ovipositor as long or longer than segments  
six and seven and laterally compressed  
.....Efferia Coquillet  
Remnant of sectoral vein never present;  
male genitalia project horizontally.....5
5. Uppermost occipital bristles almost  
always strongly proclinate; dorsocentral  
bristles of mesonotum well developed; male  
genitalia have large convex epandria; female  
ovipositor elongate and attenuate, and com-  
posed of five segments.....Neoitamus Loew

- Uppermost occipital bristles straight  
 or slightly curved; genitalia in both  
 sexes generally not as large, ovipositor  
 composed of three segments.....6
6. Lateral areas of abdominal segments near  
 the incisures without a row of large  
 bristles.....7
- Lateral areas of abdominal segments near  
 incisures with a row of bristles which  
 are clearly larger than the hairs on  
 rest of abdomen.....8
7. Body brownish or yellowish; legs brown;  
 frons brown pollinose.....Asilus sericeus Say  
 Body black; legs black; frons polished  
 between antennae and gibbosity  
 .....Nigrasilus nitidifacies Hine
8. Hind femora yellowish or deep reddish with  
 a black spot on anterior side.....9
- Hind femora wholly black or with a pale  
 apical spot or a preapical band.....10



9. Mystax black haired with some yellowish  
gray bristles below; ventral margin of  
eighth abdominal sternite of male pro-  
duced and covered with a few bristly  
black hairs.....Machimus avidus Van der Wulp

Mystax entirely white haired (may be a  
few black hairs dorsally); sternite  
eight not produced, edged with fine  
white hair. ("Asilus"-Tolmerus complex)

.....10

10. Abdominal tergites with distinct strong  
bristles along lateral posterior margins;  
mesonotal and notopleural bristles strong,  
large and black, and confined to posterior  
one-half of mesonotum.....Tolmerus Loew

Abdominal tergites lacking bristles or with  
weak bristles along lateral posterior  
margins; mesonotal and notopleural bristles  
weaker, and often cover more than one-half  
of mesonotum....."Asilus" Linn

## Genus ASILUS Linnaeus

Asilus Linnaeus, 1758. Systema Naturae, Tenth edition,  
pp. 605-606.

Generic Characteristics - Antennal segments elongate, especially the third segment, segment one with numerous stiff bristles, style usually subequal in length to third segment, and with a distinct basal microsegment and no apical spine; frons plane or concave on upper half, lower half gradually developed and prominent, frons about one-fourth the width of the head and strongly divergent below; mystax of long stout bristles extending down to subepistomal margin; mesonotum densely covered with short stiff subappressed setae, with four to six pairs of prominent dorsocentral bristles on posterior part of mesonotum; wings often tinged with yellow or brown,  $R_4$  and  $R_5$  end closely above and below apex respectively; abdomen stout and elongate, bristles restricted to sides of first tergite with an occasional patch in middle of lateral margin of second; hypopygium small with only moderately long epandria, aedeagus with three fine prongs. Length 16 to 28 mm.

Key to Species of Tolmerus and "Asilus"

1. Male hypopygium wider at apex than at  
     base; eighth abdominal segment of female  
     is longer than sixth plus seventh  
     segments.....2  
     Male hypopygium narrower at apex than at  
     base; eighth abdominal segment of female  
     shorter than sixth plus seventh.....4
2. Hind femora yellow only at base; hypopygium  
     twice width of segment eight  
         .....Asilus latipennis Hine  
     Hind femora mostly yellow; hypopygium  
     slightly wider than segment eight.....3
3. Mystax golden to pale yellow with a few  
     black bristles above; preapical  
     bristles of abdominal segments yellow  
         .....Asilus auricomus Hine  
     Mystax largely black with white hairs  
     intermixed; preapical bristles of  
     abdominal segments sordid white  
         .....Asilus piceus Hine

4. Hind femora wholly black, very rarely with  
faint preapical reddish spot on posterior  
or ventral side.....5
- Hind femora never wholly black, as  
described above.....10
5. Less than one-half of protibia with yellow  
or red markings (tibia may appear  
entirely black on occasional greased  
specimens).....6
- More than one-half of protibia with  
yellow or red markings.....8
6. Tarsi completely black; tibiae with a  
trace of red at base, appearing completely  
black in greased specimens  
.....Tolmerus maneei Hine
- Tarsi with red or yellow areas; tibiae with  
basal one-fourth, or more, distinctly red  
.....7
7. Epandria slender and straight (Fig. 12);  
bases of tibiae usually yellow  
.....Tolmerus virginicus (Banks)

Epandria stout and decurved at tip

(Fig. 11); bases of tibiae usually red

.....Tolmerus notatus Wiedemann

8. Metatibiae brownish-black; mystax mostly

black with white bristles below

.....Tolmerus sadyates (Walker)

Metatibiae yellow with black apices; mystax

mostly pale.....9

9. Median stripe of thorax bipartite; epandria

straight ventrally, not narrowed or

deflexed apically; dark brown species

with tan highlights....Tolmerus novaescotiae Macquart

Median stripe of thorax fused anteriorly;

epandria concave ventrally, narrowed and

deflexed apically; black species with gray

highlights.....Asilus autumnalis Banks

10. Hind femora yellow or reddish with black

spot on anterior side; mystax white,

frequently with few black hairs dorsally

.....Tolmerus antimachus Walker

Hind femora black with preapical brownish  
 or reddish band; mystax black with few  
 scattered white hairs.....11

11. Ventral side of front femora with abundant  
 long hair, usually sordid white,  
 occasionally black and sordid white  
 mixed, only rarely entirely black;  
 large brownish species

.....Tolmerus snowii Hine

Ventral side of front femora with bristles  
 rather than long hair.....12

12. Inner posterior base of metafemora with a  
 distinct red or yellow spot; bristles  
 on venter of profemora white and weak

.....Asilus erythrocnemius Hine

Inner posterior base of metafemora entirely  
 black; bristles on venter of profemora  
 stout and usually some are black

.....Tolmerus paropus Walker

Asilus auricomus (Hine)

Asilus auricomus, 1909. Ann. Ent. Soc. Amer. 2: 148.

Description - Yellowish gray in color; antennae black, third segment equal in length to segments one and two, style decidedly longer than segment three; frons narrow with yellowish gray pollen, gibbosity prominent; mystax mostly golden yellow, a few black hairs intermingled; beard gray; coxae dark, legs mostly shining yellow, with gray pollen and yellow hair, femora with an elongate black mark on middle of anterior side, tibia with a black spot at the apex of anterior side; tarsal segments darker apically; abdomen yellowish gray with yellow hairs on the segments and yellow bristles laterally and caudally on each segment; hypopygium ovate in shape widest apically, blackish basally becoming yellowish distally. Length 14 to 15 mm.

Habitat Preference - Bromley (1931, 1946) states this species is found in open woods in areas of oak and mixed mesophytic regions.

Michigan Distribution - Ten specimens were examined from these counties: Barry, Ingham, Livingston, Kalamazoo,

Washtenaw and Monroe.

Bromley (1931) reports this species from Medina Co., Ohio. Hine (1909) and McAtee and Banks (1920) report this species occurs from New Jersey and Virginia westward to Illinois.

Flight Range - All specimens collected within Michigan were collected between 11 August and 25 August. Blanton (1939) states this species occurs through July and August. Bromley (1931, 1946) reports this species to be a "late summer" species and reports 17 August to 22 September.

Asilus autumnalis (Banks)

Asilus autumnalis Banks, 1914. Psyche, 21: 131.

Description - Black with gray highlights, antennae black, third segment with sides nearly parallel, style as long as the third segment, frons pale yellowish pollinose and white pollinose on gibbosity; gibbosity moderately produced; mystax black above and yellowish or yellowish white below; beard white; femora all black, tibiae and metatarsi pale yellowish, with black or blackish apices; abdomen brown with yellowish pollen laterally and



posteriorly, with yellow hairs all over; hypopygium relatively large, epandria elongate and thickened, narrowed and deflexed toward tip becoming concave on ventral margin. Length 14 to 15 mm.

Habitat Preference - This rather delicate species was collected by me in a mesic habitat very close to a large swamp. The plants found in the immediate area were: Quercus alba, Ambrosia artemisifolia, Monarda fistulosa, Calea sp., Lonicera sp., Lactuca sp.

The specimen was captured alongside a road leading into an opening at the edge of a very moist forest. Very little sunlight filtered through the tree canopy. The specimen was resting on dead dry leaves laying on the ground.

Michigan Distribution - Only eight specimens have been collected within Michigan: Keweenaw Co., 9 July 1935, O. Taboada; Marquette Co., Presque Isle, 18 July 1949, G.D. Gill; Marquette Co., Marquette, 21 July to 6 August, G.D. Gill; Marquette Co., 20 June 1955, RRD; Midland Co., 29 July 1936, RRD; Oakland Co., Bloomfield Hills, 1 September 1965, student collection; Livingston Co.,

E.S. George Reserve, T1N, R3E, S19, 11 August 1957,  
NTB.

Bromley (1931) reports this species from  
Portsmouth, Scioto Co., Ohio. Banks (1914) described  
the species from Virginia. McAtee and Banks (1920)  
record the species from Washington, D.C.

Flight Range - McAtee and Banks (1920) report 10 August  
to 30 September for Washington. Bromley (1931) reports  
27 August for Ohio. Blanton (1939) reports the species  
common in September for New York.

Asilus erythrocnemius Hine

Asilus erythrocnemius Hine, 1909. Ann. Ent. Soc. Amer.  
2: 163.

Description - Dark brown species; antennae black, third  
segment rather wide, style slightly shorter than third  
segment; frons brown pollinose; gibbosity prominent and  
occupying one-half frons; mystax mostly of pale yellow  
bristles with a few black hairs above; beard white;  
femora black with reddish brown preapical band, venter  
of profemora with a row of rather weak white bristles;  
tibiae red usually with a dark marking on middle of

anterior side, dark apically; tarsi dark blackish except metatarsi which are reddish; abdomen dark brown to tan and concolorous with thorax, two or three small bristles on either side before the incisures; hypopygium relatively small, brown or brownish-black in color with gold hairs. Length 11 to 14 mm.

Habitat Preference - Bromley (1931) reports this species occurs in dry hay fields or meadows where timothy, sorrel and ox-eye daisy grow.

I have collected this species in sandy habitats which had extensive amounts of grass approximately eight to ten inches high. The ground was always covered with dead dry leaves with which erythrocnemius blended into very well.

Michigan Distribution - Twenty-four specimens were examined from these counties: Isle Royale, Dickinson, Iron, Schoolcraft, Cheboygan, Otsego, Benzie, Iosco, Midland, Shiawassee, Allegan, Washtenaw, and Wayne. Hine (1909) and Bromley (1950c) report this species from New England south to Florida and west to Montana and Colorado.

Flight Range - 21 May to 15 September with the greatest majority of specimens captured throughout July.

Asilus latipennis Hine

Asilus latipennis Hine, 1909. Ann. Ent. Soc. Amer.

2: 152.

Description - Rather dark in color with hairs and bristles nearly all yellow; antennae black, third segment about as long as one and two, style subequal in length to segment three; frons narrow and golden pollinose; gibbosity rather small; mystax yellowish below and black above; beard yellowish gray; legs with black bristles and yellow hair, femora vary from mostly black to mostly yellow, metafemora always yellow basally; all tibia yellow with narrow black apices; tarsi brown except for yellowish base of first tarsal segment; abdomen scantily covered with brown pollen, caudal margin of each segment yellow pollinose and preceded on either side by several yellow bristles; hypopygium relatively large and bulbous, distinctly wider than the abdomen, shining black in color. Length 15 to 17 mm.

Habitat Preference - Bromley (1931) states this species is very rare and usually is taken along edges of pine plantings. Habitat is usually very dry.

Michigan Distribution - A single specimen is known from Michigan: Ingham Co., 30 August 1887, coll. ? Bromley (1931) recorded this species as possibly occurring in Ohio, but it never appeared in subsequent lists. Hine (1909) recorded this species from New York and Massachusetts. McAtee and Banks (1920) recorded the species from Maryland.

Flight Range - Bromley (1931) lists August. Hine (1909) lists 10 August and 24 August. McAtee and Banks (1920) record 1 September.

Asilus piceus Hine

Asilus piceus Hine, 1909. Ann. Ent. Soc. Amer. 2: 149.

Description - Generally black species with brown legs; antennae black, third segment equals length of segment one and two, style and third segment same length; frons gray pollinose; gibbosity not very prominent, occupies half of frons; mystax of intermixed black and white hairs;

beard white; legs brown with light colored hair and light and dark bristles; anterior sides of all femora, apices of all tibiae and last four segments more or less darkened, abdomen black, caudal margins with narrow band of gray pollen; hypopygium distinctly notched at upper corner of the apex. Length 15 to 17 mm.

Habitat Preference - Cockerell (1894) states this species is usually found on edges of pine groves usually in the sun. Small winged ants were recorded as prey by Bromley (1946).

I have collected a single specimen of this species in a dry sandy habitat next to a pine planting. The plants in the area were: Acer saccharum, Populus grandidentata, Prunus serotina, Quercus rubra, Agromonia sp., Pteridium aquilinum, Acer rubrum and Thuja occidentalis.

This species was observed to be fairly active in the field. It would light or perch upon dead leaves or ferns to watch for prey.

Michigan Distribution - Only four specimens have been recorded from Michigan: Grand Traverse Co., Williamsburg,

24 August 1960, R.J. Snider and G.C. Eickwort; Wexford Co., T24N R9W S?, 22 August 1965, J.H. Shaddy (by malaise trap); Newaygo Co., T12N R12W S2, 28 August 1967, NTB; Iosco Co. Oscoda, 20 August 1934, T.H. Hubbel. Bromley (1934b, 1946) and Hine (1909) recorded this species from Massachusetts and from Lucas Co., Ohio, and notes this rare species is previously recorded only from New England. Bromley also noted this species is usually taken in August.

Asilus sericeus Say

Asilus sericeus Say, 1823. Jour. Acad. Nat. Sci., Phil., 3: 48.

Description - A large brown pollinose species with brown wings and pale brown legs; antennal segments one and two yellow-gold, third segment black and much longer than segments one and two together, style about one-fourth as long as third segment; frons golden pollinose; gibbosity not very prominent, except at oral margin; mystax entirely of yellow bristles and hairs; beard yellow; legs pale brown with black bristles and sub-apressed gold and black hair, all femora with a dark

marking on the anterior side; tarsi usually lighter in color than legs; abdomen brown pollinose without bristles before the incisures; hypopygium relatively small and slightly deflexed apically, with golden hairs and a few black hairs apically. Length 20-28 mm.

Habitat Preference - Blanton (1939) reports this species is usually found sitting on the ground among bracken ferns at the edges of fields. Bromley (1946) reports it is commonly found in meadows or moist areas where herbage is rank.

Bell (1924) has observed this species preying on other insects and reports that it never takes resting prey but always flying prey. The prey could even walk or crawl in front of the asilid in apparent safety. If the prey started to fly, it was often captured and killed. Bell also reports that some prey, mostly Lepidoptera would fall into vegetation as a means of escape when pursued and if sericeus was close enough it would dart into the vegetation and make its capture while the prey was falling. This behavior is not unlike other species in this subfamily.



Britton (1927), Bell (1921, 1924) and Bromley (1946) all report that this species has an apparent fondness for Lepidoptera and record Phyciodes tharos Drury (Nymphalidae), Epargyreus tityrus Fabricius (Hesperiidae), Strymon titus (Lycaenidae), Chrysophaneus sp. (Lycaenidae), and Nymphalis sp. (Nymphalidae). This common species has never been recorded or observed preying on aculeate Hymenoptera.

Harris (1862) recorded this species feeding on the roots of rhubarb and states that when pupated and ready to emerge they burrow their way to the surface of the soil and emerge there. Pupal skins are left sticking vertically out of the soil.

Michigan Distribution - Fifty-three specimens were examined from: Charlevoix, Montmorency, Alpena, Crawford, Wexford, Roscommon, Ogemaw, Iosco, Clare, Midland, Barry, Ingham, Oakland, Kalamazoo, Washtenaw, Wayne and Cass counties. Hine (1909) states this species is generally distributed over the eastern part of North America from southern Canada westward to Texas and to Kansas.

Flight Range - 13 June to 23 August with one very late record of 13 November 1931 by K.D. Bailey in Oakland Co.,

Michigan. The majority of dates occur in July and largely August.

Genus EFFERIA Coquillett

Efferia Coquillett, 1893. Can. Ent. 25: 175.

Generic Characteristics - Antennae short, style bristle-like and one to two times the length of segment three with no microsegment or apical spine; frons pubescent and plane below antennae lower one-half strongly gibbous; mystax of strong bristles and coarse hair; mesonotum with bristly setae, lateral and posterior dorsocentral bristles present, anterior dorsocentrals usually absent or hair like; wings long and narrow, costa is occasionally strongly dilated in males,  $R_4$  and usually  $R_5$  end before apex of wing,  $R_4$  with stump vein at proximal end; abdomen robust, stout and with hair, males frequently with long white parted hair on one or more segments; bristles laterally on segment one; hypopygium large, usually projecting upward about  $30^\circ$  from the axis of the body, as long as or longer than segments six and seven together. Length 10-38 mm.

Key to Species of Efferia

1. Palpal hair white.....E. albibarbis (Macquart)  
     Palpal hair black.....2
2. Mystax sordid yellow; costal vein of  
     male not dilated.....E. pogonias (Wiedemann)  
     Mystax of black, with some white bristles;  
     costa of male dilated  
                                 .....E. aestuans (Linnaeus)

Efferia aestuans (Linnaeus)

Asilus aestuans Linnaeus, 1763. Systema Naturae, 11th  
 Edition, p. 413.

Description - Mystax black with many white or yellowish  
 hairs below; palpal hairs black; scutellar bristles  
 mostly black with a few whitish, black bristles and  
 black and yellowish white hair on legs; costa dilated  
 in male; with sides of segments two to four and caudal  
 margin of four and all of segments five, six and seven  
 silvery pollinose. Length 18 to 22 mm. usually, but  
 specimens may be as little as 14 mm. or as large as  
 28 mm.

Habitat Preference - Bromley (1946) reports this species found in fields, pastures, thickets and edges of woods, in almost any dry situation where it alights on nearly any exposed object.

This species is known to feed on a wide variety of insects such as Philanthus sp. (Sphecidae), Tenthredinidae, Tachinidae, Apis mellifera Linn. (Apidae), Halictidae, Aedes sp. (Culicidae), Musca domestica Linn. (Muscidae), Eristalis sp. (Syrphidae), leafhoppers, small butterflies and moths (Bromley, 1934b, 1946).

McAtee and Banks (1920) report that this species has been observed ovipositing in old cedar posts and on twigs of red cedar (Juniperus virginiana) and on the bark of a tulip tree (Liriodendron).

I have collected this common species on very dry flat sandy soil associated with: Pteridium squilinum, Cassandra calycullata, Quercus velutina, Carya sp., Liatrus spicata, Rumex acetocella, Lespedeza capitata, Lespedeza caroliniana, and Helianthus sp. In one instance a malaise trap was set up in this habitat to capture a number of this species. Although a dozen specimens were captured in two days there were often that many or more

sitting on top of the trap at one time. I have also observed this species to land on large slow moving objects such as people or livestock and to remain there ten to fifteen seconds and then fly away. Bromley (1934b, 1946) has reported this rather unique behavior also.

If it is assumed that large slowly moving objects such a man or cow or deer do not pose a threat to the robberfly, i.e., try to kill it, it is conceivable that the behavior of the species could evolve to feed on insects attracted to the animal. It is possible that this species may feed on Tabanidae, Sarcophagidae or some other pest flying about any large animal.

Michigan Distribution - Seventy-seven specimens were examined from these counties: Newaygo, Kent, Shiawassee, Allegan, Barry, Ingham, Livingston, Oakland, Van Buren, Kalamazoo, Jackson, Washtenaw and Berrien. This common species occurs over most of the eastern United States and west to Wyoming, Colorado, New Mexico, and Texas. (Wilcox, 1966)

Efferia albibarbis (Macquart)

Erax albibarbis Macquart, 1838. Diptera exotique ou  
peu connus. Paris. 1: 117.

Description - Mystax white; palpal hair white; scutellar  
hairs and bristles white; black bristles and white  
subappressed hair on legs; costa not dilated; abdomen  
of male with segments one through five and segment eight  
gray, six and seven white pollinose, segment two with  
small brown basal spots. Length 13 to 20 mm.

Habitat Preference - This species has been collected in  
very sandy but mesic habitats. Occasionally, it is  
exceptionally numerous in the proper habitat. This  
species is quite common along the Lake Michigan sand  
dunes especially where the edge of the forest and dunegrass  
(Ammophila breveligulata) meet. It nearly always rests  
directly on the sand with which it is well camouflaged.

Michigan Distribution - Ninety-four specimens were examined  
from these counties: Bay, Mecosta, Newaygo, Montcalm,  
Gratiot, Ottawa, Kent, Clinton, Shiawassee, Genessee,  
Livingston, Allegan, Van Buren, Kalamazoo, Washtenaw,  
and Berrien. Hine (1919) and Wilcox (1966) state this

species covers the United States and ranges south to Guatemala. No records are known from Canada.

Flight Range - 30 May to 1 September with majority of dates in July. Wilcox (1966) states that for California the species occurs from April to October.

Efferia pogonias (Wiedemann)

Asilus pogonias Wiedemann, 1821. Diptera Exotica.

Kiliae., 1: 198.

Description - Mystax yellowish, with a few black bristles below on lateral edge; palpal hair black; scutellar hair and bristles black; black bristles and numerous dark reddish hairs on legs; costa not dilated in male; abdomen of male with segments six and seven white pollinose. Length 18 to 27 mm.

Habitat Preference - Bromley (1946) reports this species from "sand plains," "oak openings," and dry fields in sandy or gravelly areas. Often it is taken in pastures and old fields.

This species flies with a sharp high pitched buzz and feeds on small insects of all the major orders. Prey

is usually smaller than expected from the robustness of the fly. (Bromley, 1946)

Michigan Distribution - This species has not yet been collected within Michigan but will undoubtedly be collected in the southern part of state. Wilcox (1966) has recorded this species from New York southward to Virginia and westward to Minnesota and Kansas and Texas. Bromley (1947) reported this species from central Ohio.

Flight Range - Wilcox (1966) reports this species flying from August to October over its known range.

#### Genus MACHIMUS Loew

Machimus Loew, 1849. Linnaea Entomologica, 4: 1.

Generic Characteristics - Antennae elongate, style moderately long, stout and nearly equal in length to third segment, microsegment and apical spine present; frons plane beneath antennae, lower three-fourths quite prominent, frons is one-fifth the width of the head at antennae and diverges strongly below; mystax of dense numerous long, slender or stout, curved bristles, little or no fine hair present; mesonotum with dense



suberect long setae, four to nine pairs of long dorso-central bristles occur posteriorly; wing venation similar to Asilus, alula large; abdomen robust, cylindrical, posterolateral third of tergites with prominent stout bristles, sides of tergite one with five or six long stout bristles, eighth sternite of male with an apical rounded lobelike or lappetlike extension; hypopygium large, epandria prominent and divergent but with apices converging and opposed. Length 12 to 30 mm.

Machimus avidus (Wulp)

Asilus avidus Wulp, 1869. Tijdschr. v. Ent. 12: 82.

Description - Generally a reddish gray species with the abdomen darkest and with gray margins to segments; antennae black, third segment somewhat shorter than segments one plus two, style shorter than third segment; frons gray pollinose; gibbosity rather prominent; mystax with black bristles above and yellow gray ones below; beard white; legs covered with fine white or yellowish hair and prominent black bristles; coxae and anterior side of femur black and rest is reddish; abdomen reddish to yellowish gray pollinose; caudal margin of each segment

narrowly gray, ventral margin of eighth segment of male produced caudally and forming a distinct angle with a slight tuft of hair; hypopygium about as long as segments six, seven and eight and ovate in general outline, black with reddish basally, covered with fine yellow hair. Length 15 to 18 mm.

Habitat Preference - Unknown.

Michigan Distribution - Only two specimens are known: Iron Co., 12 August 1953, RRD; Cass Co., August 1954, RRD. Hine (1909) reports the species is known from Colorado and New Mexico. Martin and Wilcox (1965) report this species from Wisconsin.

Flight Range - Hine (1909) reports species taken late August and early September.

#### Genus NEOITAMUS Osten Sacken

Itamus Loew, 1849. Linnaea Entomologica 4: 84.

Generic Characteristics - Antennae of average length, style with a microsegment and without an apical spine, style subequal in length to segment three; upper half of frons plane with eye, pubescent and with some hair,

lower half very gibbous, middle of frons one-tenth the width of head; mesonotum with scant long suberect bristly pile, with extensive bare areas laterally and medially, dorsocentral bristles become long and slender past humeralcallus; humerus pilose; quite stout bristles laterally; wing venation like Asilus except  $R_{4+5}$  forks well beyond end of discal cell; abdomen slender and cylindrical with scant pile first segment with four or five pairs of bristles laterally, last three segments sometimes shining; hypopygium large and club-like, epandria high and broad with a deep lateral constriction, hypandrium long and prominent and fused laterally to base of epandria. Length 15 to 22 mm.

Key to Species of Neoitamus

1. Front and middle femora yellow with black stripe on upper side; mystax black or golden or mixed black and gold in male

.....N. flavofemoratus (Hine)

Front femora black with apical end yellow,

middle femora yellow or, rarely, front

femora nearly all black; mystax pale golden

in male.....N. orphne (Walker)

Neoitamus flavofemoratus (Hine)

Asilus flavofemoratus Hine, 1909. Ann. Ent. Soc. Amer.  
2: 153.

Description - Mystax of male entirely black or golden,  
female with few black above and several white below;  
frons golden or white; profemora yellow with black stripe  
on upper side; epandria not notched dorsally at apex.  
Length 12 to 18 mm.

Habitat Preference - Bromley (1946) reports this species  
from oak and mixed mesophytic woodlands. It occurs in  
areas of open woodlands and pastures alighting on the  
tips of twigs in exposed situations. Holopogon tibialis  
and Dichelonyx sp. (Scarabaeidae) have been preyed upon  
by this species. McAtee and Banks (1920) report  
Elateridae, Chrysophila sp. and Tipula sp. as prey.

I have collected numbers of this species in habitats  
with these plants: Onoclea sensibilis, Cornus canadensis,  
Quercus rubra, Viola sp., Morus sp., Juncus sp., Pinus  
strobus, Arelia sp., Medeola virginica, Solidago sp.,  
Rosa sp., Polygonatum pubescens, Galtheria procumbens,  
Plantago sp. and Carex sp. The habitat is usually quite

wet and protected from wind. At night I have taken specimens at blacklight.

Michigan Distribution - Eighty specimens were examined from these counties: Marquette, Cheboygan, Charlevoix, Antrim, Leelanau, Benzie, Grand Traverse, Manistee, Wexford, Roscommon, Iosco, Mason, Clare, Midland, Bay, Huron, Muskegon, Montcalm, Gratiot, Ionia, Shiawassee, Allegan, Barry, Ingham, Livingston, Oakland, Kalamazoo, Calhoun, Washtenaw and Monroe.

Hine (1909) records the species from Quebec and New England south to North Carolina and westward to Illinois.

Flight Range - 1 June to 28 August with majority of dates in mid-July.

Neoitamus orphne (Walker)

Asilus orphne Walker, 1849. List of the specimens of dipterous insects in the collection of the British Museum, 2: 456.

Description - Mystax golden to pale yellowish, without black bristles; frons dull white; profemora mostly black

with yellow apex; epandria notched dorsally at apex.

Length 12 to 19 mm.

Habitat Preference - Bromley (1931, 1946) has found this species primarily about the edges of woods and thickets alighting on the tips of twigs in exposed situations. Argyrotoxa semipurpurana Kraft (Tortricidae) has been recorded as prey.

Michigan Distribution - Seventy specimens were examined from these counties: Houghton, Gogebic, Iron, Marquette, Manistee, Delta, Luce, Mackinac, Cheboygan, Otsego, Grand Traverse, Crawford, Wexford, Missaukee, Roscommon, Oscoda, Gladwin, Isabella, Midland, Gratiot, Kent, Clinton, Shiawassee, Ingham, Livingston, Oakland, and Washtenaw. Hine (1909) records this species commonly taken from Maine to Illinois and from Quebec to North Carolina. Specimens are also known from Colorado and Montana.

Flight Range - 31 May to 6 August with most dates near the end of June.

## Genus NIGRASILUS Hine

Nigrasilus Hine, 1908. Can. Ent. 40: 203.

Generic Characteristics - Antennae of moderate length, style about one-half the length of third segment; frons plane with eyes beneath antennae and shining black, gibbosity very prominent on lower one-half; mystax of moderately strong bristles and little hair; mesonotum with scant fine pile and no well developed bristles; wing venation like Asilus; abdomen like that of Asilus or Tolmerus but predominately black and with little pollen; genitalia of male distinctly turned upward near middle of length. Length 12 to 15 mm.

Nigrasilus nitidifacies Hine

Nigrasilus nitidifacies Hine, 1908. Ann. Ent. Soc.

Amer. 2: 204.

Description - Very dark brownish black species; antennae black, third segment of antennae rather narrow and a little longer than segments one and two together, style about one-half the length of the third segment; frons bare and shining; gibbosity prominent; mystax of black bristles above and white bristles below; beard white;

femora all black with fine white hair and black bristles; tibiae and tarsi dark red becoming black in some areas; metatibia with three or four black bristles on the front side near the middle; abdomen black dorsally with gray pollinose caudal margins on all segments, not preceded by bristles distinctly different than those on the remainder of the abdomen; hypopygium distinctly different, epandria deflexed upward at about one-half their length and with two slightly divergent arms at the apex which resemble a thumb and opposable finger. Length 12 to 15 mm.

Habitat Preference - Unknown.

Michigan Distribution - Only a single specimen has been taken in Cheboygan Co., 1 July 1929, Angell. Hine (1909) lists this species known range as British Columbia, Washington and Oregon. These specimens examined by Hine were taken on 2 July and 16 July.

#### Genus OMMATIUS Wiedemann

Ommatius Wiedemann, 1821. *Diptera exotica*, pt. 1: 213.

Generic Characteristics - Antennae short, third segment short and pyriform with a long style bearing one or two



ventrally directed rows of plumes; frons short and pubescent becoming more prominent below, about one-seventh to one-tenth the width of head at antennae, divergent below; mesonotum densely pubescent with scanty, fine setate pile laterally and with a double acrostical row, with dorsocentral bristles on posterior half; wings of moderate length, costal vein may be greatly thickened with proximal cells strongly rippled; abdomen cylindrical with nearly parallel sides, pollinose on surface and with scant pile, first tergite with four or more bristles on sides; hypopygium with well developed relatively short epandria, curved and opposed apically with or without a dorsal notch. Length 6 to 30 mm.

Ommatius tibialis Say

Ommatius tibialis Say, 1823. Jour. Acad. Nat. Sci.,  
Phil. 3: 49.

Description - A black and gray pollinose species; coxae black; scutellum with weak white hair and no marginal bristles; legs yellowish; femora blackish brown dorsally and anteriorly and yellow otherwise; apices of tibia and tarsal segments blackish brown, yellow otherwise; costa

of male dilated. Length 13 to 17 mm.

Habitat Preference - Bromley (1946) records this creature as a rather sluggish flier usually found resting on twig tips or tall weeds in moist luxuriant meadows.

Michigan Distribution - Nineteen specimens were examined from: Newaygo, Allegan, Livingston, Van Buren, Kalamazoo, Jackson and Monroe counties.

Martin and Wilcox (1965) and Bromley (1950a) give the known distribution of this species as New England south to Florida and Westward to Kansas and Texas.

Flight Range - 13 June to 26 August with most dates throughout July.

#### Genus PROCTACANTHUS Macquart

Protacanthus Macquart, 1838. Dipteres exotiques, 1: 120.

Generic Characteristics - Antennae of moderate length and set far apart, style thick and subequal in length to combined length of antennal segments; frons short but very prominent on lower two-thirds to three-fourths, about one-fourth to one-fifth the width of head; mystax with some fine hair, mostly coarse hair and bristles; mesonotum

with sparse short stubby setae; wings long and slender, shorter than abdomen,  $R_4$  and  $R_5$  end above apex; abdomen robust, long and tapered, last two or three segments may have parallel sides and be cylindrical, pile is coarse, subappressed, short and setate but somewhat longer on sides of first three tergites; hypopygium elongate, epandria divided and overlap at base, aedeagus short and not protrusive. Length 20 to 45 mm.

### Key to Species of Proctacanthus

#### within Michigan

1. Dorsum of thorax uniformly brown; male

genitalia wider than segment eight

.....P. hinei Bromley

Dorsum of thorax gray, usually striped with

black or brown; male genitalia narrower

than segment eight.....P. milbertii Macquart

#### Proctacanthus hinei Bromley

Proctacanthus hinei Bromley, 1928. Psyche 35: 13.

Description - Palpi red with pale hair; thoracic dorsum uniformly brown; abdomen orange to brown pollinose;

hypopygium longer than segments seven plus eight. Length 30 to 36 mm.

Habitat Preference - Bromley (1931, 1946, 1950a) states this species is restricted entirely to sand plains in the vicinity of the coast or along large rivers. The species always alights on the sand and is very active and wary. Prey of this species includes: the following bees: Xylocopa virginica Drury, Apis mellifera Lumaeus, Bombus sp., Psithyrus sp., and the vespid, Polistes apachus Saussure.

This impressive species is quite common in the proper habitat and I have collected numerous specimens. It has always been in association with Ammophila on the sand dunes along Lake Michigan.

This interesting species is relatively easy to observe because of the contrast with the light colored sand of its habitat. When disturbed, they fly three to five feet above the sand in long undulating flights before again landing on the sand or occasionally on a grass stem (Ammophila). The abdomen is often curved upward while flying. I was never able to discover where P. hinei spent the night although I am sure they do not

remain on the beach over night because almost no specimens could be found amongst the Ammophila at dusk.

In early morning this species will sit on the sand with all its legs stretched out and its body closely pressed to the sand. Often it will crawl three or four inches and face a different direction which is nearly always in the general direction of the sun. As the ambient temperature raises, the flies become more active. Lavigne and Holland (1969) have reported very similar behavior for Promachus dimidiatus.

Courtship and copulation is quite similar to that of P. milbertii. Differences undoubtedly occur but at present they were not ascertainable. The flies were seen to copulate almost anytime during the warmest part of the day.

Oviposition was observed only in the morning hours. In all cases the females entered clumps of Ammophila for oviposition. Usually the females crawled into the thickest part of the clump where it was often too thick for her to escape by flight. The female raises the body up high on the tarsi. From this position, the female curves the abdomen downward so that the ovipositor was

held vertically to the sand. Then, using her weight combined with a side to side wedging motion of the abdomen she forces the ovipositor deep into the sand to a depth of about twenty to twenty-five millimeters. She remains here for about two minutes after which she extracted her abdomen. Using just the tip of the ovipositor she tamped the sand down with an up and down motion, crawled away from the Ammophila and flew away. Attempts to find the eggs were futile.

Pupal cases were often found sticking up through the sand. In some areas five to ten could be easily gathered. The pupae are interesting in that the spiracular openings have little operculate covers over them, presumably to keep out sand. Emergence apparently occurs in the morning as this is the time when the majority of pupal cases are discovered and teneral specimens are collected. It may be that emergence is triggered by rising temperatures or light in the morning.

P. hinei was often seen with species of Bombus as prey. Specimens captured with prey had usually punctured the thorax at the anterior part of the junction of wing and thorax. If prey was not readily available, the flies

would often fly slowly just over the top of the Ammophila and land on the sand or on stems of the Ammophila. After resting a short time they would again fly short flights of twenty to forty feet. Disturbing them often sent them on flights on which they were lost from sight. On one occasion, a female specimen was found impaled in the thorax on the sharp end of a blade of dune grass. She had been unable to free herself and was merely hanging from the grass or buzzing loudly trying to escape.

Michigan Distribution - This species is completely restricted to the Lake Michigan sand dunes. Fifty specimens were examined from Mason, Oceana, Van Buren and Berrien counties. This species has also been recorded from New Mexico, Ohio, Kentucky and Florida (Martin and Wilcox, 1965).

Flight Range - 7 July to 17 August with nearly 90% of collection dates in mid-July. Bromley (1931) records 1 July to 28 July for Ohio.

Proctacanthus milbertii Macquart

Proctacanthus milbertii Macquart, 1838. Soc. Doy. des  
Sci., Mem. 1838 No. 3: p. 124.

Description - Palpi black with black hair; thoracic  
dorsum striped with black or brown; abdomen densely gray  
pollinose; hypopygium shorter than segments seven and  
eight combined. Length 28 to 40 mm.

Habitat Preference - This extremely common species has  
been called the "Missouri Bee-Killer" and the "boo-hoo  
fly" Bromley (1931, 1947, 1950a) reports this species is  
characteristically found in prairies and plains. It is  
common in sandy fields and pastures with Andropogon and  
Solidago and often in association with Diogmites discolor  
and Mallophora orcina in southern areas of the United  
States. Blanton (1939) has found it resting in open  
sunlight in open fields, dirt roads and fence rows.

Prey records for this species are very common.  
Bromley (1949) analyzed 659 prey records and found  
Lepidoptera and Orthoptera make up 75% of its prey.  
Honeybees make up only 4% of its prey. This species is  
known to be cannibalistic. I have examined specimens



collected while feeding on Pentatomidae, Melanoplus sp. (Acrididae), Pyralidae, Bembix sp. (Bembecidae), Apis mellifera Linn. (Apidae), Cicindela sp. (Cicindelidae), Vespa sp. (Vespidae) and Proctacanthus milbertii.

I have collected this species in very dry habitats with these plants: Pteridium aquilinum, Cassandra calycullata, Quercus volutina, Solidago sp., Carya sp., Lyatrus spicata, Rumex acetocella, Lespedeza capitata, Lespedeza caroliniana and Helianthus sp. The soil was very sandy and dry with considerable amounts of dead Solidago sp. twigs and dead leaves. The fly blends very well with such a background which makes observation somewhat difficult. It flies about six to ten inches above the soil and usually lands on soil or twigs and never on dead leaves. As soon as it lands it freezes and does not move which also helps to camouflage the creature. These flies are quite active as long as the proper habitat is hot and sunny.

When dusk approached, and the sun no longer shone on the habitat of P. milbertii, the flies cease all activity. Attempts to discover where they spent the night were nearly futile until I discovered the flies

were often resting in or under dead leaves beneath nearby trees or bushes. When the sun set these flies entered a stupor and became very inactive. If disturbed they would buzz their wings for a second or two and then again become inactive. Perhaps the buzzing will frighten a possible predator. The positions these flies assume are often ridiculous. They appear to be dead. In one instance I discovered a male "standing on his head" and supported only by his front legs. Hull (1962) has also observed this behavior and labeled it as "death feigning."

Under caged conditions males and females of P. milbertii were fed honeybees. Usually a single fly would consume approximately three bees per day. The honeybees were always captured in flight and killed immediately by insertion of the hypopharynx into the occiput above the cervix before the asilid lands. P. milbertii always wrapped all six legs about the honeybee and held it until the bee was dead. Often the fly would land and lay on its side or dorsum. Once the bee was dead the fly would sit upright and often fly for short distances of three or four feet three or four times

during consumption of the prey.

I have observed this species follow grasshoppers in flight without capturing them. The fly will follow about six inches behind for several yards. When the grasshopper lands, the asilid will turn and fly away.

The point of insertion of the hypopharynx is changed often during a single feeding. The first insertion into the back of head was to kill the prey. Thereafter P. milbertii would insert the hypopharynx into a thoracic spiracle or the membrane at the base of wing or between abdominal tergites or through the membranous area between the abdominal tergites and sternites. The prey is handled with the prolegs much the same as one would roll or turn a barrel. The prey is handled only when the hypopharynx is to be re-inserted. When one P. milbertii had attached and killed another milbertii, the method of handling and consumption was nearly the same although the body was punctured many more times. Time for consumption was usually about ten to twenty minutes although a feeding may last an hour or more on occasion. The abdomen is usually slightly swollen basally after feeding but may be swollen for its entire length.

The defensive reactions to being attacked are interesting. The attacked fly nearly always spreads its legs and wings outward and curves the abdomen upward. This is a defensive reaction. Generally the fly turns to face the attacker and then tilts backward allowing it to better fend for itself.

The behavior of the sexes during the courtship and copulation of P. milbertii is a fascinating sequence of events. Essentially the courtship is best described as rape. Copulation is something akin to wrestling combined with acrobatics.

Observation of courtship and copulation in the field could not be seen to be different from that which occurred in caged condition except that a much larger area of habitat was involved. Good observations in the field are extremely difficult due to the camouflaging color and wariness of milbertii.

Males of milbertii were often observed to fly rather long distances zig-zagging back and forth in search of females. They never flew more than 6 to 8 inches above the ground, and would often retrace a route just previously covered.

Courtship is initiated when a male sees a female begin to fly. He immediately takes off and flying very quickly captures her just as prey would be captured, i.e., by wrapping all of his legs about her body. He then carries her to the ground where he attempts to couple with the female. The female usually struggles violently to escape. The male holds the female in a very characteristic way. The protarsi are used to hold onto the head, usually by the mystax or oral margin. The mesolegs are placed behind the wings forcing them to be held at right angles from the body. The males mesolegs exert enough force on the wings to turn or twist them into a vertical plane with the costa uppermost. The male also uses the mesolegs to support himself over the female. If the male does not support both of them the female will probably escape. The male's metalegs are crossed under the abdomen of the female. The male's position over the female is such that his head is over her mesonotum. The male's abdomen is directly over the female's and may curve downward on either her left or right side in order to couple with the female. The last three or four segments of the male are curved upward and

almost anterad, so the female genitalia are approached by the male from below. As the hypopygium of the male nears the ovipositor the epandria are spread and coupling is then accomplished. On a few occasions the male may be able to couple with the female before they even land on the ground. During the course of copulation, the male may disengage the genitalia once or twice and then re-engage them.

During copulation the female remains quiescent. The male usually but not always buzzes his wings a few times during copulation. It was observed that the halteres of the male were sometimes moved in a circular arc after the wings were buzzed. This usually occurred just prior to the flies disengaging the genitalia.

At the end of copulation the male disengages the genitalia, releases his hold on the female, crawls a short distance and flies away. The female also flies away soon after the male. On one occasion the male again captured the female and repeated the entire process a second time.

As soon as the male has engaged the genitalia the female usually stops struggling. Before the genitalia

are coupled the female tries to dislodge the male by hooking his legs with hers and preventing him gaining control of her head and abdomen. If possible she will turn her body over immediately after being captured so that her venter faces his. She then almost always struggles free and escapes.

Michigan Distribution - Two hundred and nine specimens were examined from these counties: Marquette, Alger, Menominee, Cheboygan, Benzie, Grand Traverse, Alcona, Manistee, Wexford, Iosco, Lake, Gladwin, Huron, Oceana, Newaygo, Midland, Muskegon, Ottawa, Kent, Ionia, Shiawassee, Genesee, Allegan, Barry, Ingham, Livingston, Oakland, Macomb, Kalamazoo, Jackson, Washtenaw, Wayne, Berrien, St. Joseph, Hillsdale, Lenawee, and Monroe. This species is known to occur over most of North America from coast to coast.

Flight Dates - 19 June to 5 November with most dates occurring in August.

## Genus PROMACHUS Loew

Bactria Mergerle, in Meigen, 1820. Systema Beschreibung...  
der zweiflugligen Insekten, 2: 307.

Generic Characteristics - Antennae short and set far apart, style is stout and not quite as long as remainder of antennae without microsegment or apical spine; frons plane or slightly gibbous on lower half with a straight oral margin, frons one-fifth of head width; mystax triangular with exceptionally stout, long bristles on lower median area and on subepistomal margin; mesonotum with varying amounts of bristly setae; wings long and slender, shorter than abdomen, with anal lobe extended,  $R_4$  ends well above the wing apex,  $R_5$  ends well behind apex; abdomen broad and robust basally but narrowed and tapered on last three or four segments or is gently tapered over whole length, surface pollinose, bristles only on sides of first tergite, pile coarse and suberect, somewhat longer on first two tergites and laterally on third and fourth tergites; hypopygium elongate and porrect, epandria forceplike, aedeagus is three pronged and may extend far beyond the epandria. Length 17 to 40 mm.



Key to Species of Promachus

1. Color of tibiae lighter than femora; palpi

with yellowish and some black hair

.....P. vertebratus Say

Tibiae and femora concolorous; palpal hair

entirely yellow or entirely black

.....2

2. Palpi black haired; abdomen with black

and white hair.....P. bastardii Macquart

Palpi yellow haired; abdomen covered with

yellow hair.....P. fitchii Osten Sacken

Promachus bastardii Macquart

Promachus bastardii Macquart, 1838. Dipt. Exot., 1: 104.

Description - Palpi with black hair; mystax yellow; color of tibia concolorous with femora; abdomen black above with a narrow band of white hair on posterior margin of each segment; hypopygium with dense silvery hair on dorsum. Length 21 to 28 mm.

Habitat Preference - Bromley (1931, 1934c, 1946) states that this species occurs in brushy pastures, along stone fences, and edges of woods and fields. It alights on twigs posts, stones and tall weeds or other exposed objects. It flies with a high pitched buzz. It can become a pest around apiaries.

Bromley (1931, 1934c, 1946) has recorded these insects as prey: Eristalis tenax Linn (Syrphidae), small Tipulidae, Apis mellifera Linn. (Apidae), Tachysphex sp. (Sphecidae), Solemius sp. (Sphecidae), Scoliidae (Tiphia sp.), Pogonomyrmex barbatum Smith (Formicidae), Diognites symmachus, Canthon sp. (Scarabaeidae), Neoclytus sp. (Cerambycidae), Leptoglossus phyllopus Linn (Coriidae), Menecles insertus Say (Pentatomidae), Orphulella sp. (Acrididae) and its own species.

I have collected the species in a very old burn area where these plants were found: Pinus resinosa, Prunus virginiana, Achillea millifolium, Centaurea sp., Agrostis stolonifera, Rhus sp., Fragraria virginica, Chrysanthemum, and Hypericum perforatum. The habitat was very sandy and dry in full hot sun. The whole area

was exposed and near the top of a very large hill. There is usually a considerable amount of dry dead leaves and twigs on the ground.

Males of bastardii were observed to fly closely around the limbs of Pinus resinosa as if they were in search of something. Males and females usually fly close to the ground and landed on the litter where they were quite well camouflaged. This species is always well dispersed and never seems to be congregated in one area. Specimens were collected preying on Callopietra monetifera Guenee (Noctuidae).

Michigan Distribution - One hundred and twenty-nine specimens were examined from these counties: Houghton, Baraga, Marquette, Alger, Schoolcraft, Menominee, Luce, Mackinac, Chippewa, Emmet, Cheboygan, Antrim, Otsego, Benzie, Grand Traverse, Wexford, Roscommon, Mecosta, Midland, Huron, Van Buren, Kalamazoo, Wayne and Berrien.

Hine (1911) and Bromley (1950a) records the distribution of this species from Massachusetts to Kansas and south to Texas and Florida. Bromley (1931) recorded the species as fairly common in Ohio.

Flight Range - 12 June to 27 August with most dates in late July. One copulating pair taken 5 August.

Promachus fitchii Osten Sacken

Promachus fitchii Osten Sacken, 1878. Catalogue of the described Diptera of North America, Smithson. Inst. Smithsn. Misc. Collect. 16: 234.

Description - Palpi with yellow hair; mystax of dense yellow hair; tibia concolorous with femora; abdomen covered with light yellow hair, tan pollinose with bare areas of brown ground color on incisures becoming narrower posteriorly; hypopygium very elongate black, with appressed white hair dorsally, yellow hair laterally and ventrally, some black hair on apex of epandria; aedeagus often exerted beyond apex of hypopygium. Length 25 to 30 mm.

Habitat Preference - Bromley (1931, 1946) reports this species to be locally very abundant. It occurs in dry hay fields, alighting on grass or weed stalks. Its flight is a high-pitched buzz suggestive of a honeybee or megachilid bee.

Bromley (1946) records Eristalis sp. (Syrphidae), Asilus, Ommatius, and small Pompilidae as prey. He also reports the larvae feeding on Phyllophaga sp. (Scarabaeidae) grubs.

Michigan Distribution - This species has not been recorded from Michigan yet but probably will be in the southern part of the lower peninsula. Bromley (1931) recorded this species as possibly occurring in Ohio but was subsequently never taken. Hine (1909) reports this species from Kansas, Nebraska and Missouri, and from Connecticut and Florida.

Flight Range - Bromley records 30 June to 2 August for Connecticut.

Promachus vertebratus (Say)

Asilus vertebratus Say, 1823. Jour. Acad. Sci. Phil.,  
3: 47.

Description - Palpi with yellowish and some black hair; mystax white; tibia much lighter in color than femora; abdomen largely gray pollinose, with pale hairs and with rectangular black markings on anterior half of each

segment; hypopygium without silvery hair above. Length 26 to 31 mm.

Habitat Preference - Bromley (1931, 1947) records this is a prairie species which has undoubtedly extended its range since clearing of the forests. It often occurs in considerable numbers in clover fields, iron-weed swales and pastures. The pupae are often found in the soil about cornfields when the soil is plowed.

Christopher Brand has collected this species in large numbers in Illinois and reported the habitat to be an old field with Daucus carota, tall grasses, Solidago sp. Populus sp., Asclepias syriaca and Chrysanthemum leucanthemum. The females were seen ovipositing in unopened flowers of Daucus carota. Many specimens were collected in open sandy areas with large concentrations of Daucus carota and Solidago sp. Many pairs were observed in copulation in early August.

Michigan Distribution - Only nine specimens have been taken in Michigan: Eaton Co., Grand Ledge, 13 August 1967, B. Matthews; Ingham Co., Lansing, 9 July 1964, D. Barton; Ingham Co., T3N R2W S19, ? September 1967,

J.R. Dayton (by malaise trap); Ingham Co., E. Lansing  
10 August 1968, Steve Middleton; Jackson Co., Jackson,  
22 August 1963, R.J. Matthew; Wayne Co., Plymouth,  
18 August 1959, R.J. Snider (three specimens). Martin  
and Wilcox (1965) give the distribution of this species  
as Ohio, Wisconsin and Illinois westward to Missouri,  
Kansas and Colorado. Bromley (1931) recorded this species  
from several localities in Ohio.

Flight Range - Flight dates are 30 July to 2 September  
for Ohio.

Genus TOLMERUS Loew

Tolmerus Loew, 1849. Linnaea Entomologica, 4: 94.

Generic Characteristics - Antennal segments long and  
slender, style thick and shorter than third segment with  
a basal microsegment and an apical spine; upper one-third  
of frons plane with eye, moderately gibbous on lower  
part, frons one-sixth width of head and widely divergent  
below; mystax with fine hair and numerous stiff bristles  
in median, upper bristles black and upper central bristles  
distinctly stouter, lower medial bristles are pale,  
slender; mesonotum with abundant stout short slightly

appressed bristles, row of six or seven pairs of dorsocentral bristles start at transverse suture and become longer caudally; wings gently rippled and very similar to Asilus,  $R_4$  and  $R_5$  end close to apex just above and below apex respectively; abdomen slightly tapered and subcylindrical, sides of first tergite only moderately protuberant, pile scant, appressed and setate; hypopygium large, epandria elongate and pointed apically, directed upward and slightly curved inward at the apex. Length 12 to 18 mm.

Tolmerus antimachus (Walker)

Asilus antimachus Walker, 1849. List of the specimens of dipterous insects in the collection of the British Museum. 2: 454.

Description - A light tan and brown species with clear white mystax and with legs almost wholly yellow; antennae rather long, black and slender, base of third segment distinctly yellow, style longer than third segment; frons narrow and silvery yellow pollinose; gibbosity prominent; mystax white, an occasional specimen will have some black bristles; beard white; legs completely yellow except



black coxae, anterad spot on all femora, apices of metatibia, and apices of tarsal segments all of which are black; abdomen brown and tan pollinose with brown bristles and golden hair; hypopygium longer than segments seven and eight, epandria black, elongate, straight, with black and golden hair; aedeagus trifid; venter of hypopygium polished. Length 16 to 20 mm.

Habitat Preference - Hine (1909) and Bromley (1931) report this species common in open weedy areas and pastures. Bromley (1931) has recorded this species feeding on small Bombyliidae.

Michigan Distribution - Only two specimens have been collected in Michigan; Cheboygan Co., Univ. Mich. Biol. Sta., 4 August 1963, J.R. Dayton; Lenawee Co., T8S R2E S31, 9 July 1969, J.P. Donahue. Hine (1909) reports this species from Ohio, Indiana, Kansas, Virginia and Missouri.

Flight Range - Bromley (1931) reports this species is common in Ohio from 24 June to 22 September with the majority of dates in August.

Tolmerus maneei (Hine)

Asilus maneei Hine, 1909. Ann. Ent. Soc. Amer. 2: 158.

Description - A small black species with black legs; antennae black with apex of second segment and base of third lightened in color, third segment equal in length to segments one and two and in length of the style; frons with gray pollen; gibbosity prominent; mystax of intermingled gray and black hair; beard white; legs black with a slight reddishness at bases of tibiae, coxae with white hair, femora with some white hair and black bristles, tibia and tarsi with short black hair and prominent bristles; abdomen black with rather long gray hairs especially toward the base, caudal margins of each segment gray pollinose; hypopygium shining black, slender, elevated somewhat on distal half and about as long as abdominal segment six, seven and eight together. Length 10-12 mm.

Habitat Preference - Unknown.

Michigan Distribution - Five specimens have been taken in Michigan: Shiawassee Co., Bath, 24 July 1958, R.A. Scheibner (two specimens); Livingston Co., E.S. George

Reserve, 7 July 1939, I.J. Cantrall (two specimens)  
 Livingston Co., E.S. George Reserve, 7 July 1936, Ada  
 Olson. This uncommon species is recorded from North  
 Carolina and Florida by Martin and Wilcox (1965), McAtee  
 and Banks (1920) record it from Virginia, Maryland and  
 Washington, D.C. Bromley never recorded the species  
 from Ohio or Connecticut but listed it as a possibility.

Flight Range - McAtee and Banks (1920) record 23 June  
 to 22 September for the known range with most dates of  
 collection in September.

Tolmerus notatus (Wiedemann)

Asilus notatus Wiedemann, 1828. Aussereuropaische  
 zweiflugelige Insekten 1: 451.

Description - This species is closely related to  
T. virginicus.

Both T. notatus and T. virginicus have: generally  
 blackish gray in color; antennae black, segment three  
 about as long as segment one and two, style about as  
 long as segment three; frons gray pollinose, occasionally  
 with a dark median line; gibbosity prominent; mystax with  
 a few black hairs above and numerous pale yellow or white

hairs beneath; beard white; legs black except for bases of tibiae; metatarsi may be somewhat reddish; venter of tibia and metatarsi often have areas of dense golden pile; abdomen black with narrow white margin caudally on each segment; hypopygium black. Length of notatus, 14-18 mm., virginicus, 15-18 mm.

Distinction of these two species is easily done by comparison of the respective hypopygia. The epandria of virginicus (Figure 12) are longer, narrower and not deflexed as in notatus (Figure 11). This is a slight prominence on the ventral margin of the epandria in virginicus but it is not nearly as well developed as in notatus. Also notatus is lighter in color and somewhat more robust in the appearance of the abdomen than virginicus.

Habitat Preference - This species is the most abundant and ubiquitous asilid in Michigan. It should properly be called the picniker's friend because of its abundance on picnic grounds in many of the state's parks and recreation areas.

This species is nearly always found in well established but disturbed areas along a forest edge. The

habitat is open but shaded by large trees. Shrubs are usually rather sparse and not very large. The species is usually most common in more mesic areas.

This species usually alights or rests on nearly anything that is not moving in its habitat. When temperatures are fairly cool however it nearly always rests directly on the ground in full sun. Collected specimens have Tabanus sp. (Tabanidae), small Bombyliidae, Sarcophagidae, Crambus sp. (Pyralidae), Callopistria monetifera Guenee (Noctuidae), Itame pustularia Guenee (Geometridae) as prey. McAtee and Banks (1920) report small moths, Draeculacephala mollipes Say (Cicadellidae), Tabanus sp., Tipulidae, Nephrotoma ferruginea Fabricius (Tipulidae) and small Chrysomelid beetles as prey. Bromley (1946) records Winthemia quadripustulata Fabricius (Tachinidae) and Pollenia rudis Fabricius (Calliphoridae) and Musca domestica Linn (Muscidae).

Michigan Distribution - Approximately four hundred specimens were examined from every county in Michigan except: Ontonagon, Iron, Isabella, Tuscola, Sanilac, Lapeer, Saint Clair, Macomb, Calhoun and Jackson. This species is known from Maine westward to Kansas and south to Florida

and Texas. (Martin and Wilcox, 1965; Bromley, 1950a)

Flight Range - 30 May to 29 August with most dates in July. McAtee and Banks (1920) report 21 May to 20 September for Washington, D.C. Copulation occurs throughout the season.

Tolmerus novaescotiae (Macquart)

Asilus novae-scotiae Macquart, 1847. Mem. Soc. Roy. des Sci., No. 1846: p. 62.

Description - Dark brown species with plain black femora and yellow tibiae; antennae slender and black, apex of second segment and base of third segment distinctly lighter in color, apex of style yellowish; frons gray pollinose; gibbosity rather prominent; mystax composed of black hair above and yellowish below (an occasional specimen may have the entire mystax pale yellow); beard white; femora completely black, tibia yellow with black tips, tarsi black with narrow yellow bases on each segment except for mostly yellow metatarsi; abdomen brown pollinose with narrow tan pollinose caudal margin on each segment; hypopygium about as long as abdominal segments six, seven and eight. Length 14 to 18 mm.

(Hine, 1909). All Michigan specimens examined were 12 to 15 mm.

Habitat Preference - Cockerell (1894) reports this to be a woodland species of oak and mixed mesophytic areas. It usually occurs along edges of woods and brushy pastures.

Michigan Distribution - Only seven specimens are known: Gogebic Co., T49 R38W S8, 4 August 1968, NTB; Marquette Co., Presque Isle, 18 July 1949 and 8 July 1949, G.D. Gill; Iosco Co., Oscoda, 7 April 1937, I.J. Cantrall; Montcalm Co., 16 August 1950, RRD; Midland Co., 19 July 1936, RRD; Monroe Co., T6S R6E S35, 23 July 1965, J. Truchan. Hine (1909) McAtee and Banks (1920) and Bromley (1946, 1950a) report this species from Nova Scotia to Florida. Bromley (1931) also reports it from central Ohio from 18 June to 3 July.

Flight Range - McAtee and Banks (1920) report the species common in Washington, D.C. and occurs from 14 June to 24 September and in copulation throughout August.

Tolmerus paropus (Walker)

Asilus paropus Walker, 1849. List of the specimens of dipterous insects in the collection of the British Museum, 2: 455.

Description - A tan or brown species with reddish preapical rings on black femora; antennae black, narrowly yellow at apex of second segment and base of third; frons light tan; gibbosity prominent; mystax of dense bristly pale hairs with a few black hairs in upper portion; beard very pale tan color; proleg and mesolegs black except reddish preapical band on femora and middle and apex of tibia and narrow apex of metatarsus and bases of tarsal segments; metaleg similar except base of tibia is black; profemora with close lying hairs and a row of distinct bristles on venter; abdomen covered with scant yellow pollen, caudal margins of segments gray; hypopygium rather small, black and subshining with long pale hair, somewhat curved downward over entire length. Length 13 to 17 mm.

Habitat Preference - Bromley (1946) reports this species common in dry sandy fields and pastures. He also reports



it occurs in large numbers in the proper habitat.

I have collected this species in similar situations with these plants: Monarda fistulosa, Lonicera sp., Solidago canadensis, Carex pennsylvanica and Sanguisorba canadensis.

Juillet (1961) recorded this species as being important in controlling populations of Rhyacionia buoliana Schiff., the European pine shoot moth. Each specimen consumed up to six moths per day. They unfortunately also preyed on the pine shoot-moth parasites as well. McAtee and Banks (1920) record Epiphragma solatrix Osten Sacken (Tipulidae) and Cordulegaster sp. (Aeschnidae) as prey.

Michigan Distribution - Seventy-five specimens were examined from these counties: Keewenaw, Houghton, Ontonagon, Baraga, Dickinson, Menominee, Schoolcraft, Mackinac, Chippewa, Emmet, Cheboygan, Benzie, Manistee, Wexford, Missaukee, Iosco, Mason, Midland, Bay, Muskegon, Kent, Gratiot, Saginaw, Sanilac, Ionia, Shiawassee, Genesee, Allegan, Ingham, Livingston, Oakland, Kalamazoo, Jackson, Washtenaw and Berrien.

Martin and Wilcox (1965), and McAtee and Banks (1920) and Hine (1909) report this species from New England west to Wyoming and Colorado and south to Virginia.

Flight Range - 16 June to 3 October with the majority of dates in July.

Tolmerus sadyates (Walker)

Asilus sadyates Walker, 1849. List of the specimens of dipterous insects in the collection of the British Museum, 2: 453.

Description - Somewhat larger blackish species; antennae black, segments one and two longer than the third segment, style about as long as third segment; frons white pollinose; gibbosity prominent; mystax of numerous black hairs above and fewer white or pale hairs below; beard white; femora black; tibia reddish with black markings on the outside; metatarsi reddish with brown apex, tarsal segments otherwise black or brown; abdomen black with white pollinose border on caudal margin of each segment; hypopygium large and longer than abdominal segments six, seven and eight. Length 13 to 17 mm.

Habitat Preference - This species is reported to be quite like notatus in habits and habitat by Bromley (1931, 1946). He records Ormenis pruinosa Say (Fulgoridae), a small tortricid and the ant, Formica fusca Say (Formicidae), as prey.

I have taken this species in ecotonal areas along edges of forests or in sunny openings of rather mesic areas. This species seems to be more active in the morning than in the afternoon. They have been observed to be cannibalistic. This species is often taken at light.

Michigan Distribution - One hundred fifty specimens were examined from every county in the Upper Peninsula except Menominee and Mackinac and from these counties in the Lower Peninsula: Emmet, Cheboygan, Charlevoix, Leelanau, Benzie, Manistee, Wexford, Missaukee, Roscommon, Ogemaw, Iosco, Mason, Lake, Clare, Gladwin, Huron, Oceana, Newaygo, Mecosta, Isabella, Midland, Muskegon, Montcalm, Ottawa, Kent, Ionia, Shiawassee, Ingham, Livingston, Oakland, Van Buren, Jackson, Wayne, Berrien, St. Joseph and Monroe.

Hine (1909) reports this species is known from New York south to North Carolina and westward into Ohio and Indiana.

Flight Range - 23 June to 10 October with the greatest majority of dates in middle August. McAtee and Banks (1920) report 10 July to 28 October for Washington, D.C.

Tolmerus snowii (Hine)

Asilus snowii Hine, 1909. Ann. Ent. Soc. Amer. 2: 160.

Description - Large dark brown species; antennae black, third segment long and slender with style about one-half as long; frons golden brown pollinose; gibbosity prominent; mystax mostly of pale yellow bristles with some black above and below on oral margin; beard sordid pale yellow; femora black with a reddish preapical band; protibia and mesotibia reddish with dark ring in center and black apex; metatarsus mostly yellow with black apically; tarsal segments black with yellow only at the base; metatibia mostly dark with narrow yellow area basally; abdomen covered with dark brown pollen, narrow caudal margins of segments lighter in color than rest of abdomen; hypopygium relatively small, very scanty pollinose, with numerous

golden hairs. Length 15 to 20 mm.

Habitat Preference - Bromley (1946) reports this species usually found in wet meadows with luxuriant vegetation. A pyralid moth is listed as prey.

Michigan Distribution - Seventy-one specimens were examined from these counties: Isle Royale, Houghton, Gogebic, Marquette, Menominee, Mackinac, Chippewa, Emmet, Cheboygan, Charlevoix, Antrim, Montmorency, Benzie, Alcona, Manistee, Wexford, Missaukee, Roscommon, Oscoda, Clare, Gladwin, Newaygo, Mecosta, Midland, Huron, Saginaw, Genesee, Shiawassee, Ingham, Kalamazoo, Jackson, Washtenaw and Berrien.

Hine (1909) examined specimens from nearly all of eastern North America to Kansas.

Flight Range - 3 June to 25 August with the majority of dates in late July and early August.

Tolmerus virginicus (Banks) NEW STATUS

Asilus virginicus Banks, 1920. Proc. Ent. Soc. Wash. 22: 31.

Description - Refer to T. notatus.

Habitat Preference - This species prefers habitats very similar to T. notatus with one exception; virginicus invariably is found in habitats with a lighter colored substrate such as a white or tan colored sand. Like notatus this species is ubiquitous in its distribution and although not as numerically common as notatus it is nevertheless difficult to adequately define its habitat because of its ubiquity.

This species has the unique habit of alighting on patches of bright areas. This habit makes it especially susceptible to capture using white cottage cheese cartons and ethylene glycol as pitfall traps.

Michigan Distribution - Seventy-five specimens were examined from: Marquette, Cheboygan, Presque Isle, Leelanau, Benzie, Manistee, Wexford, Roscommon, Iosco, Clare, Oceana, Newaygo, Mecosta, Isabella, Midland, Montcalm, Kent, Ionia, Allegan, Eaton, Ingham, Livingston, Wayne, Cass, Hillsdale and Lenawee counties.

McAtee and Banks (1920) record this species from Maryland to Virginia. Bromley (1947) recorded it from central Ohio.

Flight Range - 15 June to 16 September with the greatest majority of dates in late July. McAtee and Banks (1920) record 28 May to 20 July for the known range of the species.

## LITERATURE CITED



#### LITERATURE CITED

- Andrews, A.W. 1918. Diptera Collected on Whitefish Point, Chippewa Co. Occ. Papers Mus. Zool. Univ. Mich. No. 53, 8 pp.
- Back, E.A. 1909. The Robber Flies of America North of Mexico Belonging to the Subfamilies Leptogastrinae and Dasypogoninae. Trans. Amer. Ent. Soc. 35: 137-400.
- Banks, N. 1914. Notes on Asilidae, With Two New Species. Psych 21: 131-133.
- \_\_\_\_\_. 1917. Synopsis of the Genus Dasyllis. Bull. Brooklyn Ent. Soc. 12: 52-55.
- Bell, E.L. 1921. Collecting Notes. Bull. Brooklyn Ent. Soc. 16: 96.
- \_\_\_\_\_. 1924. Notes on Asilus sericeus. Jour. New York Ent. Soc. 32: 219.
- Blanton, F.S. 1939. Collecting Notes on the Family Asilidae (Diptera). Bull. Brooklyn Ent. Soc. 34: 229-235.
- Britton, W.E. 1927. Silky Robberfly. Bull. Conn. Agr. Exp. Sta. No. 285: 278-279.
- Bromley, S.W. 1931. A Preliminary Annotated List of the Robber Flies of Ohio. Bull. Ohio State Mus. Sci. 1: 1-19.
- \_\_\_\_\_. 1933. Courting and Mating Performance of an Asilid Fly (Heteropogon lautus). Psyche 40: 144.

- \_\_\_\_\_. 1934a. The Robber Flies of Texas. Ann. Ent. Soc. Amer. 27: 74-113.
- \_\_\_\_\_. 1934b. Additions to the Ohio List of Robber Flies. Ohio Jour. Sci. 24: 163-164.
- \_\_\_\_\_. 1934c. The Laphriine Robber Flies of North America. Unpublished Ph.D. Thesis, Ohio State University.
- \_\_\_\_\_. 1936a. Additions to the Ohio List of Robberflies III. Ohio Jour. of Science 36: 130.
- \_\_\_\_\_. 1936b. The Genus Diogmites in the USA With Descriptions of New Species. Jour. New York Ent. Soc. 44: 225-237.
- \_\_\_\_\_. 1937. The genus Stenopogon in the USA. Jour. New York Ent. Soc. 45: 291-309.
- \_\_\_\_\_. 1946. Guide to the Insects of Conn. Part VI Asilidae. Conn. State Geol. and Nat. Hist. Survey Bull. 69: 1-48.
- \_\_\_\_\_. 1947. Ohio Robber Flies IV. Ohio Jour. Sci. 67: 67.
- \_\_\_\_\_. 1949. Missouri Bee Killer, P. milbertii Macq. Bull Brooklyn Ent. Soc. 44: 21.
- \_\_\_\_\_. 1950a. Florida Asilidae. Ann. Ent. Soc. Amer. 43: 228-235.
- \_\_\_\_\_. 1950b. Records and Descriptions of Asilidae in the Collection of the Univ. of Mich. Museum of Zoology. Occ. Papers of the Mus. of Zool. Univ. of Mich. No. 527, 5 pp.
- \_\_\_\_\_. 1950c. Ohio Robber Flies V. Ohio Jour. Sci. 50: 229-234.
- \_\_\_\_\_. 1951. Asilid Notes with Descriptions of Thirty-two New Species. Amer. Mus. Novit. No. 1532, 24 pp.

- Carrera, M. 1949. Contribuicao ao Conhecimento dos Asilidae Neotropicais (Diptera) I. Sobre as Especies Brasileiras com Esparao no Tibia. Agk. Zool. 7: 1-148.
- Champlain, A.B. and J.N. Knull, 1923. Notes on Pennsylvania Diptera Ent. News 34: 212.
- Clements, F.E. 1916. Plant Succession. Carnegie Inst. Wash. Publ. No. 242, 512 pp.
- Cockerell, T.D.A. 1894. On the Habits of Some Asilidae. Ent. News 5: 173-174.
- \_\_\_\_\_. 1913. A Fossil Asilid Fly From Colorado. Ent. 46: 213-214.
- Cole, F.R. and Wilcox, J. 1938. The Genera Lasiopogon and Alexiopogon Curran in North America. Ent. Amer. 18: 1-19.
- Crampton, G.C. 1942. Guide to the Insects of Conn. Part VI. The Diptera or True Flies of Conn. First Fascicle. The External Morphology of Diptera. Conn. State Geol. and Nat. Hist. Survey Bull. 64: 1-509.
- Curran, C.H. 1923. Studies in Canadian Diptera. I Revision of the Asilid Genus Cyrtopogon and Allied Genera, II. The Genera of the Family Blepharoceridae. Can. Ent. 55: 92-95, 116-125, 132-142, 169-174, 185-190, 266-269.
- \_\_\_\_\_. 1924. Two Undescribed species of Cyrtopogon With Notes. Can. Ent. 105: 277-280.
- \_\_\_\_\_. 1930. New American Asilidae. Amer. Mus. Novit. No. 425, 25 pp.
- Dice, L.R. 1943. The Biotic Provinces of North America Univ. Mich. Press, Ann Arbor. 78 pp.

- Emden, Frity Ivan. 1956. Diptera, Chapter 21 in  
Tuxen, S.L.: Taxonomists Glossary of Genitalia  
in Insects. Munksgaard, Copenhagen. pp. 1-284  
Diptera pp. 111-122.
- Hardy, G.H.H. 1934. The Asilidae of Australia. Ann.  
Mag. Nat. Hist. Part I, Ser. 10, 13: 498-525  
and Part 2, Ser. 10, 14: 1-35.
- Harris, T.W. 1862. A Treatise on Some of the Insects  
Injurious to Vegetation. Third Edition. Boston.  
640 pp. (Asilidae 604-605)
- Hays, K.L. 1956. A Synopsis of the Tabanidae of  
Michigan. Misc. Publ. Mus. Zool. Univ. Mich.  
No. 98, 70 pp.
- Hine, S. 1909. Robberflies of the Genus Asilus. Ann.  
Ent. Soc. Amer. 2: 136-172.
- \_\_\_\_\_. 1911. Robber Flies of the Genera Promachus  
and Proctacanthus. Ann. Ent. Soc. Amer. 4: 153-172.
- \_\_\_\_\_. 1919. Robber Flies of the Genus Erax. Ann.  
Ent. Soc. Amer. 12: 103-157.
- Hull, F.M. 1942. Mating Habits of Robber Flies. Ent.  
News 53: 132.
- \_\_\_\_\_. 1962. Robber Flies of the World. The Genera  
of the Family Asilidae. U.S. Natl. Mus. Bull.  
No. 224, Part 1, pp. 1-430, Part 2, pp. 431-907.
- James, M.T. 1941. The Robber Flies of Colorado  
(Diptera, Asilidae). Jour. Kansas Ent. Soc.  
14: 27-53.
- Johnson, C.W. 1909. Notes on the Synonymy of the  
Species of Erax of the eastern United States.  
Psyche 16: 32-33.
- \_\_\_\_\_. 1913. Insects of Florida. I Diptera. Bull.  
Amer. Mus. Nat. Hist. 32: 37-90.

- \_\_\_\_\_. 1925. Fauna of New England. Part 15.  
List of the Diptera of Two-Winged Flies. Occ.  
Pap. Boston Soc. Nat. Hist. 7: 3-326. (Asilidae  
pp. 113-120)
- Juillet, J.A. 1961. Observations on Arthropod  
Predators of the European Pine Shoot Moth.  
Rhyacionia buoliana (Olethreutidae) Can. Ent.  
113: 195-198.
- Karl, E. 1959. Vergleichend-Morphologische Unter-  
suchungen der Mannlichen Kopulationsorgane bei  
Asiliden. Beitrage zur Entomologie 9: 619-680.
- Kormondy, E.J. 1958. Catalogue of the Odonata of  
Michigan. Misc. Publ. of Mus of Zool. Univ.  
Mich. No. 104, 40 pp.
- Lavigne, R. and F.R. Holland. 1969. Comparative  
Behavior of Eleven Species of Wyoming Robber  
Flies. Univ. Wyoming Agr. Exp. Sta. Sci. Mono.  
No. 18, 60 pp.
- Leach, E. 1819. In Samouelle: The Entomologists  
Useful Compendium. London pp. 1-496.
- Linnaeus, C. 1758. Systema Naturae Tenth edition.  
Systema Naturae per Regna Tria Naturae Secundum  
Classes, Ordines, Genera, Species, cum Character-  
ibus, Differentiis, Synonymicis, Locis. Stockholm  
pp. 1-824 (Asilidae pp. 605-606).
- Macquart, P.J.M. 1838. Diptera Exotiques Nouveaux ou  
Peu connus. Mem. Soc. Sci Agric. et Arts, Lille.  
1: 14-156.
- Martin, C.H. 1957. A Revision of the Leptogastrinae  
in the United States. Bull. Amer. Mus. Nat.  
Hist. No. 111, pp. 345-385.
- \_\_\_\_\_. 1959. The Holopogon complex of North America  
excluding Mexico With the Descriptions of New  
Genus and a New Subgenus. Amer. Mus. Novit.  
No. 1908, 40 pp.

- \_\_\_\_\_. 1965. Distribution Patterns and Corrected Identifications of Asilid Species Reported as Common to North and South America. Trans. Amer. Ent. Soc. 91: 1-37.
- \_\_\_\_\_. 1968. The New Family Leptogastridae (Grass Flies) Compared With the Asilidae. Jour. Kansas Ent. Soc. 41: 70-100.
- Martin, C.H. and J. Wilcox. 1965. In Stone, A. et al. A Catalog of the Diptera of America North of Mexico. Agr. Res. Serv., Agric. Hndbk. 276. Washington, D.C. 1696 pp.
- McAtee, W.L. 1918. Key to the Nearctic Species of the Genus Laphria. Ohio Jour. Sci. 19: 143-170.
- McAtee, W.L. and N. Banks. 1920. District of Columbia Diptera: Asilidae. Proc. Ent. Soc. Wash. 22: 13-33.
- Meigen, J.W. 1803. Versuch einer Neuen Gattungseintheilung der Europäischen Zweifflugeligen Insekten. Mag. Insektenkunde 2: 250-281.
- Melander, A.L. 1923a. Studies in Asilidae. Psyche 30: 207-219.
- \_\_\_\_\_. 1923b. The Genus Lasiopogon. Psyche 30: 135-145.
- Melin, D. 1923. Contributions to the Knowledge of the Biology, Metamorphosis, and Distribution of the Swedish Asilids in Relation to the Whole Family of Asilids. Uppsala Univ. Zool. Bidr. 8: 1-317.
- Merriam, C.H. 1892. The Geographic Distribution of Life in North America With Special Reference to Mammalia. Proc. Biol. Soc. Wash. 7: 1-64.
- \_\_\_\_\_. 1894. Laws of Temperature Control of Geographic Distributions of Terrestrial Mammals and Plants. Nat. Geogr. Mag. 6: 229-238.

- Newkirk, M.R. 1963. The Feeding and Mating of Leptogaster annulatus. Ann. Ent. Soc. Amer. 56: 234-236.
- Nikolsky, G. 1947. On Biological Peculiarities of Faunistic Complexes and on the Value of Their Analysis for Zoogeography. Zool. Zh. 26: 231.
- Oldroyd, H. 1969. The Family Leptogastridae. Proc. Royal Ent. Soc. London (B) 38: 27-31.
- Poulton, E.B. 1924. The Relation Between the Larvae of Hyperechia and Those of Xylocopid Bees. Trans. Ent. Soc. London 1924: 121-133.
- Pritchard, A.E. 1938. Synopsis of North and Central American Holcocephala with a Description of a New Species. Jour. New York Ent. Soc. 66: 11.
- Ritcher, P.O. 1940. Kentucky White Grubs. Ky. Agr. Exp. Sta. Bull. 401: 73-157 (p. 143).
- Schiner, J.R. 1868. Diptera In Reise der Oesterreichischen Fregatte Novara 1857-59 Zool. Theil. 2: 1-388.
- Schmid, J.M. 1969. Laphria gilva, a Predator of Dendroctonus ponderosae in Black Hills of South Dakota. Annals Ent. Soc. Amer. 62: 1237.
- Uvarov, B.P. 1938. Ecological and Biogeographical Relations of Eremian Acrididae. Mem. Soc. Biogeogr. 6: 231-273.
- Vockeroth, J.R. 1966. A Method of Mounting Insects From Alcohol. Canad. Ent. 98: 69-70.
- Voous, K.H. 1955. Het Probleem van de Zoogeographische Indeling van de Landfauna. Inaugur. Vrije Univ. Wolters, Groningen. 20 pp.
- \_\_\_\_\_. 1963. The Concept of Faunal Elements or Faunal Types. Proc. XIII Internat. Ornith. Congr., pp. 1104-1108.

Wilcox, J. 1936. Asilidae, New and Otherwise, from the Southwest, With a Key to the Genus Stichopogon. Pan Pacific Ent. 12: 201-212.

\_\_\_\_\_. 1966. Efferia Coquillet in America North of Mexico Proc. Calif. Acad. of Sci. 34: 85-234.

Wilcox, J. and C.H. Martin. 1936. A Review of the Genus Cyrtopogon Loew in North America. Ent. Amer. 16: 1-94.

\_\_\_\_\_. 1941. The Genus Dioctria Meigen in North America. Ent. Amer. 21: 1-22.