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A Review of the Characters Used in Identification of Minnesota *Eristalis*, Latreille (Diptera, Syrphidae)¹

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The species of *Eristalis* comprise a conspicuous fraction of the insects commonly seen hovering about flowers or near the edges of lakes and ponds. The superficial bee-like appearance of these flies has also served to distinguish this group. Most zoologists even have some knowledge of the larval stage (rat-tailed maggot) as well as the adult, however, a specific identification problem remains in spite of the widespread general information concerning the group. Many of the characters used in species separation are variable or unreliable. A critical review of these characters and consideration of new character combinations seems desirable.

The family Syrphidae may readily be distinguished from other Diptera by the so-called false or spurious vein, which is a vein-like thickening of the wing membrane between the 3rd and 4th longitudinal veins (R4 + 5 and M1 + 2), and running through the anterior radio-medial cross vein. The present grouping of syrphid genera has been greatly influenced by Shannon (1921), however, Malloch (1922) noted the presence of a patch of black spinules on the anterior surfaces of the bases of all femora only in *Eristalinae*. The spinule character in combination with the deep bending of vein R4 + 5 into cell R5 serve to distinguish the *Eristalinae*.

The genus *Eristalis* is characterized as follows: Face tuberculate, and a little produced downward. Antennae short; arista long and short, plumose basally, bare or microscopically pubescent. Eyes bare to pilose, unicolorous to dark vertical bands or numerous spots. Mesonotum short; scutellum convex. Squamae large. Marginal cell of wing closed; loop of third vein deep; anterior cross-vein at or near middle of discal cell. Abdomen rather short and compact. Hind femora slender to moderately thickened without spines or processes; tibiae straight to moderately arcuate. Genotype: *Musca arbutorum* Linné.

Hull (1949) recognizes five subgenera based chiefly upon head characters.

Characters Used In *Eristalis* Identification:

Head Characters: The markings and pile of the eyes aid in the definition of two local *Eristalis* species. The facial profile and ground color of the face are helpful to a degree, however, the width of the facial stripe seems to have very limited significance. Antennal characters, i.e. length of segments and pilosity of arista, also have little influence in identification of Minnesota species.

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Thoracic Characters: The density and color of thoracic pile is a prominent and useful character in separation of species groups. In non-pilose species, the presence of dark or light bands on the mesonotum may be a significant character. The bright yellow scutellum readily identifies *E. transversus* among our local species.

Leg Characters: Abrupt color changes of tarsal segments or portions of the tibiae have been used extensively. Bristles, spines, and other processes do not seem to be usable.

Abdominal Characters: Considerable use has been made of color patterns and opaque markings of the two characters. The greater stability of the opaque markings provide a readily recognizable basis for identification of *E. dimidiatus*, however, these opaque markings are not an unmixed blessing. In some species, opaque markings occasionally appear on some specimens, but not on others.

Wing Characters: Infuscated areas in the wing membrane are characteristic of most individuals of some *Eristalis* species, however, the shape and extent of these pigmented areas are too variable to be used as specific characters. Wing length may possibly be used as another sex differentiating character in several species. The wings of five Minnesota species were measured with the average length of the female wing at least a millimeter longer than that of the male.

Genitalia Characters: It seems quite remarkable that the abundance of characters in the male genitalia have been used so little in separating *Eristalis* species. Illustrations of *Eristalis* terminalia appear rarely in the literature and no published dependence on these characters was found. Metcalf (1921) presented Syrphid fly workers with a useful description of male genitalia. Unfortunately, Metcalf all but ignored the *Eristalinae* terminalia.

The genital structures of *Eristalis barda* are shown in Fig. 1-3. The descriptive terminology is that used by Cole (1927).

The styli are well developed and may vary significantly among species. The cerci are small and not particularly useful in separating species. The paraphalli are blade-like and seem to protect the aedeagus. The interior forceps are articulated to the aedeagus and project upward between the blades of the paraphalli. In this study, considerable weight is given to variations in shape of the paraphalli and interior forceps.

The male genitalia normally fit into a pouch and are

therefore concealed from view. The genitalia may be extended in relaxed specimens and then snipped from the specimen for closer examination. In this study, the abdomen was broken free from the specimen before treatment. All drawings of genitalia presented herein were prepared after boiling the abdomen in a 10% solution of KOH for as long as necessary to soften and bleach the genitalia. The postabdomen was then dissected free from the abdomen and both parts neutralized in an acetic acid rinse. The postabdomen was then transferred to a drop of glycerine on a glass slide; the genitalia extended and examined with a compound microscope containing an ocular grid. All drawings were originally made on graph paper using the ocular grid as a scale basis. The abdomen and terminalia are kept with the specimen by storing them in small vials containing glycerine with the specimen pin run through the cork.

KEY TO MINNESOTA SPECIES

1. Thorax and abdomen with dense long pile.....2
Thorax and abdomen bare or with short pile.....3
2. Legs black, except reddish hind tarsi; large hairy species*barda* (Say)
Legs black, except reddish hind tarsi; smaller individuals with abundant reddish pile on third and fourth abdominal segments.....*barda* var. *rufipilis* Hull (new combination)
Legs black, hind tarsi dark brown or black, abdominal pile usually black although some yellow pile may be present*bastardii* Macq.
3. Eyes with small round black dots.....*aeneus* Scopoli
Eyes unicolorous or without such dots.....4
4. Third tergite of abdomen wholly able to reflect light....8
Third tergite of abdomen with opaque markings unable to reflect light5
5. Thorax with broad transverse stripe, scutellum bright yellow*transversus* Wied.
Thorax unicolorous or indistinctly vittate, scutellum glossy6
6. Posterior margin of third abdominal segment with a fringe of pale yellow pile; opaque markings limited to two widely separated oval spots on third segment.
See fig. 6.....*latifrons* Loew
Fringe of pale yellow pile lacking on posterior margin of third abdominal segment.....7
7. Third tergite of abdomen with three opaque spots. Fourth tergite with a rounded opaque spot near anterior edge. See fig. 5.....*dimidiatus* Wied.
Third tergite of abdomen with opaque posterior band or other opaque pattern.....9
8. Basal portion of hind tibiae light yellow....*latifrons* Loew
Hind tibiae entirely dark brown or black; pile of eyes restricted to a broad vertical stripe.....*tenax* Linné
9. Basal joints of hind tarsi pale in color; third antennal joint red to dark reddish brown in female; infuscated spot on basal half of wing prominent in female....**rupium* (Fab.)
Basal joints of hind tarsi dark.....10
10. Transverse band of opaque black on third abdominal tergite; face entirely pilose; basitarsi of middle leg often yellowish*arbustorum* (Linné)
Basal two joints of middle tarsi yellow; face with a shining black stripe.....**nemorum* (Linné)

* Were seen only in the University of Minnesota collection.

This key separates only those species of which we have actual Minnesota collection records. Fluke (1922) lists *E. saxorum* Wied., *compactus* Walk., and *vinetorum* Fab.

from Wisconsin. *Eristalis hirtus* Linné and *obscurum* Loew from South Dakota are listed in the South Dakota State College collection.

Significance of Genitalia Characters: The foregoing key does not show the influence of the genitalia characters which greatly influenced its construction. Genitalia examinations frequently reduced confusion resulting from varying specimens within an apparent series. Particularly the problem of color variation has plagued workers within this group.

Hull (1925) divided the North American *Eristalis* species into a number of groups. He recognizes the scarcity of structural characters, but feels his grouping arrangement is strengthened when considered in the light of geographic distribution. One of Hull's groups, the *pilosus* group, clearly shows how useful genitalia characters can be in separating species. Specimens resembling *E. montanus*, *anthophorinus*, *bastardii*, and *mellisoides* may be found among pilose specimens taken in Minnesota. Hull (1925) states *montanus* Williston is the same as *anthophorinus* Fallén, and that *anthophorinus* is a holartic species, which reduces the list by one. Hull differentiates *bastardii* and *anthophorinus* on the basis of the median black stripe on the abdominal segments and the color of the abdominal pile. Hull's species *mellisoides* is differentiated from *bastardii* by its larger size and more narrow opaque band on the posterior margin of the third abdominal tergite. There is little doubt that *occidentalis* Williston is also closely related to the other pilose species found in the Northern States.

During the course of this study, the writers prepared a long series of pilose specimens starting with specimens with a narrow black median stripe on a predominantly yellow-orange abdomen, ranging through intergrades of black and yellow-orange to specimens with a predominantly black abdomen. The specimens at either extreme of this color range could be readily assigned to *anthophorinus* or *bastardii*. The intergrades could often be tentatively placed as *mellisoides* or *bastardii*. An examination of male genitalia from all color variants showed the genitalia structures to be remarkably constant with one exception. The single variant (provided by Dr. Laffoon of Ames, Iowa) was collected at Grafenwöhr, Germany, and neatly fits the description of *anthophorinus* (fig. 10). The constancy of male genitalia structure in this series certainly casts doubt regarding the reliability of color of pile and abdominal markings as specific characters in this group. This examination of male terminalia also creates some doubt concerning the true range of *anthophorinus*. In view of these findings, the writers feel that Northern States specimens keying to *montanus*, *anthophorinus*, *mellisoides*, and probably *occidentalis* should be regarded as *Eristalis bastardii* Macquart.

The paraphalli and interior forceps of the pilose species are shown in Figs. 3, 9-12. These terminalia portions of *barda* and *barda* var. *rufipilis* bear a close resemblance to those of the other pilose species. In the absence of biological data, the similarity of genital structures seem to provide additional evidence suggesting the close relationship of the pilose species.

Another identification problem clarified by genitalia examination is the confusion between *arbustorum* Linné and *brousii* Williston. Hull (1925) regards *brousii* as a native species which has been seriously challenged by the imported *arbustorum*. Metcalf (1913) and others have considered *meigenii* Wiedemann conspecific with *brousii*. Curran (1926) maintained *meigenii* was distinct from *brousii* on the basis of more extensive opaque abdominal markings and darker legs; and later (1930), upon examination of Wiedemann's type, declared *meigenii* does not even exist in the nearctic region. Another frequently appearing synonym for *brousii* is *androcles* Osten Sacken, however, it appears that Osten Sacken did not publish a description for *androcles*.

The usual distinction between *brousii* and *arbustorum*

has been the yellowish basal joint of the middle tarsi in *arbustorum*. This tarsal character agrees fairly well with an opaque band or spot on the third tergite. The writers have found specimens where these characters were reversed. During the past summer five specimens of *arbustorum* were reared from what was believed to be the same egg mass. Individuals among this short series could be placed in either *arbustorum* or *brousii*, however, one specimen showed the basitarsal markings of one species and tergite markings of the other. Subsequent efforts to rear *arbustorum* have thus far failed. An examination of the genitalia of *arbustorum* and *brousii* show them to be identical which further casts suspicion concerning the reliability of color patterns and abdominal markings. Pending accumulation of more biological data, the writers consider *brousii* and *arbustorum* as conspecific and propose this population be considered as *arbustorum*.

In all likelihood a genitalia study of the nearctic *Eristalis* species could ease many of the identification prob-

PLATE I

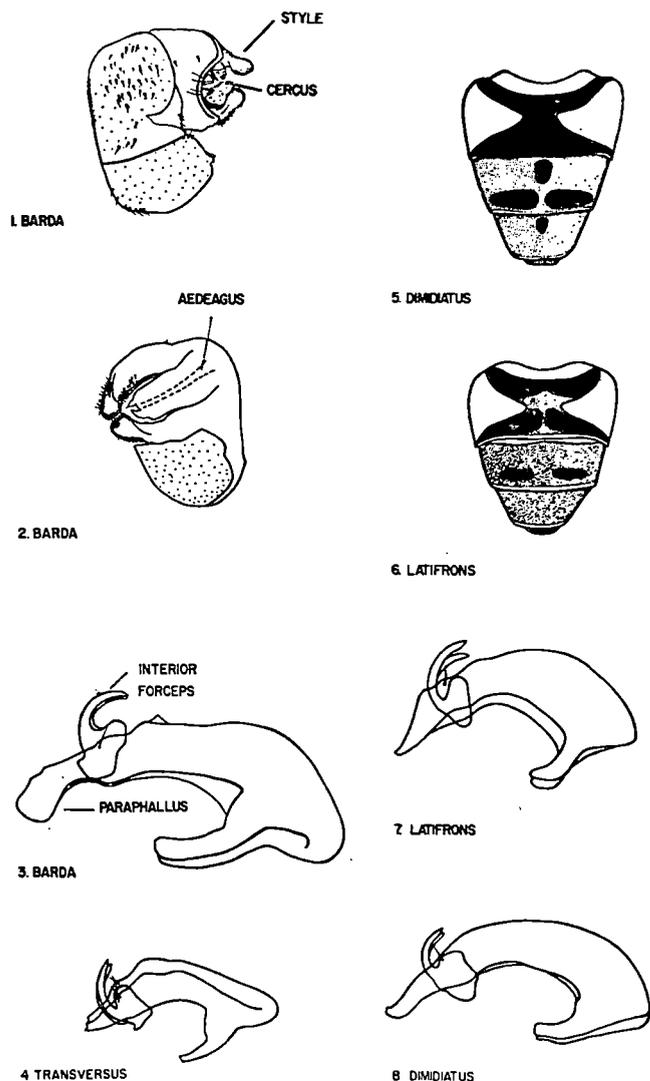


FIGURE 1: *Eristalis barda* postabdomen, lateral view.
 FIGURE 2: *Eristalis barda* postabdomen, ventral view.
 FIGURE 3: *Eristalis barda* paraphalli and aedeagus dissected free.
 FIGURE 4: *Eristalis transversus* paraphalli.
 FIGURE 5: *Eristalis dimidiatus* abdomen; white portion: yellow, solid black: opaque, stippled areas: shining black.
 FIGURE 6: *Eristalis latifrons* abdomen.
 FIGURE 7: *Eristalis latifrons* paraphalli.
 FIGURE 8: *Eristalis dimidiatus* paraphalli.

PLATE II

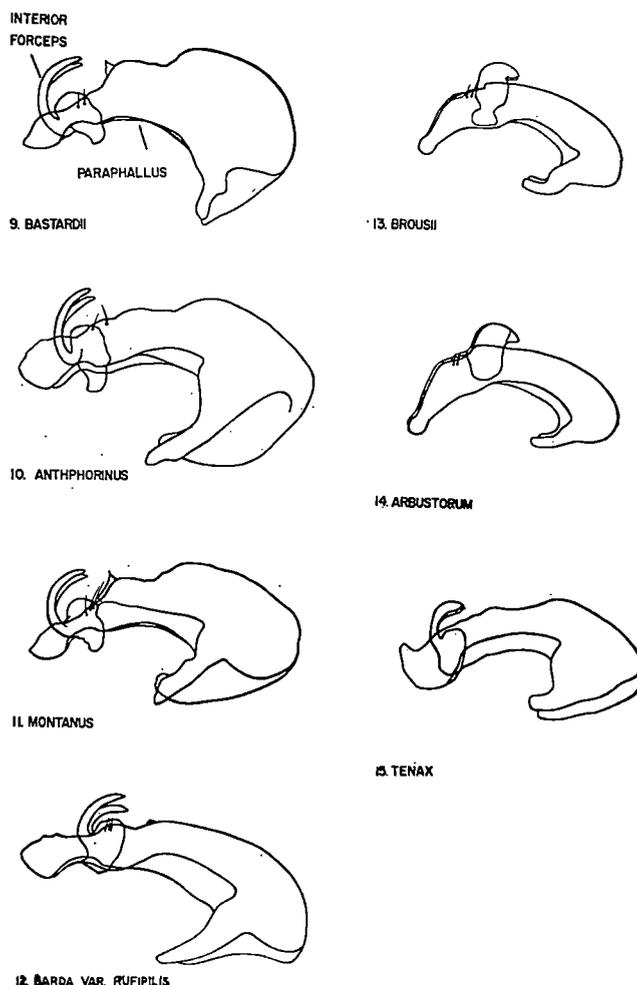


FIGURE 9: *Eristalis bastardii* paraphalli.
 FIGURE 10: *Eristalis anthophorinus* paraphalli.
 FIGURE 11: *Eristalis montanus* paraphalli.
 FIGURE 12: *Eristalis barda* var. *rufipilis* paraphalli.
 FIGURE 13: *Eristalis brousii* paraphalli.
 FIGURE 14: *Eristalis arbustorum* paraphalli.
 FIGURE 15: *Eristalis tenax* paraphalli.

lems within the species groups. The results of this fragmentary study of the genus indicate the male terminalia may be valuable in designating closely related species. Wherever our local study touched Hull's species groupings, the genitalia similarities within these groups tend to validate Hull's group separations.

Damaged or discolored male specimens may still be usable through the examination of the genitalia characters.

The use of genitalia characters in combination with color, degree of pilosity, and opaque markings has simplified the identification of Minnesota *Eristalis* specimens. However, the variable nature of the abdominal markings is still a distraction to the writers. It is possible that color extension or restriction may represent an environmental influence. Perhaps the somewhat varied climate in the different regions of Minnesota may account for this variation, although this was not obvious in our series. The most promising answer to this question seems to be the development of rearing techniques for *Eristalis* populations.

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