

An Overview and Dichotomous Key to the Bittacidae
(Insecta: Mecoptera) of Illinois

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Introduction

The insect order Mecoptera is a morphologically basal group of holometabolous insects represented by 600 extant species divided into 34 genera and 9 families (Dunford, 2008). Fossil Mecopterans first appeared in the Permian period and are represented by 400 species. These insects are an important evolutionary link in the evolution of Dipterans and Siphonapterans. Of the extant Mecopterans, 95% of species are represented by only two families. The Panorpididae are represented by 380 species, while the Bittacidae are represented by 180 (Grimaldi, 2006), however Krzeminski (2007) estimates extant Bittacid species at 270. The Family Bittacidae first appears approximately 150 million years ago in the late Jurassic (Grimaldi, 2006), although some authors cite a Triassic origin (Grimaldi, 2006; Krzeminski, 2007).

Morphology of the Bittacidae

Much work has been published on the morphology and behavior of the Bittacidae, including important works by Hine (1898), Setty (1940), and many publications by Dr. George W. Byers. Bittacids get their common name of “Hangingflies” from their resting behavior. Bittacid legs are long and slender, possess a five-segmented tarsus, are tipped with a single raprorial pretarsal claw, and an elongated tibial spur. The fifth tarsomere closes against the fourth allowing the insect to grasp prey. This predatory adaptation prevents Hangingflies from landing and walking; therefore they must hang from vegetation by pro- and sometimes mesothoracic legs while at rest or while feeding on captured prey.

The head of Bittacids possess one pair of compound eyes and three ocelli. Antennae are filiform with 14 to 20 antennomeres. The rostrum is formed by the elongation of the clypeus. Each mandible is slender, flattened, and tipped with a single tooth which moves in a scissor-like motion across the opposing mandible.

Males possess pheromone producing vessicles located between abdominal sclerites 6-7 and 7-8. The shape of the vesscles is of diagnostic importance in identifying some species. Also of diagnostic significance are the male abdominal terminalia, particularly the ninth tergum.

Bittacids possess two pair of long, narrow wings which are similar in size. However, two genera, *Anomalobittacus* and *Apterobittacus*, are flightless,

and the latter is wingless. Venation is complete and similar between fore- and hindwings. Wing venation and resting position are important diagnostic characters for determining Bittacids.

Larvae of Bittacids are holometabolous and eruciform. The head is well sclerotized and possesses two large lateral eyes (Setty, 1940), each with seven ommatidia, and one ocellus. Antennae are two-segmented; mandibles are large and sclerotized. The thorax is equipped with three pair of single clawed legs. One pair of fleshy three-branched dorsal projections is present on the meso- and metanotum and on abdominal segments 1 through 9. The tenth abdominal segment possesses a sucker which aids in locomotion and helps fix the position of the larva during pupation.

Life History and Behavior

In many species of Bittacids, males capture prey and emit pheromones to attract females. When a female arrives, the male offers the prey item as a nuptial gift, and if the gift is judged acceptable by the female, mating occurs while the female feeds. Eggs are dropped onto the leaf litter on the forest floor while the female is suspended above, hatching within two weeks (Webb et al, 1975). Larval development consists of four instars, a prepupal stage, and a pupa. Larval development is rapid if food is abundant, but the prepupal stage may lie dormant for several months. Pupation generally occurs at the surface among vegetation and leaf litter; however some species excavate a shallow burrow in the soil. Pupae are exarate and become extremely active when disturbed. Pupation lasts from 15 to 24 days (Setty, 1940).

The mating behavior of the Bittacidae, particularly *Hylobittacis apicalis*, has been extensively studied. Thornhill (1980) determined that female *H. apicalis* discriminate based of the size and quality of the nuptial gift presented, allowing males presenting larger prey items to mate longer. In addition, Thornhill discovered that the sex ratios of species that exhibit the nuptial gift behavior are biased towards females. Males spend more time hunting than females, thus increasing the risk of predation by becoming trapped in spider webs. Species that do not demonstrate this behavior, like *B. strigosus*, have similar sex ratios because both sexes must hunt to obtain food. In addition to the nuptial gift phenomenon, males of *H. apicalis* have also been observed exhibiting “kleptoparasitism”. Thornhill (1979) discovered that the survival of males improved if they could obtain prey by

other means besides actively hunting. This was done in two ways. First, males will sometimes locate other males that have obtained a prey item, or a mating pair that is actively feeding, and grapple with them in an attempt to steal the prey. Secondly, some males will locate a male with a prey item and mimic the abdominal movements of a female in order to initiate mating. Once the nuptial gift is presented, the “transvestite” male will grasp the prey item and attempt to flee. Males that successfully obtain prey items by kleptoparasitism decrease the likelihood of predation and expend less time and energy hunting. As a result, they increase their chance to successfully mate.

Taxonomy and Diversity of the Bittacidae in Illinois

Family BITTACIDAE Enderlein, 1910

Three genera of the family Bittacidae, *Apterobittacus* MacLachlan, 1893, *Orobittacus* Villegas and Byers, 1982, and *Hylobittacus* Byers, 1979, are unique to North America, although a questionable record of *Hylobittacus* exists from Hidalgo, Mexico. The genus *Hylobittacus* was separated from *Bittacus* in 1979 by Dr. George Byers based upon the venation and resting position of the wings. Byers determined that *Hylobittacus* was more closely related to the genus *Kalobittacus* Esben-Petersen, 1914 of Mexico and Central America. The large genus *Bittacus* Latreille, 1805 is worldwide in its distribution and makes up the entire Mecopteran fauna of Africa.

Of the ten species of Bittacids collected in North America, six are known to occur in Illinois. These include *Hylobittacus apicalis* (Hagen, 1861), *Bittacus stigmaterus* Say, 1823, *B. strigosus* Hagen, 1861, *B. punctiger* Westwood, 1846, *B. pilicornis* Westwood, 1846, and *B. occidentis* Walker, 1853. Other species outside Illinois include *Orobittacus obscures* Villegas and Byers, 1982, *Bittacus texanus* Banks, 1908, *B. chlorostigma* MacLachlan, 1881, and the wingless *Apterobittacus apterus* (MacLachlan, 1871). Of those species collected outside of Illinois, *Bittacus texanus* ranges the closest with records from Kansas, New Mexico, Texas, and Florida, and is included in the taxonomic key. The following distributional data is replotted from Griffiths (1995), with one new county record of *Bittacus stigmaterus*.

Key to the Bittacidae of Illinois
(From Webb et al, 1975 and Griffiths, 1995)

1. Apices of wings dark brown and held out to the sides while at rest (Fig. 1)
..... *Hylobittacus apicalis*
- 1'. Apices of wings without dark brown spot; wings folded over back while at rest (Fig. 2) genus *Bittacus*2

2. Apical crossveins present (Fig. 5) 3
- 2'. Apical crossveins absent (Fig. 3) 4

3. Hind femora with brown spots surrounding base of setae; wings mottled with small light-brown spots (Fig. 4) *Bittacus punctiger*
- 3'. Hind femora lacking brown spots surrounding setae; wings without small light-brown spots (Fig. 5) *B. pilicornis*

4. Subcostal crossvein distal to the first fork of the radial sector (Fig. 6)
..... *B. occidentis*
- 4'. Subcostal crossvein basal to the first fork of the radial sector (Fig. 7) 5

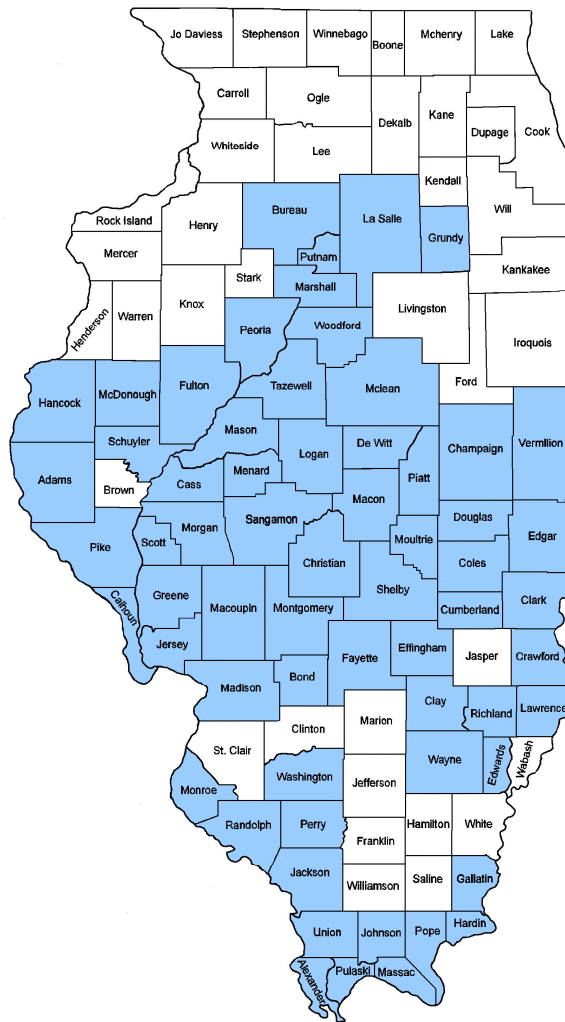
5. Wing membranes colorless; crossveins margined (Fig. 7) *B. strigosus*
- 5'. Wing membranes yellow to amber; crossveins not margined (Fig. 8)..... 6

6. Wing color yellow to amber; in males, the lobes of the ninth tergum each bear two medial prominences bearing several black spines (Fig. 10)
..... *B. stigmaterus*
- 6'. Wing color brown to dark brown; in males, the lobes of the ninth tergum bear one medial prominence bearing several black spines (Fig. 11)
..... *B. texanus*

Hylobittacus apicalis (Hagen, 1861)

Diagnosis: Body pale yellow to brown. Wings pale; apices dark brown to black; apical crossvein absent and subcostal crossvein is basal to the first fork of the radial sector. Wings possess a single pterostigmal crossvein. Forewings are held out to the sides laterally while at rest; hind wings also held to the sides, but inclined slightly ventrally. Male abdominal pheromone dispersing vesicles are rounded.

Range: Occurs from New York south to Georgia and west from Missouri to Oklahoma. Common throughout Illinois with the exception of the northern fourth of the state.



Distribution of *Hylobittacus apicalis*

Bittacus punctiger Westwood, 1846

Diagnosis: Body pale yellow to brown; abdomen dark brown. Wings yellow and heavily patterned with concentrations of pigment associated with crossveins; apical crossvein present and subcostal crossvein is basal to the first fork of the radial sector. Wings possess two pterostigmal crossveins. Wings are folded above body while at rest. The base of each femoral setae possess a dark brown spot.

Range: Occurs from Maryland south to Florida and west from Illinois to Texas. Rarely collected in Illinois.

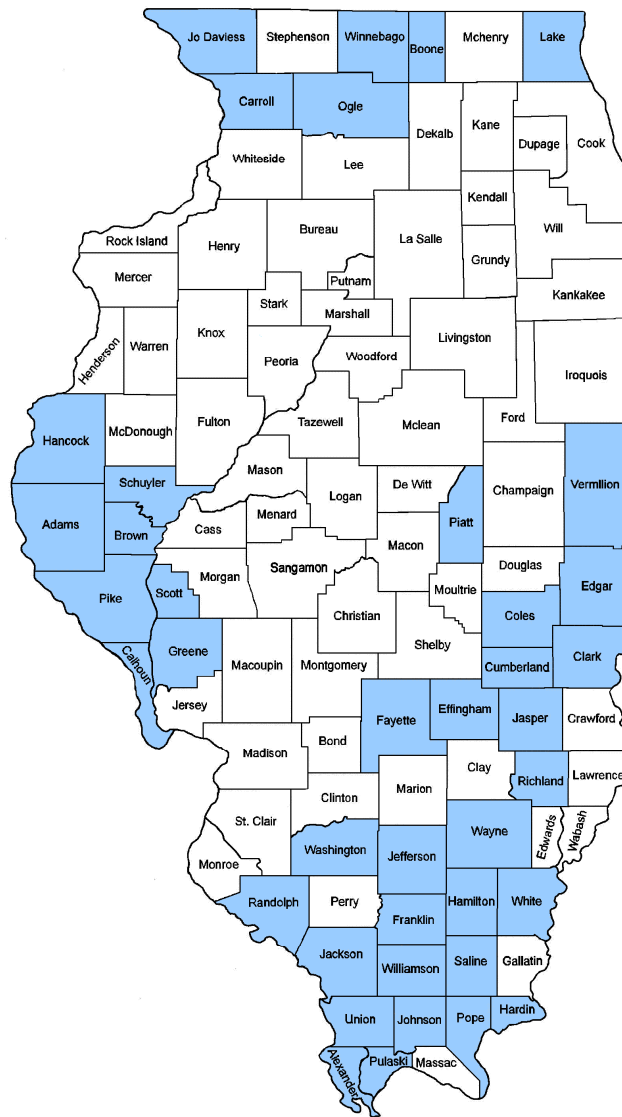


Distribution of *Bittacus punctiger*

Bittacus pilicornis Westwood, 1846

Diagnosis: Body dark yellow to brown. Wings yellow to amber with margined crossveins; pterostigma slightly darker; apical crossvein present and subcostal crossvein is basal to the first fork of the radial sector. Wings possess two pterostigmal crossveins. Wings are folded above body while at rest. Apices of tibiae and basitarsus dark brown.

Range: Occurs from Maryland south to Florida and west from Illinois to Texas.



Distribution of *Bittacus pilicornis*

Bittacus occidentis Walker, 1853

Diagnosis: Body dark yellow to brown. Wings yellow; apical crossvein absent and subcostal crossvein is distal to the first fork of the radial sector; two pterostigmal crossveins present. Wings are folded above body while at rest. Legs yellowish to brown; apices of tibiae dark brown; hind femora swollen.

Range: Occurs from New York south to the Carolinas and west from South Dakota to Arizona. Not commonly collected in Illinois, with specimens existing from only six counties in the northern two-thirds of the state.



Distribution of *Bittacus occidentis*

Bittacus strigosus Hagen, 1861

Diagnosis: Body dark yellow to brown. Wings clear with heavily margined crossveins; apical crossvein absent and subcostal crossvein is basal to the first fork of the radial sector; two pterostigmal crossveins present. Wings are folded above body while at rest. Legs pale yellow.

Range: Occurs in the U.S. from Maine south to the Carolinas and west from Montana to Oklahoma. This is the most commonly collected Bittacid occurring in Illinois.



Distribution of *Bittacus strigosus*

Bittacus texanus Banks, 1908

Diagnosis: Head and thorax dark reddish-brown. Wings pale brown; crossveins not margined; apical crossvein absent and subcostal crossvein is basal to the first fork of the radial sector; two pterostigmal crossveins present. Wings are folded above body while at rest. Legs dark reddish-brown with slightly swollen femora. Webb et al (1975) notes that in areas where *B. texanus* and *B. stigmaterus* overlap, the crossveins of *B. stigmaterus* are margined. The two species are otherwise very similar.

Range: Collected from Kansas New Mexico Texas and Florida. No records occur from Illinois.



Distribution of *Bittacus texanus*

Conclusions

Illinois possesses a diverse assemblage of Bittacids, with six species occurring in the state. It is likely that rare species such as *Bittacus occidentis* and *B. punctiger* are only rare due to inadequate collecting efforts. Bittacids resemble tiputid flies and are easily missed by the untrained. The cryptic habit of hanging also limits detection of these insects. Byers (1993) relays an anecdotal account suggesting that *B. occidentis* populations in Kansas are cyclical, noting “outbreaks” in 1964, 1978, 1985, and 1992. Whether or not these seven year increments are coincidental, Dr. Byers is the world authority on Mecoptera and his yearly collection efforts were consistent enough to identify this phenomenon. Further, *B. occidentis* is a species that is readily collected by light traps, suggesting that diurnal collecting may be less effective due to the insect’s nocturnal habits.

The goal of my thesis in 1995 was to determine the diversity of Mecoptera at the Rocky Branch Nature Preserve in Clark County, Illinois. Although the study site was only 52.6 hectares, it produces three families, four genera, and nine species of Mecoptera. Of these, five species of Bittacidae were collected, including *Hylobittacus apicalis*, *Bittacus strigosus*, *B. punctiger*, *B. stigmaterus*, and *B. pilicornis*. In addition, records of *B. occidentis* exist from neighboring counties. It is likely that similar habitats in Illinois harbor a diversity of Mecoptera such as that found at Rocky Branch, but field work in these areas is inadequate. Clearly, greater collecting efforts must be undertaken in order to fully understand the distribution of the Bittacidae in Illinois. Until then, the occurrence of *Bittacus texanus* in Illinois remains a possibility due to its Midwestern distribution and its resemblance to *B. stigmaterus* makes identification difficult for the novice.

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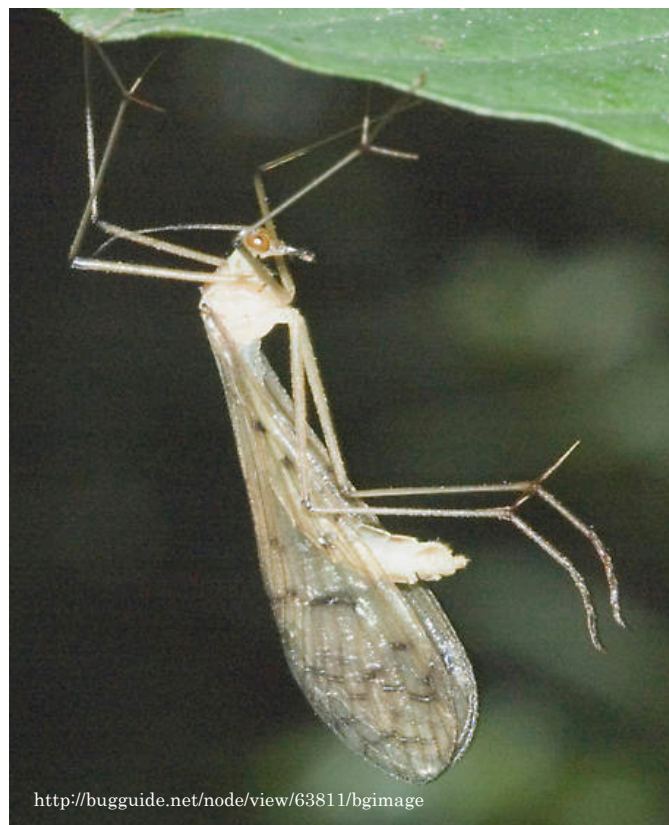
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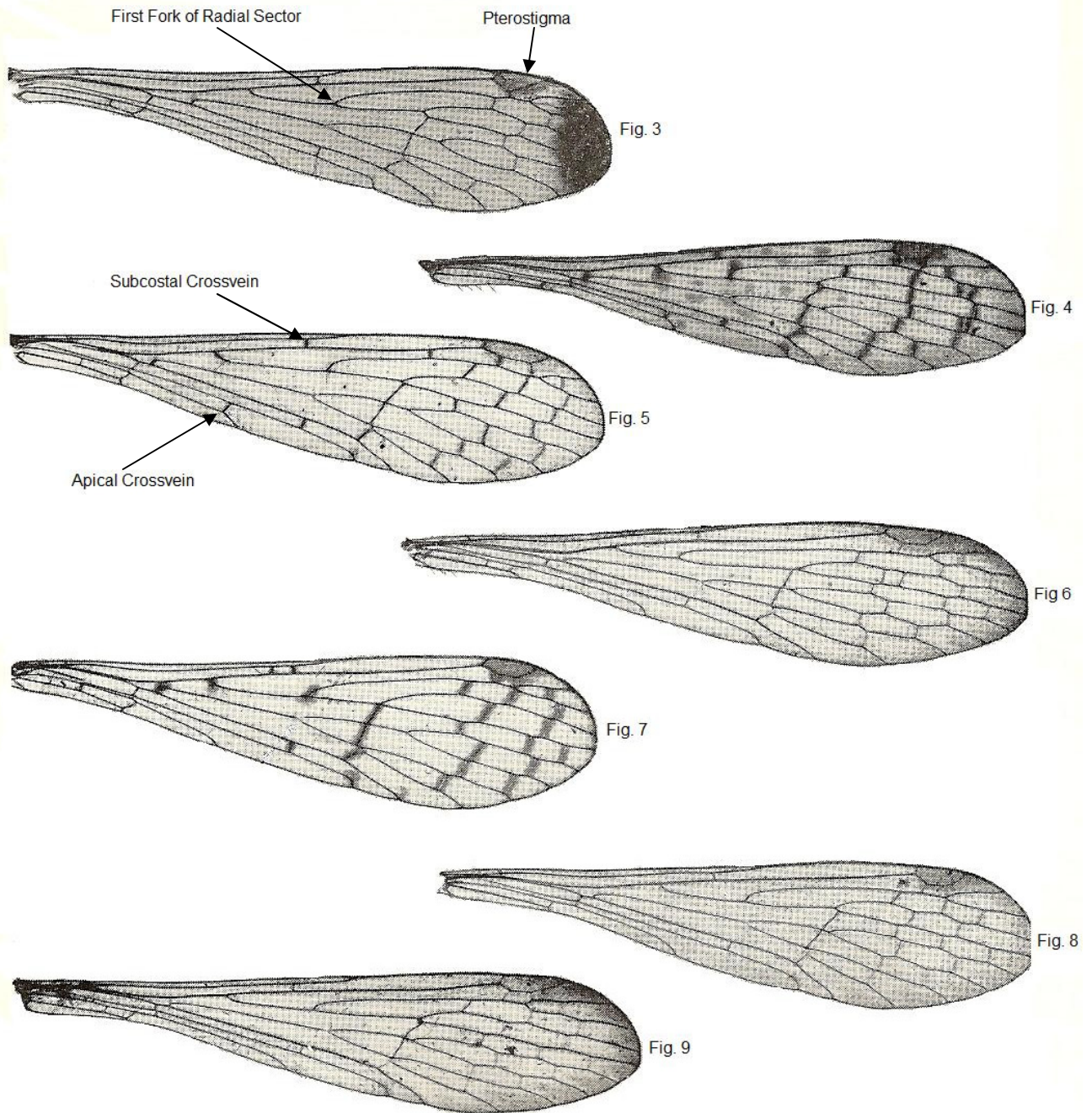
Figures

Figure 1. *Hylobittacus apicalis* – position of wings at rest.



Figure 2. Genus *Bittacus* – position of wings at rest.





Figures 3-9. - Forewings of Midwestern Bittacidae - Recreated from Webb et al, 1975.

- Figure 3. - *Hylobittacus apicalis*; Figure 4. - *Bittacus punctiger*
Figure 5. - *Bittacus pilicornis*; Figure 6. - *Bittacus occidentis*
Figure 7. - *Bittacus strigosus*; Figure 8. - *Bittacus stigmaterus*
Figure 9. - *Bittacus texanus*

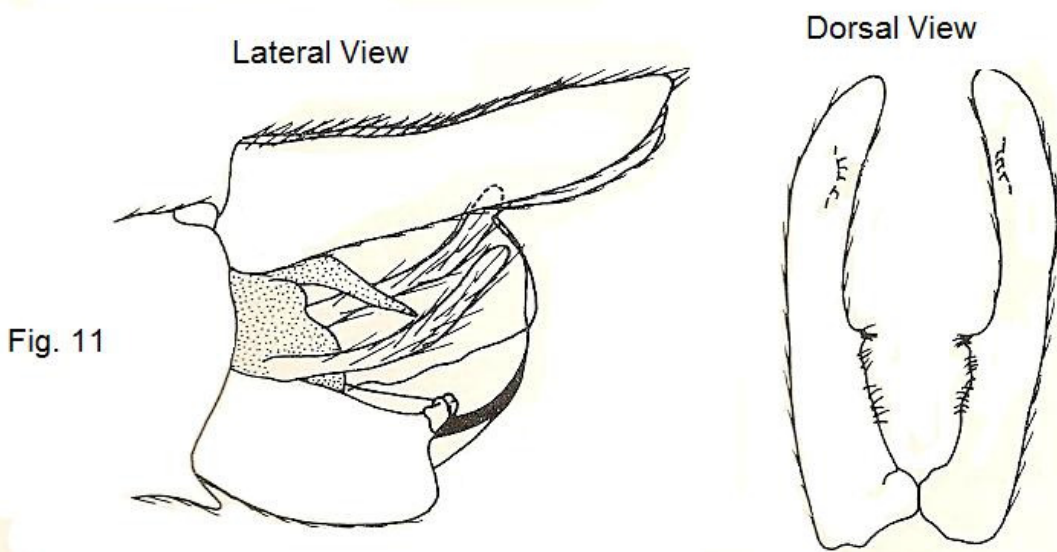
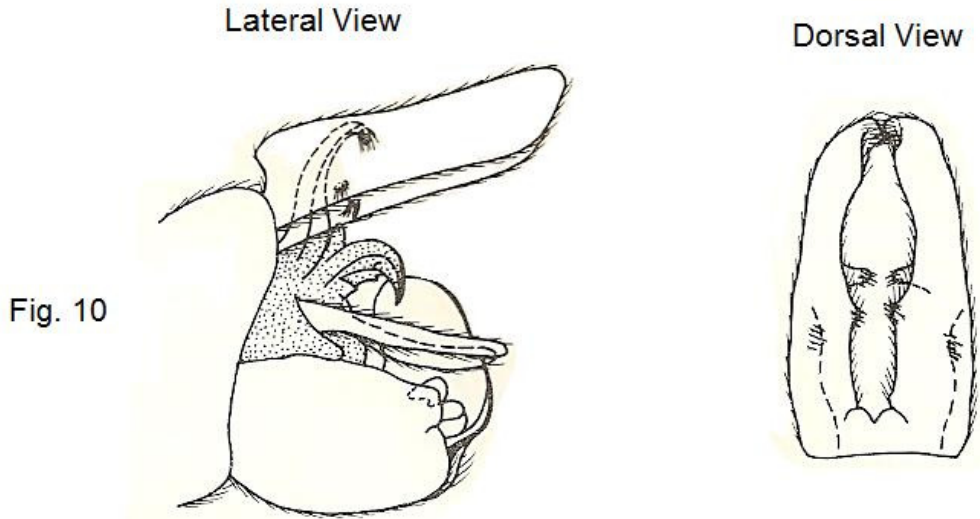


Figure 10-11 - Male Ninth Tergum of Abdomen - Recreated from Webb, et al 1975

Figure 10. - *Bittacus stigmaterus*

Figure 11. - *Bittacus texanus*