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Lovebug, *Plecia nearctica* Hardy (Diptera: Bibionidae)[1]

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INTRODUCTION: *Plecia nearctica* (Fig. 1) is the lovebug that motorists frequently encounter as a serious nusiance when traveling in southern states. It was first described by Hardy (1940) from Galveston, Texas, and at that time he reported it to be widely spread, but more common in Texas and Louisiana than other Gulf Coast states. It has now progressed to all states bordering on the Gulf of Mexico, as well as Georgia, South Carolina, and parts of Central America. Hetrick (1970a) studied the biology of *P. nearctica*, and estimated that flights reached altitudes of 300 to 450 meters, extended several kilometers over the Gulf of Mexico and covered one-fourth the land area of Florida. Today it is found throughout Florida. It has been erroneously reported that the lovebug was introduced into Florida by University of Florida entomologists. Buschman (1976) documented the progressive movement of the lovebug around the Gulf Coast into Florida (Fig. 3). Research was conducted by the University of Florida and U.S. Dept. of Agriculture entomologists after the lovebug was well established in Florida. It was first collected in Florida during 1949, in Escambia County, the westernmost county of the panhandle.

Thompson (1975) reported over 200 species in the genus *Plecia*. There are only 2 species of *Plecia* in the U.S.A., *P. nearctica* and *P. americana* Hardy. Their ranges are similar, but *americana* extends northeastward to North Carolina and south to Mexico, whereas *nearctica* ranges farther south to Costa Rica. *P. americana* is a woodland species that does not seem to be a problem on highways. Each of 2 generations of *P. nearctica* lasts about 4 weeks in May and September. In addition to large emergences in May and September, it has been collected in Florida every month of the year except November (Buschman, 1976). Buschman stated that throughout its extensive range, *P. americana* has been collected only in April, May, and June, with no evidence of a fall emergence. Thus, lovebugs that emerge in the fall are *P. nearctica*. He added that most of the spring collection dates of *P. americana* in north central Florida are 2 or 3 weeks earlier than similar dates for *P. nearctica*. A description and key to these two species are provided at the end of this circular.

Another bibionid, *Dilophus sayi* Hardy (1966) [=*Dilophus orbatus* Osten Sacken; =*Philia orbata* (Osten Sacken)] is a March fly (Bibionidae) in which the behavior of the adults is somewhat similar to that of *P. nearctica*, but the adults do not congregate noticeably on highways. In Florida, populations of *D. sayi* peak from late January through April, but can be observed most of the year beginning with cooler weather in October. Most Florida records are in the peninsula south to Dade County. *D. sayi* is smaller than *Plecia* spp., and has an all-black body, lacking the reddish color of the thoracic region of *Plecia*. The males of *D. sayi* are smaller than the females and have clear wings as opposed to the brown fumose wings of the females. We have observed *D. sayi* attracted to recently parked cars in Gainesville, Florida, and to barbecue grills. Thornhill (1976a) in studies at Gainesville, Florida stated that aggregates of up to 300 larvae of *D. sayi* could be found on or near the surface of the soil among the roots of grasses. Under lab conditions females lived about 72 hours and males about 92. Both Thornhill and Rothamel (1969) gave details on orientation and coupling of *D. sayi*. This bibionid attains nuisance numbers as adults in Florida and elsewhere from South Carolina south and west to Texas and California. Complaints about the larvae and adults of *D. sayi* (reported as *D. orbatus*) were statewide in California during October of 1970 (USDA, Cooperative Economic Insect Report 20: 797). In this same volume of C.E.I.R., there were numerous reports of it being a problem during autumn in sod and lawns, including one report of 1,000 larvae per sq. meter in a nursery at Oakland, Alameda County, California. This species, however, is of minor importance, compared to *P. nearctica*, which is a major nusiance on Florida highways.

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BEHAVIOR OF *P. NEARCTICA*: Callahan and Denmark (1973) reported that ambient temperatures above 28°C and visible light above 20,000 Lux (2000 ft-C) stimulated lovebug flight but not orientation behavior. Lovebugs are attracted to irradiated automobile exhaust fumes (diesel and gasoline) when the ultraviolet light incident over the highway ranges from 0.3 to 0.4 microns (3000 to 4000 angstroms (A)) between 10 AM and 4 PM, with a temperature above 28°C. Hot engines and the vibrations of automobiles apparently contribute to the attraction of lovebugs to highways. Solar radiation below 2.9 microns (2900 A) does not penetrate the atmosphere. Callahan et al. (1985) reported that formaldehyde and heptaldehyde were the two most attractive components of diesel exhaust.

The following description of reproductive behavior was taken largely from Leppla et al. (1974), who reported on the daily rhythmicity of flight, mating, and feeding of lovebugs in the laboratory and in the field, which coincided with the ambient temperature of 19°C and an incident light intensity range of 15,000 to 20,000 Lux (1500-2000 ft-C). Adult males begin hovering between 8-10 AM EDT. Males orient into the wind 0.3-0.9 meters above ground level. This behavior tends to cease after 10 AM and a resurgence occurs at 4-5 PM and lasts until about 8 PM. Females do not hover but crawl up vegetation and take flight through the swarm of hovering males. The female is grasped by a male during flight, or while she is on vegetation before flight. Copulating pairs begin dispersal flights around 9-11 AM. Individuals may feed alone, or while in copula, on nectar or pollen in the vicinity of the emergence site. There are few or no mating pair flights by afternoon. By using traps 12.5x9.1 meters in area, it was determined that most lovebugs emerge from 6-9 PM with a smaller number emerging from 8 AM - 12 noon (Thornhill, 1976b). Eclosion from the pupal stage requires about 5.2 h at 27°C for males and 6 h for the females. Both sexes become fully sclerotized within 2 hours. Thornhill (1976b) did not report any positive evidence for the emission of a sex pheromone by either sex during or proceeding copulation. Males apparently hover near their emergence sites and use visual and perhaps auditory cues to locate the opposite sex.

Copulatory behavior begins with the male darting and grasping a female that is flying through the swarm. The pair falls to the ground where they couple. Initially the male is positioned on the back of the female and both sexes face the same direction. After coupling, the male turns 180° and faces the opposite direction. Successful genitalic engagement takes from 1.5-10 min. There is intense competition among males for females at emergence sites. Hovering males may grasp and attempt to disrupt copulating pairs flying in the vicinity. Larger males are more successful in disrupting copulating pairs. It was also observed that the larger females laid more eggs. Marked copulating pairs were collected up to 3 days after their release. In nature, pairs were never observed to disengage in flight or at night, but termination was observed in the daytime on vegetation. Second matings were observed in the laboratory when a virgin of the opposite sex was provided. Females that mate once usually lay their eggs and die after an average of 68 h. Females that mated twice before laying eggs lived for a mean of 86 h. Maximum sperm transfer requires about 12.5 h.

Lovebugs vary considerably in size; males weigh 6-10 mg and females 15-25 mg. The weight difference between sexes is largely due to the ovaries which contain 70% of the total protein. Neither sex has the ability to store lipids in fat body cells (Van Handel, 1976).

DISTRIBUTION: *P. nearctica* is known from Costa Rica, Guatemala, Honduras, Mexico, and the southeastern U.S.A in the states of Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas.

HOSTS: The larvae (Fig. 2) develop under dead, partially decayed plant material, particularly in moist to damp areas and in pastures under cow manure.

ECONOMIC IMPORTANCE: *P. nearctica* is beneficial in the larval stages in helping recycle organic matter. The adult flies are a nuisance to motorists because the flies are attracted to highways and spatter on the hood and windshield of automobiles (Fig. 4). Large numbers of lovebugs can cause overheating of liquid cooled engines, reduce visibility, and etch automobile paint. The body fluids are slightly acid; however, if the egg mass (average about 350 per female, Hetrick, 1970a) and body parts are allowed to remain on a car for several days, bacterial action increases the acidity and etches the paint. A soaking with water for about 5 minutes followed by a scrubbing within 15-20 minutes should remove most of the lovebugs without harm to automobile paint. A hood air deflector or screen will reduce the number of spattered lovebugs on an automobile.

DESCRIPTION: Thompson (1975) illustrated and prepared a key for the 2 species of *Plecia* that occur in the U.S.A. His key and illustrations are used here with his permission.

KEY TO THE NEARCTIC SPECIES OF *PLECIA* WIEDEMANN

1. Thorax with dorsum rufous and pleura extensively black; head with oral margin distinctly produced forward (Fig. 5,7). Male genitalia with 9th tergum (Fig. 13) not as broad as in *americana*, just slightly broader than long, with shallow medial excavation and ventromedial flap, not produced ventrolaterally; 9th sternum (Fig. 15) with dorsolateral lobe extending under 9th tergum, produced ventromedially into a narrow forked process; telomeres (Fig. 11) large, L-shaped in lateral view. Female genitalia with 9th tergum (Fig. 16, 18) large, almost completely concealing cerci in lateral view, strongly excavated dorsomedially; cerci (Fig. 18) small, narrow in dorsal view; 8th sternum (Fig. 16, 20) small, with a shallow medial excavation; ovipositor lobes broad, blunt apically and strongly sclerotized dorsally . . . . . *nearctica* Hardy

1'. Thorax almost completely rufous, rarely slightly brownish black on metathoracic pleura; head with oral margin not produced forward, but evenly convex (Fig. 6,8). Male genitalia with 9th tergum (Fig. 12) much broader than in *nearctica*, almost twice as broad as long, with a deep medial excavation and without a ventromedial flap, ventrolateral corners produced posteriorly; 9th sternum (Fig. 14) with a dorsolateral lobe, not produced ventromedially and without a medial forked process, but with a broad ventromedial excavation; telomeres (Fig. 10) small, almost completely round. Female genitalia with 9th tergum (Fig. 17, 19) small, not concealing cerci in lateral view, not excavated medially; cerci (Fig. 19) large, broad in dorsal view; 8th sternum large, with a deep and narrow medial excavation; ovipositor lobes narrow, acute apically, not strongly sclerotized dorsally . . . . . *americana* Hardy

CONTROL: Local reduction of annual burning of woodlands, the development of improved pastures, and the increase of cattle probably have contributed to the presence of larger populations of lovebugs. Chemical controls are ineffective as the lovebug is widespread and they continually drift onto highways from adjacent areas. The senior author tested aerial applications of malathion and dimethoate in the late 1960's. The adults are killed at rates as low as 2 oz. per acre, but roadways were cleared for only about 30 minutes. The degree of natural control and the amount of annual rainfall causes fluctuation in the population. Kish et al. (1977) isolated and identified 3 kinds of fungi from dead lovebugs collected in Alachua County, Florida. These fungi were *Tolypocladium cylindrosporum* W. Gams, *Metarhizium anisopliae* (Metsch.) Sorok., and *Beauveria bassiana* (Bals.) Vuill. Tests demonstrated that each fungus apparently affected larval mortality; however, data analyses indicated that only *B. bassiana* caused significant mortality levels (27-33%). Nine additional fungi were reported from dead or moribund larvae collected in the field. These fungi are likely important in the natural control of lovebugs. Further study is needed to determine how these fungi or other organisms may be used to control lovebugs.

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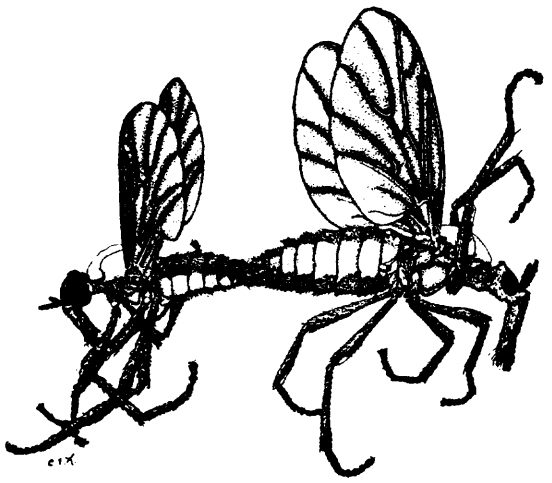

Fig. 1. Mating pair of *Plecia nearctica* Hardy; female on right. Color: Black with red dorsal portion of thorax. Length of mating pairs, 13-15 mm. Drawing by C. E. Leach.

Fig. 2. Larva of *Plecia nearctica*. Color: Slate gray with darker head capsule. Length of full-grown larvae, 11-12 mm. Drawing by C. E. Leach.

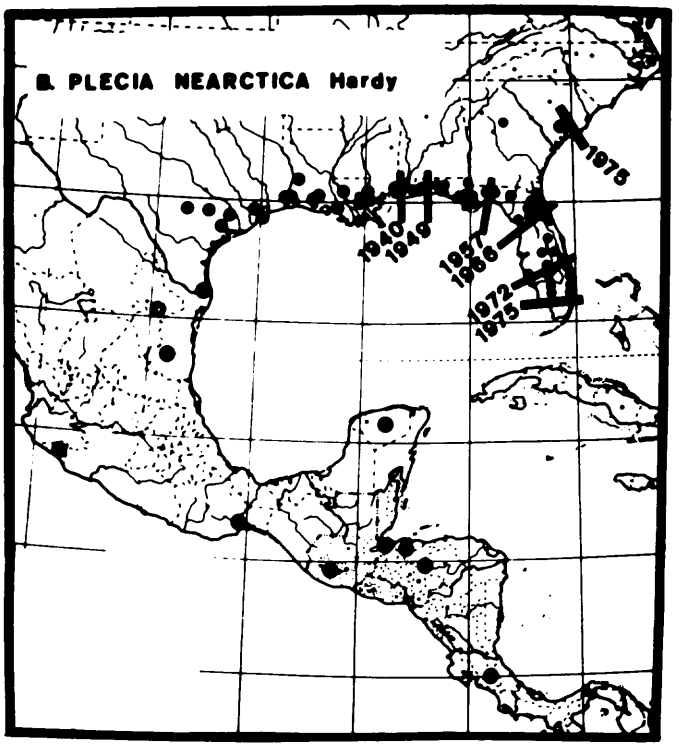

Fig. 3. Geographic distribution of *Plecia nearctica* in North America. The date lines indicate how far east *Plecia nearctica* has been collected as of that date (after Buschman, 1976).

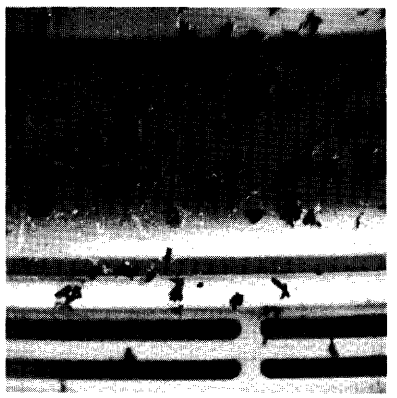

Fig. 4. Dead "lovebugs" stuck on car hood.

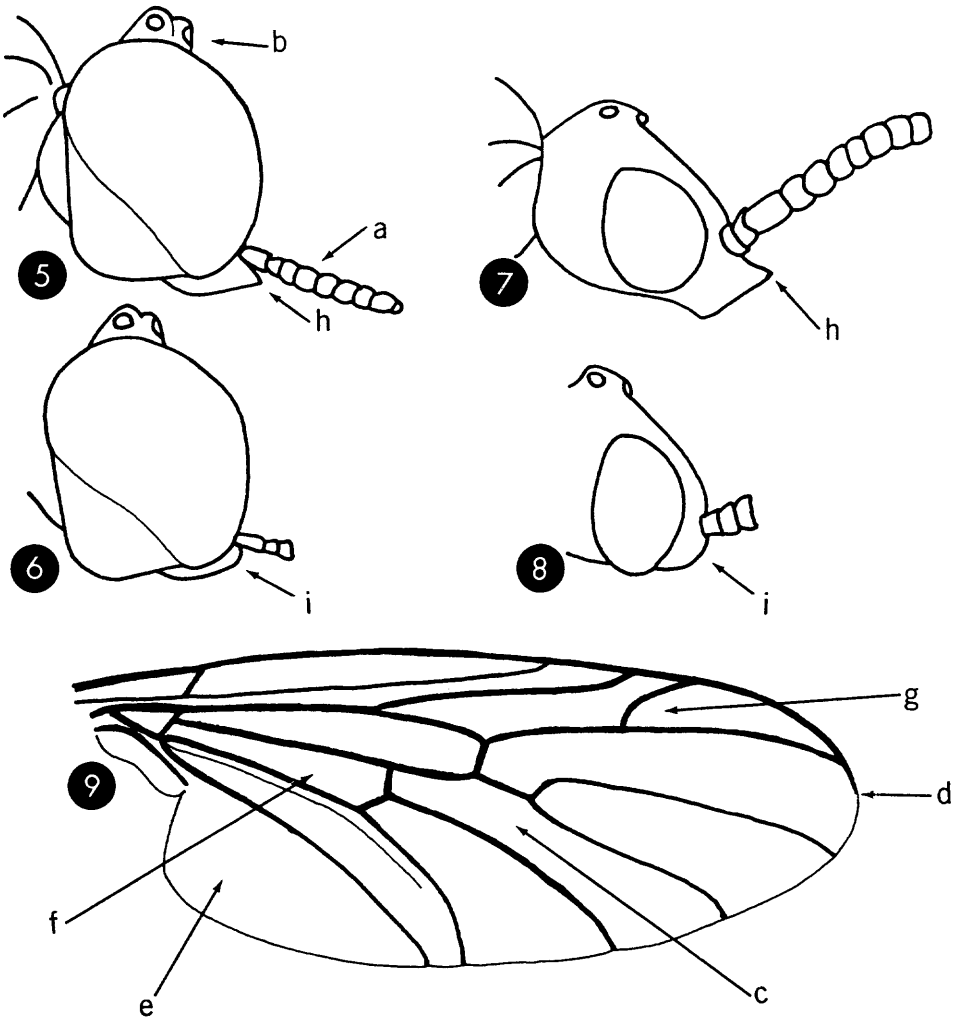

Fig. 5-9. Fig. 5-8. Heads of *Plecia*, lateral view; 5. *nearctica* Hardy, male; 6. *americana* Hardy, male; 7. *nearctica* Hardy, female; 8. *americana* Hardy, female. 9. Wing of *Plecia nearctica* Hardy.

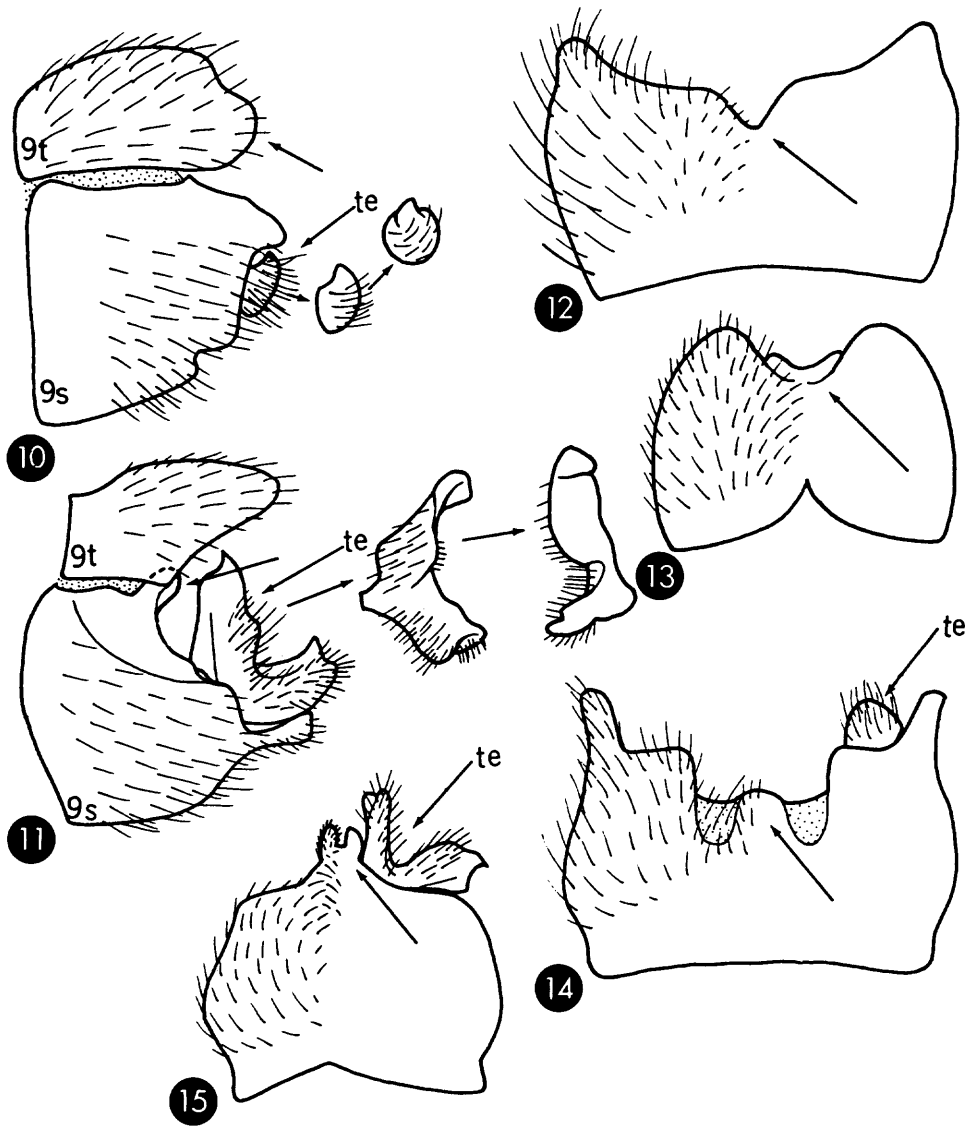

Fig. 10-15. Male genitalia of *Plecia*. Fig. 10-11. 9th abdominal segment and associated structures, lateral view, with additional posterolateral and posteromedial views of the right telomere; 10. *americana* Hardy, 11. *nearctica* Hardy; 12-13. 9th tergum, dorsal view; 12. *americana* Hardy; 13. *nearctica* Hardy; 14-15. 9th sternum with left telomere attached, ventral view; 14. *americana* Hardy; 15. *nearctica* Hardy. 9t= 9th tergum, 9s= 9th sternum, te= telomere; the arrows point to the characteristics mentioned in the key.

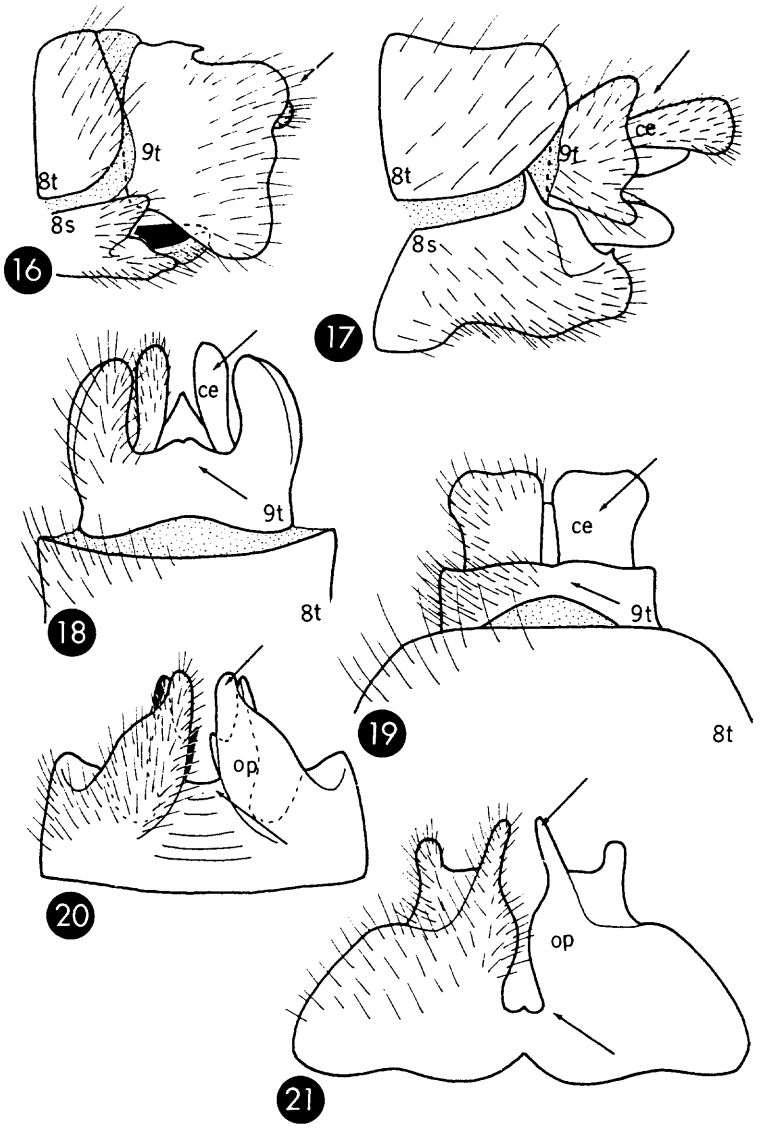

Fig. 16-21. Female genitalia of *Plecia*. Fig. 16-17. 8th and 9th abdominal segments and associated structures, lateral views. 16. *nearctica* Hardy; 17. *americana* Hardy. 18-19. 8th and 9th terga and associated structures, dorsal view; 18. *nearctica* Hardy; 19. *americana* Hardy. 20-21. 8th sternum, ventral view; 20. *nearctica* Hardy; 21. *americana* Hardy. 8t= 8th tergum, 8s= 8th sternum, 9t= 9th tergum, ce= cercus, op= ovipositor; the arrows point to the characteristics mentioned in the key.