

Living With Lovebugs¹

Norman C. Leppla²

The "lovebug," *Plecia nearctica* Hardy (Diptera: Bibionidae), is a seasonally abundant member of a generally unnoticed family of small flies related to gnats and mosquitoes. The males are about 1/4 inch and the females 1/3 inch in length, both entirely black except for red on top of their thoraxes (middle insect body segment). Other common names for this insect include March flies, double-headed bugs, honeymoon flies, united bugs and some expletives that are not repeatable. Lovebugs characteristically appear in excessive abundance throughout Florida as male-female pairs for only a few weeks every April-May and August-September (IPM Florida 2006). Although they exist over the entire state during these months, they can reach outbreak levels in some areas and be absent in others. They are a nuisance pest, as opposed to destructive or dangerous, in areas where they accumulate in large numbers.

Lovebug Description and Biology

Lovebugs can be identified superficially as swarms of little black flies (order Diptera, 1 pair of wings) with red thoraxes that fly as pairs of males and females in tandem (Figure 1). Due to their many segmented antennae, Bibionid flies belong to the

suborder Nematocera. Flies in the other suborder, Brachycera, have five or fewer antennal segments. Some families of Nematocera contain pests of agriculture and vectors of pathogens that cause human and animal diseases, e.g., sand flies (Psychodidae), mosquitoes (Culicidae), biting midges (Ceratopogonidae), black flies (Simuliidae), fungus gnats (Mycetophilidae) and gall midges (Cecidomyiidae). Bibionids have antennae with seven to 12 segments and ocelli (simple eyes) on their heads (Figure 2 A, a,o). Their wings each have an undivided medial cell, a costal vein (front of wing) that ends at or before the wing tip, a large anal area and two basal cells (Figure 2 E, mc, c, a, bc). All members of the genus *Plecia* have an upper branch to the radial sector vein of the wing (Figure 2 E, rs). The only two species of this genus in the U.S., *P. nearctica* and *P. americana* Hardy, are very similar in appearance. Males of both species are considerably smaller than females and have much larger compound eyes, *P. nearctica* males weighing 6-10 mg and females 15-25 mg (Van Handel 1976). Both species and sexes have red dorsal thoraxes but *P. nearctica* has completely black pleura (sides of thorax) and a head with an oral margin distinctly extended forward (Figure 2 A, B, om-f). The thorax of *P. americana* is almost completely red and rarely slightly brownish

1. This document is fact sheet ENY-840 (IN694), one of a series of the Department of Entomology and Nematology, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication Date: January 2007. Revised: September 2009. Please visit the EDIS Website at <http://edis.ifas.ufl.edu>.

2. Norman C. Leppla, professor, Entomology and Nematology Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

black on the metathoracic pleura (sides of 3rd thoracic segment). The oral margin of the head does not extend forward but is evenly convex (Figure 2 C, D, om-c). Taxonomic descriptions of many species in the genus, including *P. nearctica* and *P. americana*, were published by Hardy (1940). Characteristics to distinguish these two U.S. species were reviewed by Thompson (1975), who provided detailed drawings and descriptions of the male and female genitalia.

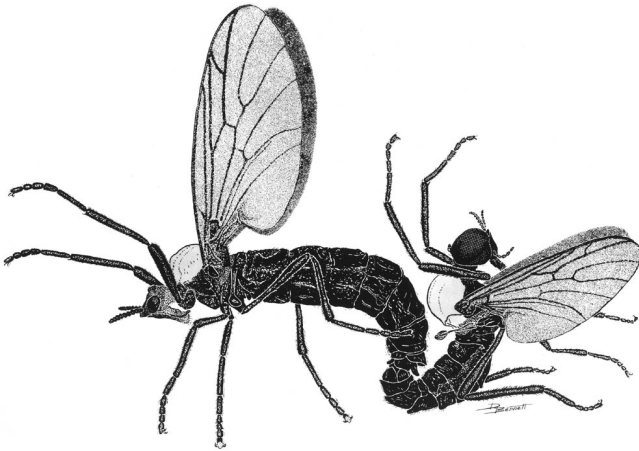


Figure 1. Pair of mating lovebugs with larger female on left. Note the elongated female rostrum (snout-like prolongation of the head) and large circular male eyes. Credits: Dwight Bennett

Denmark and Mead (2001) repeated some of the information from Thompson (1975) and characterized another member of the family Bibionidae in Florida that might be confused with the lovebug, *Dilophus sayi* Hardy (= *Dilophus orbatus* Osten Sacken, = *Philia orbata* (Osten Sacken) (Hardy 1966). However, *D. sayi* adults are clearly smaller than the *Plecia* species, completely black, and much less abundant, appearing only in April to June (Buschman 1976) and not congregating noticeably on highways. Females are larger than males and have smoky brown rather than clear wings. The reproductive behavior of *D. sayi* is similar to that of the lovebug and in both species males and females can mate more than once (Thornhill 1976a). Unlike lovebugs, however, *D. sayi* adults do not disperse in pairs; instead, after mating occurs, males remain in the emergence areas while the females seek suitable oviposition sites. Females crawl under debris on the soil and deposit 100-300 eggs that hatch in about 20 days. Under laboratory conditions, females live for about 72 hours, whereas males survive for about 92

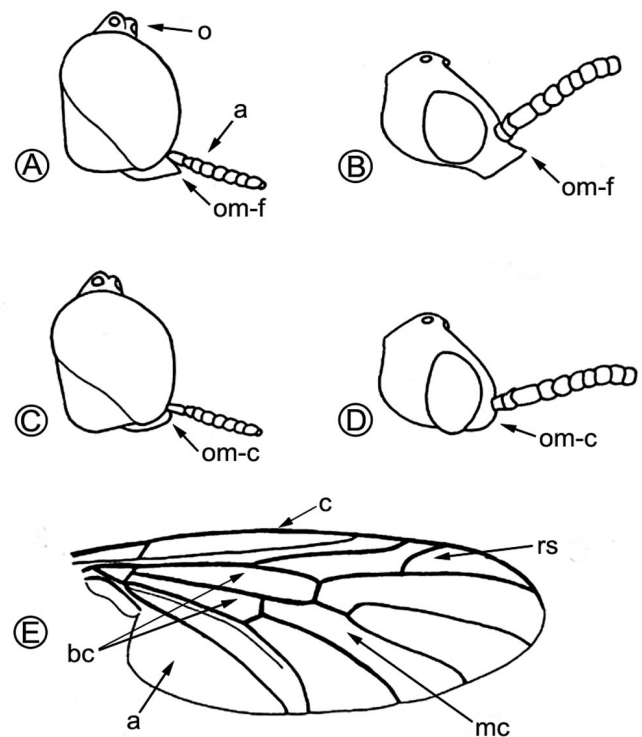


Figure 2. Taxonomic characters to distinguish *P. nearctica* from *P. americana*. Head of *Plecia nearctica* male (A) and female (B), head of *P. americana*, male (C) and female (D): ocelli (o), antenna (a), oral margin- forward (om-f), and oral margin- convex (om-c). Wing of *P. nearctica* (E): costa (c), radial sector (rs), medial cell (mc), anal cell (a), and basal cells (bc). Credits: Buschman 1976

hours. Adults of *D. sayi* are periodically considered a nuisance pest from South Carolina to Florida and across the Gulf States into Texas, and also in California.

Although the lovebug has two distinct generations per year in Florida, adults can be found during most months (Buschman 1976). Higher temperatures cause adult populations to peak slightly earlier in the southern areas of the state. As in all other flies, lovebugs exhibit complete metamorphosis, having egg, larva, pupa and adult stages (Figure 3). An individual female deposits an average of 350 eggs under decaying vegetation in a grassy or weedy area with adequate moisture. Conditions must not be too wet or dry, although the larvae soon emerge and can move short distances to locate the best habitats. Larvae develop more rapidly at higher temperatures, so the summer generation is shorter than the one in the winter. The larvae feed on decomposing leaves and grass until they pupate. The

pupal stage lasts 7-9 days (Hetrick 1970). In nature, the adults live just long enough to mate, feed, disperse and deposit a batch of eggs, about 3-4 days (Thornhill 1976b).

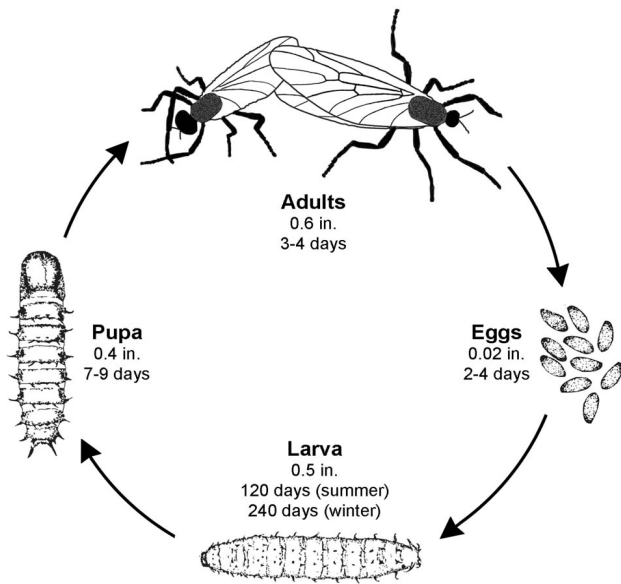


Figure 3. Lovebug life cycle with the approximate duration and size of each stage (not drawn exactly to scale, adult pair 0.6 in. head to head, partially derived from Pinto 2002). The lovebug has two generations each year, emerging as adults in April-May (winter generation, larvae 240 days) and August-September (summer generation, larvae 120 days). Credits: Wiedemann

Lovebug reproductive behavior occurs within three general activity periods during the day (Leppla et al. 1974). The first period (8 am-2 pm) begins with the insects moving up onto the plants and feeding on nectar. Lovebug flight is initiated when the air temperature reaches about 68°F and illumination is 1500-2000 ft-c. Males and females that coupled and mated late during the previous day fly into the air to disperse. Unmated males and females first couple and mate before dispersing. Mating begins when swarms of 40 plus males form above the emergence sites, oscillating up and down rhythmically sometimes more than 20 feet above the ground, even on windy days (Thornhill 1976c). These swarms last 10 to 30 minutes and end with the males eventually landing to rest or feed. Swarming peaks at 10-11 am and again at 6-8 pm. Larger males occupy preferred positions at the bottom of a swarm (Hieber and Cohen 1983). Individual females fly into a swarm and are grasped almost immediately by a male, after which the pair

lands on vegetation to mate. Males prefer larger and heavier females, often grasping them before they fly into swarms or displacing attached males. In this competition for females, larger males are able to displace smaller ones about 20% of the time but success diminishes if the original male has been attached for a long time. Even if undisturbed, however, males and females often will disengage and mate a second time. After coupling, the male faces the opposite direction from the female within 1.5 to 10 minutes and the pair begins copulating. Insemination involves discharging the contents of a spermatophore (sperm capsule) into the spermatheca (sperm reservoir) of the female (Leppla et al. 1975). During the second activity period (2-5 pm), single males and females are considerably less mobile but pairs continue to disperse. As in the morning, males swarm and grasp incoming females during the third period (5-8 pm) but this time the pairs remain on vegetation throughout the night. Pairs that have been dispersing during the day also settle on vegetation when illumination falls below the 1500-2000 ft-c threshold, even though the temperature remains above 68°F. Lovebugs do not fly during the night. After a pair disperses, the male dies and the female deposits as many as 600 eggs under decaying leaves or grass before also dying. Groups of about 300 larvae have been found on or near the surface of the soil among the roots of grasses (Thornhill 1976a).

Lovebug Myths

Lovebugs escaped after University of Florida researchers brought them into Florida. Lovebugs are not native to most of the southern United States (Hardy 1945). According to Buschman (1976), since 1940 *P. nearctica* has extended its range from Louisiana and Mississippi across the Gulf States, reaching Florida in 1949. In the late 1960s, it became established entirely across north Florida. During the 1970s explosive populations occurred progressively southward nearly to the end of peninsular Florida and northward into South Carolina (Figure 4). Its movement may have been accelerated by prevailing winds, vehicle traffic, sod transport, increased habitat along highways and expansion of pastures but not by UF researchers.

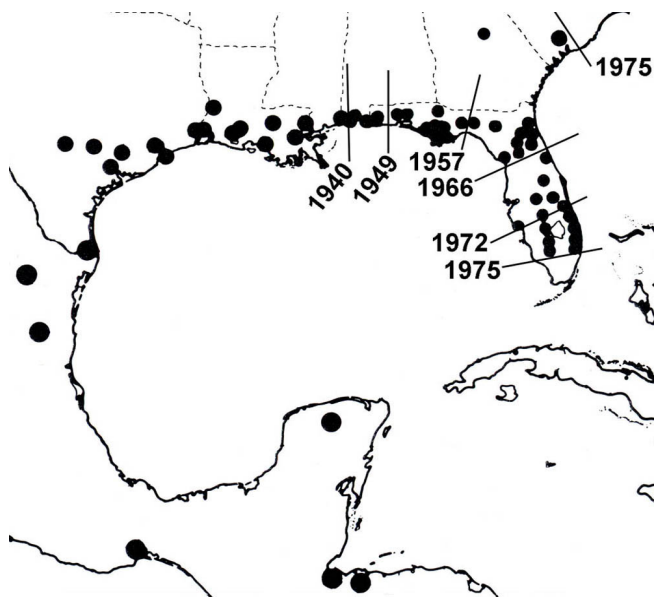


Figure 4. Pattern of migration of *Plecia nearctica* from Central America to the southeastern U.S. Credits: Buschman 1976

University of Florida researchers genetically engineered lovebugs to kill mosquitoes. Lovebugs are small, slow herbivorous insects that feed on the pollen and nectar found in flowers. Thus, they lack the mandibles (jaws), grasping legs, speed and other characteristics of predaceous insects, such as dragonflies. Lovebugs are active during the day, whereas most mosquitoes are crepuscular (active at twilight) or nocturnal, and they are only adults for a few weeks each year. For these and many other reasons, the lovebug would be a poor candidate to genetically engineer as a mosquito predator, even if it were possible.

Lovebugs are attracted to automobiles. After mating, lovebugs disperse as coupled pairs, presumably flying in search of nectar on which to feed and suitable oviposition sites. Mated females are attracted to sandy sites with adequate moisture, dead leaves, grass clippings, cow manure and other decomposing organic debris. Cherry (1998) found that lovebugs are attracted to anethole, an essential oil found in plants that also attracts bees. Additionally, Female lovebugs are attracted to UV irradiated aldehydes, a major component of automobile exhaust fumes (Callahan and Denmark 1973, Callahan et al. 1985). They may confuse these chemicals with the odors emitted from decaying organic matter at typical oviposition sites. Heat has

also been shown to attract lovebugs (Whitesell 1974) and contribute to their abundance on highways. Additionally, lovebugs seem to collect on light-colored buildings, especially when freshly painted (Callahan 1985). Many kinds of flies are attracted to light-colored and shiny surfaces, although the physiological or behavioral mechanisms are unknown. Thus, lovebugs apparently accumulate in relatively warm, humid, sunny areas with food and chemicals in the atmosphere that mimic oviposition sites.

Dispersing lovebugs move great distances and are attracted to homes. Lovebug pairs are not strong fliers, so tend to remain within a few hundred yards of emergence sites when there is little or no wind (Thornhill 1976b). They are able to move across the wind when it is 5-7 mph and search for sources of nectar and suitable oviposition sites. Stronger winds blow them as high as 1500 ft in the air and concentrate them against down wind objects. Coupled females initiate and control flight but males assist if they are able to obtain food (Sharp et al. 1974). Locations within 20-30 miles can have quite different levels of lovebug emergence and dispersal (Cherry and Raid 2000) and this variable distribution can lead to naturally occurring "hotspots" in different places from year to year. Lovebugs are most abundant in moist grassy habitats. People who live near these habitats, or are exposed to winds that deposit the insects at their homes, can perceive erroneously that they are attracting these pests.

Lovebugs mate the entire time they are coupled. The general pattern of mating in lovebugs begins with males forming swarms above emergence areas each day in the morning and afternoon (Leppla et al 1974, Thornhill 1976c). Individual males also may fly just above these areas. Females emerge from the soil later than males, crawl on to vegetation, and fly into the swarms. A male may grasp a female before or after she flies into a swarm. In either case, the pair lands on vegetation where the male transfers sperm to the female. Sperm transfer requires an average of 12.5 hours but the pair can remain coupled for several days during which they feed and disperse (Thornhill 1976c). The male ejects a depleted spermatophore after separating from the female (Leppla et al. 1975) and both sexes may mate again. Pairs formed during

the morning hours begin dispersal flights, whereas those that couple in the evening remain on vegetation until taking flight the following day.

The body fluids of lovebugs are acidic and immediately dissolve automobile paint. When numerous lovebugs are smashed on the front of a vehicle, the contents of their bodies, especially eggs, coat the painted surface. No permanent damage is caused, however, if the surface is cleaned before the coating is baked by the sun for a day or two. Marisa and Jeffrey Gedney (personnel communication) determined that macerated lovebugs are about neutral with a pH of 6.5 but become acidic at 4.25 within 24 hours. Yet, automobile paint was not damaged after being coated with macerated lovebugs and held in a humid indoor environment for 21 days. A lovebug-coated surface exposed to the sun for an extended period of time, however, may be damaged by the insects and their removal (Denmark and Mead 2001). The front of a vehicle can be protected by coating it with “car wax” and removing the lovebugs within 24 hours.

Lovebugs have no significant natural enemies. No parasites have emerged from lovebug larvae or adults held in the laboratory and few cases of predation have been observed in nature over the years (Hetrick 1970, Mousseau 2004). Apparently lovebugs adults are avoided by red imported fire ants, *Solenopsis invicta* Buren (= *S. wagneri* Santschi), and other predators but periodically eaten by spiders, dragonflies and birds. They have aposematic coloration that implies defensive mimicry but have not been chemically analyzed or tested as food for predators (Dunford et al. 2008). Bee keepers report anecdotally that honeybees do not visit flowers infested with lovebugs. Fungal pathogens have been identified by screening, six from larvae and one from adults, that could be limiting lovebug populations (Kish et al. 1974). These fungi include the well-known insect pathogenic genera, *Metarhizium*, *Beauveria* and *Conidiobolus*. Although not yet studied, lovebug eggs may be subjected to predation or parasitism.

Insecticides are effective in controlling lovebugs. Insecticides available to the public for controlling houseflies, mosquitoes and other flies will also kill

lovebug adults. However, there are risks associated with using these products around humans and pets, and the lovebugs will return almost immediately. Other insects are often misidentified as being lovebugs, some of which are innocuous or beneficial and therefore should not be killed. It is important to preserve lady beetles, lacewings, honeybees and other insects that help to protect or pollinate plants. Thus, insecticides are expensive, potentially harmful and of no value in controlling lovebugs. It is best just to avoid lovebugs if they become a nuisance during their brief appearances each year.

University of Florida scientists are working to control lovebugs. The University of Florida research programs in urban and public health entomology are among the strongest in the U.S. Priority is placed on destructive or dangerous pests that threaten human health and resources. These pests include mosquitoes that transmit West Nile virus, equine encephalitis and other diseases; those that infest people, livestock and pets; and urban insects, such as cockroaches, ants and termites. Nuisance pests like lovebugs and blind mosquitoes are important but much less damaging and costly. The Florida Legislature funded research on lovebugs at the University of Florida during the outbreak that swept through the state in the early 1970s. Additional resources were contributed by the USDA and Florida Department of Agriculture and Consumer Services, Division of Plant Industry. Even though this support is no longer available, the University of Florida continues to provide information to help educate Florida residents and tourists about lovebugs.

Lovebugs and People

It is possible but usually not necessary to avoid lovebugs and the problems they cause. Unlike some of their close relatives, lovebugs do not bite, sting or transmit diseases and are not poisonous. Lovebugs are only active in the daylight and are much less mobile during the early and late daytime hours. Typically, the pairs fly across the wind during their dispersal flights and are blown against obstacles, especially vehicles traveling at high speeds. Their remains can be removed from surfaces easily if not left to bake in the sun. Lovebugs are poor fliers that can be kept out of a building by creating positive pressure with an

air-conditioning fan. If a few lovebugs enter, a vacuum cleaner can be used to remove them. Screens can be added to windows and doors, particularly on the prevailing windward side of a building, and placed over decks and swimming pools. A fan can be used outside near work or recreational areas to keep lovebugs away. Due to their abundance and mobility, lovebugs cannot be controlled effectively with poisons or repellents.

Some people consider the lovebug to be among the peskiest alien invasive species to become established in the Gulf States. On the contrary, these potentially annoying flies are actually beneficial as larvae because they help to decompose dead plant material. People would also appreciate esthetic aspects of the adults, if these insects were not such a nuisance. Like cute little migratory birds, lovebugs signal changes in the seasons from spring to summer and again from summer to fall. Moreover, if they were larger, people could easily see and admire their delicate features, particularly the big round eyes of the males. Wilhelm Rudolph Wiedemann named the lovebug genus *Plecia* in 1828, so his concept for the term may never be known. A reasonable guess, however, is that he applied the Greek verb "pleo" intending to mean "to sail" (Jaeger, E. C. 1955). Lovebugs sail from flower to flower much like butterflies and in smaller numbers could be perceived as beautiful. They have become less abundant over the past 30 years and people living in the Gulf States are beginning to accept them as a normal part of nature. However, newcomers are much less tolerant of lovebugs until they learn that these insects are not dangerous. Since lovebug populations tend to rebound unpredictably, we are fortunate that these creatures create inconveniences and tickle, rather than threaten human health and the environment.

Acknowledgement

The figures were prepared by S. H. Johnson; J. P. Cuda, M. A. Branham, and J. L. Gillett-Kaufman provided very helpful reviews of the manuscript.

References

- Buschman, L. L. 1976. Invasion of Florida by the "Lovebug" *Plecia nearctica* (Diptera: Bibionidae). Florida Entomologist 59:191-194.
- Callahan, P. S. 1985. Dielectric waveguide modeling at 3.0 cm of the antenna sensilla of the lovebug, *Plecia nearctica* Hardy. Applied Optics 24:1094-1097.
- Callahan, P. S. and H. A. Denmark. 1973. Attraction of the "lovebug," *Plecia nearctica* (Diptera: Bibionidae), to UV irradiated automobile exhaust fumes. Florida Entomologist 56:113-119.
- Callahan, P. S., T. C. Carlisle and H. A. Denmark. 1985. Mechanism of attraction of the lovebug, *Plecia nearctica*, to southern highways: further evidence for the IR-dielectric waveguide theory of insect olfaction. Applied Optics 24:1088-1093.
- Cherry, R. 1998. Attraction of the lovebug, *Plecia nearctica* (Diptera: Bibionidae) to anethole. Florida Entomologist 81:559-562.
- Cherry, R. and R. Raid. 2000. Seasonal flight of *Plecia nearctica* (Diptera: Bibionidae) in southern Florida. Florida Entomologist 83:94-96.
- Denmark, H. A. and F. W. Mead. 2001. Lovebug. University of Florida, IFAS, Entomology and Nematology Department, Featured Creatures, EENY-47. (<http://edis.ifas.ufl.edu/IN204>).
- Dunford, J. C., M. A. Branham and J. M. Leavengood, Jr. 2008. Additional notes on aposematic insects at Archbold Biological Station, Florida, with comments on the arrival of the lovebug, *Plecia nearctica* Hardy. Journal of Entomological Science 43:337-343.
- Hardy, D. E. 1940. Studies in New World *Plecia* (Bibionidae: Diptera). Part I. Journal of the Kansas Entomological Society 13:15-27.
- Hardy, D. E. 1945. Revision of nearctic Bibionidae including neotropical *Plecia* and *Penthetria* (Diptera). Univ. Kansas Sci. Bull. 30:367-547.
- Hardy, D. E. 1966. Family Bibionidae. In: A catalog of the Diptera of the Americas south of the United States. Departamento de Zoologia, Secretaria da Agricultura, Sao Paulo. 18:1-20.

Hetrick, L. A. 1970. Biology of the "love-bug", *Plecia nearctica* (Diptera: Bibionidae). Florida Entomologist 53:23-26.

Hieber, C. S. and J. A. Cohen. 1983. Sexual selection in the lovebug, *Plecia nearctica*: the role of male choice. Evolution 37:987-992.

IPM Florida. 2006. University of Florida, IFAS website: <http://ipm.ifas.ufl.edu>.

Jaeger, E. C. 1955. A Source-Book of Biological Names and Terms. Charles C. Thomas Publisher, Springfield, IL.

Kish, L. P., G. E. Allen, J. W. Kimbrough and L. C. Kuitert. 1974. A survey of fungi associated with the lovebug, *Plecia nearctica*, in Florida. Florida Entomologist 57:281-284.

Leppla, N. C., T. C. Carlisle and R. H. Guy. 1975. Reproductive systems and the mechanics of copulation in *Plecia nearctica* Hardy (Diptera: Bibionidae). J. Insect Morphol. and Embryol. 4:299-306.

Leppla, N. C., J. L. Sharp, W. K. Turner, E. W. Hamilton and D. R. Bennett. 1974. Rhythmic activity of *Plecia nearctica*. Environmental Entomology 2:323-326.

Mousseau, T. A. 2004. Populations of the lovebug, *Plecia nearctica* (Diptera: Bibionidae) go unchecked by predators. Bull. Royal Entomol. Society. Antenna 28:78-80.

Pinto, L. G. 2002. Insecta - Diptera - Bibionidae. Fauna Amazonia Brasileira, Belem 17:1-16.

Sharp, J. L., N. C. Leppla, D. R. Bennett, W. K. Turner and E. W. Hamilton. 1974. Flight ability of *Plecia nearctica* in the laboratory. Ann. Entomol. Soc. Amer. 67:735-738.

Thompson, F. C. 1975. "Lovebugs," a review of the nearctic species of *Plecia* Wiedemann (Diptera: Bibionidae). USDA, Cooperative Economic Insect Report 25:87-91.

Thornhill, R. 1976a. Biology and reproductive behavior of *Dilophus sayi* (Diptera: Bibionidae). Florida Entomologist 59: 1-4.

Thornhill, R. 1976b. Dispersal of *Plecia nearctica* (Diptera: Bibionidae). Florida Entomologist 59:45-53.

Thornhill, R. 1976c. Reproductive behavior of the lovebug, *Plecia nearctica* (Diptera: Bibionidae). Ann. Entomol. Soc. Amer. 69:843-847.

Van Handel, E. 1976. Metabolism of the "Lovebug" *Plecia nearctica* (Diptera: Bibionidae). Ann. Entomol. Soc. Amer. 69:215-216.

Whitesell. 1974. Heat, sound, and engine exhaust as "lovebug" attractants (Diptera: Bibionidae: *Plecia nearctica*). Environmental Entomology 3:1038-1039.