

# Uranotaenia sapphirina Osten Sacken (Insecta: Diptera: Culicidae: Culicinae)<sup>1</sup>

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*The Featured Creatures collection provides in-depth profiles of insects, nematodes, arachnids and other organisms relevant to Florida. These profiles are intended for the use of interested laypersons with some knowledge of biology as well as academic audiences.*

## Introduction

The mosquito genus *Uranotaenia* includes about 200 species that occur throughout the temperate and tropical regions of the world. The greatest diversity of *Uranotaenia* species is found in tropical areas. *Uranotaenia sapphirina* is one of two members of the genus *Uranotaenia* occurring in Florida and is native to eastern North America. It is one of the smallest mosquito species in the United States and is striking in appearance, with patches of iridescent blue scales on the sides of the body. This species is unique among mosquitoes in that it specializes on invertebrate annelid hosts, such as earthworms and leeches (Reeves et al. 2018), whereas all other studied blood-feeding mosquito species are specialists of vertebrate hosts. This species is thought to rarely, if ever, feed on humans and other vertebrates and therefore poses little medical or veterinary importance.

## Synonymy

*Aedes sapphirina* Osten Sacken, 1868

*Uranotaenia coquilletti* Dyar and Knab, 1906

Information gathered from the Integrated Taxonomic Information System and International Commission on Zoological Nomenclature ITIS Report, at [www.itis.gov](http://www.itis.gov).

## Distribution

Three species of *Uranotaenia* are found in the United States. *Uranotaenia sapphirina* is the most widespread of these and is one of only two *Uranotaenia* species occurring in eastern North America (Darsie and Ward 2005). In North America, the geographic distribution of *Uranotaenia sapphirina* extends from southern Manitoba, Ontario, and Quebec in Canada (Carpenter and LaCasse 1955, Stuart 2007) south through the majority of the eastern United States into Florida, excluding only the northeastern corner

of New York, and northern Maine, New Hampshire and Vermont (Darsie and Ward 2005). In Florida, *Uranotaenia sapphirina* occurs throughout the state. Its range extends westward to the central United States and the upper Midwest with disjunct populations in Colorado and New Mexico (Darsie and Ward 2005), and southeastern Arizona (L. Reeves, unpublished data). *Uranotaenia sapphirina* also occurs south through eastern and southern Mexico and into the northern Neotropics (Martini 1935, Ortega-Morales et al. 2019, Canto-Mis et al. 2021, Navarrete-Carballo et al. 2021). There are scattered records of this species from Central America (El Salvador), northern South America (Surinam), and the Caribbean (Cuba, Hispaniola, Puerto Rico; Galindo et al. 1954, Broche et al. 2006, WRBU 2021), though these records likely represent *Uranotaenia socialis*, a closely related and morphologically similar species that replaces *Uranotaenia sapphirina* in Central and South America (Galindo et al. 1954). In the United States, *Uranotaenia sapphirina* is morphologically similar to *Uranotaenia anhydor* and *Uranotaenia lowii*, the only other *Uranotaenia* species known from the United States. In some regions west of the Mississippi River in the United States, *Uranotaenia sapphirina* co-occurs with *Uranotaenia anhydor*, and in the southeastern United States *Uranotaenia sapphirina* co-occurs with *Uranotaenia lowii* (Darsie and Ward 2005).

## Description

### Adults

The genus *Uranotaenia* belongs to the subfamily Culicinae. All species of *Uranotaenia* are small mosquitoes that can be distinguished from other mosquitoes by wing venation characters (the arrangement of the wing veins; Galindo et al. 1954). The proboscis of the adult male and female is swollen at the end in most species, including all three from the United States, and the palps of both sexes are short. Adult *Uranotaenia* may be distinguished from other mosquito genera by the following combination of characters: presence of short palps that are less than half the length of the proboscis and an R<sub>2</sub> wing cell that is shorter than vein R<sub>2+3</sub> (Figure 1) (Darsie and Morris 2003). In the United States, the genus *Uranotaenia* can be distinguished from other mosquito genera by the presence

of patches of iridescent blue scales on the head, thorax, and wings (Figure 2). This unique trait is not shared with any other mosquito genus or species in North America, though a few species within other genera have iridescent purple or green scales (e.g., *Toxorhynchites rutilus*, species of *Psorophora* subgenus *Janthinosoma*, *Aedes purpureipes*, among others).

Adult *Uranotaenia sapphirina* are among the smallest mosquito species in North America. The base color of the body varies from a golden, orange brown to dark brown, almost black. The proboscis of adults of both sexes is swollen at the tip (Figure 2). *Uranotaenia sapphirina* can be distinguished from the other eastern North American *Uranotaenia* species, *Uranotaenia lowii*, by the absence of pale scales on the hind tarsomeres 4 and 5, the last segments of the leg, which are completely dark-scaled in *Uranotaenia sapphirina* and completely pale-scaled in *Uranotaenia lowii* (Figures 2 and 3) (Darsie and Morris 2003). They also can be distinguished from *Uranotaenia lowii* by the absence of iridescent blue scales on the abdomen of *Uranotaenia sapphirina*, while these scales are present on the abdomen of *Uranotaenia lowii* (Burkett-Cadena 2013; Figure 2). In some areas west of the Mississippi River in the United States, the range of *Uranotaenia sapphirina* overlaps with that of *Uranotaenia anhydor*. These species can be distinguished from each other by the presence of a stripe of iridescent blue scales extending down the center of the scutum (the dorsal surface of the thorax) in *Uranotaenia sapphirina*, and the absence of this stripe in *Uranotaenia anhydor*.



Figure 2. Adult female *Uranotaenia sapphirina* Osten Sacken (left) compared with adult female *Uranotaenia lowii* Theobald (right). Both species occur in the southeastern United States. Note the patches of iridescent blue scales (black arrows) on both species, and absence of blue scales on the abdomen of *Uranotaenia sapphirina*. Note also the absence of pale scales on the hind tarsomeres of *Uranotaenia sapphirina*, and the presence of pale scales on the hind tarsomeres of *Uranotaenia lowii* (yellow arrows). The adult female *Uranotaenia sapphirina* on the bottom left has recently taken a blood meal, and the abdomen is engorged with blood. Credit: Lawrence Reeves, UF/IFAS

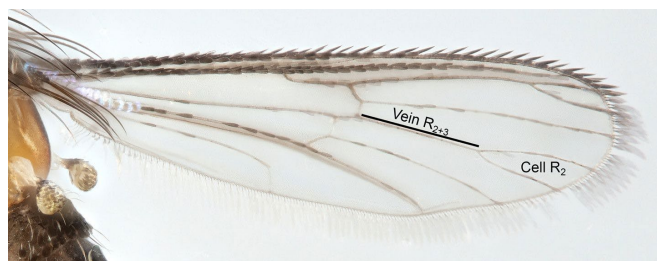


Figure 1. Adult *Uranotaenia lowii* Theobald wing, illustrating cell  $R_2$  and vein  $R_{2+3}$ . Credit: Lawrence Reeves, UF/IFAS

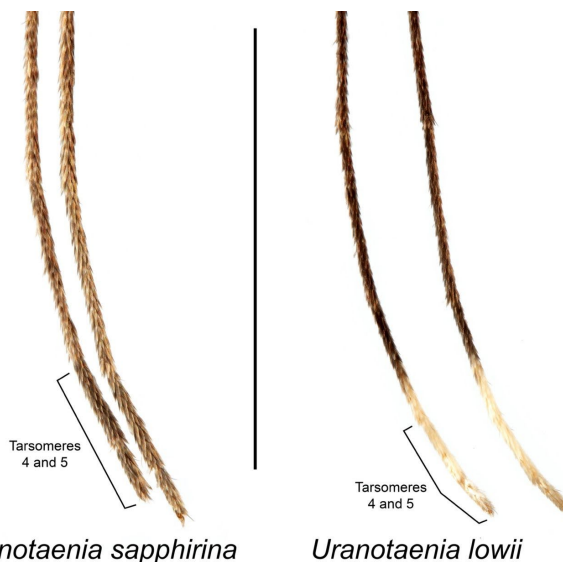


Figure 3. Hind tarsi of adult *Uranotaenia sapphirina* Osten Sacken and *Uranotaenia lowii* Theobald. Tarsomeres 4 and 5 of the hind legs are entirely dark scaled in *Uranotaenia sapphirina*, while in *Uranotaenia lowii* tarsomeres 4 and 5 are entirely pale scaled. Credit: Lawrence Reeves, UF/IFAS

## Eggs

Like the southern house mosquito, *Culex quinquefasciatus*, *Uranotaenia sapphirina* lays rafts of eggs on the surface of the water in vegetated permanent and semi-permanent water bodies (Hinman 1935). The eggs are smaller than those of *Culex quinquefasciatus*, about 2 mm in diameter, and fewer eggs, 45-50, are laid per raft (Dyar 1901, Dodge 1962). The individual eggs are black and bullet shaped. Eggs in the raft stick together with the pointed side facing upward, and float partially submerged at the surface of the water. Egg rafts are laid on the surface of the water, often among duckweed, *Lemna* spp. (Figure 4), in permanent or semi-permanent water bodies (Dyar 1901, Hinman 1935).



Figure 4. *Uranotaenia sapphirina* Osten Sacken egg raft laid between leaves of floating vegetation (*Lemna* sp.).

Credit: Lawrence Reeves, UF/IFAS

## Larvae

Like other mosquito genera from the subfamily Culicinae, *Uranotaenia sapphirina* larvae have a siphon, or breathing tube (Figure 5), on the posterior end of the abdomen with a row of spines (pectin spines). Their coloration can vary from pale to dark brown. *Uranotaenia* larvae can be distinguished from other mosquito genera by the following combination of characters: the presence of a large lateral comb plate, or plate-like structure, located on the posterior end of the abdomen at the base of the siphon, bearing barb-like structures called comb scales and a head of that is longer than it is wide, with four strong, spine-like structures (Figure 6) (Darsie and Morris 2003).

*Uranotaenia* larvae are small compared to those of other North American mosquito species. *Uranotaenia* larvae often rest nearly parallel to the surface, which may lead to confusion with *Anopheles* larvae. At rest, the larvae of *Anopheles* mosquitoes rest essentially parallel to the surface of the water. *Anopheles* larvae can be distinguished from those of *Uranotaenia* by the absence of a siphon (Figure 5) (Stuart 2007). *Uranotaenia sapphirina* and *Uranotaenia lowii* larvae are very similar in appearance,

but can be distinguished by the number of setae, or hairs, on the thorax (Darsie and Morris 2003).



Figure 5. Larva of *Uranotaenia sapphirina* Osten Sacken (A) with arrow pointing to siphon. Credit: Nathan Burkett-Cadena, UF/IFAS. Compare with larva of *Anopheles crucians* Wiedemann (B). Both *Uranotaenia* and *Anopheles* species larvae may rest nearly parallel to the surface of the water, but the genera can be distinguished by the presence of a siphon (yellow arrow) in *Uranotaenia* larvae, and the absence of this structure in *Anopheles* species larvae. Credit: Lawrence Reeves, UF/IFAS

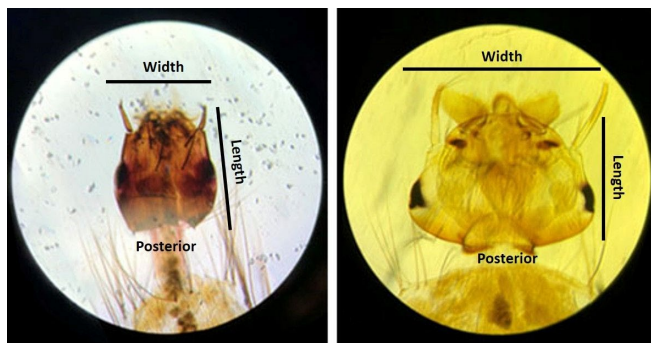


Figure 6. Head of larval *Uranotaenia sapphirina* Osten Sacken (left). Note the narrow appearance of the head, with a length that is greater than its width. Compare with *Aedes* spp. larva (right), with head width greater than the length. Credit: Sarah Maestas, UF/IFAS

## Pupae

Like all mosquito species, *Uranotaenia sapphirina* undergoes a pupal stage between the larval and adult life stages. During the pupal stage, the mosquito does not eat. Mosquito pupae are mobile, and are able to swim throughout their aquatic habitat, propelled by paddles located at the end of the pupal abdomen. They spend much of their time just below the surface of the water but will swim downward if they sense a potential threat. Mosquito pupae have a fused head and thorax, forming the cephalothorax, and an abdomen that forms a characteristic curled shape, with the paddles at the tip (Figure 7). Pupae breathe through respiratory trumpets, similar to a snorkel, projecting from the cephalothorax (Figure 7) at the water surface. The pupae of *Uranotaenia sapphirina*, as the adults, are small in size compared to other mosquito species, resembling those of *Culex* mosquitoes, though

smaller and with unusually long respiratory trumpets (Dyar 1901).

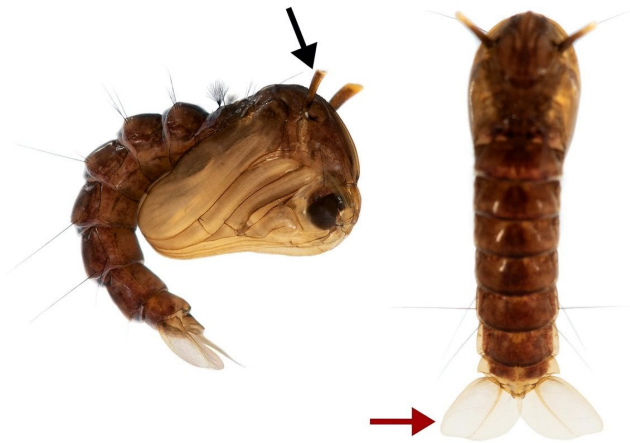


Figure 7. Lateral (left) and dorsal (right) views of a mosquito (*Toxorhynchites rutilus* (Dyar and Knab)) pupa illustrating the respiratory trumpets (black arrow) on the cephalothorax and paddles at the end of the abdomen (red arrow). Note that the pupae in this figure are not *Uranotaenia sapphirina* but are intended to illustrate basic pupal morphology of mosquitoes.

Credit: Lawrence Reeves, UF/IFAS

## Life Cycle

Like all mosquitoes, *Uranotaenia sapphirina* undergoes complete development with four life stages: eggs, larvae, pupae, and adults. *Uranotaenia sapphirina* eggs are laid in permanent and semi-permanent wetlands (Figure 8), typically characterized by being sunlit and containing floating and emergent vegetation (Joy and Clay 2002, Stuart 2007), and often containing *Spirogyra* algae (Hinman 1935, Lawlor 1935). *Uranotaenia sapphirina* larvae often rest underneath leaves of *Lemna* duckweed or in the shade of rice plants (Hinman 1935, Stark and Meisch 1984). After hatching, larvae develop within these pools throughout the spring and summer months (Hinman 1935), likely feeding from filamentous algae (Dodge 1962). Larvae develop through four larval stages, or instars, shedding the exoskeleton between each. After completing the fourth instar of the larval stage, they molt into pupae, and then eclose into adults. Larvae have been collected as early as January and as late as September. Males and females of most, if not all, mosquitoes require plant-derived sugar for nutrition and energy (Peach and Gries 2019), and *Uranotaenia sapphirina* adults have been found with plant sugar in their abdomens (Bidlingmayer and Hem 1973). Mating is thought to occur throughout the summer and into the fall. *Uranotaenia sapphirina* overwinters as adults, with mated females sheltering in dark, humid microhabitats such as caves, hollow trees or similar crevices where they undergo a winter diapause before emerging to lay multiple batches of eggs in the

spring (Hinman 1935; Lawlor 1935; Burkett-Cadena et al. 2011). While *Uranotaenia sapphirina* adults are most often collected near wetlands, they have the potential to disperse substantial distances and adults have been collected over the Gulf of Mexico, 32 km from the shoreline (Sparks et al. 1986).



Figure 8. Typical habitat of *Uranotaenia sapphirina* Osten Sacken. Larvae are associated with vegetated, sunlit wetlands, and adults are most common near such habitats. At this site, River Styx, Alachua County, Florida, adult females feed from hosts in the sandy mud at the edge of the water at night and rest in the shaded vegetation during the day. Larvae occur in the shade of floating and emergent vegetation.

Credit: Lawrence Reeves, UF/IFAS

## Hosts

*Uranotaenia sapphirina* is the only known mosquito species to specialize on invertebrate host animals, feeding on annelids such as earthworms and leeches (Reeves et al. 2018) (Figure 9). Female *Uranotaenia sapphirina* have been observed at night congregated in the wet mud at the edge of water sources, where they have been reported to feed on earthworms in the genus *Sparganophilus* and multiple genera of leeches. While some mosquitoes are autogenous (non-blood-feeding), such as *Toxorhynchites* spp., feeding only from plant-derived sugars as adults (Steffan and Evenhuis 1981), females of the majority of mosquito species are hematophagous (blood-feeding), using proteins and other nutrients from blood to produce viable eggs. These hematophagous species are known to feed on mammals, birds, reptiles, amphibians, and even fish (Tempelis 1975). Of these, *Uranotaenia sapphirina* is the only species known to depart from the association with vertebrate hosts of other mosquito species. There is some evidence that *Uranotaenia sapphirina* will feed on various vertebrate species, although these occurrences may be rare or in error (Irby and Apperson 1988, Cupp et al. 2004). Others found that adult female *Uranotaenia sapphirina* could not be induced to feed from vertebrate hosts, and prior to the discovery that they feed from

invertebrates, were suspected to be autogenous (Headlee 1921).

The linked video demonstrates the feeding habits of *Uranotaenia sapphirina* (<https://www.youtube.com/watch?v=CRY7j0-vtx0>) (Credit: Lawrence Reeves, UF/IFAS).



Figure 9. Adult *Uranotaenia sapphirina* Osten Sacken feeding on the leech *Macrobella ditetra*.

Credit: Lawrence Reeves, UF/IFAS

## Medical and Veterinary Importance

Infection with viruses, such as Eastern equine encephalitis and West Nile virus, has been reported from some *Uranotaenia sapphirina* specimens (Cupp et al. 2003, Andreadis et al. 2004, Armstrong and Andreadis 2010). These pathogens can cause illness and death in both humans and domestic animals. However, the feeding preferences of *Uranotaenia sapphirina* may preclude significant pathogen transmission risk, as they likely rarely feed on vertebrate hosts. It has been suggested that the source of infection in these mosquitoes may result from feeding on leeches that have in turn taken a blood meal from an infected vertebrate host (Reeves et al. 2018). Vertebrate DNA has been detected in small numbers of *Uranotaenia sapphirina* during blood meal analysis, and infected blood meals may represent potential sources of infection (Irby and Apperson 1988, Cupp et al. 2004). The host feeding characteristics of this mosquito make it unlikely for an infected individual to transmit pathogens to a human or other susceptible vertebrate animal. *Uranotaenia sapphirina* has been found infected with a Cypovirus (Shapiro et al. 2005) and a Nucleopolyhedrovirus (Shapiro et al. 2004), though these viruses are not known to infect vertebrates.

## Management

The feeding habits of *Uranotaenia sapphirina* seem to preclude human biting, and it likely only rarely, if ever, feeds on other vertebrate animals. Due to the lack of significance as a vector or pest of medical or veterinary

importance, management or control efforts targeting *Uranotaenia sapphirina* are not warranted.

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