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Aedes canadensis (Theobald) (Insecta: Diptera: Culicidae)[1]

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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

Aedes canadensis (Figure 1) was first described by Frederick V. Theobald as *Culex canadensis* in the early twentieth century (Theobald 1901) but was later transferred to the genus *Aedes* (Freitas and Bartholomay 2021). It was subsequently moved to the genus *Ochlerotatus* as part of a reclassification of the mosquito tribe "Aedini" (Reinert 2000) and eventually restored to the genus *Aedes* after a taxonomic reclassification (Wilkerson et al. 2015). *Aedes canadensis* is a woodland mosquito that is widely distributed in North America (Carpenter and LaCasse 1955). It has one generation per year and is notable for the long period of dormancy of its eggs, lasting through the summer, fall, and winter (Magnarelli 1977). It is regarded as a minor nuisance species that is capable of spreading multiple human and animal pathogens.

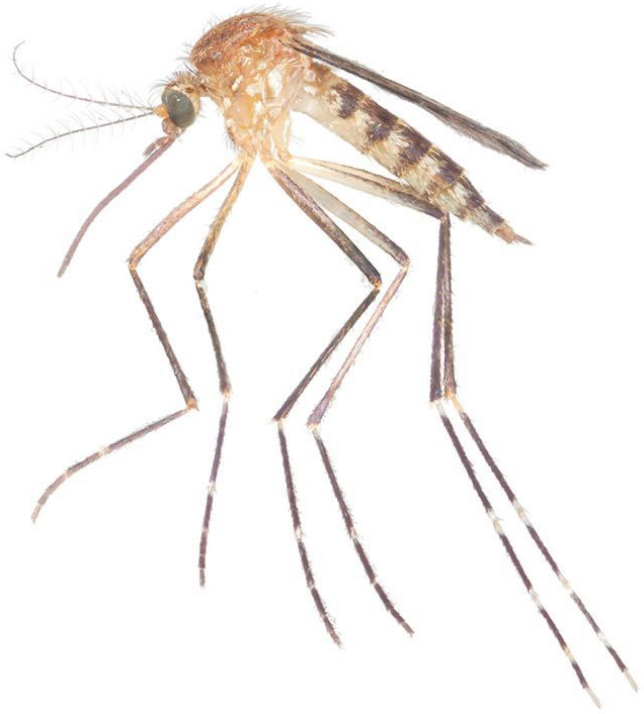

Figure 1 . Aedes canadensis (Theobald) adult female.
Credit: Nathan Burkett-Cadena, UF/IFAS

A geographical variant of this species is present in the southern United States. This variant of *Aedes canadensis* was originally described as *Aedes mathesoni* by Middlekauff in 1944. It is distinguished by subtle differences in the coloration of its thorax and hindlegs (Carpenter and LaCasse 1955) and is indigenous to parts of Alabama, Georgia, South Carolina, and Florida. *Aedes mathesoni* was later reclassified as a subspecies of *Aedes canadensis* (Rings and Hill 1948, Darsie and Ward 2005) but is now considered to be a geographical variant of *Aedes canadensis* (Harbach and Wilkerson 2023). No genetic studies have been conducted as of May 2025 to examine if these geographic variants within *Aedes canadensis* are associated with any genetic variations (data source: GenBank).

Distribution

Aedes canadensis is found throughout most of Canada, as well as in the eastern, midwestern, and southern United States (Figure 2) (Darsie and Ward 2005). It has also been reported from Mexico and the Dominican Republic,

although no locality data is available (Harbach and Wilkerson 2023).

Figure 2 . Distribution of Aedes canadensis in Canada and the United States.
Credit: Data from Darsie and Ward 2005

Morphology

Adult

Aedes canadensis is a medium-sized, dark brown mosquito, with hind legs that appear banded, even to the naked eye (Figure 3). The dorsal aspect of the head bears a large patch of narrow, pale yellow scales, and the lateral aspects bear broad, white scales (Carpenter and LaCasse 1955). The proboscis and palps (fingerlike appendages of the mouthparts) are entirely dark scaled (Harrison et al. 2016; Figure 1).

The wings of this species range in length from 3.2–4 mm (0.13–0.16 in) and have narrow, dark scales (Carpenter and LaCasse 1955). The upper (dorsal) surface of the thorax (called the scutum) is brown and is clad in golden-brown scales that do not form a distinctive pattern (Figure 4). Grayish-white scales are present in patches on the sides of the thorax (Carpenter and LaCasse 1955; Figure 1).

The upper two leg segments (femur and tibia) are mostly dark, with pale coloration on the rear side of each segment (Figure 1). There is a pale knee spot on the distal end of each femur, and each tibia bears pale scales at its base and apex (Carpenter and LaCasse 1955). On the hindlegs, the upper and lower margins of the first-fourth tarsomeres (lower leg segments) bear pale bands (Figure 3) (Darsie and Ward 2005). The terminal segment (fifth tarsomere) of each hindleg is entirely pale scaled in *Aedes canadensis* (Theobald), and dark scaled in *Aedes canadensis* var. *mathesoni*.

The dorsal (upper) portion of the first abdominal segment is dark with scattered white scales. The dorsal portion of the other abdominal segments bears a narrow pale band on the margin of the segment closest to the thorax. This band widens into large pale patches on either side of the segment. The sixth and seventh abdominal segments typically have a thin strip of white scales at their apex (Carpenter and LaCasse 1955). The underside of the abdomen is usually pale but dark scales may be present on the margin of each segment farthest from the thorax (Carpenter and LaCasse 1955).

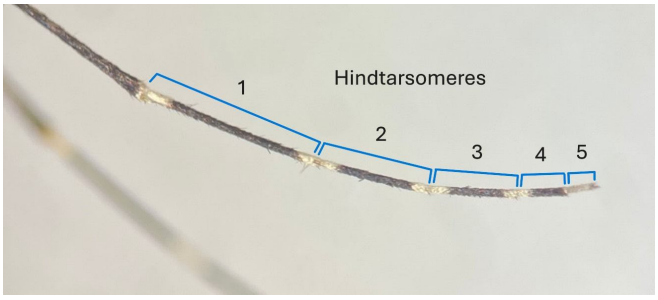

Figure 3. Hindleg of *Aedes canadensis* (Theobald), featuring the pale bands on the upper and lower margins of the first through the fourth segments (tarsomeres) and the entirely pale-scaled terminal segment.
Credit: Bryna Wilson, UF/IFAS

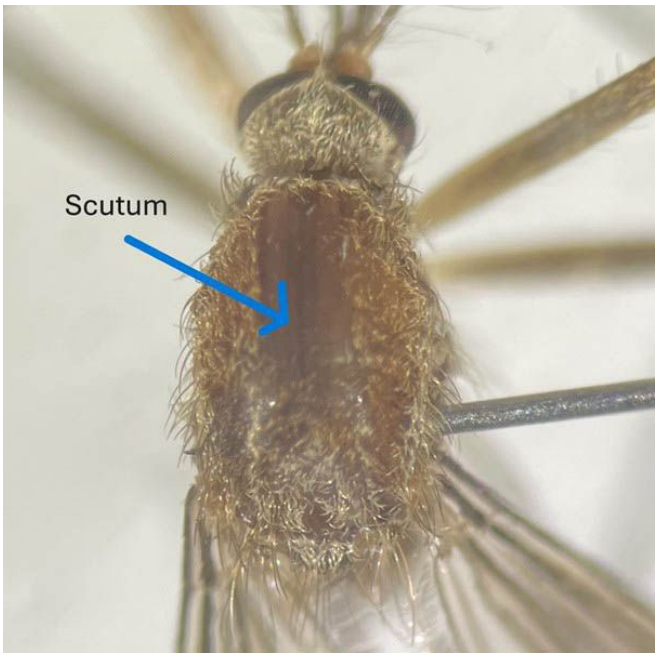

Figure 4 . Scutum of Aedes canadensis (Theobald), displaying the characteristic golden-brown scales.
Credit: Bryna Wilson UF/IFAS

Egg

The egg of *Aedes canadensis* is dark brown, measuring between 630–758 µm (0.025–0.030 in) in length and 180–206 µm (0.007–0.008 in) in width (Kalpage and Brust 1968). It is spindle-shaped appearing rounded at the anterior end and tapered at the posterior end (Kalpage and Brust 1968).

Larva

The fully developed larva of *Aedes canadensis* is medium-sized and often brown in color (Figure 5). Its head is wider than long, with the widest part in the posterior half. The antennae on its head are half the length of the head and covered in small spines. A tuft of setae arises near the middle of each antenna (Carpenter and LaCasse 1955).

The eighth abdominal segment bears a cluster of pointed scales, called comb scales. Each comb scale is fringed with thin spines that are similar to each other in length (Carpenter and LaCasse 1955).

The siphon is moderately long, slightly wider at its base than its apex, and has a single pair of branched setae arising near its middle (Figure 6). The basal half of the siphon bears a row of 13–24 spines (called the pecten) (Carpenter and LaCasse 1955). The spines of the pecten are similar to one another and more or less evenly spaced. The siphon is three to four times longer than it is wide (Carpenter and LaCasse 1955).

The terminal abdominal segment bears a darkened dorsal plate, called a saddle, that does not completely encircle the segment (Darsie and Ward 2005). The terminal abdominal segment also bears a large cluster of fanlike setae (called the ventral brush) and has anal papillae that measure 1–1.7 times the length of the saddle (Carpenter and LaCasse 1955).

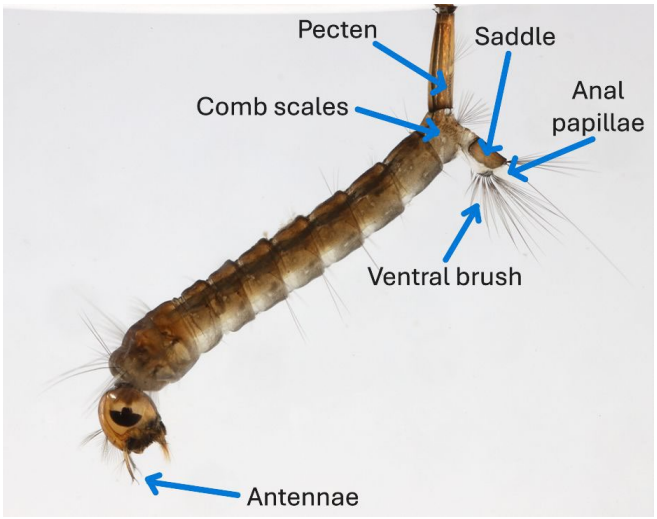

Figure 5 . Mature larva of Aedes canadensis.
Credit: Nathan Burkett-Cadena, UF/IFAS

Figure 6 . Siphon of Aedes canadensis larva, showing the single pair of setae on the siphon and the siphon index exceeding 3.0.
Credit: Nathan Burkett-Cadena, UF/IFAS

Pupa

Mosquito pupae have comma-shaped bodies consisting of a cephalothorax and abdomen. Compound eyes and tubular respiratory organs called trumpets arise laterally on the anterior portion of the cephalothorax (Yamany et al. 2024). The abdomen has nine distinct segments, each of which has dorsal (tergal) and ventral (sternal) sclerites (Yamany et al. 2024). The terminal abdominal segment bears a locomotory structure called the paddle. The presence, length, position, and branching of the setae on the cephalothorax and abdomen are used to identify pupae to genus and species (Darsie 2005). The pupa of *Aedes canadensis* can be differentiated from other *Aedes* pupae by minor differences in the branching of setae on its cephalothorax and abdominal segments (Darsie 2005).

Life Cycle

Aedes canadensis is a univoltine species, meaning that it undergoes only one generation per year (Crans 2004). In Canada and the northern United States, the adults emerge primarily between April and June (Carpenter and LaCasse 1955), and peak adult abundance occurs in June and July (Andreadis et al. 2014, Shahhosseini et al. 2021). The timing of life stages in the southern United States has not been reported in the literature and may differ from the patterns observed in the northern United States. In the southern states, the abundance of adult *Aedes canadensis* has been observed to peak in the spring and they are rarely encountered in the summer or fall (Burkett-Cadena, personal observation).

Aedes canadensis is an early-breeding mosquito, mating soon after the adults emerge (Berry et al. 1986). Males remain near their larval habitats and die soon after mating (Magnarelli 1977), but females persist for several months before dying off (Carpenter and LaCasse 1955). In the northern United States and Canada, egg laying occurs at the edges of woodland bodies of water in late spring or early summer (Mallack et al. 1964).

Warmth induces *Aedes canadensis* eggs to enter a state of diapause that will end only after they have been chilled or

frozen (Mallack et al. 1964). Thus, the eggs remain dormant for the remainder of the year and begin to hatch in the early spring when they are inundated with water from melting snow or spring rain (Magnarelli 1977). Large numbers of larvae may be present in woodland bodies of water as early as the beginning of March and persist through the end of May (Crans 2015). In addition to temporary vernal pools, larvae may be found near the surface of the water in small ponds, puddles, marshes, and pools ranging from 3 inches to 2 feet deep (Jenkins and Knight 1952).

The mosquito species that share larval development habitat with *Aedes canadensis* vary depending on location and season. In New York State, *Aedes canadensis* larvae often develop alongside larvae of *Aedes abserratus*, *Aedes punctor*, *Aedes trichurus*, *Aedes stimulans*, *Aedes excrucians*, and *Aedes fitchii,* and may also be found with *Culex restuans* and *Culex territans* during the summer (Magnarelli 1977). In New Jersey, *Aedes canadensis* has been found to be associated in the spring with *Aedes stimulans*, *Aedes grossbecki*, and *Aedes excrucians*, and in the summer with *Aedes cinereus*, *Aedes sticticus*, *Aedes vexans*, *Aedes atlanticus*, and *Psorophora ferox* (Crans 2015). In Pennsylvania, mid-summer *Aedes canadensis* larvae have been found to share habitat with *Aedes vexans*, *Aedes trivittatus*, *Culex restuans*, *Culex territans*, and *Psoropjora ferox* (Wills and Fish 1973). *Aedes canadensis* generally inhabits shallower areas of water bodies than the larvae of these other species (Carpenter and LaCasse 1955). No habitat associations data specific to the southern United States is available for this species.

Aedes canadensis eggs that remain above water level throughout the spring may hatch in midsummer or early fall if heavy rainfall floods woodland pools or creates temporary puddles. This second hatching is responsible for the midsummer spikes in *Aedes canadensis* abundance that have been observed in Wisconsin and New York (Magnarelli 1977). It is also thought that fall hatching may occasionally be from newly laid eggs, rather than eggs that have overwintered (Carpenter and LaCasse 1955).

Hosts

Aedes canadensis feeds from dawn to dusk, with peak activity around 8:00 p.m. (Sherwood et al. 2020, Trueman and McIver 1986). Its daily activity pattern does not exhibit any predictable seasonal variations (Trueman and McIver 1986). Although this species is mainly encountered in forest habitats, it can also be found in suburban areas (Cloutier et al. 2021), where it can be a significant biting nuisance to humans and domestic animals, particularly in shaded areas (Carpenter and LaCasse 1955).

Aedes canadensis is known to feed upon mammals, birds, and reptiles, and seems to prefer one host group over the others in different regions within its range. In a study conducted in Connecticut, USA, for example, *Aedes canadensis* took 93% of blood meals from just one host species (white-tailed deer), with the remaining 7% of bites on humans, house cats, opossum, American woodcocks, and turtles (Molaei et al. 2008). A similar propensity for favoring mammals was observed in a Canadian study, in which 62% of *Aedes canadensis* blood meals were from mammals (26% deer, 12% wild boar, 12% humans, 12% wolves) and 38% were from American crows (Shahhosseini et al. 2021). A study of *Aedes canadensis* host associations further south (in North Carolina) found that turtles are the preferred hosts for this species (Irby and Apperson 1988). In this study, 15% of the blood-fed *Aedes canadensis* females had fed on mammals (primarily deer) and 85% had fed on turtles (Irby and Apperson 1988). It was previously documented that *Aedes canadensis* is highly attracted to tethered Eastern box turtles in New Jersey and is the primary mosquito species that feeds on them (Crans and Rockel 1968). Thus, it is possible that *Aedes canadensis* may feed predominantly on turtles when they are readily available (as the Eastern box turtle is in North Carolina).

Medical and Veterinary Importance

Multiple studies have implicated *Aedes canadensis* in the transmission of the California serogroup of encephalitis viruses (Bunyaviridae: *Orthobunyavirus*), which includes La Crosse encephalitis virus, Jamestown Canyon virus, and snowshoe hare virus (Snyman et al. 2023). These viruses circulate in populations of wild mammals but sometimes cause disease in humans. Infected humans are often asymptomatic, but may experience mild to severe neurological symptoms, occasionally leading to death (Webster et al. 2017).

Aedes canadensis has been shown to carry La Crosse encephalitis virus in Ohio (Berry et al. 1986), and homogenized field-collected specimens from West Virginia have also tested positive for the virus (Nasci et al. 2000). This virus primarily infects small mammals such as chipmunks, which are abundant in the woodland habitat of *Aedes canadensis*. *Aedes triseriatus* is known to be the primary mosquito species involved in the transmission of La Crosse encephalitis virus (Harris et al. 2015), but *Aedes canadensis* may also play a role in transmitting the virus between wild animals and could potentially spread La Crosse to humans.

Jamestown Canyon virus has frequently been detected in *Aedes canadensis* in Connecticut, and it has been confirmed that *Aedes canadensis* can transmit it under laboratory conditions (Andreadis et al. 2008). Since *Aedes canadensis* feeds heavily on white-tailed deer (Molaei et al. 2008), which are the species most frequently infected with Jamestown Canyon virus, it is strongly suspected of being able to spread Jamestown Canyon Virus in the wild. A number of other species of *Aedes*, *Anopheles*, *Culex*,

Culiseta, and *Coquillettidia* mosquitoes are also suspected of carrying Jamestown Canyon virus.

Snowshoe hare virus is spread by *Culiseta inornata*, *Culiseta impatiens*, and multiple species of *Aedes* (Walker and Yuill 2023). Like La Crosse encephalitis virus, this pathogen circulates among small woodland mammals, which are frequently bitten by *Aedes canadensis*. The virus has been detected in homogenized field-collected *Aedes canadensis* in the Yukon (McLean et al. 1974) and in Newfoundland (Carson et al. 2017). These studies indicate that *Aedes canadensis* may play a role in spreading Snowshoe hare virus.

Aedes canadensis is known to transmit the dog heartworm parasite, *Dirofilaria immitis* (Bickley et al. 1977). In the northern United States, it is one of several mosquito species responsible for transmitting Cache Valley Virus between white-tailed deer (Andreadis et al. 2014). It is also thought to spread Eastern Equine Encephalitis virus by feeding on humans after biting infected birds (Sherwood et al. 2020). Additionally, some researchers have suggested that *Aedes canadensis* may contribute to the transmission of West Nile virus, a pathogen that is spread primarily by *Culex* mosquitoes (Giordano et al. 2018).

Surveillance

In the eastern and midwestern United States, surveillance of *Aedes canadensis* is particularly important in spring and late summer, when Jamestown Canyon virus and La Crosse virus cases peak, respectively (Coleman et al. 2021, Vahey et al. 2021). Carbon dioxide-baited CDC light traps are an accessible and highly effective means of trapping *Aedes canadensis* (NJ Department of Health 2024).

Management

The management of *Aedes canadensis* in its preferred habitat (forests and wetlands) is complicated by the need to balance the environmental risks of treatment with the risks of allowing the population to persist unchecked. Wetlands are protected by law and contain a rich variety of species that may be harmed by frequent applications of insecticides to target *Aedes canadensis* (Rey et al. 2012). Since *Aedes canadensis* is not the primary species responsible for transmitting human diseases of concern, it is infrequently targeted for management. Instead, its populations are reduced inadvertently when mosquito control districts treat forest and wetland areas to target high-priority disease-spreading species such as *Aedes aegypti* and *Aedes albopictus*.

Ultra-low volume applications of organophosphates and pyrethroids are the standard method of decreasing populations of adult mosquitoes in large outdoor areas (Kaura et al. 2022). Since *Aedes canadensis* is active throughout the day, adulticide applications that occur during daylight hours can be expected to reduce their population along with that of the target species (Sherwood et al. 2020).

Temephos is currently the preferred organophosphate larvicide for use in wetland areas (Rey et al. 2012), and it demonstrates broad-spectrum efficacy against many mosquito species (Martínez-Mercado et al. 2022). Additionally, the larvicides *Bti* and methoprene are commonly used to target a variety of mosquito species and are known to be effective against *Aedes canadensis*. Field applications of *Bti* can reduce *Aedes canadensis* larval populations in woodland pools by 98% (Wilmot et al. 1993). Similarly, aerially applied methoprene has been shown to produce an 80% reduction in *Aedes canadensis* larvae in flooded woodlots (McCarry 1996).

Concluding Remarks

Aedes canadensis is a widespread North American mosquito that hatches from woodland bodies of water in the early spring and midsummer. It feeds on mammals and spreads dog heartworm parasites and several arboviruses. Although it is not often specifically targeted for management, adulticidal and larvicidal strategies used to control other mosquito species can aid in reducing populations of *Aedes canadensis*.

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