

APPENDIX E: GENERAL OVERVIEW OF MOSQUITO HABITAT AND BIOLOGY

Larval Habitat

Mosquitoes successfully inhabit almost every kind of collection of water. A “breeding site” can be any place that will hold water for a week or more after rainfall. Prime breeding sites include marsh edges, short-grass ditches, tire ruts, hoof prints, discarded tires left outdoors, poorly maintained bird baths, holes in trees, clogged rain gutters, unused swimming and plastic wading pools, and pots and pans with standing water, and many other habitats that will hold stagnant water (New York City Department of Health and Mental Hygiene 2003, Metropolitan Mosquito Control District [MMCD] 2002). The most prolific breeding sites in the city are probably flood-irrigated lands, and seasonally wet/dry locations when stagnant water is present.

Some areas that do not support mosquitoes include moving water (rivers, streams, and creeks), deeper lakes, ornamental ponds, and duck ponds. Other conditions that are unfavorable for breeding of mosquitoes are turbulence and the presence of natural predators.

Adult Habitat

In the daytime, adult mosquitoes avoid adverse environmental conditions, such as intense heat, by taking refuge in resting areas known as “harborage sites”. Typically, these resting areas are composed of natural vegetation, including forests, tree stands, grass, shrubs, or other foliage. Ideal resting areas are generally shaded with cooler daytime temperatures and high relative humidity. These conditions are typically found in forests or tree stands that have a canopy, and dense underbrush. Wetlands also may be present nearby. Other resting sites include culverts, hollow logs, areas underneath decks, shaded sides of buildings, basements, and garages.

General Mosquito Biology

Mosquitoes develop through four general stages in their life cycle. The following sections describe these four stages.

Eggs

All mosquitoes must develop in water before they can fly. The adult female mosquito, after taking a blood meal, will search for a place to lay her eggs. *Culex* mosquitoes lay eggs in clusters, also called egg rafts, on the water’s surface. *C. tarsalis* lay eggs in rafts on the surface of permanent and semi-permanent clear ground pools, springs, and ditches. In late summer, they also lay eggs in temporary pools and containers that contain standing water. *C. pipiens* use standing or slow-moving water that contains decaying organic materials to lay their eggs.

Larvae

Larvae develop in shallow water. They have four growth stages known as instars (Figure D-1). They are found in the water hanging head down just below the surface because the larvae breathe through a respiratory siphon at the tail end of their body that breaks the surface of the water. When larvae first hatch, they are less than 1/8 inch long and they grow to be approximately 3/8 inch long by the fourth instar.

The larvae of *C. tarsalis* and *C. pipiens* are found in somewhat different habitats. *C. tarsalis* larvae are found in a wide variety of semi-permanent and permanent sources of water in both rural and urban areas (Nielsen et al. 2002). They occupy a wide variety of either fresh

or polluted water habitats, usually in open, sunlit locations (Harmston and Lawson 1963). In contrast, *C. pipiens* larvae are found in a wide variety of natural and artificial sources of water that often are highly polluted with organic wastes (Nielsen et al. 2002, Harmston and Lawson 1963). They have been found in containers of various types, catch basins, ornamental pools, cesspools, swimming pools that are not completely drained, ditches, and tree holes (Nielsen et al. 2002).

Pupae

At the end of the fourth instar, the larva molts into a pupa. The pupa is a cocoon-like stage when the adult mosquito is forming. This stage typically lasts about 2 days; however, the amount of time spent in the pupa may vary depending on water's temperature. The mosquito does not feed during the pupa stage, but when disturbed, will tumble as it avoids danger.

Adult

When the adult is fully formed, it breaks through and emerges from the pupal skin. It rests for a short time on the water surface while its wings expand and dry. Male mosquitoes usually emerge first and form a swarm where they will mate with females as they emerge from their pupae. Females mate only once and store sperm in their bodies to fertilize their eggs as they are laid. Once the female has mated, she flies off in search of a blood meal to obtain the proteins necessary for laying eggs. Males and females feed on plant nectar for energy.

A number of factors influence the blood feeding of the adult female. They include humidity, wind, temperature, light, and animal emanations (such as respiration or body heat). For most mosquitoes, the primary period for feeding on blood is between sunset and midnight during the summer. A second feeding period occurs around sunrise. This feeding behavior may change during the spring and fall, when daytime conditions favor mosquito activity over evening conditions. Temperatures above 55 degrees F and humidity levels at or in excess of 70 percent are optimum feeding conditions.

Mosquitoes of the genus *Culex* can overwinter as gravid (egg bearing) females. This characteristic results in populations that are low in numbers in the spring but grow geometrically during August and September. Because the populations of mosquitoes increase greatly late in the summer, potential vectors and disease transmission are most prevalent at this time.

C. tarsalis breeds several generations per year. Females overwinter in protected places, including caves, abandoned mines, and cellars (Harmston and Lawson 1963). Adults prefer to feed on birds, but will bite humans and other mammals (Nielsen et al. 2002; Harmston and Lawson 1963). Feeding occurs near dusk and after dark (Nielsen et al. 2002). Its life cycle varies from 4 days to 30 days, depending on conditions. *C. tarsalis* commonly travels up to 2 miles for a blood meal. Collections have been made at elevations up to 10,000 feet (Harmston and Lawson 1963).

C. pipiens females hibernate in cellars, basements, and other protected sites (Harmston and Lawson 1963). Studies suggest that birds are the major hosts of *C. pipiens* because it takes blood meals from them more than 95 percent of the time. Mammals constitute the rest, with humans representing less than 1 percent of the total (Nielsen et al. 2002).

C. tarsalis is probably the main carrier of WNV because of its affinity to take blood meals from birds. At least 120 bird species and eight mammal species have been infected (USGS 2002). Corvids (crows, magpies, ravens, and jays) seem to be affected more than other species; however, because many corvids die when infected, they are not an ideal host for the virus. Other species, such as house sparrows, do not seem to die as readily when infected and are therefore a more effective host for the virus.

Figure D-1 Mosquito Life Cycle

