



Integrated Mosquito Management Program

City of Victoria, Texas

Introduction

Over 2,500 different species of mosquitoes have been identified throughout the world, with approximately 165 species occurring in the United States. The Texas Department of Health estimates there are approximately 84 mosquito species in the state of Texas. Only about 12 of these mosquito species have been implicated in the transmission of serious diseases.

Mosquitoes are insects that belong to the order Diptera or true flies due to having two wings. Defining characteristics of mosquitoes are long, many-segmented antennae, a piercing and sucking mouthpart system elongated into a distinctive proboscis, and scales on the wing veins and margins. Only female mosquitoes have modified mouthparts that forms the proboscis. Male mosquitoes have mouthparts incapable of piercing skin.

Mosquitoes typically need still, stagnant water isolated from fish or other small predators to complete their egg to adult life cycle. Larval habitats can range from marshes, freshwater wetlands, and tree holes to human-made structures like ditches, gutters, and discarded tires. Not all species of mosquitoes feed on humans and other mammals. Many species feed mostly on birds, amphibians, or reptiles. Only a small percentage of the known mosquito species are considered to carry viruses such as Dengue, Zika, Chikungunya, or West Nile Virus.

Mosquitoes may be controlled through a variety of different physical, chemical, and biological methods. Physical methods usually involve source reduction which is simply the physical removal of mosquito breeding habitats. Biological measures mainly center on the use of bacteria to kill mosquito larvae or the use of natural mosquito predators such as *Gambusia*, otherwise known as mosquito fish. Chemical treatment typically involves the application of pesticides to attempt to control adult mosquito populations.

Today, communities are developing locally tailored mosquito control programs adaptable to changing conditions. For many areas, this means providing the basic level of protection by monitoring mosquito movement, population size, infection rates, and type of species. By knowing and understanding how many and what species of mosquitoes are in the area, we can be proactive, respond more effectively when threatened, and begin to predict possible virus trends.

Explanation of Terms

Acronyms

CDC	Centers for Disease Control
IMMP	Integrated Mosquito Management Program
WNV	West Nile Virus
CHIKV	Chikungunya Virus
DENV	Dengue Virus
ZIKV	Zika Virus

Definitions

Adulticide (spraying or fogging) - product used to kill adult mosquitoes. Adulticides can be applied from handheld sprayers, truck-mounted sprayers, or airplanes. Adulticides, when used in accordance with the label, can have an immediate impact by reducing the number of adult mosquitoes in an area.

Aedes – Genus name for the *Aedes aegypti* (yellow fever) and *Aedes albopictus* (Asian tiger) mosquitoes. These mosquitoes tend to be day-time biters and are sometimes called ankle biters. Resting areas tend to be in tall grasses and shrubs low to the ground. Both species typically remain within a range of 200 meters. This mosquito species is the common transmitter of Dengue, Zika, and Chikungunya virus.



Aedes aegypti



Aedes albopictus

Arbovirus – Any virus transmitted by arthropods (mosquitoes)

Chikungunya – Chikungunya (pronunciation:\chik-en-goon-ye). The most common symptoms of chikungunya virus infection are fever and joint pain. Other symptoms may include headache, muscle pain, joint swelling, or rash.

Culex – Genus name of a general group of mosquitoes which are nighttime-active, opportunistic blood feeders and a primary vector for the WNV. Temperature-dependence drives prevalence of species. In warm temperatures *Culex quinquefasciatus* (southern house mosquito), becomes prevalent, although *Culex restuans* is an important vector species in the early spring and late fall. These species tend to rest high in trees during the day and come down at night to feed. The feeding range is typically 1-2 miles. *Culex quinquefasciatus* is a medium-sized brown mosquito that exists throughout the tropics and the lower latitudes of temperate regions.



Culex quinquefasciatus

Dengue – Dengue (pronounced den' gee) is a disease caused by any one of four closely related dengue viruses (DENV 1, DENV 2, DENV 3, or DENV 4). The principal symptoms of dengue are high fever, severe headache, severe pain behind the eyes, joint pain, muscle and bone pain, rash, and mild bleeding (e.g., nose or gums bleed, easy bruising). Dengue Hemorrhagic Fever (DHF) is a more severe form of dengue infection. With good medical management, mortality due to DHF can be less than 1%.

Integrated Pest Management (IPM) – a science-based, commonsense approach for managing populations of disease vectors and public health pests. IPM uses a variety of pest management techniques that focus on pest prevention, pest reduction, and the elimination of conditions that lead to pest infestations.

Larvicide – products used to kill immature mosquitoes before they become adults. Larvicides can be either biological (such as toxin from specific bacteria that is lethal to mosquito larvae, but not to other organisms) or chemical products, such as insect growth regulators, surface films, or organophosphates. Larvicides are applied directly to water sources that hold mosquito eggs, larvae, or pupae. Larvicides can help to reduce the overall mosquito burden by limiting the number of new mosquitoes produced.

Vector – the primary agent responsible for transmitting a disease. For the purpose of this plan, mosquitoes are the common vector.

West Nile Virus (WNV) – most people infected with WNV will have no symptoms. About 1 in 5 people who are infected will develop a fever with other symptoms. Less than 1% of infected people develop a serious, sometimes fatal, neurologic illness. There are no medications to treat or vaccines to prevent WNV infection. Risk of being infected is reduced by using insect repellent and wearing protective clothing to prevent mosquito bites.

Zika – a disease caused by the Zika virus. Common symptoms are fever, rash, joint pain, and conjunctivitis (red eyes). The illness is usually mild with symptoms lasting for several days to a week.

1.) Highlights and Objectives

Highlights

- Chikungunya cases from mosquito-borne transmission have not been reported in the United States but have been in countries outside of the United States;
- The Zika Virus became an emerging concern in 2016, but concern has since declined;
- Adulticide is our most extreme method for addressing the mosquito population, and is used to help reduce the adult mosquito population;
- There are multiple arboviruses and the different species of mosquitoes (vector) that spread them vary in behavior and ecology;
- The City's response, as a vector control agency, will vary vastly depending on the vector important in the spread of each disease.
- Personal protective measures are an effective method for preventing the spread of arboviruses;
- The City will monitor for the presence of WNV in mosquito pools from May - November;
- Chikungunya and Zika have not yet shown a pattern of mosquito transmission within the United States to establish assumptions, but travelers visiting affected areas outside the United States should remain cautious.

Objectives

- Provide public education and personal responsibility through the distribution of guidelines and information on mosquito populations, and prevalence of diseases;
- Provide a systematic approach of surveillance and monitoring utilizing mosquito sampling and human disease data to establish risk levels;
- Establish mosquito control methods through consultation with subject matter experts;
- Establish three (3) risk levels and response actions for each risk level;
- Formalize the public notification procedures.

2.) Public Education

General Information

The prevention of any mosquito-borne disease is most efficiently accomplished by ensuring prompt and accurate information reaches the public in a timely manner. The typical risk begins as mosquitoes emerge in the spring months; therefore, the City will renew a public education campaign and will provide continuous information on the City's website, social media, publications, and signs concerning arbovirus/disease frequently asked questions (FAQs), disease symptoms, personal preventative measures, and points of contact for additional information.

Personal Protection and Responsibility

The CDC and other health-related organizations have found the most effective control of arboviral disease is personal protection. All citizens must be active in personal protection and do their part to aid in the abatement process to protect themselves, their family, homes, and community.

Avoiding bites by using personal protection is a very effective way to avoid acquiring disease. In addition, since much of the land within Victoria is private property, it is imperative residents are aware mosquito breeding sites are developed due to the creation of artificial breeding sites around their homes. Homeowners must take personal action to prevent breeding mosquitoes.

The key components of personal responsibility include:

- Drain: Drain any standing water on your property. This includes water from flowerpots, bird baths, rain gutters, rain barrels, and pet dishes.
- Dress: Keep skin covered as much as possible by wearing loose, long sleeved shirts and long pants. Light-colored clothing can be more effective as it allows you to see mosquitoes more effectively:
- DEET: Use repellants containing DEET as the active ingredient for treating exposed skin areas;

Reduce exposure to adult mosquito populations through the following actions:

- Mow tall grass and reduce the amount of brush and other foliage on the property, both provide a resting site for adult mosquitoes;
- Use screening in homes and pet kennels. Keep door and window screens in good repair, and be sure they are properly sealed around the frames;
- Protect pets with medication that eliminate heartworm.

3.) Mosquito Surveillance and Monitoring

The City's surveillance and monitoring program is conducted in partnership with Texas Department of State Health Services (DSHS). The timing of the surveillance program is May through November, but may be adjusted as recommended by the DSHS.

Information obtained from these surveillance efforts will be used to map mosquito populations, provide public information, and determine the occurrence of any mosquito-borne disease.

The City will use mosquito surveillance and monitoring to determine what control measures are to be used and evaluate the potential for any arboviral disease outbreak within the community. The objective of the surveillance and monitoring program is to:

- Identify areas conducive to being at risk for increased adult mosquito populations;
- Identify mosquito species in the City of Victoria;
- Identify larval habitats in need of targeted control;
- Test for West Nile Virus in mosquitoes;
- Monitor the effectiveness of control measures;
- Determine what level of control methods need to be implemented.

Trapping for pools of mosquitoes in a location can provide a scientific basis for taking action and preventing the risk of disease in humans. The purpose of using traps is to determine the relative human health threat by detecting the presence of arboviral agents in female mosquitoes. The City utilizes two distinct traps based upon the species targeted. The information obtained from these surveillance efforts will assess the extent of the problem and determine the need for various control measures. Every effort is made to consistently collect a sample of mosquitoes every other week through the trapping season starting the first week of May through November.

Trapping for Mosquito Species

The City will utilize four (4) gravid traps and four (4) light traps to mosquito species. These traps are industry standard for species identification. Traps will be moved to different locations in the City, depending on surveillance results or supporting evidence of a localized problem.

Culex species pose a threat to spreading WNV. Trapping for this species can provide information on the timing of presence and population distribution. Understanding the population dynamics is the lead indicator of disease threat.

In the event of a human case of a mosquito-borne disease transmission, City officials will be notified. This information is considered confidential to the patient and will not be published or shared. For some diseases, monitoring for human cases is indicative of the risk for local acquisition of disease for the community.

4.) Mosquito Control Methods

Source Reduction

The elimination or modification of mosquito breeding sites is critical, and the most effective and economical solution for long-term mosquito control.

The normal habitat for mosquito larvae is produced by spring and summer rain pools and stagnant water from over watering of landscapes. Small pools of water are created by irrigation or heavy rains during the summer which produces most of our nuisance species of mosquitoes. A rainfall of less than an inch can produce breeding grounds for mosquitoes. Almost anything, whether natural or artificial, capable of holding water for at least a week, is likely to breed mosquitoes. Mosquitos have adapted to a wide variety of larval habitats, and it is important to check for larvae in any pools of standing water.

However, it may be noted one of the most frequent bodies of water reported to the City are ponds, especially neighborhood ponds. Where mosquito fish and other natural predators (e.g. frogs and benthic insects) exist, these bodies of water rarely support a mosquito population. It is beneficial to introduce or re-introduce populations of predators, especially mosquito fish, where possible.

Source reduction practices are a key component for mosquito control which focuses on eliminating breeding sites for larvae by encouraging the following:

- Regularly inspect property for potential breeding, especially after each rain event
- Drain and treat areas where shallow stagnant water can accumulate;
- Where appropriate, keep grass cut low to reduce mosquito resting places;
- Reduce all standing water around the property to reduce breeding sites by emptying items such as dog bowls, birdbaths, wading pools, tires, and flower containers every few days;
- Inspect irrigation systems for leaks or breaks and adjust to prevent excessive watering of lawns and plant beds;
- Clean gutters often to remove debris which traps water;
- Use mosquito fish in decorative ponds and fountains;
- Fill holes or depressions in trees with sand or mortar;
- Utilize larvicidal dunks where water cannot be drained or otherwise treated;
- Provide education outreach to address misinformation about mosquito breeding areas;
- When requested, or if a need exists, perform a field assessment of property, assisting residents in identifying potential breeding areas;
- Provide solutions to property owner(s) when breeding sources are found and treat areas with larvicides as appropriate and with permission then follow-up as needed.

Larval Mosquito Control

Larvicide is used when source water cannot be eliminated. There are several larval control methods available and the City will consider effectiveness, ecological impact, and economics when choosing which larval control to apply. These include:

- Industry standard mosquito larvicides with reduced environmental impacts;
- Mosquito fish.

The City will focus on applying larvicide on public property along drainage ditches and in other standing water. When inspections determine the source water that cannot be eliminated lies on private property the City encourages the property owner to eliminate the source.

Adult Mosquito Control

Adulticides are used in the application of pesticides to kill adult mosquitoes. The City will use the following threshold when applying adulticide:

- When a mosquito pool has tested positive for an arbovirus during the season;
- Upon the recommendation by the CDC or DSHS for any public health reason;
- The landing rate at a given location (including nuisance investigations) exceeds 5 different mosquitos per minute;
- Within 10 days of an event with a minimum accumulation of one inch when larvicide was unable to be applied or was not effective;
- Or, when the City's leadership believes the threat level has increased to necessitate a response, for example: the presence of an increased population in a location at or before a large public event;

The City will use the following guidelines when applying adulticide:

- Review and strict adherence to the manufacture's label and safety data sheet prior to each application;
- Spraying shall be conducted during hours as appropriate for the vector and indicated on adulticide manufacturer's label;
- When variables prohibit on a specific day the spray schedule will not be altered;
- Spraying activity will be conducted as recommended by the CDC.

5.) Risk Levels and Response

The City of Victoria will operate the Integrated Mosquito Management Program under three different risk levels. The risk levels include low risk, medium risk, and high risk. Risk levels dictate the below action steps to be taken by the City.

Low Risk Level

Probability of human outbreak is low, subnormal to normal mosquito activity is observed, and no evidence of WNV in the immediate area.

Public Education - The City of Victoria will conduct abatement mosquito operations and education outreach by providing continuous information via the City's website, social media, publications, and signs. Information will include concerning arbovirus/disease frequently asked questions (FAQs), disease symptoms, personal preventative measures, and points of contact for additional information.

- Provide property assessments by request to help identify mosquito-breeding habitats on individual properties and publicize information about avoiding mosquito bites and encourage larviciding by residents
- Larvicide - The City of Victoria will larvicide within public rights-of-way areas and City owned properties containing stagnant water with mosquito larvae. This operation will be conducted year-round, more so during the mosquito season (typically May 1 to November 1);
- Surveillance - The City of Victoria will set out four (4) gravid traps (For WNV Mosquito) and four (4) CDC light traps (for species identification) bi-weekly, or more often depending on staff availability, alternating between locations identified within the City, and submit mosquito samples to the DSHS for testing (typically May 1 to November 1);

Medium Risk Level

A virus has been detected in trapped mosquitoes increasing probability of human outbreak. Normal to above normal mosquito activity is observed. All activities at the Low Risk Level will continue and the following additional actions will take place at this level.

- Site-specific investigation - The City will conduct an area inspection within a ¼-mile radius of the mosquito-sampling site that tested positive in order to identify locations in need of mosquito source or habitat reduction. The survey will include all areas that are visible from public property and will not involve City staff entering private property. If obvious sources of mosquito breeding environments are found, code enforcement officials will notify property owners of the situation and direct that action be taken to eliminate the source(s) within ten (10) days. If, after the ten-day period, the breeding sources have not been remediated, a citation may be issued. Obvious sources of mosquito breeding environments include, but are not limited to tires, open containers, and overhead roof drains clogged with leaves, etc.;
- Test site mitigation – Immediately upon receiving notification of a positive sample, the test site location will be treated using low toxicity materials.
- Targeted application of adulticides – In the situation where a virus has been detected at a single test site during the season, the trap location will receive a targeted application of adulticides and will continue to receive a targeted

application of adulticides for the remaining duration of the season in response to any additional positive virus mosquito samples.

- Notification – Signage will be installed in the area of the trap indicating a virus has been detected in a trapped mosquito and encouraging the public to apply products containing DEET and to dress appropriately.

High Risk Level

A confirmed human case has occurred within the jurisdiction, or four (4) mosquito samples at one location have tested positive for a mosquito borne virus during the season, and the detection of increased or continued viral mosquito activity is observed. All activities at the Medium Risk Level will continue and the following additional actions may take place at this level.

- Notification - Citizens will be immediately notified of the detection of a positive human case or trap site positive by a suitable method within a ½-mile radius of the confirmed positive human case and ¼ mile for trap site information of the infected area will be posted on the City's website so that citizens can take extra precautions to avoid being bitten;
- Site-specific investigation - The City will conduct an area inspection within a ½-mile radius of the area of concern that tested positive in order to identify locations in need of mosquito source or habitat reduction. The survey will include all areas that are visible from public property and will not involve City staff entering private property. If obvious sources of mosquito breeding environments are found, code enforcement officials will notify property owners of the situation and direct that action be taken to eliminate the source(s) within ten (10) days. If, after the ten-day period, the breeding sources have not been remediated, a citation will be issued. Obvious sources of mosquito breeding environments include, but are not limited to tires, open containers, and overhead roof drains plugged with leaves, etc.;

Adulticiding – The City may initiate adulticide application based on the following:

- Consistent with the adulticiding policy identified at the medium risk level;
- In response to a confirmed human case(s);
- At this risk level, the City is authorized to initiate a larger application of adulticide utilizing truck mounted fogging equipment to apply within public rights-of-way.

Adulticiding will be coordinated with larviciding and public information/bite avoidance actions, in order to be effective.

Elevated Risk Information

If a sampled mosquito pool tests positive for arbovirus/diseases, information will be posted on the City's website describing the location of the sampling event, the date, and any other pertinent information.

Information dissemination methods may include the following:

- Utilization of the City's website to post mosquito abatement activities, maps, surveillance reports, mosquito FAQ's, personal protection best practices, and mosquito control website links;
- Letters, pamphlets, brochures, and/or door hangers distributed within the community;
- Presentations to community groups and target populations concerning mosquito breeding reduction and related activities;
- Press releases describing arboviral response activities.

What Can Citizens Do to Help?

Yard & Home Checklist

- ✓ Remove old tires, tin cans, buckets, drums, bottles, or any containers capable of holding water.
- ✓ Fill in or drain any low places (puddles, ruts) in yard.
- ✓ Clean gutters regularly.
- ✓ Keep drains, ditches, and culverts clean of weeds and trash so water will drain properly.
- ✓ Cover trash containers to keep out rain water.
- ✓ Repair leaky pipes and outside faucets.
- ✓ Empty plastic wading pools at least once a week and store them indoors when not in use.
- ✓ Make sure your backyard pool is properly cared for while on vacation.
- ✓ Fill in tree rot holes and hollow stumps that hold water with sand.
- ✓ Change the water in bird baths and plant pots or drip trays at least once each week.
- ✓ Keep grass cut short and shrubbery well-trimmed to prevent adult mosquitoes from resting.
- ✓ Additional advice can be found at <https://agrillifeextension.tamu.edu/browse/mosquito-control/home-yard/>