Mosquito Control Applications in the Urban Landscape

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Mosquito Foraging

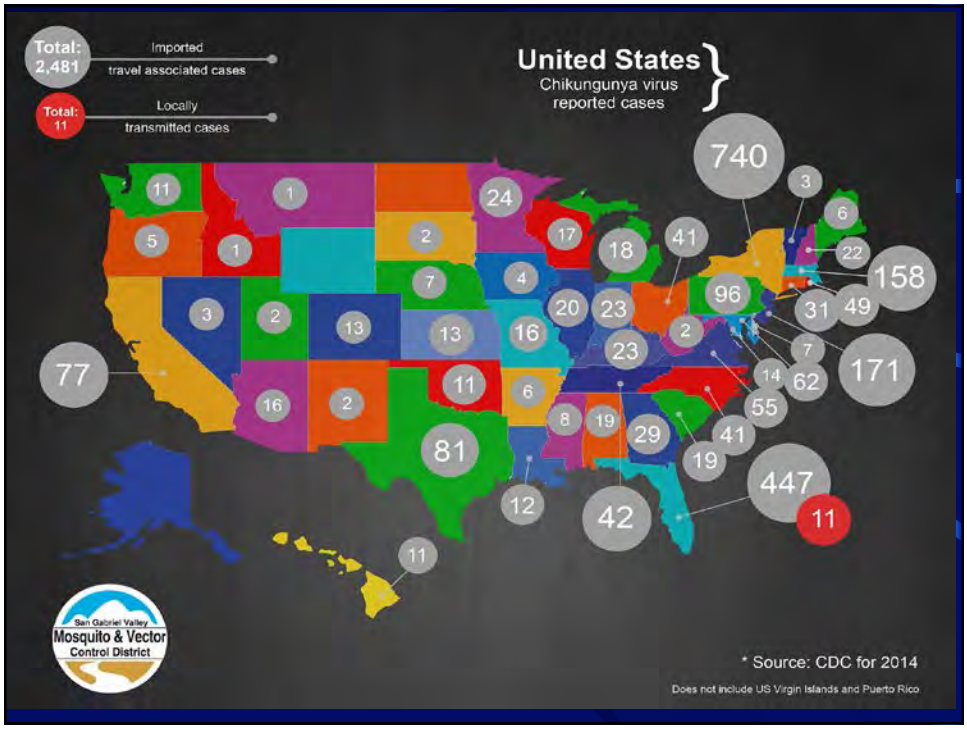
- Adult mosquitoes feed on nectar from blooming plants for nutrition.
- Mosquito species are somewhat specific as to what variety of nectar they prefer.
- Need sugars to support metabolic functions
- Nectar derived primarily from plants, but also from other sources such as aphid honeydew.
- Mosquitoes can serve as pollinators
- Female mosquitoes need protein in the form of a blood meal in order to reproduce.
- A blood meal must be consumed prior to egg deposition.

Mosquito Flight

- Flight is focused on behaviors such as seeking nutritional sustenance (nectar, sugars), mating, seeking animal hosts for blood (females only), and seeking oviposition sites.
- Most flight s consummatory within a localized area.
- Migratory flight is uncommon for most species.
- Flight can be triggered by light intensity, relative humidity, rain, cloud cover, wind velocity, and wind direction.
- Sugars derived from nectar sources are necessary for flight.

Mosquito Vectored Diseases

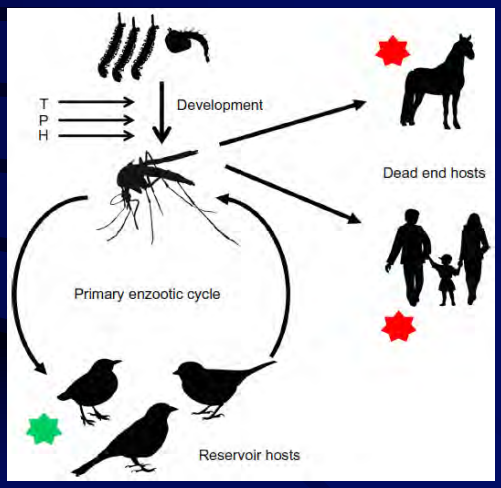
- **Malaria** – Although still the mosquito-vectored disease that kills the most people worldwide, malaria is not reported frequently in the continental US. Have had no significant outbreaks in recent history.
- **Dengue** – No reported outbreaks in the US this year, but this vectored disease poses a real threat to the southeastern US. Can cause human fatalities and long term disability.
- **Chikungunya** – Few reported cases in the US (almost all are travel-related), but this disease constitutes a potential threat in the southeastern US. Causes severe debilitation for up to a year in some cases, and can lead to human death in rare instances.



Mosquito Vectored Diseases

- **Eastern Equine Encephalitis (EEE)** – Sporadic outbreaks in the US during summer months. High probability of human death if under 15 or over 60 yrs. 30% of cases have neurological damage and require long-term care.
- **West Nile Virus (WNV)** – Probably endemic in southeastern mosquito populations. Rarely symptomatic, can cause human death in the elderly. Fatal to birds.
- **Zika** –Of great concern now in the US because it is likely to cause birth defects. Most cases asymptomatic, does not cause death or long term illness. Now endemic in Miami, Florida, but low probability that it will become endemic in SC (possibly Charleston area).

Reservoir Hosts (WNV, EEE)



Malaria

- Transmitted by *Anopheles* mosquitoes (30 to 40 species)
- *Plasmodium vivax* (non-viral)
- No reservoir host
- Mosquito-Human cycle (possibly monkeys as well)
- No vertical transmission within mosquitoes
- *Anopheles* spp. are crepuscular and breed in flowing water
- Reintroduction into the US is possible.

Dengue Hemorrhagic Fever

- Transmitted by *Aedes* spp. (primarily *Aedes aegypti*)
- Is a Flavivirus (Arbovirus)
- Humans and primates are the only hosts.
- Exhibits vertical transmission in mosquitoes
- Human to human, or primate to human transmission is possible through blood.
- *Aedes aegypti* are crepuscualr and nocturnal, sometimes diurnal.
- Reproduce in standing water / containers

Chikungunya

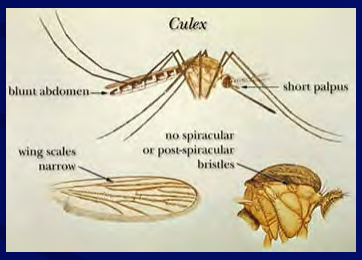
- Transmitted by *Aedes* spp. (*A. aegypti* and *A. albopictus*)
- Togaviridae (alphavirus)
- Reservoir hosts include primates, birds, cattle and rodents
- Low (less than 1%) vertical transmission in mosquitoes
- Positive vertical transmission in animals (mother-fetus)
- Species that transmit are crepuscualr, nocturnal, diurnal, and container breeders

Encephalitis (EEE, St. Louis, etc.)

- Transmitted primarily by *Culex* spp., but possible through *Aedes* and *Coquillettida* spp.
- Alphavirus
- Positive vertical transmission in mosquitoes
- Requires bird as reservoir host
- Must have mosquito that feeds on birds and mammals
- No human-human or horse-human transmission.
- Breed in standing fresh water, most prevalent around fresh water swamps and urban areas
- Nocturnal and crepuscular

West Nile Virus (WNV)

- Transmitted by Culex spp. Mosquitoes
- Flavivirus
- Birds serve as reservoir host
- Very good vertical transmission in mosquitoes
- Humans and other mammals are dead-end hosts, no human-human or human-mosquito transmission. Can become infected from bird blood.
- No vertical transmission in humans or other animals.
- *Culex* spp. are nocturnal and crepuscular.



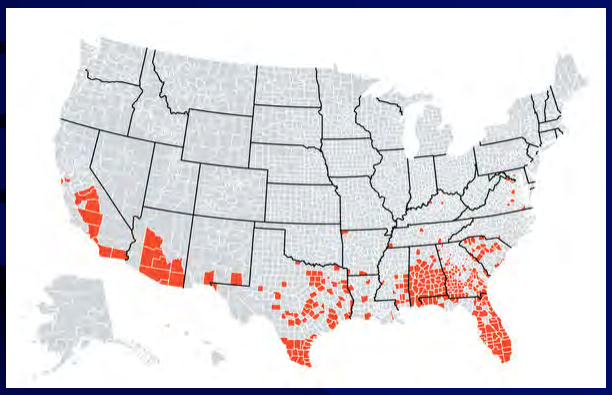
Zika Virus

- Transmitted by *Aedes* spp. (primarily *A. aegypti* an *A. albopicuts*)
- Flavivirus
- Vertical transmission in Aedes
- No reservoir host, primate-mosquito-primate transmission
- Also good primate-primate transmission through blood, semen, mother-fetus, etc.
- *Aedes aegypti* are nocturnal, crepuscular, and sometimes diurnal. *Aedes albopictus* are diurnal

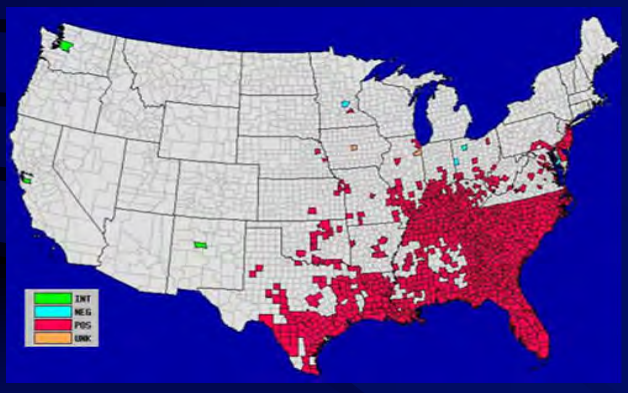
Zika Transmission by *Aedes*

- *Aedes aegypti* are very effective vectors of Zika and other mosquito borne diseases because adult females feed almost exclusively on humans (typically four blood meals per adult female in a life cycle for *Aedes* spp.)
- Blood meals are necessary for egg-laying and reproduction to be successful.
- *Aedes albopictus* feed on a wide variety of hosts, so not as likely to transmit a virus to humans.
- *Aedes albopictus* usually bite during the day so people who work outside are at greater risk of being bitten by this species.

US Distribution of *Aedes aegypti*



US Distribution of *Aedes albopictus*



Controlling Mosquitoes in Residential Areas

- Cultural controls are the most effective means to control container-breeding mosquito species.
- All mosquitoes need water for egg deposition and eclosion (hatching)
- Success of any control program depends on good public education
- Reduce the necessity of pesticide applications by reducing or eliminating mosquito habitat
- Most mosquitoes that are vectors of diseases with public health significance breed in standing water (fresh or stagnant), and can be artificial container breeders.

Controlling Mosquitoes in Residential Areas

- Adulticides are used to kill adult mosquitoes, usually when they are in their resting stage (stationary on a substrate), not when they are flying.
- It is very important to know the species and biology of the target mosquito population.
- Adults of most mosquito species rest on the underside of plant foliage, so spraying over plants does little good.
- *Aedes aegypti* adults rest under and in built structures (in sheds, under decks, under porch roofs, outdoor furniture, garden umbrellas, etc.).
- Most adult mosquitoes of human health significance rest at a level below 15 feet, so spraying tops of trees is not necessary.

Ways to Alter or Eliminate Mosquito Habitat

- Empty any standing water on a property (old tires, tarps, buckets, etc.)
- Change pet water in outdoor containers DAILY
- Eliminate any trash piles or compost heaps
- Reduce resting habitat (weeds, underbrush, thick groundcovers, foundation plantings)
- Clean and treat water features, keep fish in ponds
- Trim Magnolia trees up and mow/mulch or remove leaves underneath
- DO NOT cut bamboo or other hollow-stemmed plants unless stems are completely removed to ground level (no standing stubble)
- Clean gutters regularly, screen tops of rain barrels

Persons Licensed For Mosquito Control Applications

- Currently, there are 646 licensed Public Health (Category 8) applicators in South Carolina. There also are 3,341 Category 3 (Ornamental and Turf) applicators, 1,952 Category 7A (Structural, Institutional, and Health-Related) applicators, and 540 Category 5 (Aquatic) applicators.
- Applicators in each of these categories are able to apply pesticides to control mosquitoes in SC in specific situations.
- These situations vary, depending upon both location and purpose of the pesticide application.

Mosquito Control Applications in SC

- **Category 8** : Application of adulticides and larvicides in a variety of outdoor situations to control mosquitoes and other vectors of human and animal diseases. May be aerial, ground, or other application methods. Also category necessary to install and maintain outdoor mosquito misting systems.

Mosquito Control Applications in SC

- **Category 3**: Application of adulticides and larvicides in residential yards (around houses and buildings) and in parks, playgrounds, small water features, etc. to control mosquitoes as a part of a lawn and ornamentals maintenance contract and not as a stand alone mosquito control program.

Mosquito Control Applications in SC

- **Category 7A**: Application of insecticides to control mosquitoes in and immediately adjacent to structures (residential, commercial, agricultural, schools, etc.). This includes the installation and maintenance of mosquito misting systems indoors, treatment of pet enclosures/kennels, garages, sheds, storage buildings, pool houses, and other "built" components of a property.

Mosquito Control Applications in SC

- **Category 5:** The application of larvicides directly into bodies of water (standing or running) that have inlets from and outlets to other bodies of water. This also would include retention ponds, catch basins, or other areas holding water that would have a diversity of plant and animal species present. Category 5 is not required to treat backyard fish ponds, fountains, and other self-contained water features (can be done with a Category 3 license).

Mosquito Control Applications in SC

- **Category 11** (Aerial Application of Pesticides) license is needed in addition to Categories 8 and 5 if aircraft are used in applying adulticides or larvicides to large areas or bodies of water .

Reciprocal Licensing

South Carolina has standing reciprocal agreements with the following states for pesticide applications:

Alabama	Arkansas
Florida	Georgia
Kentucky	Louisiana
Virginia	Mississippi
Indiana	North Carolina
Tennessee	New Jersey
Maryland	

Regulatory Assistance and Response (Zika Virus)

- Assist with the dissemination of pertinent information to pesticide applicators and the public in a timely manner.
- Expedite licensing processes for Public Health and Aerial pesticide applicators (special exam sessions, reciprocal licensing agreements with other states, prioritizing public health and mosquito control license processing).
- Petition the US EPA for Emergency Exemption (Section 18) and Special Local Needs (24c) registrations of pesticides that may be necessary to combat vectors of mosquito-borne diseases in SC.

Mosquito Control Assistance

- In time of Zika or other vector-borne disease outbreak, communicate with county and local mosquito control districts, and SC DHEC to determine specific pesticide-related regulatory requirements (time of application, application to water, honey bee protection, etc.).
- Provide assistance to aerial and other public health applicators in determining locations of managed honey bee hives and other sensitive sites.

Notification Requirement

There is a requirement in SC for a 24-hour advance notice to be given in any area designated for a public health aerial application of insecticides. Mosquito control to be done in this manner must be advertised at least 24 hours in advance in a local newspaper or some other means of mass-communication.

Pollinator Protection

- Pollinator protection in SC still will be important during applications made in response to a public health emergency.
- Federal Regulations (FIFRA) related to pesticide label restrictions cannot be relaxed by state authority.
- DPR can enter communications with the US EPA and petition for special allowances and emergency / crisis exemptions for the special use of existing products, and for use statement amendments to labels.

Pollinator Protection Label Statements

- Care must be taken to adhere to current labels and minimize impact to honey bees and other managed pollinators, especially when using synthetic pyrethroid and neonicotinoid active ingredients.
- Pollinator Protection Advisory Statements are listed on the label in a separate advisory “box” and usually are easy to see.

What is Causing the Decline?

- **Compromised Habitat**
- **Poor Hive Management**
- **Poor Nutrition**
- **Pathogens and Pests**
- **Movement of Bees / Pollination Services**
- **Weather / Climate**
- **Pesticides**
- **Improper Pest. Use**

EPA Product Label Changes

- Any active ingredient that has an LD50 less than 11 micrograms per bee causes that chemical to be placed on a list of pesticides highly toxic to bees.
- These chemicals will have label restrictions for agricultural and public health uses
- Primarily liquid and dust formulations will be restricted because of hazard / risk assessments
- Restrictive statements will come to bear when managed pollinator services are in place

Labelling Measures For Protection

- The new labels for neonicotinoids say:
  - "Do not apply this product while bees are foraging."
  - "Do not apply this product to plants that are flowering."
  - "Only apply after all flower petals have fallen off."

In South Carolina:

- The Clemson Regulatory Services Division has developed a honey bee hive mapping database. This now is functional for bee keepers to enter hive locations and can be accessed through the website **dpr.clemson.edu**
- Licensed SC applicators can obtain location data by contacting the Department of Pesticide Regulation or checking the following website: http://kellysolutions.com/clemson/pesticideapplicatornotifications/
- Extension, Regulatory, and Mosquito Control Districts are working together to avoid spraying hives.

State Emergency Health Powers Act

ARTICLE IV

DECLARING A STATE OF PUBLIC HEALTH EMERGENCY

Section 401

Declaration.

A state of public health emergency may be declared by the Governor upon the occurrence of a "public health emergency" as defined in Section 1-103(m). Prior to such a declaration, the Governor shall consult with the public health authority and may consult with any additional public health or other experts as needed. The Governor may act to declare a public health emergency without consulting with the public health authority or other experts when the situation calls for prompt and timely action.

(f)

"Infectious disease" is a disease caused by a living organism or other pathogen, including a fungus, bacteria, parasite, protozoan, or virus. An infectious disease may, or may not, be transmissible from person to person, animal to person, or insect to person.

Possible Effect to State Pesticide Law

- Enactment of the State Emergency Health Powers Act in SC may eliminate the need for licensing in categories 3, 5, 7A, and 8 for the application of General Use Pesticides temporarily if deemed important by the Governor.
- This relaxation of the South Carolina Pesticide Control Act (if put into effect) would last only until the end of the declaration. Once the governor and/or state legislature declare the emergency to be over, reversion to the original restrictions of the state pesticide laws and regulations would occur.
- Any application of a Restricted Use Pesticide (RUP) would still require a license because of federal law (FIFRA).

State Emergency Health Powers Act

Executive order.

The Governor shall terminate the declaration of a state of public health emergency by executive order upon finding that the occurrence of an illness or health condition that caused the emergency no longer poses a high probability of a large number of deaths in the affected population, a large number of incidents of serious permanent or long-term disability in the affected population, or a significant risk of substantial future harm to a large number of people in the affected population.

Automatic termination.

Notwithstanding any other provision of this Act, the declaration of a state of public health emergency shall be terminated automatically after thirty (30) days unless renewed by the Governor under the same standards and procedures set forth in this Article. Any such renewal shall also be terminated automatically after thirty (30) days unless renewed by the Governor under the same standards and procedures set forth in this Article.

State Emergency Health Powers Act

State Legislature.

By a majority vote in both chambers, the State legislature may terminate the declaration of a state of public health emergency at any time from the date of original declaration upon finding that the occurrence of an illness or health condition that caused the emergency does not or no longer poses a high probability of a large number of deaths in the affected population, a large number of incidents of serious permanent or long-term disability in the affected population, or a significant risk of substantial future harm to a large number of people in the affected population. Such a termination by the State legislature shall override any renewal by the Governor.

State Emergency Health Powers Act

Section 809

Conflicting laws.

(a)Federal supremacy.

This Act does not restrict any person from complying with federal law or regulations.

(b) Prior conflicting acts.

In the event of a conflict between this Act and other State or local laws or regulations concerning public health powers, the provisions of this Act apply.

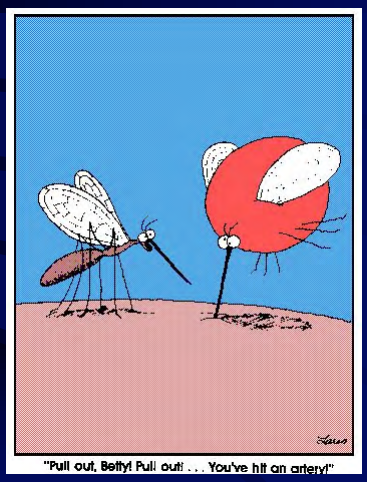
Dorchester County Bee Kill Case

- 2016 case in Dorchester County involving the claim by a beekeeper that many hives were killed by an aerial public health application.
- News media sensationalized the incident, and DPR was contacted from as far away as Europe to answer questions about the “millions of bees” killed by pesticide applications in SC.
- After an intense investigation, the applicator was not found to be in violation of FIFRA, SC regulations, or label requirements. No enforcement actions were taken by DPR.

Federal Zika Grant

- Clemson Regulatory Services received a federal grant to enhance mosquito control training and outreach in counties that have small budgets for mosquito control / public health activities.
- Katie Moore is the person who will be coordinating this outreach in the various counties.
- Several trainings are planned for different counties in SC. The first two will be held in Hampton County on February 16, and Orangeburg County on February 22.

Questions ?



"Pull out, Betty! Pull out! . . . You've hit an artery!"