New Challenges of a Warming Climate

Mosquito Control from the Ecological Perspective

Can We Protect Ourselves from Mosquito-Borne Illness Without Increasing Pesticide Spraying?

E. Heidi Ricci
hricci@massaudubon.org

Martha Gach, Ph.D.
mgach@massaudubon.org
Mass Audubon

Protecting the Nature of Massachusetts for People and Wildlife

Shaping the Future of Your Community

Assists the fastest-developing communities chart a more sustainable future

- Customized workshops
- Technical assistance
- Planning advice

Losing Ground
NATURE'S VALUE IN A CHANGING CLIMATE
West Nile Virus Transmission Cycle

In nature, West Nile virus cycles between mosquitoes (especially Culex species) and birds. Some infected birds can develop high levels of the virus in their bloodstream and mosquitoes can become infected by biting these infected birds. After about a week, infected mosquitoes can pass the virus to more birds when they bite.

Mosquitoes with West Nile virus also bite and infect people, horses and other mammals. However, humans, horses and other mammals are ‘dead end’ hosts. This means that they do not develop high levels of virus in their bloodstream, and cannot pass the virus on to other biting mosquitoes.
Our climate is already changing

- Temperature: 2.9°F Since 1895
- Growing Season: 11 Days Since 1950
- Sea Level Rise: 11 inches Since 1922
- Strong Storms: 55% Since 1958

Sources: Fourth National Climate Assessment, NOAA Ocean Service, NOAA nClimDiv dataset, ACIS
Biodiversity: Wetlands, Invertebrates, Pollinators & Ecology
Cue the marsh video ...
Wetlands Energy Flow

- Complex web
- Multiple possible interactions
- Biomagnification
- What’s missing?
Green Heron with Lunch – what did the frog eat???
Mosquito predators – odonates
Damselfly (Bluet sp.) with lunch ...
Odonates

- Dragonflies & damselflies
- 166 species in MA
- Can fly 35 mph
- Nymphs aquatic, predatory
- ID by behavior, markings
- Conservation – habitat loss, degradation
Mosquito predators... Water Striders

- Bug: Piercing rostrum, eats mosquito larvae & drowning insects
- Hairy, buoyant legs support 15x weight
- Communicates with potential mates by sending ripples over the surface
- Lays eggs on plant stems at water’s edge
- Conservation action – water quality, habitat

Aquarius remiges by Tom Murray
Craneflies

Terrestrial adult

- Larvae are shredders & predators
- Adults do not feed, or feed on nectar
Wetlands Biodiversity

Competition may reduce larval mosquito populations

Source: City of Boulder, CO. Ecological Integrated Pest Management
What good are insects?

Amy Severino
Insects Provide Many Important Services

• **Food** for higher level beneficial organisms e.g. birds, frogs, fish

• Parasitic wasps, dragonflies, etc. **reduce pest populations**

• **Nutrient cycling**

• **Pollination** – 1000’s of species (bees, beetles, flies, moths, other nonbiting insects). Many are small and/or present at night – likely exposed to mosquito spray.
Wetlands
Food Chain

Beetle larva feeding on *Culex* mosquito larva
Source: City of Boulder, CO. Ecological Integrated Pest Management
Insects are disappearing

Ecologically-based Approaches to Mosquito Control
Public Communications – Sample Materials

Protect Yourself from Mosquitoes
Mosquitoes can spread diseases that make you very sick. Take steps to prevent mosquito bites.

Use an EPA-approved repellent anytime you’re outdoors.

Wear long pants, long sleeves and socks to reduce exposed skin outdoors.

Repair torn screens early in the season to keep mosquitoes outdoors.

Remove standing water around the house to prevent mosquitoes from breeding.

Dusk to dawn is peak biting time for mosquitoes that carry disease.

Protect Yourself From Mosquitoes and Ticks
mass.gov/MosquitoesAndTicks
Categorizing Breeding Sites to Tailor Response

Vector
(potential to transmit disease)

Non-Vector
("nuisance" mosquitoes unlikely to transmit disease to people)

1
Low quality/
Low breeding

2
High quality/
Low breeding

3
Low quality/
High breeding

4
High quality/
High breeding

Source: City of Boulder, CO. Ecological Integrated Pest Management
Larviciding - Bti

- Bacterial based pesticide
- More targeted, less nontarget impacts than broad spectrum chemical pesticides

But recent literature finds:
- Toxicity to tadpoles
- Reduced biodiversity in treated wetlands – 50-80% overall reduction in insect density
- Targets all aquatic fly larvae (Nematocera), including non-biting midges (Chironomidae) – more than 100 species, many are important food for other species e.g. fish and birds
- Beneficial zooplankton and microcrustaceans impacted
Common items of trash provide mosquito breeding sites
Improve Development Siting and Design

Sparsely developed floodplain, Taunton River, Taunton

Heavily developed floodplain, Taunton River, Taunton
Homes in Harm’s Way
Culverts – undersized, perched, clogged

- barriers to fish passage
- stagnant water
Restore Healthy Hydrology

- Replace undersized culverts
- Remove obsolete dams
Stormwater Management and Mosquito Habitat
Low Impact Development

- Minimize impervious surfaces
- Maintain naturally vegetated buffers
- Filter runoff through plants and soils

Rain gardens collect stormwater and enhance the beauty of a neighborhood.
Use Rooftop Drainage as a Resource

Roof drains direct water to the street and increase flooding

Rain barrels catch runoff for garden watering
Concerns about Aerial Spraying

### Aerial Spray Efficacy – 2019

<table>
<thead>
<tr>
<th>Aerial Intervention Location</th>
<th>Start Date</th>
<th>End Date</th>
<th>Total Reduction in Primary Mosquito Vector*</th>
<th>Total Reduction in Mosquito Trapped</th>
<th>Avg High Temp</th>
<th>Relative Humidity</th>
<th>Aerial Spray Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol / Plymouth</td>
<td>8/8/2019</td>
<td>8/11/2019</td>
<td>66%</td>
<td>58%</td>
<td>85</td>
<td>83%</td>
<td>$ 891,585</td>
</tr>
<tr>
<td>Bristol / Plymouth</td>
<td>8/21/2019</td>
<td>8/25/2019</td>
<td>91%</td>
<td>25%</td>
<td>80</td>
<td>86%</td>
<td>$ 891,226</td>
</tr>
<tr>
<td>Middlesex / Worcester</td>
<td>8/26/2019</td>
<td>8/27/2019</td>
<td>38%</td>
<td>20%</td>
<td>72</td>
<td>70%</td>
<td>$ 583,989</td>
</tr>
<tr>
<td>Middlesex / Norfolk / Worcester</td>
<td>9/10/2019</td>
<td>9/18/2019</td>
<td>NR</td>
<td>NR</td>
<td>72</td>
<td>74%</td>
<td>$ 2,261,727</td>
</tr>
<tr>
<td>Hampden, Hampshire and Worcester</td>
<td>9/15/2019</td>
<td>9/17/2019</td>
<td>NR</td>
<td>NR</td>
<td>71</td>
<td>71%</td>
<td></td>
</tr>
<tr>
<td>Bristol / Plymouth</td>
<td>9/18/2019</td>
<td>9/24/2019</td>
<td>NR</td>
<td>53%</td>
<td>78</td>
<td>84%</td>
<td></td>
</tr>
</tbody>
</table>

NR = No Reduction

Other: Supplies, Lab Testing, Employee Travel & OT, Ground Spraying & Late Fees $ 457,108

Total Costs: $ 5,085,636

Factors affecting efficacy
- The greater the mosquito activity, the greater the efficacy
  - Mosquito activity minimal at 60 degrees, increases with increasing temperature
  - Mosquito activity generally increased with increasing humidity but reduced when raining
- Large spray blocks conducted over the fewest possible nights increases efficacy
  - Small spray strips and increased time to complete entire polygon reduce efficacy
- Toxic to fish
- Toxic to bees
- PBO synergist – suspected human carcinogen
- Respiratory irritant
Fireflies

Credit: Judy Asarkof

Credit: Kristin Foresto
So Many Amazing Insects

Credit: Judy Asarkof
So Many Tiny Insects

Credit: Judy Asarkof
And many are nocturnal

Credit: Judy Asarkof
Wetland Butterflies

Credit: Michael Newton
Hummingbird Moth on Milkweed
Credit: David Alexander
Ecosystem Services

Spiders and other beneficial “bugs” keep pests under control.

Credit: Judy Asarkof
What Needs to be Done

• Keep development out of harm’s way.
• Restore and maintain healthy and diverse wetlands ecosystems to keep nature in balance.
• Restore and maintain free-flowing streams.
• Low Impact Development (LID).
• Improve monitoring of impacts of spraying on local ecosystems.
• Public education
H.4851
An Act to Mitigate Arbovirus in the Commonwealth

• Broad powers to DPH if there is an elevated risk of arbovirus

• Amendments:
  • Notification
  • Opt-out provisions
  • Mosquito Control for the Twenty-first Century Task Force.
Resources

• EPA & CDC: **Joint statement on mosquito control**
  www.epa.gov/mosquitocontrol/joint-statement-mosquito-control-united-states

• Xerces Society: [www.xerces.org](http://www.xerces.org)
  **Ecologically Sound Mosquito Management in Wetlands**
  **How to Help Your Community Create an Effective Mosquito Management Plan**

• Boulder, CO’s Ecological Mosquito Management program
  [https://bouldercolorado.gov/ipm/living-with-mosquitoes](https://bouldercolorado.gov/ipm/living-with-mosquitoes)

• Beyond Pesticides

• Low Impact Development: [www.massaudubon.org/lidcost](http://www.massaudubon.org/lidcost)