New Challenges of a Warming Climate

Mosquito Control from the Ecological Perspective

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

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Mass Audubon

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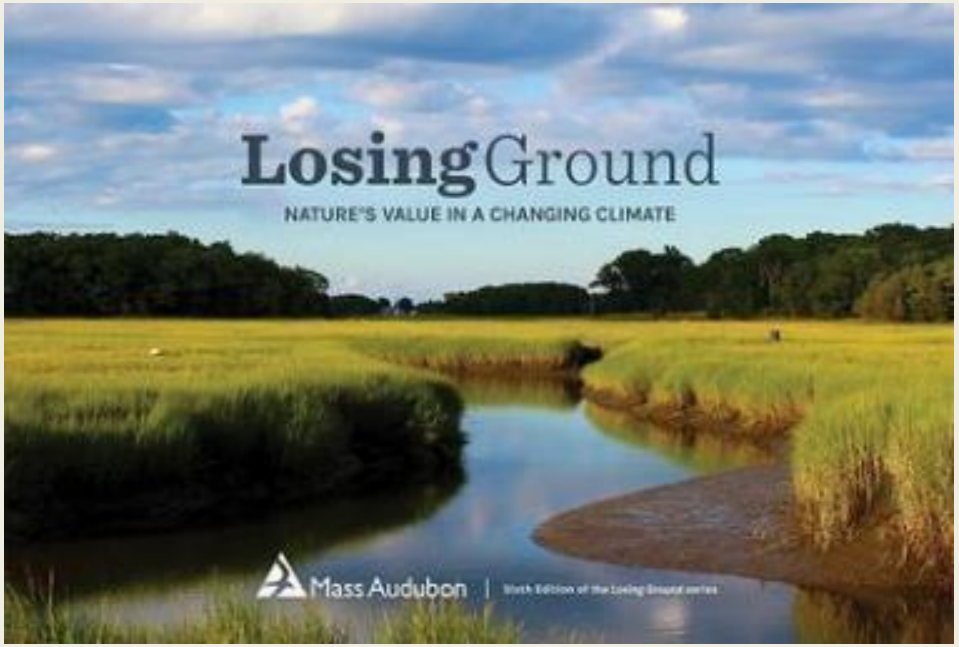
Protecting the Nature of Massachusetts for People and Wildlife

Shaping the Future of Your Community

Assists the fastest-developing communities chart a more **sustainable future**

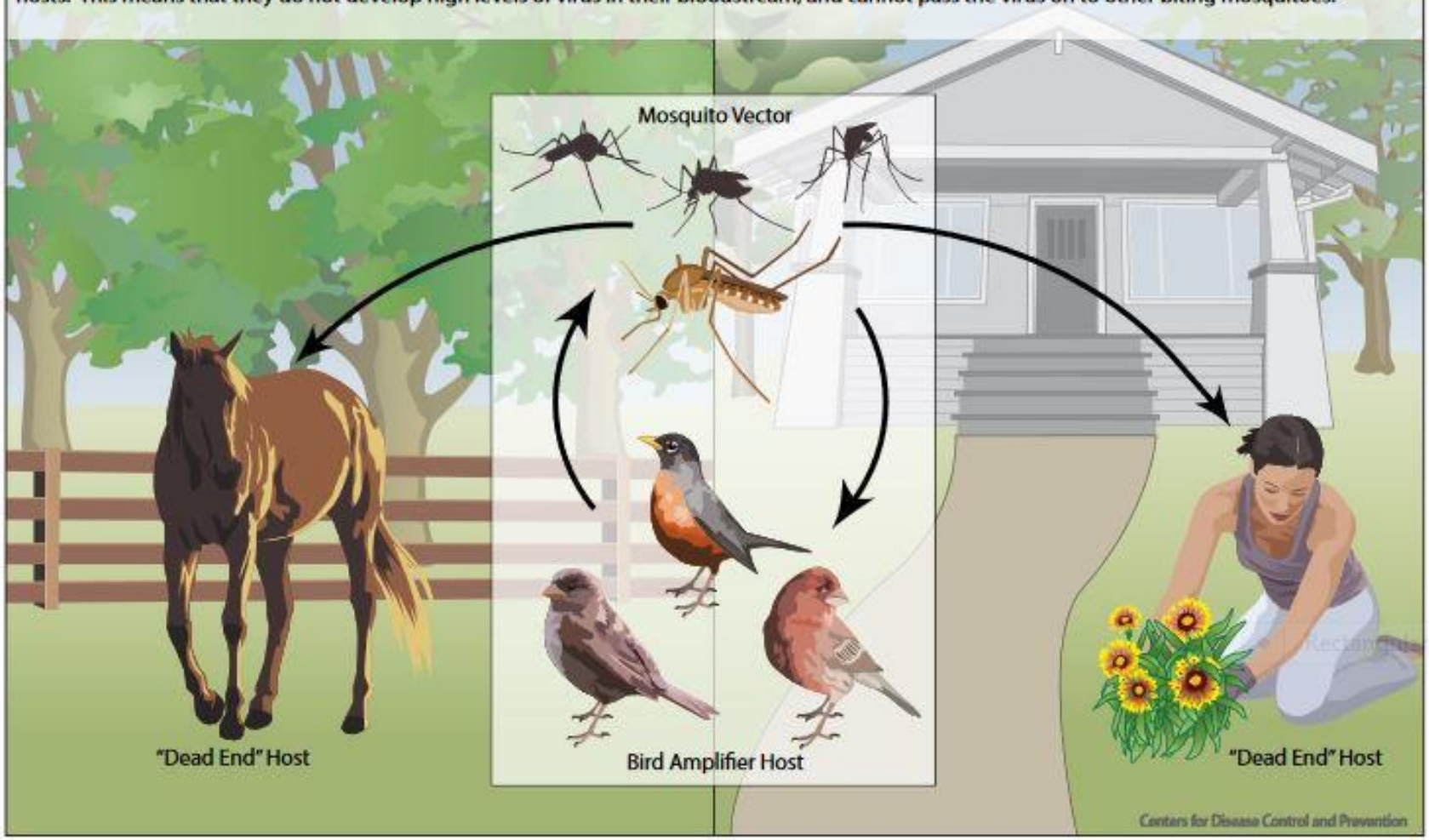
- ✓ Customized workshops
- ✓ Technical assistance
- ✓ Planning advice



West Nile Virus Transmission Cycle

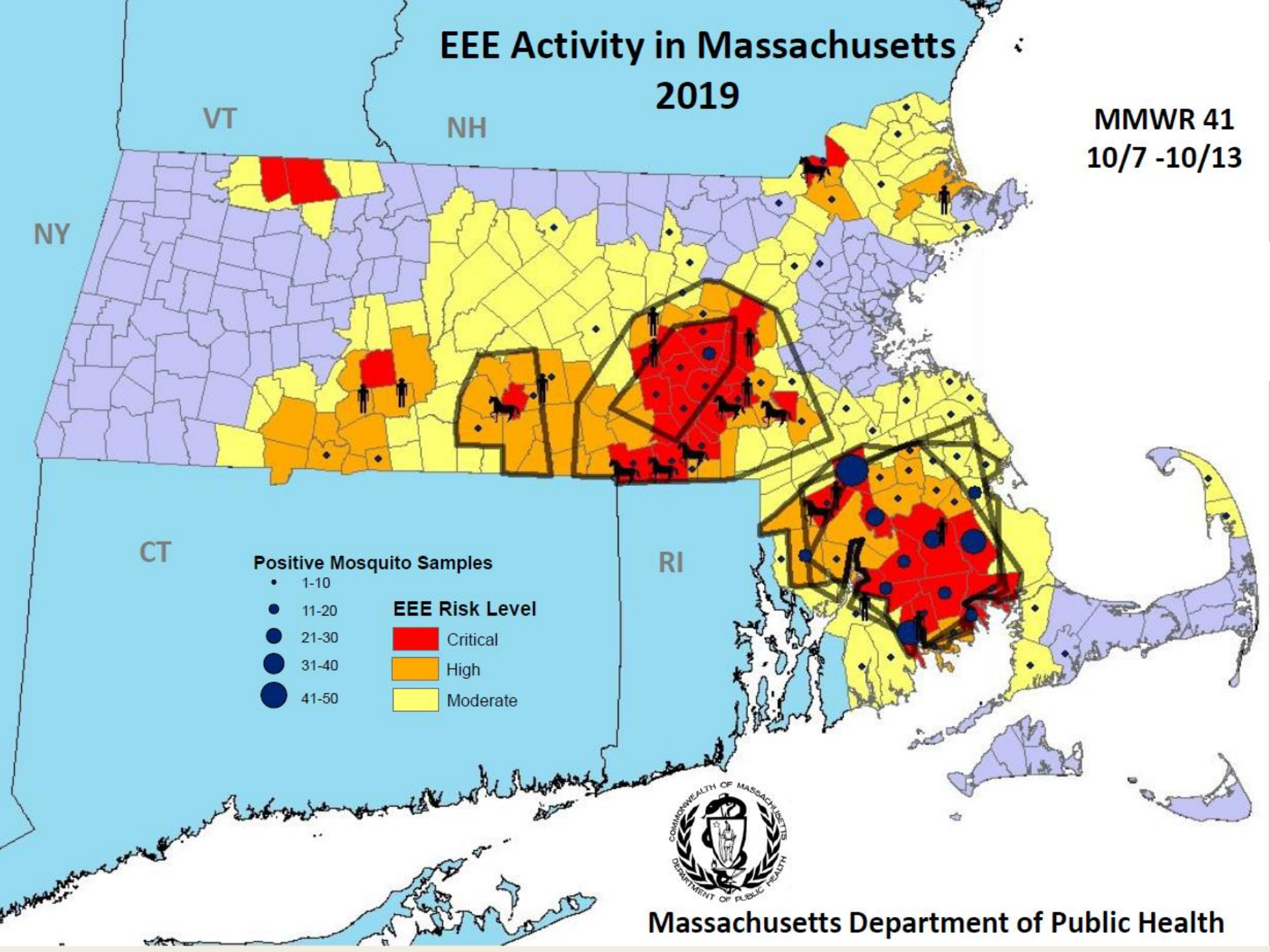
In nature, West Nile virus cycles between mosquitoes (especially *Culex* species) and birds. Some infected birds, can develop high levels of the virus in their bloodstream and mosquitoes can become infected by biting these infected birds. After about a week, infected mosquitoes can pass the virus to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



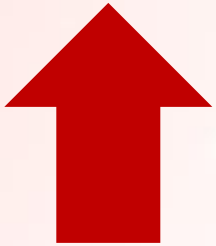
EEE Activity in Massachusetts 2019

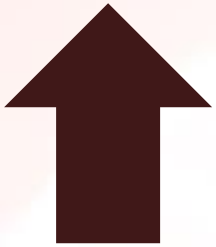
MMWR 41
10/7 -10/13

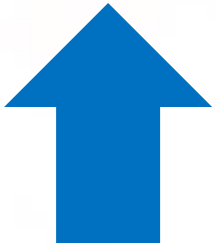


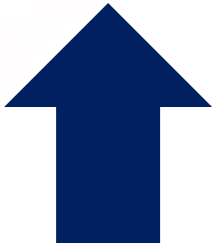
Massachusetts Department of Public Health

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?

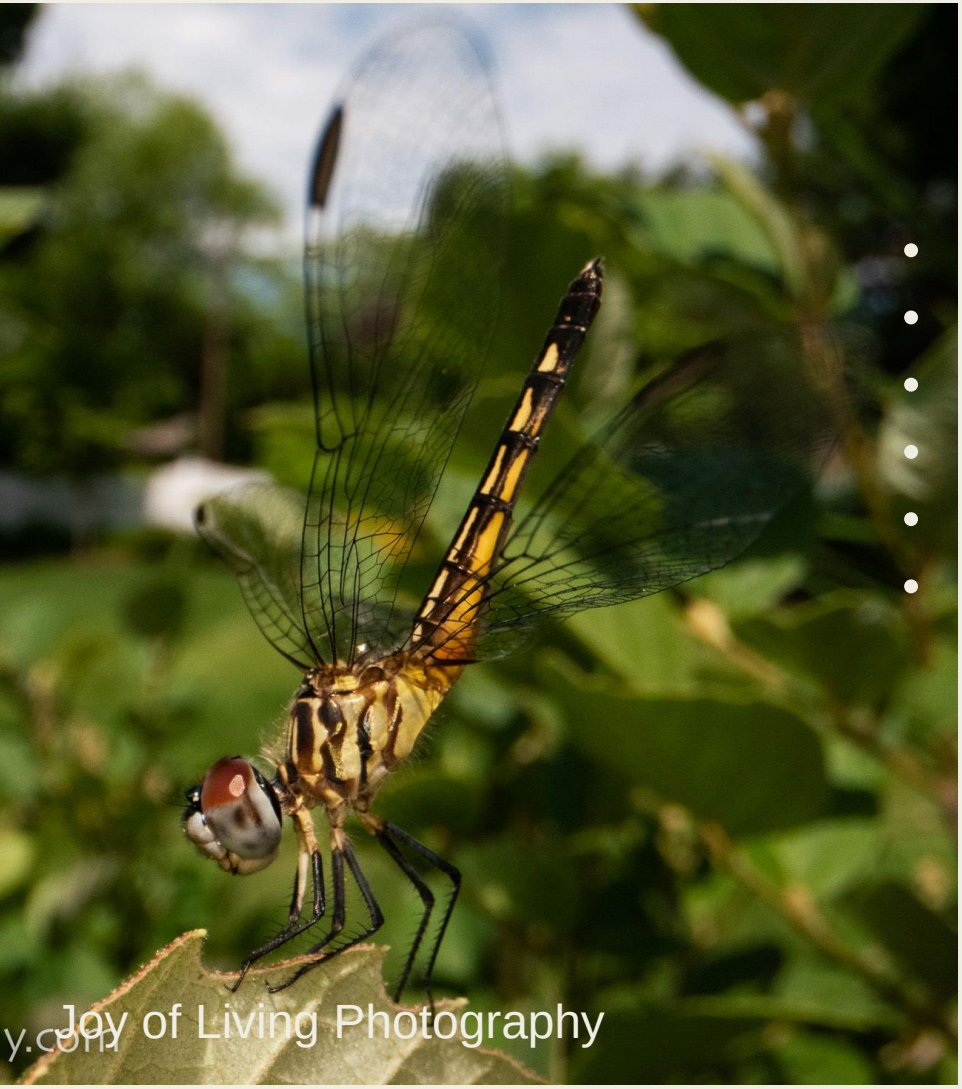
Green Heron with Lunch – what did the frog eat???

Michael Snow

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

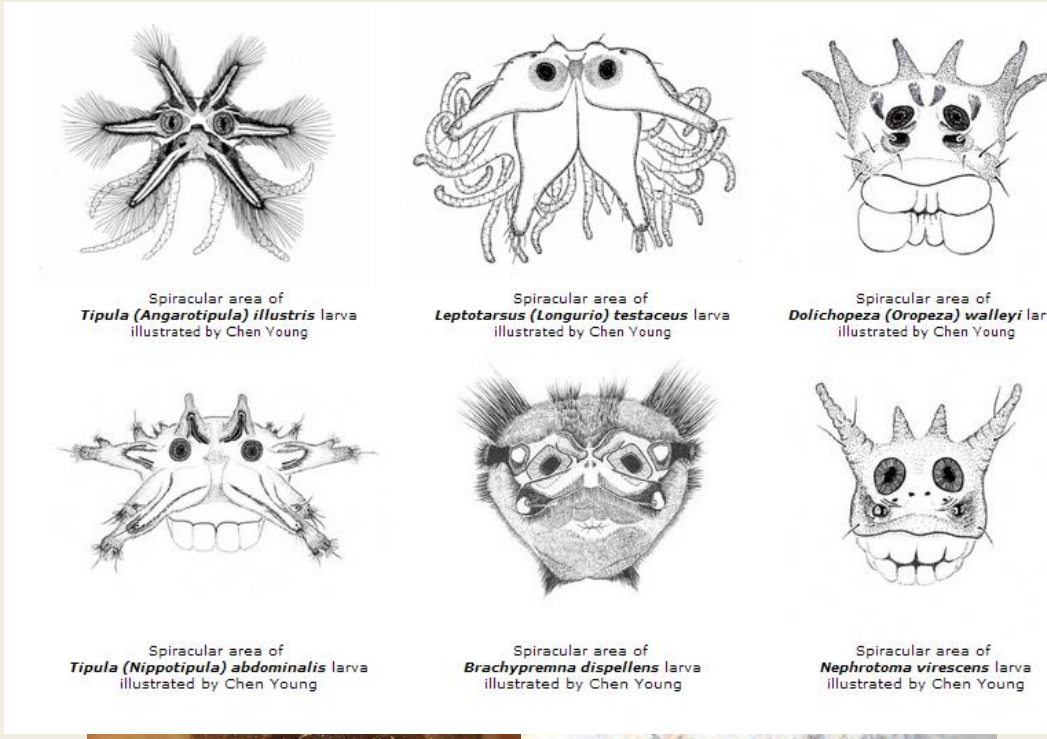
Mosquito predators… Water Striders

- 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

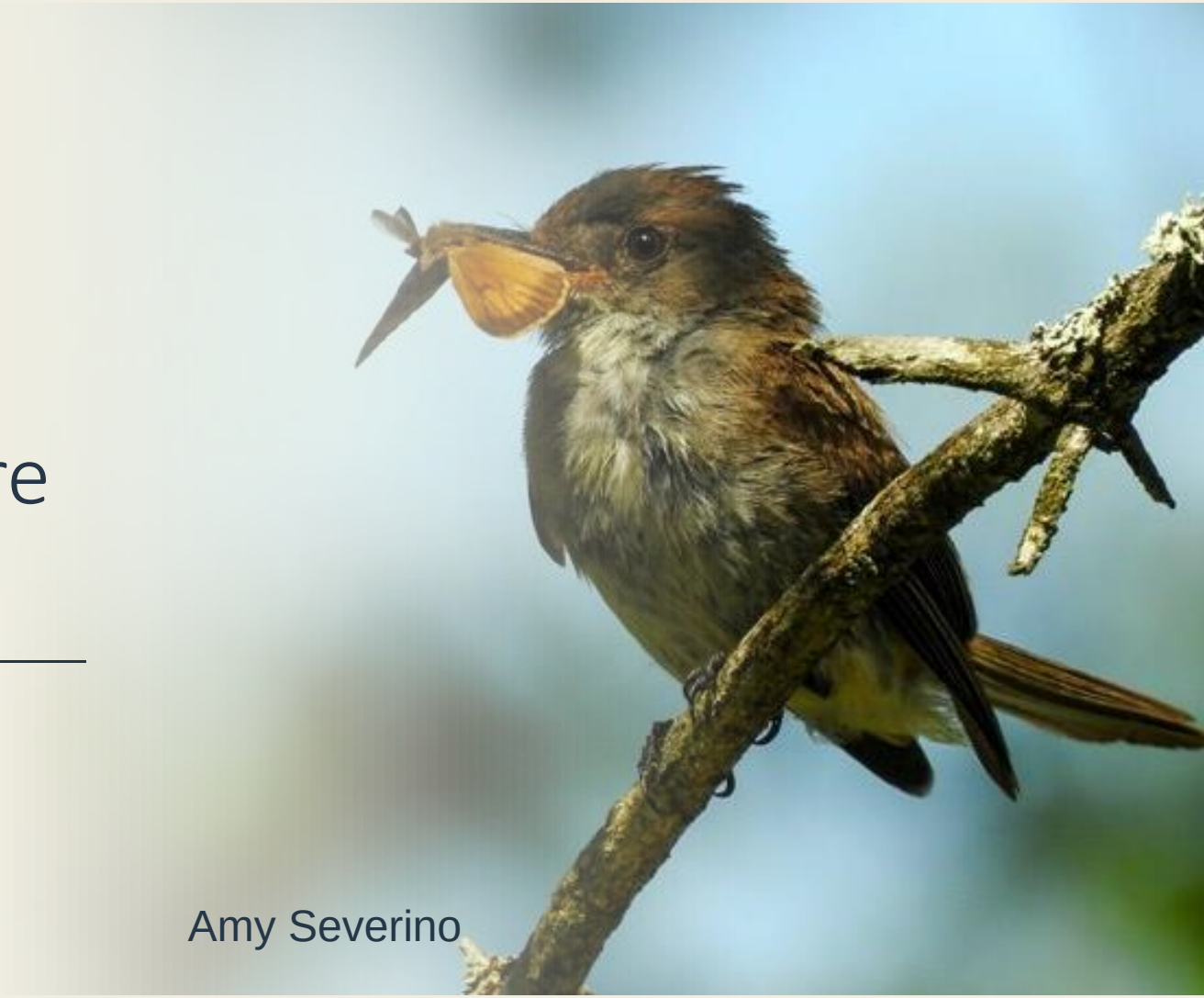
Wetlands Biodiversity

Competition may reduce larval mosquito populations

Kroeger et al. 2013, Journal of Vector Ecology

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

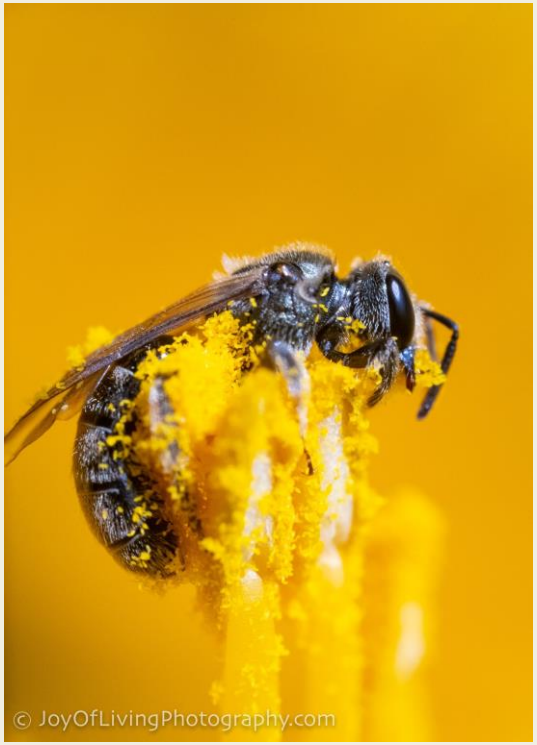
What good are insects?



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.

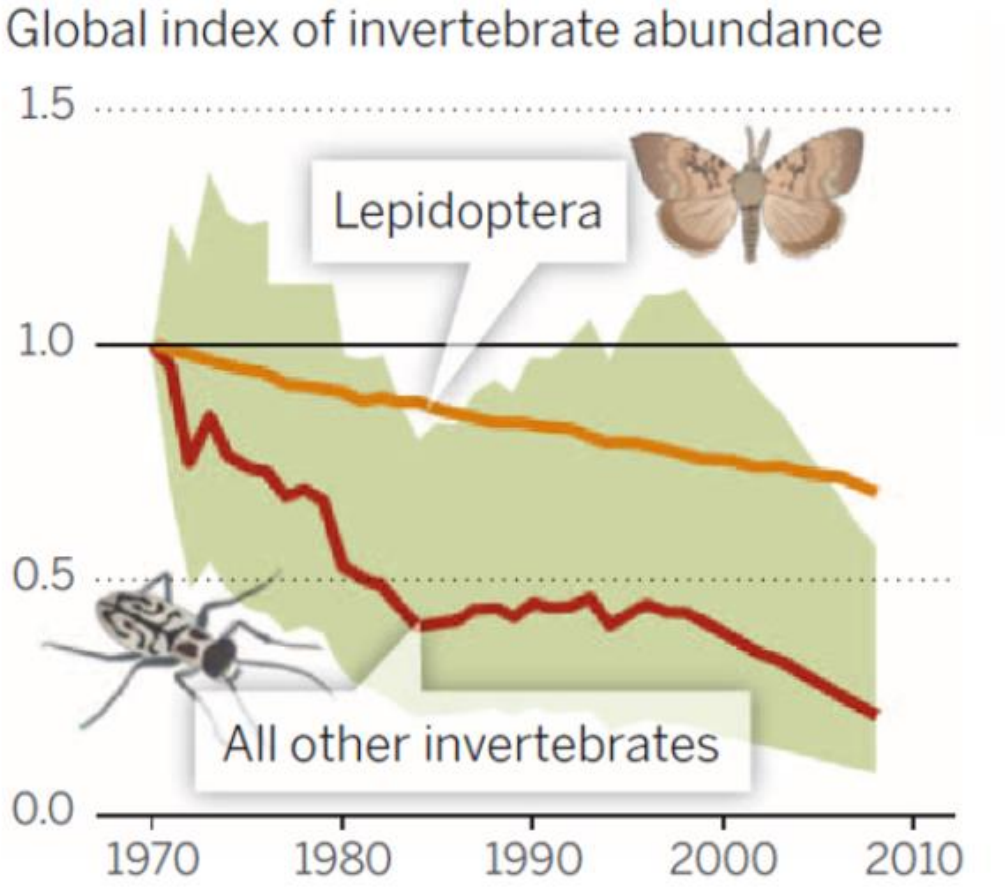


Evan Lipton

Wetlands Food Chain

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

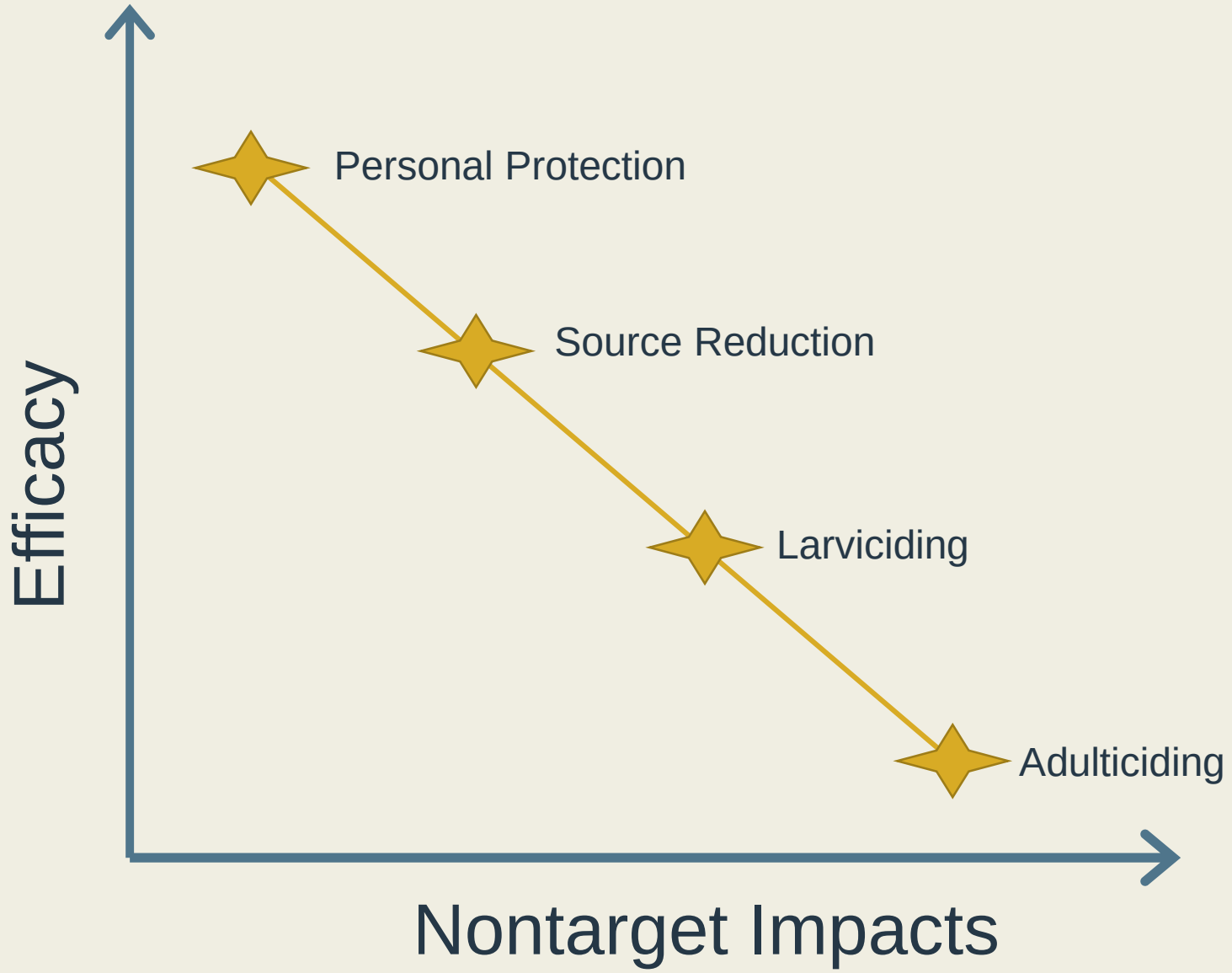
Insects are disappearing



Defaunation in the Anthropocene, *Science* ***345, 401 (2014)***

Ecologically-based Approaches to Mosquito Control

Mosquito Disease Management Techniques



Public Communications – Sample Materials

Categorizing Breeding Sites to Tailor Response

Vector
(potential to transmit disease)

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

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

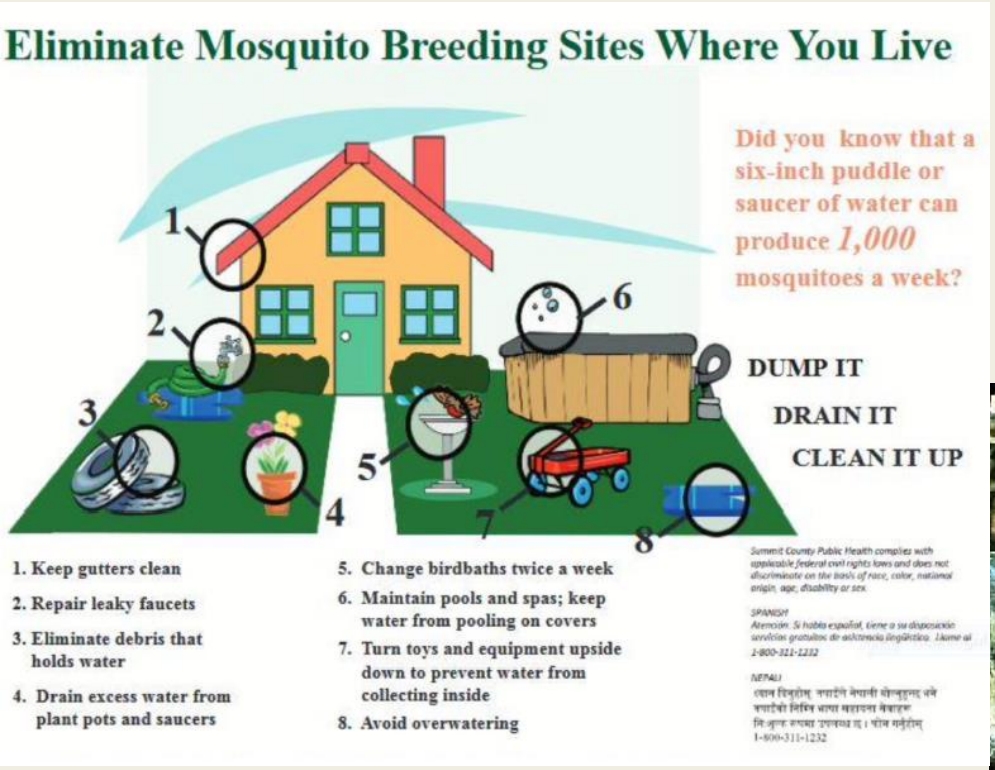
Larviciding - Bti

- 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

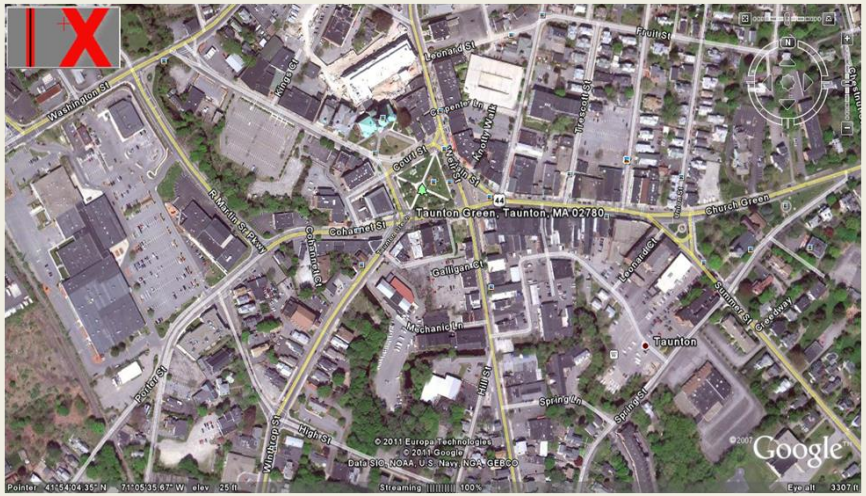
Source Reduction – Good Housekeeping



Common items of trash provide mosquito breeding sites

Improve Development Siting and Design

Heavily developed floodplain, Taunton River, Taunton



Sparsely developed floodplain, Taunton River, Taunton

Homes in Harm's Way

Culverts – undersized, perched, clogged

- barriers to fish passage
- stagnant water

Restore Healthy Hydrology

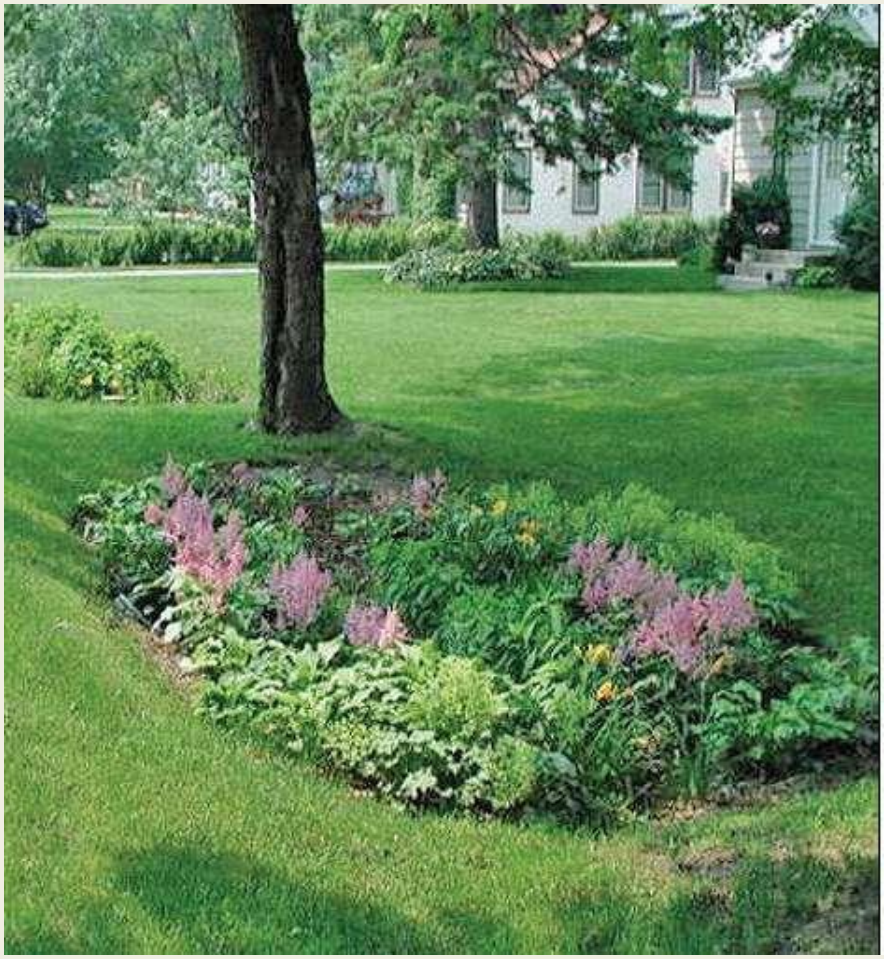
- Replace undersized culverts
- Remove obsolete dams

Former State Hospital Dam, Taunton

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

Percent Reduction in Mosquitoes Trapped: Comparing Pre-Spray Trapping Numbers to Post-spray Trapping Numbers

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

ANVIL® 10+10 ULV

CLARKE

Contains An Oil Soluble Synergized Synthetic Pyrethroid For Control of Adult Mosquitoes (Including Organophosphate-Resistant Species) In Outdoor Residential and Recreational Areas.

Precautionary Statements
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Harmful if absorbed through the skin. Avoid contact with skin, eyes or clothing. In case of contact, flush with plenty of water. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco. Remove and wash contaminated clothing before reuse.

ENVIRONMENTAL HAZARDS

This product is toxic to fish. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish. Do not apply over permanent bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material beyond the body of water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or wash waters.

This product is toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply to blooming crops or weeds when bees are actively visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribal or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

For use only by federal, state, tribal or local government officials responsible for public health or vector control, or by persons certified in the appropriate category or otherwise authorized by the state or tribal lead pesticide regulatory agency to perform adult mosquito control applications, or by persons under their direct supervision.

E.P.A. EST. No. 1021-MN-2
EPA Reg. No. 1021-1688-8329
NET CONTENTS

LOT NO.

ACTIVE INGREDIENTS:

3-Phenoxybenzyl-(1RS, 3RS; 1RS, 3SR)-2,2-dimethyl-3-(2-methylprop-1-enyl) cyclopropanecarboxylate ..	10.00%
* Piperonyl Butoxide, Technical	10.00%
** OTHER INGREDIENTS	80.00%
	100.00%

* Equivalent to 8.00% (butylcarbityl) (6-propylpiperonyl) ether and 2.00% related compounds
** Contains a petroleum distillate
Contains 0.74 pounds of Technical SUMITHRIN®/Gallon and 0.74 pounds Technical Piperonyl Butoxide/Gallon
SUMITHRIN®- Registered trademark of Sumitomo Chemical Company, Ltd.

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUCIONAL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta haya sido explicado ampliamente.

FIRST AID

IF SWALLOWED • Immediately call a poison control center or doctor. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give any liquid to the person. • Do not give anything by mouth to an unconscious person

IF ON SKIN OR CLOTHING: • Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.

NOTE TO PHYSICIAN: Contains a petroleum distillate – vomiting may cause aspiration pneumonia.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information regarding medical emergencies or pesticide incidents, call the International Poison Center at 1-888-740-8712.

MANUFACTURED FOR
CLARKE MOSQUITO CONTROL PRODUCTS, INC.
159 N. GARDEN AVENUE • ROSELLE, ILLINOIS 60172

NOTICE: Seller makes no warranty, expressed or implied concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when use and/or handling is contrary to label instructions.

- Toxic to fish
- Toxic to bees
- PBO synergist – suspected human carcinogen
- Respiratory irritant

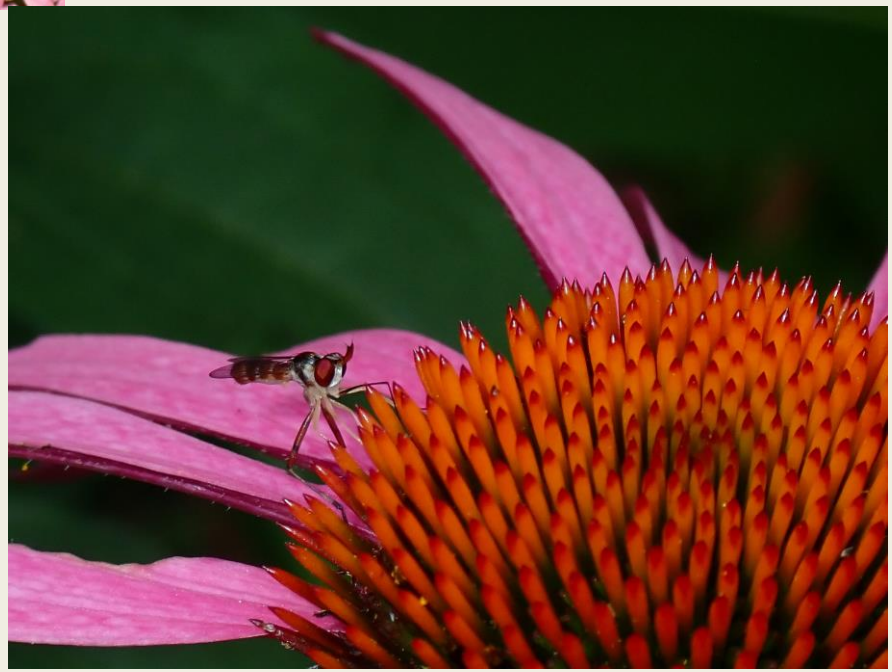
Fireflies

Credit: Judy Asarkof

Credit: Kristin Foresto

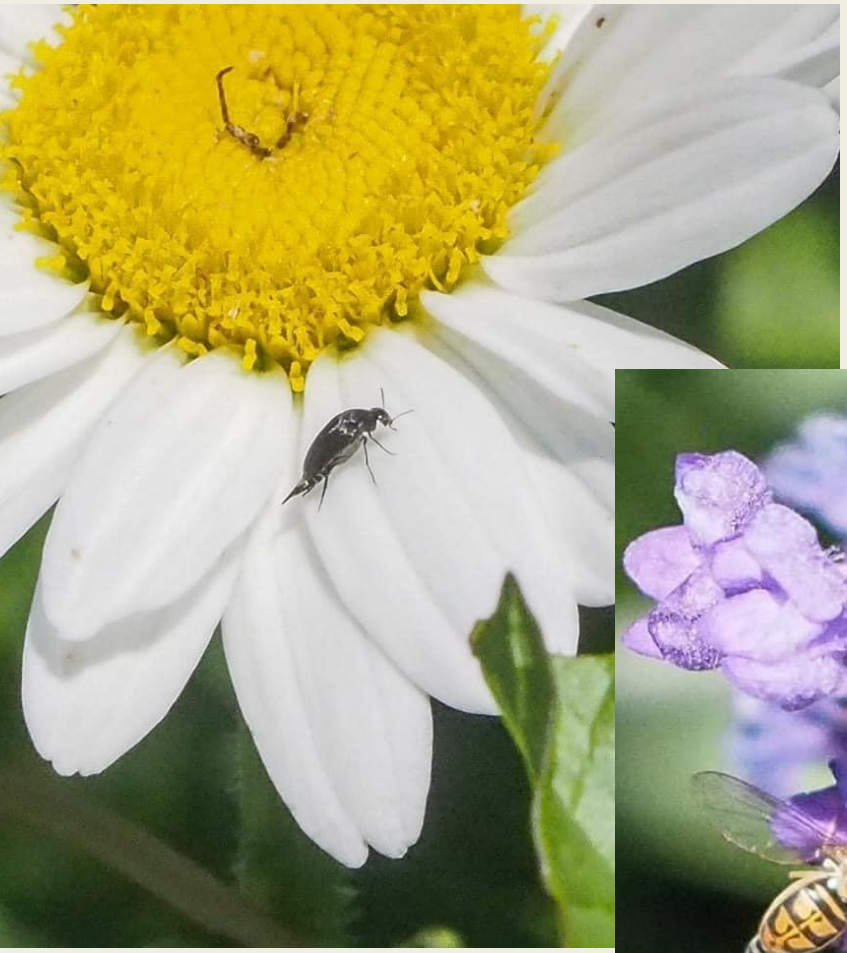

Credit: Laurie Sanders

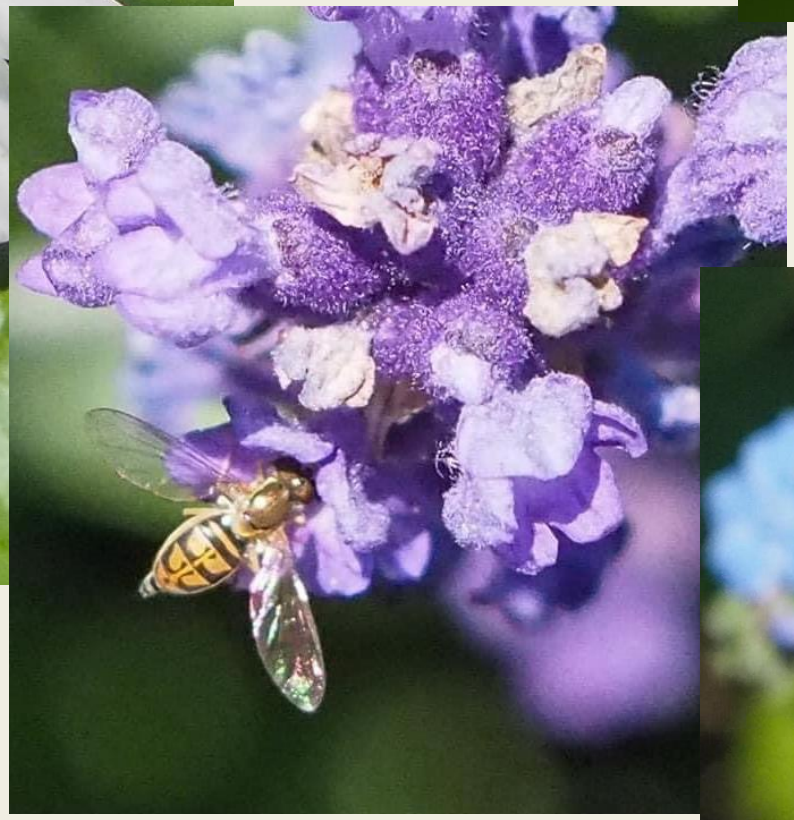
So Many Amazing Insects



Credit: Judy Asarkof

So Many Tiny Insects



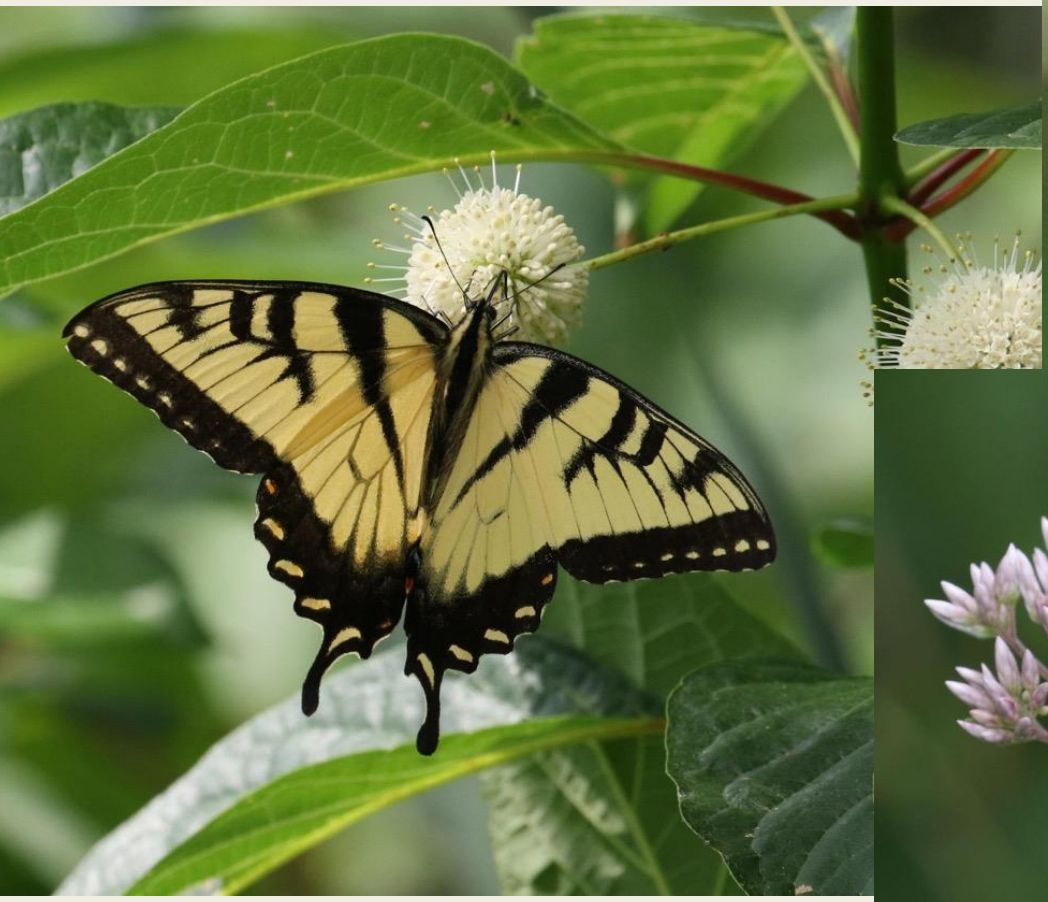


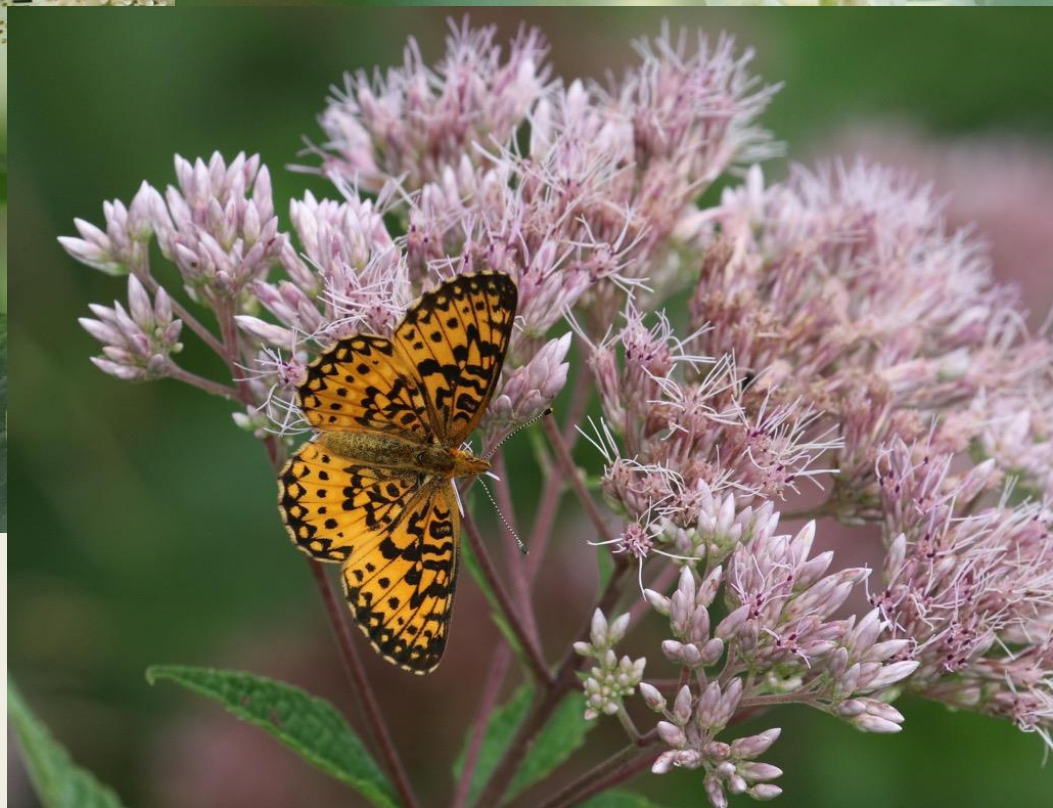
Credit: Judy Asarkof

And many are nocturnal

Credit: Judy Asarkof

Wetland Butterflies





Credit: Michael Newton

Hummingbird Moth on Milkweed

Credit: David Alexander

Ecosystem Services

45%

OF OUR AGRICULTURAL COMMODITIES IN MASSACHUSETTS RELY ON THE RICH DIVERSITY OF POLLINATORS FOR CROP POLLINATION.[6]

Credit: Kristin Foresto

Credit: Judy Asarkof

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

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

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

- Beyond Pesticides

www.beyondpesticides.org/programs/mosquitos-and-insect-borne-diseases/overview

- Low Impact Development: www.massaudubon.org/lidcost