Massachusetts Department of Public Health

150 YEARS OF ADVANCING PUBLIC HEALTH

ARBOVIRUS: DPH COMPONENTS

Mosquito Control for the 21st Century Task Force

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State Epidemiologist

DPH Role

- Surveillance
  - Mosquito – historical EEE areas of risk, emerging EEE areas, supplemental WNV in MCD areas, responsive to current findings, areas not covered by MCDs
  - Human and veterinary cases
  - Post aerial spray review of syndromic surveillance data to detect increases in healthcare seeking behavior
- Laboratory Testing
  - Mosquito testing for MCDs and DPH traps
  - Veterinary and human cases
- Risk Assessment and Communication
  - Combining data sources and field knowledge to assess risk on small area basis
  - Sharing results with partners, vulnerable populations and general public
  - Recommend non-mosquito control public health actions
  - Collaborate with partners when risk high and or increasing
  - Coordinate on broad outreach about aerial spray interventions
- Other
  - Collaborate with CDC, academic partners and others on work to improve understand of viruses

SURVEILLANCE

Arbovirus Risk

Requirements

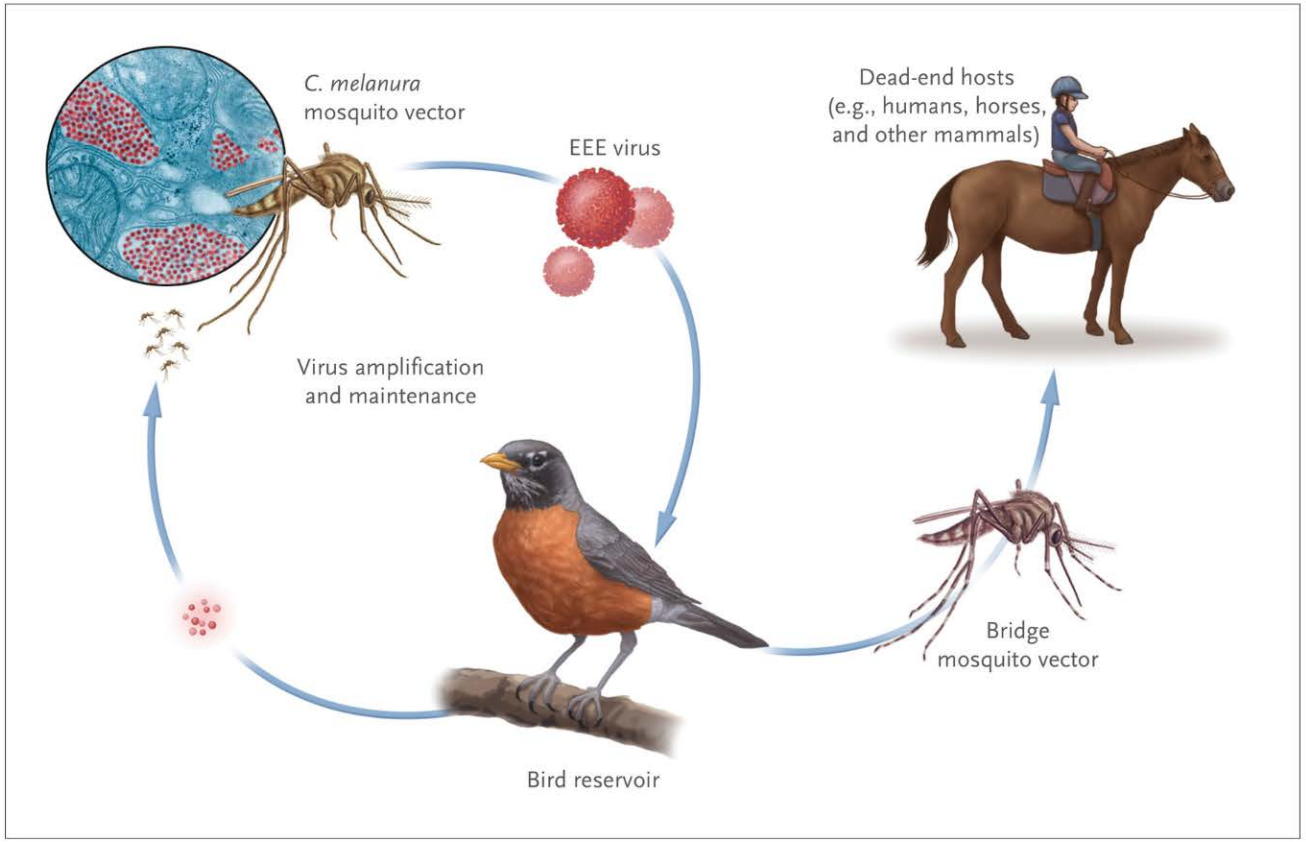
- Habitat
- Presence of infected birds
- Presence of appropriate mosquito vectors
- Human habitants

Risk modifiers

- Proportion of infected bird population
- Size of mosquito vector populations
- Weather
- Human behavior

Surveillance targets

- Mosquito vectors
- Human and Animal cases
- Weather



Perspective: Eastern Equine Encephalitis Virus — Another Emergent Arbovirus in the United States
Morens, et al. N Engl J Med 2019; 381:1989-1992

Drivers of EEE Activity

Monitored in advance

- Prior year activity
- Rainfall prior fall
- Rainfall current spring
- Juvenile mosquito populations

Monitored retrospectively

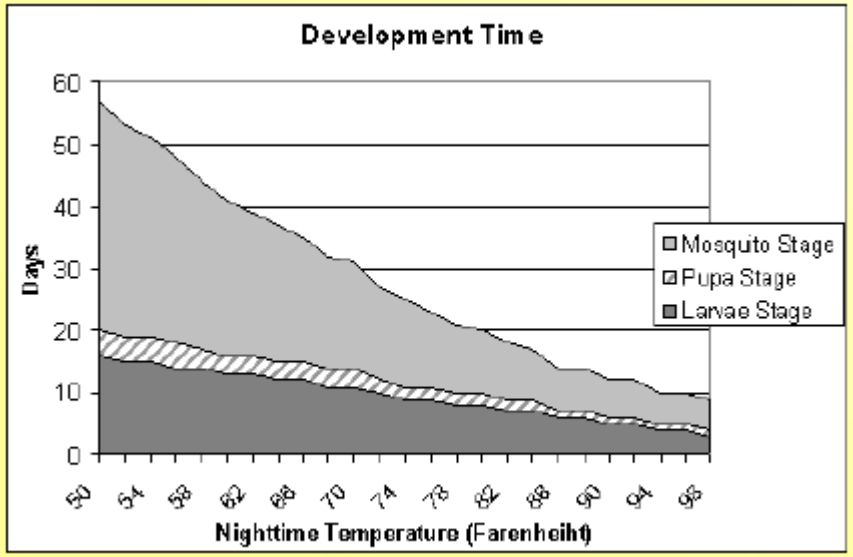
- Viral genetics

Monitored during the season

- Temperature
- Rainfall
- Populations of adult mosquitoes
- Infection rate in mosquitoes

Unable to monitor

- Susceptibility of local bird populations
- Introduction of virus through migratory birds

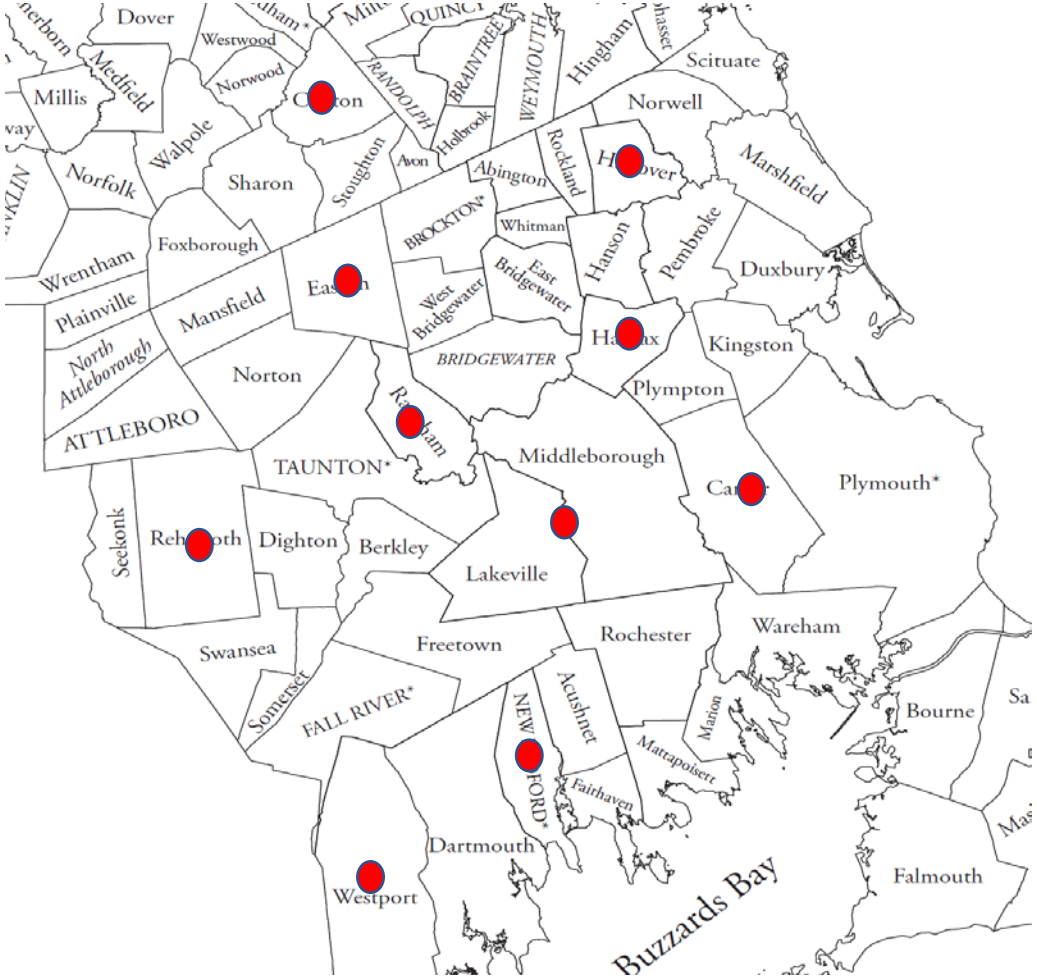


http://www.challenge.nm.org/archive/01-02/FinalReports/HTMLReports/019/

Rare Diseases

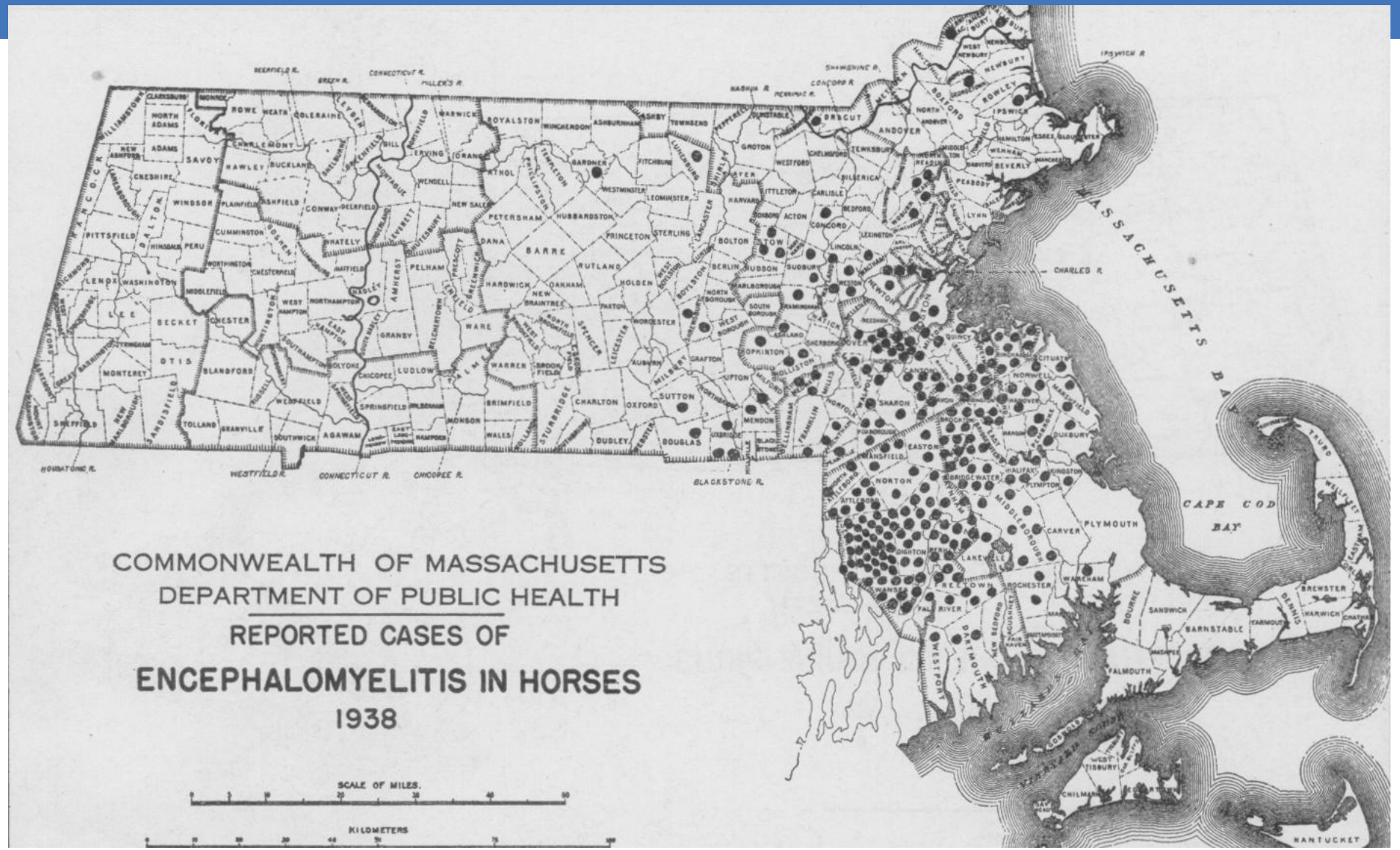
- Asymptomatic infection – definitely for WNV, unsettled question for EEE
- WNV
  - mosquito vector more opportunistic feeder, more cases
  - urban environments – more common interaction with people
- EEE
  - requires a mammal-biting mosquito to bite a bird to acquire virus, less common event
  - More focused around certain habitats – less urban
- People don’t like mosquito bites and take some steps to avoid them
  - Variable actions, may include just slapping them when they bite

EEE Surveillance



- Trap Locations
  - Long term trap sites - standardization
  - Emerging areas
  - Areas likely to have large mosquito populations
  - Locations with evidence of transmission

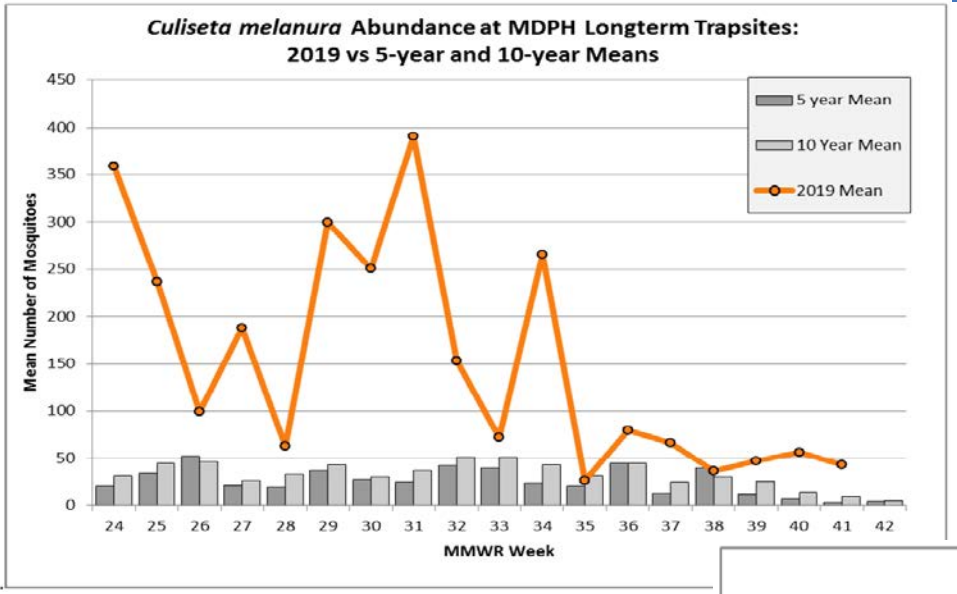
- Coordination with MCDs in areas they cover

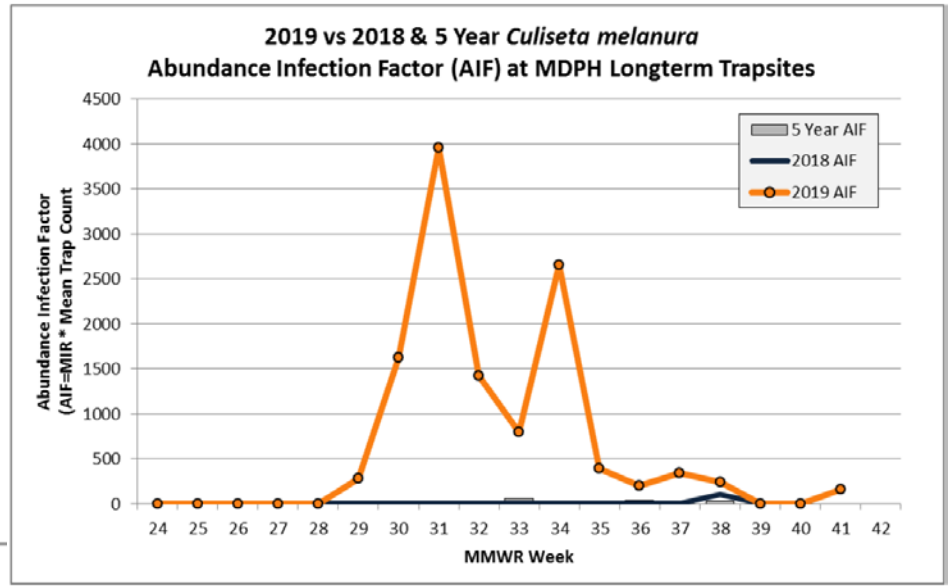

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC HEALTH
REPORTED CASES OF
ENCEPHALOMYELITIS IN HORSES
1938
SCALE OF MILES.
KILOMETERS
MASSACHUSETTS BAY
CAPE COD BAY
CHARLES R.
HOUSATONIC R.
WESTFIELD R.
CONNECTICUT R.
CHICOPEE R.
BLACKSTONE R.
NANTUCKET

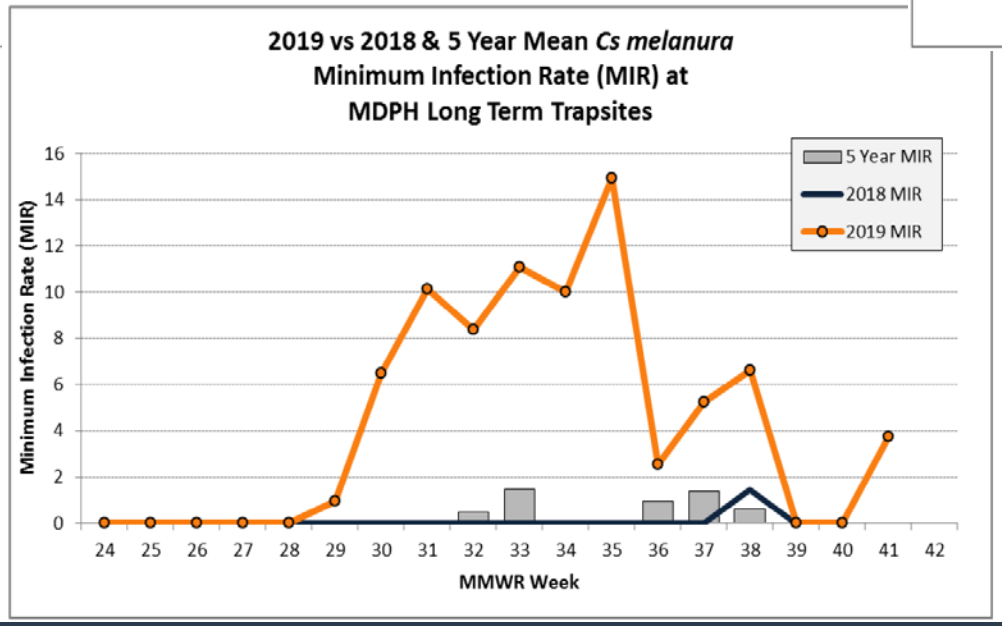
WNV Surveillance and Information Gained

- Trap Locations
  - Known areas of risk
  - Urban areas likely to have large mosquito populations
  - Locations with evidence of transmission
- Coordination with MCDs in areas they cover
- Information from mosquito surveillance
  - Relative abundance of mosquito vector populations
  - Differentiation of enzootic from bridge vectors
  - Infection rates of different vectors

Mosquito Data







Case investigations

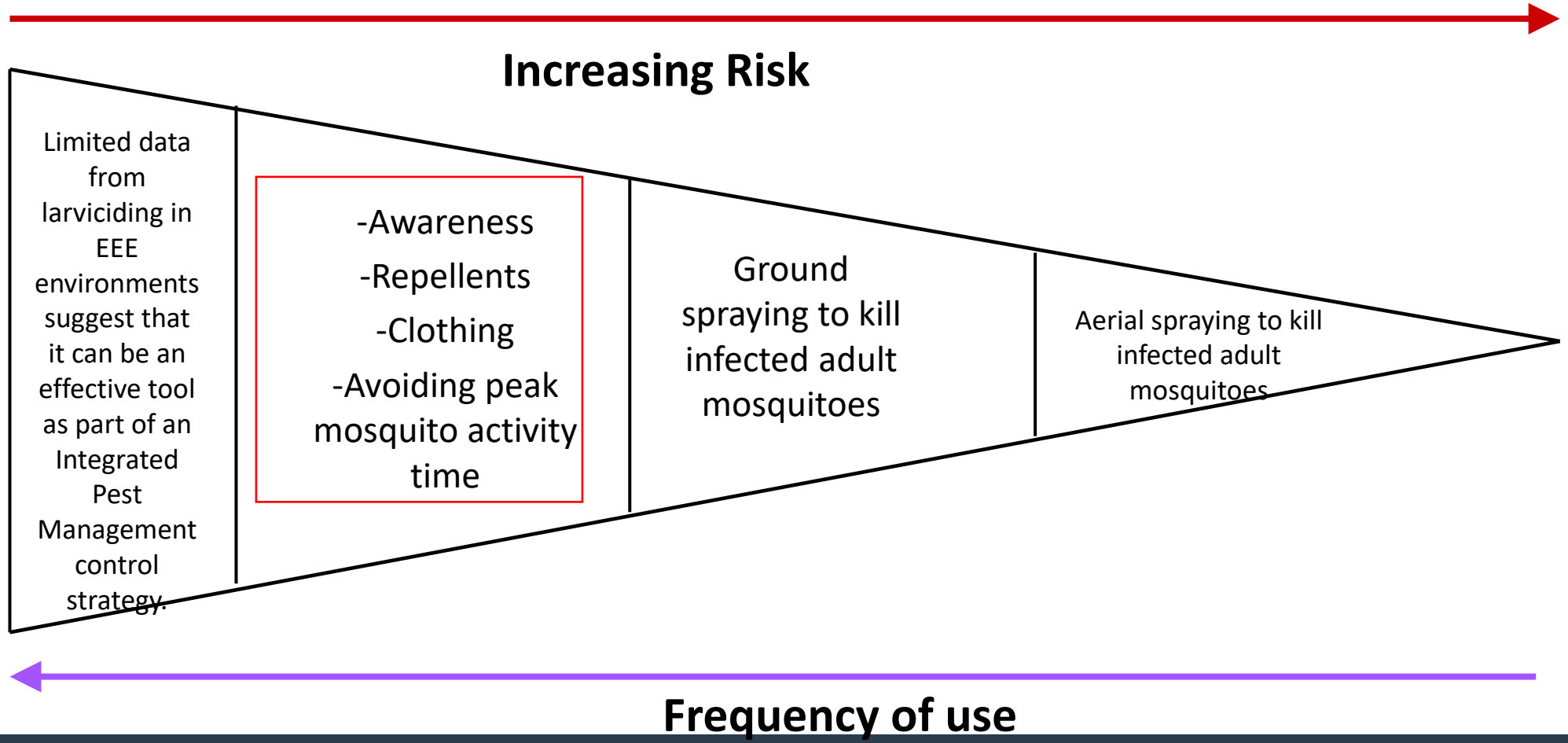
- Case investigation – veterinary
  - Location of animal
  - Recent travel
  - Vaccination status
  - Inform owners of local risk

- Case investigation – human
  - Outdoor activity
  - Known mosquito exposure?
  - Recent travel

- Challenges
  - Not always possible to interview patient
  - Family may not always have complete information
  - Emotionally difficult time
  - May learn new info over time

Arbovirus Surveillance and Response Plan

- Tiered risk levels - Objective criteria assessed in combination with more subjective information (weather) and experience
- Tiered public health recommendations - consistent with CDC (especially for WNV), they do not have specific recommendations for EEE (https://www.cdc.gov/mosquitoes/index.html)



Risk Communication

Press Releases

- Summer Safety – pre-season
- First identifications of WNV and EEE in a mosquito
- Any laboratory confirmation of WNV or EEE in a veterinary specimen
- Any laboratory confirmation of a human WNV or EEE case
- Risk assessment level changes (high or critical)
- Aerial spraying operations (per SOP Action Plan)

- Website
  - Daily updates
    - Mosquito results
    - Risk levels
    - Animal or human cases

LABORATORY TESTING

- Mosquitoes
  - PCR test- detects viral genetic material
    - Looks for two different sections (targets) of genetic material to ensure specificity of test
- Animals and Humans
  - Serology – detects antibodies to viruses
    - Screening test
    - Confirmatory test
      - Specialized test not available in commercial laboratories
  - PCR

- State Public Health Laboratory
  - Experience
  - Quality assurance and control protocols
    - CLIA
    - CDC
  - Select Agent Registered Program
  - Whole genome sequencing

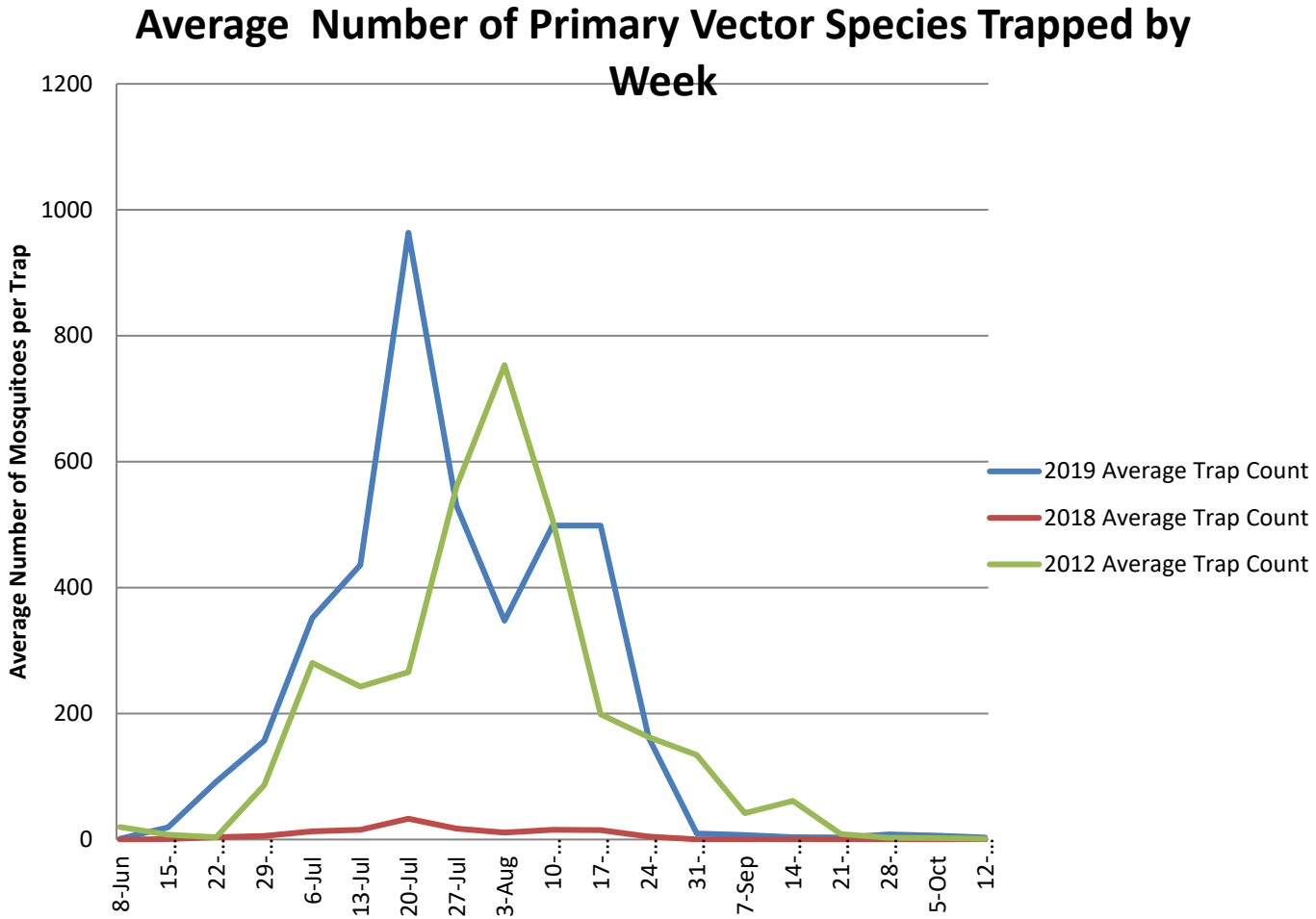
- Benefits to current centralized program
  - Increases standardization
  - Coordination of testing and release of results
    - Real-time situational awareness
  - Ability to assess risk across municipality borders
  - Existing electronic data-sharing system
  - Right-sized surveillance
  - Samples stored for additional studies

- Criteria for private vendors
  - Equivalent laboratory testing turn-around time (24 hours from arrival at lab)
  - Lab must meet a minimum quality standard to ensure accuracy of testing
    - Processes: written protocols, staff training and competency records, proficiency testing, instrument maintenance logs, cycle threshold tracking, template contamination monitoring, quality control testing and documentation of all test reagents and kits
  - Lab must have select agent registration or be able to transfer EEE positive specimens for additional studies
    - Places additional burden on MDPH SPHL
  - Knowledge of both WNV and EEE ecology
  - Staff trained in mosquito identification to the species level
  - Ability to share data close to real-time
    - Trap locations – GPS
    - Mosquito counts
    - Testing results

EFFICACY OF MOSQUITO CONTROL

Decision-making for Aerial Mosquito Control Intervention

- Mosquito abundance – how large are the populations of concern?
- Mosquito infection rates – how much EEE virus is in the populations?
- Geography – is risk widespread +/- occurring in areas where truck-based mosquito control is not available or unlikely to be effective due to habitat?
- Weather
- Time of season



Aerial Spray Efficacy

Aerial Spray Efficacy: 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[1,2]	Total Reduction in Mosquitoes Trapped	Temperature Range (°F)[3]	Dewpoint Range[4] (°F)	Acres per hour (average across all hours of spray)
Bristol/Plymouth	8/8/2006	8/9/2006	35-92%	59-86%	59-64	53-57	17,499
Bristol/Plymouth	8/22/2006	8/24/2006	0-94%	60-89%	57-69	55-62	34,191
Bristol/Plymouth	8/5/2010	8/7/2010	87-89%	77-87%	58-79	57-73	26,194
Bristol/Plymouth	7/20/2012	7/22/2012	14-84%	42-81%	56-73	54-61	30,701
Bristol/Plymouth	8/13/2012	8/14/2006	46-60%	36-47%	66-73	64-66	21,981
Bristol/Plymouth	8/8/2019	8/11/2019	66%	58%	55-72	50-70	20,112
Bristol/Plymouth	8/21/2019	8/25/2019	91%	25%	57-77	51-74	15,066
Middlesex/Worcester	8/26/2019	8/27/2019	38%	20%	53-64	45-57	16,212
Middlesex/Norfolk/ Worcester	9/10/2019	9/18/2019	ND	ND	52-70	42-69	16,975
Hampden/Hampshire/Worcester	9/16/2019	9/17/2019	ND	ND	48-58	47-51	14,388
Bristol/Plymouth	9/18/2019	9/24/2019	ND	53%	54-70	51-67	12,125

ND = Control not detected; calculations may be affected by small sample sizes

[1]Primary mosquito vector is the mammal-biting species Coquillettidia perturbans considered to be the mosquito most likely to spread EEE to humans

[2]Data sources includes DPH, and Bristol and Plymouth County Mosquito Control Districts. 2006-2012 data shown as ranges inclusive of all three data sources. 2019 combines data from all three sources into a single calculation.

[3,4]Weather data taken from Plymouth, Worcester and Westover airports and may not accurately represent actual temperature and dewpoint at location of spraying.

RISK COMMUNICATION

Risk Communication

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Available Data

- City/town data for the most recent mosquito season is available on our website at: https://www.mass.gov/info-details/massachusetts-arbovirus-update
- Mosquito data for the years 2014-2020 is available for download here: https://www.mass.gov/lists/arbovirus-surveillance-plan-and-historical-data.
- Positive veterinary specimens (animals) are included in the Summaries of Arbovirus Surveillance in Massachusetts by year here (back to 2014): https://www.mass.gov/lists/arbovirus-surveillance-plan-and-historical-data.
- Human cases are subject to privacy and confidentiality policies and they are reported by county
  - EEE very high profile but rare disease - some families may choose to disclose information about the case but others prefer not to
  - Critical public health information about cases is likely location of exposure - used to define areas of risk during a current year

Communication about Aerial Spraying

- Pre-spray calls with MDAR for LBOHs, legislature
- Notification to environmental groups
- Support MDAR outreach to bee keepers, organic gardners
- Maintain website with information
  - Link to map on MDAR site
  - Joint FAQ
- Joint press releases with MDAR
- Maintain FAQs in multiple languages
- Work with partners on distribution of information
- 24/7 Epi line – question from public, LBOH and providers

Communication Challenges

- You can never reach everyone
- Fear of something makes it harder for people to hear your message
- Other people become inured to the message and don't hear it any more
- Common messages from callers
  - Want someone to fix the problem
  - Concerns about using insect repellent, not necessarily the same concern about mosquito control pesticides
  - Specifics about when and where spraying is happening – in support and against

Long term changes likely related to risk

- Changes in land use patterns
  - Wetlands restoration
  - Suburban development
- Increased precipitation events
- Higher temperatures, prolonged mosquito season
- Alterations in songbird populations, migratory timing and/or patterns
- Alterations in mosquito populations
- Northward expansion of additional mosquito vectors

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Thank You!

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