Mosquito/Arbovirus Surveillance

Charles Lubelczyk
Maine Medical Center Research Institute
Scarborough, ME
Wildlife Health and Emerging Disease

Silent cycles of wildlife disease - *enzootic*

Flanders virus, trivitattus virus – mosquito-borne

Squirrel pox – squirrel to squirrel transmission

No impact other than to specific wildlife host

Minimal public health or veterinary importance
Wildlife Health and Emerging Disease

• *Epizootic or epidemic cycles of wildlife disease* (“Jumping the species barrier”)

• West Nile virus, eastern equine encephalitis – mosquito-borne

• Lyme disease, Powassan encephalitis – tick-borne

• Chronic wasting disease – deer to livestock transmission

• Human, veterinary, livestock, wildlife health issues
  - Non-target spillover of disease (accidental hosts)
Arboviral cycle

• Reservoirs
  – Avian species

• Arthropod vectors (ticks/mosquitoes)
  – Seasonality of disease
  – Host preference
    • ‘Dead End’ Hosts
Mosquito Vectors - EEE

• Enzootic vectors
  – Genus Culiseta
    • Ornithophillic
    • Habitat – forested wetlands

• Bridge vectors
  – Genera Coquillettiddia, Aedes (Ochleratutus), Culex
    • Catholic feeders’
    • Habitat – variable, but wetland associated
Mosquito Vectors – WNV/SLE

• Enzootic vectors
  – Genus Culex
    • Ornithophillic
    • Habitat – container breeders (nutrient rich water source)
      – Urban vs natural areas (Rochlin et al 2008)

• Bridge vectors
  – Genera Coquillettiddia, Aedes (Ochleratutus), Culex
    • Catholic feeders’
    • Habitat – variable, but wetland associated
Mosquito Habitat

- *Cs melanura* (EEE)
  - Red maple swamps or other acidic forested wetlands
  - Open forested uplands (eastern hemlock)
  - Oftentimes low visibility of disease activity (it takes a dead horse to see it!)
Mosquito Habitat

- *Culex pipiens/Cx restuans* (WNV)
  - Artificial container breeding, with high nutrient content
    - Tires
    - ‘Kiddie pools’
    - Buckets
    - Cemeteries
  - Suburban or urban environments
  - Disease activity may be highly visible
    - “There’s a dead crow on the lawn, honey!”
Mosquito Habitat

- *Aedes vexans*(EEE & WNV)
  - Temporary waterbodies following rainfall
- *Aedes canadensis*(EEE & WNV)
  - Permanent woodland (shaded) pools
- *Aedes sollicitans*(EEE & WNV)
  - Saltmarshes
- *Cq perturbans*(EEE & WNV)
  - Cattail marshes
Deer Sero-surveys

AIM: evaluate the potential for using deer sero surveys to track and map the distribution of EEEV in the state of Maine.

The overall aim is to develop a comprehensive EEEV surveillance system based on detailed information of EEEV regional distribution and focal locations within the state of Maine.
Tracking Disease

- Use of cervids to look for EEE activity
  - ~7-12% antibody + animals across Maine

Deer Sera Tested = 226
EEE Positive = 16
% Positive = 7.1%
Tracking Disease

• Large samples to look for clusters spatially and temporally
EEE Ab+ Animals

Both WTD and Moose, 2009-2014

High clustering of positivity in northern Maine
  3 sites in Aroostook County
  Kennebec County

Lower Clustering of Positives
  Piscataquis County
  Interior York County
  Washington County
  Lower Penobscot County
Tracking Disease

• Entomologic Surveillance (mosquito trapping)
  – 30 sites across Maine
  – Collaborative effort between MMCRI, MECDC and ME DACF
Tracking Disease

• Veterinary/public health surveillance
  – Rapid response investigation at site of activity (sick horse)
    • Mosquito collection and testing
Summer 2012 - Pheasant Outbreak

- Captive pheasant flock (Lebanon, ME), reports of sudden deaths occurring in flock
  - Original flock size of 75 birds; one dead bird tested positive for EEEV
• Of the original 75 birds:
  – 39 birds died suddenly, as reported by landowner
  – 36 birds were euthanized
Rapid Response - Methods

• Rapid response mosquito trapping on site (Lebanon)

• Two light traps placed in forested wetlands near flock enclosure
  – Red maple swamp
  – Hemlock swamp

• September 7 - September 30
Predicting Disease

• Models created with geographic information systems (GIS)
  – Adding biologic data with environmental data to predict where either vectors or disease may concentrate
WNV model – urban mosquitoes
EEE model v2 – across rural counties, targeting small locations

• Created to improve mosquito surveys but also emergency response
The New Kid on the Block - Zika

• How to track, where to look?
  – Use of emergent cups to collect Ae albopictus/Ae egypti larvae
  – Concentrations on port districts with incoming ship traffic in southern Maine (Portland, Kittery)

• Urban environments
  – Search for artificial containers that may act as breeding habitat for vectors
  – GIS model for urban Culex sampling