MAMCA Annual Meeting
March 30-April 1

Wednesday, March 30, 2016
Session 1

I) AMCA Update – Dennis Salmen
   a) Membership benefits
      1) Free webinars
      2) Publications
      3) Members-only section or website
   b) Position papers
   c) Washington Day
   d) Updates
      1) Federal Legislative/Regulatory
         (i) NPDES - Sportsman's Bill (S 659)
         (ii) EPA action on organophosphates
      2) Federal funding request
         (i) CDC/DVBD arbovirus support
         (ii) MASH Act
         (iii) Mosquito Control Toolbox
      3) ZIKV Task Force
      4) New executive director
      5) Mosquito Research Foundation
      6) Journal to become open-access
II) Zika Virus – Abelardo Moncayo
   a) Why do we care?
      1) Increase in microcephaly cases associated with febrile rash illness in pregnant women
      2) Feb 1, 2016 – WHO declared a public health emergency
         (i) Challenges for families
         (ii) Challenges for society
   b) What is ZIKV?
      1) The virus
         (i) Single-stranded RNA virus
         (ii) Closely related to dengue, yellow fever, Japanese encephalitis, and WNV
         (iii) Vector – *Aedes* spp mosquitoes
      2) First detected in 1947 in a monkey in the Zika Forest
      3) Two strains
         (i) African
            (a) A number of vectors
            (b) First documented human case was in 1954
            (c) Very few cases documented

(ii) Asian
(a) *Aedes aegypti* and *Ae albopictus*
(b) Very few cases documented
(iii) More recent outbreaks related to the Asian strain

c) Recent Outbreaks
1) Yap Island Outbreak
(i) High attack rate – 73%
(ii) 18% symptomatic
(iii) 82% asymptomatic
(iv) vector – *Ae henslii*
2) Case definition has recently changed
3) French Polynesian Outbreak
(i) 28000 people symptomatic
(a) Mild, self-limiting disease
(b) Symptom last 2-7 days
(c) People were hospitalized with Guillain-Barre Syndrome

d) ZIKV in the Americas
1) Brazil
(i) Huge increase in number of microcephaly cases
(a) Number of studies link ZIKV to the increase in microcephaly
(i) Pregnant women had febrile rash illness
(ii) Virus found in infants and fetuses
(iii) Case study
1. Ultrasound found microcephaly in fetus at 28 weeks
2. Entire ZIKV genome found in fetal tissue
(iv) Case Control Study – Rio de Janeiro
(b) Virus found in ocular tissue
(ii) Sexual transmission has occurred
2) Has currently spread to a number of countries in the Americas - http://www.cdc.gov/zika/index.html
3) No locally-acquired cases in the US as of yet

e) US Guidance and Response
1) Multi-agency, multi-department effort
2) Lab testing
(i) Pregnant females
(ii) Males or non-pregnant females
(iii) Infants <2 weeks
(iv) Possible congenital infection
3) Testing
(i) <7 days – molecular testing
(ii) >=4 days – antibody testing

f) Identifying autochthonous transmission
1) Humans are sentinels
2) Testing is currently restricted

(i) Test non-travel cases near travel-associated cases
(ii) Test non-family members who meet clinical case definition
(iii) Test those with sudden onset of all 4 symptoms or a descending rash

3) Recommendations are based on current knowledge, which is very incomplete

g) Mosquito issues
1) 5 Ds
(i) dress
(ii) Drain/dump
(iii) Dispose
(iv) DEET
(v) Daytime
2) Risk to US citizens varies with locations
3) Economic impact
4) Aedes populations in the US
(i) New paper
(ii) Looks at climate effects
(iii) Areas of poverty also play a role
5) Prevention message includes condoms

h) Calming the public
1) 80% of people are asymptomatic
2) Human-mosquito-human cycle
3) Air-conditioning
4) *Aedes albopictus* feeding behavior
5) Global Health Response plan
6) No money

III) Preliminary Results on a New Gravid Trap – Rosmarie Kelly

IV) History of Mosquito Control in Shelby County – Ture Carlson
a) City of Memphis
b) Yellow fever
1) First major outbreak in 1928
2) 1850-1854: yellow fever cases every year
3) 1855 outbreak
4) 1867 – 3rd major outbreak
5) 1873 – 4th major outbreak
6) 1878 – 5th and largest outbreak
7) 1879 – 6th and final outbreak
8) 1897 – last local cases of yellow fever reported

c) Board of Health convenes during outbreaks
1) 1879 National Board of Health survey
2) mosquitoes found in cisterns (probably *Aedes aegypti*)

d) A lot of people fled town during outbreaks
e) Positive results
1) 1913
(i) Mosquito control

(ii) Screened windows
2) Sanitary sewers
3) Artesian aquifer resulted in cisterns being eliminated

f) Early 1900s
1) Mostly ditching and oiling water to eliminate malaria
2) Shelby Health Department
3) City of Memphis Health Department
4) Pesticide building
(i) DDT
(ii) Paris Green
(iii) Slaked lime –
(a) A soft, white, crystalline, very slightly water-soluble powder, $Ca(OH)_2$, obtained by the action of water on lime: used chiefly in mortars, plasters, and cements.
(b) Used with Paris Green
5) Mosquito surveys
6) 1928: Malaria Control Program
(i) 1930s – 18% positives
(ii) malaria relief programs
(iii) *Anopheles* surveys
7) 1936 Howard-Krauss Society
(i) Big education push
(ii) Malaria
(iii) Other pests of public health importance

g) 1940s
1) Shelby County – Memphis Health Departments combined
2) Extended malaria program
(i) Electric traps
(ii) Inside wall treatments
(iii) Primarily used DDT

h) 1950s
1) Probably resistance to DDT
2) Switched to Chlordane-Dieldrin
3) Also Malrin (carbamate insecticide) and malathion
4) Residual spraying in homes stopped in 1953
5) 1956 – malaria free

i) 1960s
1) *Aedes aegypti* eradication program started
2) *Aedes aegypti* no longer found
3) SLE first reported

j) 1970s
1) Bought ULV sprayers
2) Started avian sentinel flocks
3) 1974-1976: big SLE outbreak

4) *Aedes aegypti* found again
5) Organophosphate resistance found
6) Switched to resmithrin

k) 1980s & 1990s
1) *Aedes albopictus* found
(i) Single female – 1983
(ii) Breeding population – 1986
2) 1989-90: no more *Aedes aegypti*

l) 2000s
1) WNV 2002
2) Fee placed on utility bill to support mosquito control county-wide
3) City of Memphis defunds Health Department
4) Currently also do rodent control

V) Sustaining Member Presentations
a) Electronic Data Solutions – www.elecdata.com
1) Technology company
2) Field data solutions
3) ESRI-based
4) Established in 1986
5) Partner with Clarke

b) Clarke

Session 2

I) Nationwide Mosquito Susceptibility Screening Against 6 Active Ingredients – Stephanie Richards
a) Why do this?
1) Routine mosquito susceptibility monitoring is important
2) Helps choose pesticide

b) Study design
1) 26 mosquito populations
2) 5 US regions
3) collected eggs
(i) 4 species collected
(ii) Reared to adults
(iii) Tried to use F_0 generation
4) Technical grade ingredients
5) Products used
(i) Malathion
(ii) Etofenprox
(iii) Permethrin
(iv) Bifenthrin
(v) Deltamethrin
(vi) Phenothrin

c) Methods
    1) Bottle bioassay - http://www.cdc.gov/malaria/resources/pdf/fsp/ir_manual/ir_cdc_bioassay_en.pdf
    2) Acetone carrier
        (i) Controls – acetone
        (ii) Tests – pesticide plus acetone
d) Analysis
    1) Categories
        (i) Susceptible: >=98% mortality
        (ii) Possible resistance: 80-97% mortality
        (iii) Resistant: <805 mortality
    2) Various statistical tests
e) Results
    1) Differences seen between species
    2) *Aedes* spp were more susceptible than *Culex* spp
    3) Difference in survival between regions
    4) Lots of resistance to malathion and etofenprox
    5) There will likely be variation between years
f) Question – How will manufactured products work compared to technical grade products?

II) Richmond County Mosquito Control Public Education Program – Fred Koehle
a) Integrated mosquito control
    1) Cost-effective program
    2) Work force is primarily seasonal retirees
    3) 324 square mile area
b) Program components
    1) Electric ULV sprayers
    2) Mule
        (i) Larviciding
            (a) 12 different kinds of storm drains
            (b) detention/retention ponds
        (ii) Barrier spray
            (a) 15 square mile area
            (b) Downtown
            (c) Huge decrease in complaints
    3) Complaints
        (i) Huge increase seen after educational program started
        (ii) All sites are visited
    4) Annual training for employees and stakeholders
    5) Surveillance – work with Phinizy Center
        (i) Gravid traps
        (ii) CDC light traps
        (iii) Prior year complaints
        (iv) Historical data

(v) Landing counts

c) Partners
   1) Who are they?
      (i) Olin Corporation
      (ii) Augusta Country Club
      (iii) Augusta University
      (iv) Augusta National Gulf Club
      (v) Resolute Forest Products
      (vi) International Paper
      (vii) Potters
      (viii) County Landfill
   2) What is provided?
      (i) Funding to mosquito control
      (ii) Surveillance and education to partners
d) Special Projects
   1) Swimming pools
   2) Goats and Retention/Detention Ponds
e) Education program/Displays
   1) Civic groups
   2) Home Owner's Association
   3) Any group that has an interest

III) Swimming Pool Program in Augusta, GA – Fred Koehle
a) Started in 2008
   1) 1976 Richmond County ordinance: HO-76-13
   2) Swimming pool code states that the pool must be in working order
   3) Took plan to judges for buy-in
b) Plan
   1) Investigate all pool complaints
   2) Fill out surveillance checklist
   3) Protocol for filling-in swimming pools
   4) Reinspect after 30 days – take photos
      (i) Repaired – send thank you letter
      (ii) No action
         (a) Send 15-day letter
            (i) Repaired – thank you letter
            (ii) No action - Citation
         (b) From then on the Marshal and the Court dictate the course of action
   5) Day before court
      (i) Re-inspect
      (ii) Fill out timeline
      (iii) Place all information in a binder to show to the judge
   6) Possible penalties
      (i) Up to $1000 fine
      (ii) Jail time

(iii) Community service

IV) Taming the Tiger – Tom Smith
- *a) Aedes albopictus*
  - 1) Container breeder
    - (i) The smaller the better
    - (ii) Abundant in many areas, and expanding
    - (iii) Can be collected in small catch basins
  - 2) Salvage yards are a problem
  - 3) Have tested positive for WNV
  - 4) Best nectar source – butterfly bush
- b) Distribution
  - 1) http://www.cdc.gov/zika/vector/range.html
  - 2) http://www.cdc.gov/chikungunya/resources/vector-control.html
- c) Dealing with complaints
  - 1) Daytime biter
  - 2) Not getting much help with neighborhood cleanup/source reduction
  - 3) Asian tiger project
    - (i) Larvicide ULV spray events
      - (a) Early morning spray events
      - (b) Altosid Liquid Larvicide concentrate – rain events flushed product
      - (c) Adulticide spray event with Duet – truck spray
        - (i) Too much habitat
        - (ii) Continual brood emergence
    - (ii) Difficulty getting products to correct sites
    - (iii) New procedure
      - (a) Vectobac WDG
        - (i) Backpack spraying
        - (ii) Worked much better
      - (b) Salvage yard also started using weed control
- d) Need to educate the public
  - 1) Educational handouts
  - 2) Outreach
  - 3) Videos
  - 4) Newspapers
  - 5) Community projects
  - 6) Free tire disposal program
  - 7) Work with commercial pest control
  - 8) Work with businesses
- e) What's next?
  - 1) Litter index
  - 2) Community improvement

V) The New BG Sentinel 2.0 – Jay Kiser
- a) BG Sentinel traps
  - 1) Targets *Aedes albopictus* and *Ae aegypti*

2) CO_2 and BG lure baited
3) potential issues with rain events - best to incorporate a rain guard
4) Version 1
    (i) Arrived on market in early 2000 (1.0)
    (ii) Modifications made in 2009 – bad move (1.5)
5) Version 2
    (i) Prototype
        (a) Hard top instead of cloth
        (b) Stand alone structure
        (c) Problem with repellency of materials used
    (ii) 2.0
        (a) Trap is now dark blue
        (b) New materials are used – eliminated material repellency
        (c) Flap added to outer funnel
        (d) Cylinder lure holder
        (e) 40% stronger suction on intake and outflow
6) No difference seen in trap catches

b) Comparison to CDC light trap
1) 5 different habitats
2) Worked better than CDC trap in most areas and for all species captured

c) 2015 trap comparison
1) Traps used
    (i) BG 1.0
    (ii) BG 2 prototype
    (iii) BG 2.0
    (iv) Snap trap – sold for use in gardens
2) Set traps in woods in an older neighborhood
3) No significant difference found amongst the BG traps
4) Snap Traps don't work all that well

VI) Sustaining Member Presentations
a) Bayer
b) Summit Chemical

Thursday, March 31, 2016
Session 3

I) Vector Index and Resistance, Shelby County – Ture Carlson
a) County divided into spray zones
b) Vector Index
1) Vector index compared to human cases
2) VI of 0.5 predicted 80% of human cases
c) Culex density
1) Weekly trap averages

2) Density per zone

d) Use New Jersey Light traps on photocells for nuisance mosquito surveillance
   1) Year data vs average
   2) Heavy rain and water just below flood stage led to a few huge spikes in 2015

e) Larval surveillance
   1) ~3500 sites inspected every 2 weeks
   2) Start collecting in March
   3) WNV
      (i) Track *Culex restuans* vs *Cx pipiens*
      (ii) Switch from nuisance mosquito control to vector control

f) Adulticiding
   1) Based on presence of disease
   2) Resistance testing
      (i) *Culex* spp
      (ii) Permethrin resistance seen, but PBO helps
      (iii) Mixed *Cx quinquefasciatus, Cx pipiens*, hybrid populations

g) Complaints
   1) Tire cleanup no longer funded
   2) Graph complaints by months
   3) Break down by type
   4) Swimming pool issues
      (i) No ordinance mentioning standing water and mosquitoes
      (ii) Ordinance mentions vegetation and mosquitoes

II) LaCrosse Encephalitis in North Carolina – Brian Byrd

a) PLoS One 2009 – LaCrosse Incidence
   1) Many cases are asymptomatic or unrecognized
   2) Seriologic evidence

b) Life cycle
   1) Small mammals – amplifying host
   2) Transovarial transmission occurs
   3) Primary vector – *Aedes vexans*
   4) Secondary vectors
      (i) Aedes albopictus
      (ii) Aedes japonicus

c) Trapping methods
   1) Types
      (i) CDC light traps
      (ii) BG Sentinel
      (iii) Gravid traps
      (iv) Nasci aspirator
   2) Many traps have a physiological bias
   3) None are good for control

d) CDC Autocidal Gravid Ovitrap
   1) Passive trap

(i) Uses hay infusion as an attractant
(ii) Adult mosquitoes get trapped on a sticky card

2) Questions
(i) Will trap collect LAC vectors?
(ii) Does in fusion type matter?

3) Study design
(i) Compared hay infusion to white oak leaf infusion
(a) Block design
(b) Collected and ID'ed mosquitoes
(c) Used PCR to check ID's
(d) Results
(i) 98% of species caught were LAC vectors
(ii) Most were gravid
1. *Ae triseriatus* were more attracted to the hay infusion
2. *Ae japonicus* didn't care
3. Not enough *Ae albopictus* caught

(ii) Change in microbial communities in infusion
(a) Look at variability in time and space
(b) Does attraction change?

(iii) Is there an impact to mosquito populations?

III) Infectious Rates in *Ixodes scapularis* in PA – Mike Hutchinson

a) Why look?
1) 2001 – Powassan virus case
2) PA is consistently in the top 3 for Lyme Diseases cases
3) Legislation pending regarding tick surveillance
(i) Senate Bill 177
(ii) Create task force to draft recommendations for TBD prevention

b) Goal
1) Tick surveillance
2) Disseminate information to citizens and physicians

c) Surveillance – J Med Ent 2015 (http://jme.oxfordjournals.org/content/52/4/693)
1) Methods
(i) Drags
(ii) Dry ice traps
(iii) Collection from hosts

2) Results
(i) Collected from 2012-2014
(ii) ~45,000 ticks collected
(iii) 5 species
(iv) Collected in every county

3) Testing
(i) Looked at infection rates in 2013
(ii) Tested adult *Ixodes scapularis*
(a) *Borrelia burgdorferi* – 47.4%

(b) 2 other disease organisms

4) Confirmed presence of *I scapularis* in every county
   (i) None had been found in the 1960s
   (ii) *B burgdorferi* found in ticks in every county

d) Final report submitted in Sept 2015
e) 2015
   1) Saw an increase in infection rates between 2014 and 2015
   2) No longer have funding

IV) Addressing *Aedes albopictus* with Community Partners (Huntsville, AL) – Cheryl Clay
a) Control and Influence
   1) Areas we can control
   2) Areas we have no control over
   3) Areas we can influence
b) Project design
   1) Identify areas of improvement
   2) Projects needs a measurable impact
   3) IPM focus
   4) Build capacity internally or externally
c) Project – Source reduction by homeowners
   1) Huntsville, AL
      (i) 188,907 population
      (ii) 100.68 square miles
      (iii) Federal land that has no treatment
   2) Problem
      (i) Aedes albopictus
      (ii) Introduced in the 1980s
   3) Focus
      (i) Target homeowners
      (ii) Facilitate partnerships among community groups
      (iii) Eliminate breeding environments
      (iv) Minimize time that vector control needs to expend
   4) Process
      (i) Media interviews
         (a) Print
         (b) Radio
         (c) TV
      (ii) Letter to tire dealers
      (iii) Social media
      (iv) Web page
      (v) Handouts
   5) Neighborhood Associations/Community Organizations
      (i) Emailed off city list
      (ii) Located groups via complaints
      (iii) Got 9 community partners

(a) Posted flyers in area businesses
(b) Emailed flyer to community distribution lists
(c) Attend community meetings
(d) Community churches (Latino Community)

6) Other groups
(i) Senior Centers
(ii) Public Library
(iii) Community events
(iv) Scouts
(v) Boys and Girls Club
(vi) Animal services
(vii) Earth Day

7) Services provided
(i) Community yard inspection
(ii) Abandoned homes
(iii) Pool complaints
(a) Not much enforcement power
(b) Will treat with Larvicide
(iv) Provide Larvicide

d) New projects
1) Educational curriculum
2) Focus on education and prevention
3) Zika coloring/activity book
4) Guides for Environmental Health Specialists
5) Door-to-door local response
6) Community cleanup

V) Sustaining Member Presentations
a) ADAPCO
b) UNIVAR

Session 4

I) A Project Report on the NSF Funded Lyme Gradient Project – Graham Hickling
a) Latitudinal gradient seen in Lyme Disease cases
1) 40 per 100,000 in North
2) 0.4 per 100,000 in South
b) Why?
1) Genetic differences in ticks?
2) Ecological differences?
3) Host differences?
c) Project
1) Standardized sampling methods
2) Multiple sites
(i) 8 sites in different states
(ii) 3 arrays per site

(iii) collections
  (a) Ticks off vegetation
  (b) Ticks off hosts
  (c) Host information
  (d) Abiotic factors
(iv) Sampling
  (a) Timing
    (i) 2-3 week intervals
    (ii) May-Oct
  (b) Climate station at each site
  (c) Host collection
    (i) Live traps for small & medium mammals
    (ii) Pitfall traps
    (iii) Burlap sacks on tree trunks
    (iv) Coverboards
    (v) Trail cams to determine host diversity
  (d) Dragged and flagged (paper)
(v) Results
  (a) Does *I scapularis* abundance vary by region (adults collected in winter)?
    (i) Tick was found everywhere
    (ii) More adults found up north
    (iii) Inland sites have lower abundance
  (b) Why?
    (i) Fewer hosts?
    (ii) Poor adult survival?
      1. Clay soils?
      2. Freeze/thaw cycles?
  (c) Does *Borrelia burgdorferi* infection vary regionally (% in questing ticks)?
    (i) North is much higher than south
    (ii) Why?
      1. Low tick numbers?
      2. Reservoir incompetence (lizard vs mouse)?
        a. Most infected ticks lose infection when feeding on a lizard
        b. Larvae feeding on lizards do not get infected
  (d) Does questing behavior of nymphs vary regionally?
    (i) Rarely find *I scapularis* on people in the south
    (ii) Almost never a nymph
    (iii) Why?
      1. Low number of nymphs found when dragging
      2. Behavioral thing
        a. Need to climb up to get attached to larger animals
        b. Southern nymphs don't climb very high
        c. If they stay in the leaf litter, they don't attach

d) What is the underlying cause for this?

e) Info
    1) Lyme Gradient Website (http://lyme-gradient.tennessee.edu)
    2) Blog (http://lymegradient.blogspot.com)

II) Heartland Virus in Tennessee – Mary-Margaret Fill
a) History
    1) First identified in 2009
    2) 7 cases in Missouri, 1 in TN
    3) All men >=50 yo
    4) 75% required hospitalization
b) Novel Phlebovirus
    1) Most closely related to SFTS
    2) Bunyaviridae
c) Heartland virus in TN
    1) Cases
        (i) Case #1
            (a) 80 yo male
            (b) Hospitalized in 2013
            (c) Complaint
                (i) Fever
                (ii) Weakness
                (iii) Confusion
                (iv) Recurrent falls
                (v) Vesicular rash
            (d) History of tick bites
            (e) Many other medical issues
            (f) Passed away 2 weeks after start of illness
        (ii) Case #2
            (a) 68 yo male
            (b) Complaints
                (i) Confusion
                (ii) Falls
                (iii) Vesicular rash
            (c) History of multiple tick bites
            (d) Very few other medical issues
            (e) Lab findings had similarities and differences to earlier case
            (f) Passed away
    2) Finding the cause
        (i) Unexplained death evaluation – CDC
        (ii) Virus found in a variety of sites
    3) Factors associated with mortality
        (i) Age – older
        (ii) Certain specific lab findings
        (iii) HLH: Over-reactive immune system
d) Vector

1) Ticks collected via drag
2) Tested at State Lab
3) Lone star tick is implicated as vector
4) No reservoir species has been found

III) Leah's Story – Andy Laudick

a) How LAC encephalitis can affect children
   1) Born Oct 2008
   2) Passed Aug 2013
   3) Healthy child

b) Timeline
   1) Aug 4-10
      (i) Location
         (a) Lived in a subdivision – not typical environmental factors
         (b) Several places where she may have been bitten by the mosquito
      (ii) August 5 – complained of a headache
      (iii) August 6-7
         (a) Still had a very severe headache
         (b) Lethargic
         (c) Admitted to hospital
      (iv) August 8
         (a) High WBC count
         (b) Less responsive
         (c) Cause unknown
      (v) August 9
         (a) Transferred to Children's Hospital
         (b) Seizures began
         (c) Admitted to PICU
         (d) Sedated
      (vi) August 10
         (a) Brain activity ceased
         (b) Leah died at 9:45 pm
         (c) Cause was still unknown
   2) Cause was originally found to be LAC
      (i) LAC does not get the attention it deserves because of its low statistical impact
      (ii) LAC is widely under-reported
   3) Several other children in area had similar symptoms that resolved without issue

c) Leah's Hope: Campaign to eliminate vector-borne illness in children and adults
   1) Why are mosquitoes still a major threat today?
   2) Why are children and elderly at highest risk?
   3) Uncounted issues
      (i) Emotional impact on families
      (ii) Unexpected financial impact
   4) Need a nation-wide mapping and surveillance program to provide better information and expand comprehensive testing.

Business Meeting

Session 5

I) Chikungunya, Zika, and How Do You Stop a Flying Tiger? – Jeff Heusel
   a) http://www.cdc.gov/chikungunya/resources/vector-control.html
   b) Chatham County Mosquito Control
      1) 438 sq mi
      2) 1/3 is salt marsh environment
      3) Long history with mosquito-borne diseases
         (i) Yellow fever
         (ii) Malaria
   c) Map of Zika risk - https://www2.ucar.edu/atmosnews/news/19850/potential-zika-virus-risk-estimated-50-us-cities
      1) *Aedes aegypti* populations decreased considerably between 2000 and 2001 and disappeared almost entirely at this point
      2) Low vector numbers reduce chance of ZIKV getting a foothold in the area
      3) CDC map - http://www.cdc.gov/zika/pdfs/zika-mosquito-maps.pdf
   d) Options for control
      1) 1990 – Toxorhynchitis release
         (i) Labor intensive
         (ii) Didn't see much control
      2) Community cleanup
         (i) People may respond initially, or not
         (ii) Problem quickly returns
      3) Liquid Larvicide
         (i) Aerial application
         (ii) In response to actual cases
   e) Surveillance
      1) BG Sentinel 1.0
      2) 92.4% of species caught are *Aedes albopictus*
      3) LBJs
         (i) Used initially to determine where albos were located
         (ii) Now they are everywhere
      4) Backpack aspirator
      5) Landing rates
   f) Testing
      1) Pool and ship albos
      2) In response to a travel-related case
   g) Control
      1) 95% adulticiding done by helicopter
      2) product - Naled
      3) Fly starting an hour before sunset
         (i) Peak activity for *Culex quinquefasciatus*

(ii) Can do lots of acreage in 30 minutes

4) Need to determine best time to spray to control albos
   (i) Early morning truck spray?
   (ii) Aerial spray?
5) Bottle bioassay

h) Education
1) Door to door
2) Community events
3) Classroom program
4) Media
5) Community outreach (Terminate the Tiger)

II) Super Females and Killer Males: Release of Modified Mosquitoes – Jason Pitts

a) Sterile Insect Technique (SIT)
1) Developed in the 1930s
2) EF Knipling and RC Bushland
3) Procedure
   (i) Mass rear and sterilize males (irradiation)
   (ii) Release in wild population
   (iii) Mating competition
   (iv) Sterile females
4) Example –
   (i) New world screwworm (https://www.aphis.usda.gov/publications/animal_health/2014/fs_new_world_screwworm.pdf)
   (ii) Mediterranean fruit fly
   (iii) Mexican fruit fly

b) *Wolbachia* (https://www.rochester.edu/College/BIO/labs/WerrenLab/WerrenLab-WolbachiaBiology.html)
1) Intracellular symbiont
2) Induces cytoplasmic incompatibility
   (i) W+ male – W- female = no offspring
   (ii) All other crossings result in offspring
3) Issues
   (i) Requires a long period of time
   (ii) If female mosquito is infected with *Wolbachia*, the male must have a different strain or there will be offspring
4) Aedes aegypti control
   (i) Suppresses populations
   (ii) Also prevents the replication of DEN virus (http://www.eliminatedengue.com/our-research/wolbachia)
   (iii) *Aedes aegypti* does not have a naturally-occurring *Wolbachia*
   (iv) O'Connor et al, PLoS Neglected Tropical Diseases 2012 (http://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0001797)

c) RIDL (Release of Insects carrying a Dominant Lethal gene)– http://www.oxitec.com/ridl-science/
    1) Males are fertile
    2) Offspring die late in development
    3) Tetracycline suppresses lethal gene in lab
    4) Cost effectiveness??
    5) Potentially very effective at reducing disease transmission in release area
    6) Refinement allows male mosquitoes to live and emerge to carry transgene to new matings
    7) http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0062711

III) Georgia's Response to ZIKV – Rosmarie Kelly

Session 6

I) Spread of Lyme Disease in Virginia – David Gaines
    a) Background
        1) Increasing incidence from 2000 (1990-2015)
            (i) Began counting Lyme cases in 1989 in middle of year
            (ii) Case definition changed in 1995
            (iii) Case definition changed again in 2008
        2) Big increase in 2007
        3) Lyme has increased in incidence and spread
            (i) Clustering of cases occur around major highways
            (ii) Urban and suburban areas – higher populations
            (iii) Far fewer cases seen in rural areas
            (iv) Most cases seen in western VA
        4) Most cases seen in areas with higher elevations (500 ft and above)
    b) Lyme disease transmission ecology
        1) Main vector is the nymphal stage of the black-legged tick (BLT)
            (i) Northern variant nymphs
                (a) Feed on over 100 different species including humans
                (b) Quest on vegetation
            (ii) Southern variant nymphs
                (a) Feed primarily on lizards
                (b) Stay down in leaf litter
        2) Location
            (i) Prior to 1990 BLT were found only in the Coastal zone
                (a) Behaved a lot like SV ticks
                (b) Nymphs were difficult to find
            (ii) Since 1990, BLT have moved southwestwards into the Piedmont and Mountain regions
                (a) Behave like NV ticks
                (b) Increase seen in Lyme disease
        3) Reservoirs
            (i) White-footed mouse

(a) Highly competent reservoir
(b) Larvae feed on small rodents
(c) Major role in maintaining the Lyme infection cycle in BLT

4) Forest environment
   (i) Species diversity
      (a) Competent vs non-competent hosts
      (b) Mixture can dilute transmission of *B burgdorferi* to ticks
      (c) Species diversity greatest in undisturbed forests
      (d) Suburbanization often results in fragmented and disturbed forest environments
      (e) White-footed mice often become an important species in these areas
   (ii) Importance of deer
      (a) Prime mating ground; unmated females do not lay viable eggs
      (b) Primary source of blood for egg production
      (c) Eliminating deer populations leads to a 99% reduction in BLT populations
      (d) Habitat
         (i) Forest edge environments (fragmented forests have more edge)
         (ii) Suburbanized areas tend to restrict hunting
         (iii) Suburbs become a refuge for deer

II) Improving Surveillance for LaCrosse Encephalitis Virus and its Vectors – Becky Trout-Fryxell
   a) Primary vector – *Aedes triseriatus*
   b) Secondary vectors
      1) *Aedes albopictus*
      2) *Aedes japonicus*
   c) Looking for good surveillance sites
      1) Would cemeteries work? (http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0122895)
      2) Ovitraps collected eggs of positive mosquitoes
      3) Results
         (i) Collected all three species
         (ii) Spatial clustering analysis
            (a) No clustering of *Aedes japonicus*
            (b) Positive mosquitoes were found near the point where the other two species clusters overlapped
   d) Looking for a better trap
      1) Urquhart et al, 2016, JAMCA
      2) Compared 5 trap types
         (i) BG trap
         (ii) CDC trap with dry ice
         (iii) CDC trap with lure
         (iv) Resting trap
         (v) Ovitrap
   e) Viral testing (Urquhart Thesis – University of TN)
      1) RT-LAMP

(i) Visual results
(ii) Specific for LACv
2) Currently checking field samples

f) Summary
1) CDC traps with BG lure
2) Gravid traps
3) Cemeteries for surveillance sites
4) RT-LAMP for testing
5) In progress – modeling populations

III) Lessons Learned from a Novel Tick-Borne Bunyavirus – Patricia Aguilar

a) Severe Fever with Thrombocytopenia Syndrome (SFTSV)
1) Isolated in China in 2009
2) Yu et al New England Journal of Medicine 2011)
3) Virus
(i) Bunyaviridae
(a) Phlebovirus genus
(b) Novel virus
(ii) Enveloped virus
(a) Negative sense RNA virus
(b) 3 genomic segments
(iii) Tick-borne (*Haemaphysalis longicornis*)
(iv) Closely related to Heartland virus
4) Clinical symptoms
(a) Non-specific
(b) Mortality rate 20-30% or higher

b) Public Health risk
1) Wide geographic distribution of vector
2) Variety of animals have detectable antibodies
3) Human-human transmission
4) No treatment
5) No vaccine

c) Virulence factors
1) Nonstructural protein NSs
(i) Studies done with mosquito-borne viruses
(ii) Would it be the same for tick-borne viruses?
2) Type I Interferon (IFN) has a key role in innate antiviral immunity
3) SFTSV NSs, but not NP, inhibits the induction of the Type I IFN response

IV) Sustaining Member Presentations

a) AMVAC

V) How Larvicides Work – Jeff O'Neill

a) Microbial larvicides
1) Must be ingested
2) Toxins unravel and bind to surface membranes in the larval gut
3) Makes the gut leaky

4) Particles that sink down through water column
5) Bti attaches to a lot of sites
    (i) 4 major toxins
    (ii) Works on many mosquito species
6) Bs attaches to a few sites
    (i) Two major toxins
    (ii) Both must be present to cause toxicity
    (iii) More persistent – recycles
    (iv) Narrow species spectrum
    (v) Sub-lethal effects
        (a) Decreases emergence
        (b) Prolonged larval and pupal development
        (c) Reduce energy stores in adults
7) Resistance management
    (i) Use alternate modes of action
    (ii) Mix Bti with Bs (1:10 ratio) to synergize activity
8) Practical considerations
    (i) Water temperature
    (ii) Species and stage
    (iii) Sedimentation
    (iv) Number of larvae vs AI units (density)
    (v) Wet-dry intervals
    (vi) Storage
    (vii) Alternate food supplies
    (viii) Depth of water
    (ix) Other

b) Insect growth regulators (IGRs)
1) Methoprene
    (i) Juvenile hormone mimic
    (ii) Interferes with insect growth and development
2) Insect brain secretes juvenile hormone to suppress RNA synthesis
3) Shuts off during last instar so embryonic cells can develop
4) Adding methoprene stops cellular division so insect starves in pupa without being able to develop
5) Dissolves into solution in all directions
    (i) Releases slowly into water
    (ii) Lighter than water
6) Most issues seen with microbials are not seen with IGRs

c) Spinosid
1) Mixture of fermented chemical compounds
    (i) Two active ingredients
    (ii) Tetracyclic ring with attached amino sugars
2) Not easily dissolved in water
3) Works more like an OP

(i) Binds to acetylcholine receptors
(ii) Hyper-excites the nervous system
(iii) Quick kill

4) Resistance develops very quickly (within a few years of use)
(i) Also get resistance to Bs at the same time
(ii) Be very careful using this product

Friday, April 1, 2016
Session 7

I) Sustaining Member Presentations
a) Central Life Sciences
b) AllPro

II) Invasive Species Impacting Native Disease Dynamics: A LAC Encephalitis Virus Case Study – Camille Harris
a) Vectors are part of a community
b) USGS - http://health.usgs.gov/vector_zoonotic/
c) Study – Forest Disturbance, Mosquito Vector Ecology, and LACv Dynamics in SW Virginia
1) Forest Disturbance and LAC vectors
(i) Each location had 7 different logging treatments
(ii) Work focused on 3 of the treatments
(a) Unlogged sites – fragmented controls
(b) Clear cut – removes 95%+ of canopy cover
(c) Shelter wood –
(i) Most disturbed
(ii) Youngest stand age
(iii) Added an undisturbed contiguous control site
2) Methods
(i) Set traps in each area
(ii) Looked at forest community
(iii) Vectors
(a) *Aedes triseriatus*
(b) *Aedes albopictus*
(c) *Aedes japonicus*
(d) *Culex pipiens/restuans*
(e) *Aedes Canadensis*
(f) *Aedes vexans*
(iv) Linear mixed effect models
(v) 3-year study
3) Results
(i) Disturbance
(a) *Aedes japonicus* declined
(b) *Aedes triseriatus* declined
(c) *Aedes albopictus* increased

(d) *Aedes canadensis* increased
(e) *Culex* – no preference
(f) *Aedes vexans* liked clear cut sites

(ii) Effect on LACv detection
(a) LACv detected in accessory vectors only
(i) 2 *Culex*
(ii) 1 *Aedes vexans*
(iii) 3 *Aedes japonicus??*
(iv) *Aedes albopictus??*
(v) *Aedes triseriatus* – no detection
(b) Evidence of competency of other vectors
(i) Found in eggs of *Aedes albopictus*
(ii) Nutritionally stressed larvae make better adult vectors

(iii) Conclusions
(a) Most vertical transmission occurs in undisturbed forested areas
(b) Evidence of LACv found in chipmunks on all sites
(c) It's complicated

III) Storm Water Management and Mosquitoes – Tom Smith
a) History
1) 1860s – massive industrial development
2) Disease issues drive changes to storm water management
b) Stormwater BMP
1) Hardly mentions mosquitoes at all
2) Revision on hold
c) NPDES permits
1) Use to be sure stormwater is being managed to decrease mosquito issues
2) Oddly enough, mosquitoes are protected by State fish and boat laws
d) Conservation Districts
1) Erosion and sediment control only
2) No mosquito control
e) MS4 Plan – pollutants in discharge
1) Trash
2) Pet waste
3) Illegal dumping
f) Complaints because of stormwater
1) Why is there a complaint?
(i) Algae?
(ii) Crane flies?
(iii) Mosquitoes?
2) Requires education of citizens
3) Mosquito complaints and stormwater
(i) Things that are rarely an issue
(a) Wetlands are a benefit
(b) Rain gardens are rarely a problem as long as they drain within 48 hours

(c) Sediment ponds
(i) Depends on how long the water is held
(ii) Case by case basis
(ii) Development site issues
(a) Catch basins
(b) Tires
(c) Ruts
(d) Spill pans under fuel tanks
(e) Concrete washouts
(f) Abandoned sites
(iii) Retention ponds – usually no issues
(iv) Detention ponds – BMPs can be bad practices for mosquito control
(a) No problem
(i) Dry out – no concern
(ii) Keep mowers out
(b) Problems
(i) Shallow water retention breeds mosquitoes
(ii) Riprap
(iii) Unmaintained systems
(iv) Mower activity
1. Tire ruts
2. Grass clippings
3. Resting habitat disturbed
(v) Inlet and outlet structures
(vi) Cattail marshes
(v) Sewage Treatment Plants
(vi) Road salt storage can create brackish water habitats
(vii) Flooding issues from stormwater discharge

4) Always have to check out adjoining properties for breeding sites
(i) Garbage in people's yards
(ii) Catch basins
(a) BioQuip Catch Basin Larval Dip Net
(b) Treat catch basins that are breeding
(i) Product used depends on particular situation
(ii) Variety of products available

5) Natural areas tend to have fewer mosquito problems
(i) Not disturbing area
(ii) More biodiversity
(iii) Mosquitoes tend to stay within area

IV) Community Ecology of LACv Vectors – Katie Westby

a) Trapping methods
1) Ovitrap
2) Larval collection
3) BG Sentinel

4) Aspiration

b) Infection rates
   1) Aedes albopictus
      (i) July and August
      (ii) 19 positves pools overall
   2) Aedes japonicus
      (i) Hard to collect
      (ii) 1 pool overall
   3) Aedes triseriatus
      (i) 34 positive pools overall
      (ii) Timing??

c) Species interactions
   1) Community level
      (i) Competitive
      (ii) Host-parasite
      (iii) Predator-prey
   2) Larval habitats are crucial
      (i) Immediate effects
      (ii) Carry-over effects
         (a) Longevity
         (b) Vectorial competence
         (c) Fecundity
      (iii) Container habitats
         (a) Disturbance
         (b) Establishment/ageing
         (c) Overlapping and non-overlapping cohorts
         (d) Others
   3) Field studies
      (i) Habitat size
         (a) April – September
         (b) Containers
            (i) 140 L
            (ii) 35 L
            (iii) 3.5 L
            (iv) 0.35 L
         (c) Experimentally reduced and filled containers
            (i) Did this to avoid complete drying out for entire research period
            (ii) More controlled collections
         (d) Results
            (i) Aedes japonicus
               1. Container size
                  a. Not found in small ovicup
                  b. Use a larger container
               2. Disturbance

a. Not in drying containers
b. Found in stable containers

(ii) *Aedes triseriatus*

1. No significant effect with container size
2. Not affected by drying and wetting cycles

(ii) Habitat age

(a) April – September

(b) Controlled for habitat age

(i) How many prior larvae used habitat

(ii) When other larvae used habitat

(iii) Excluded extra detritus addition

(c) Methods

(i) Placed and sealed containers at different time

1. Add a cohort of larvae
2. Remove larvae
3. Add experimental group

(ii) Had one open bucket at each block

(iii) Sampled weekly

(d) Results

(i) Older habitats had higher female survival

(ii) Habitats with no prior use appeared to be better

(iii) Un-manipulated habitat

1. Modeled data
2. 3 species found
3. *Aedes triseriatus* – week was important
4. *Aedes japonicus*

a. Week was important

b. Presence of *Culex restuans* was also important

(e) Conclusion – it's complicated

(iii) Disease ecology

(a) *Gregarine* parasites (http://pi.unl.edu/~jlogan1/PDFfiles/Rute2011paper.pdf)

(i) Infectious oocysts in water

(ii) Ingested by larvae

(iii) Develop in larva

(iv) Kill adults??

(b) Methods

(i) 2 gallon buckets

1. set 1 - remove *Aedes japonicus* every 3 days

2. set 2 - left japonicus

(ii) Manipulated resources

(iii) Results

1. Varies by species

2. Interaction between *Aedes japonicus* and *Culex restuans*

3. Presence of *Aedes japonicus* has a negative effect on gregarine parasites

State Reports

I) Delaware – Kim Brinson
   a) Wet Spring
   b) Dry summer
   c) WNV
      1) 1st case in early June
      2) 4 cases reported by local blood bank
      3) Usually don't see cases until Aug
   d) Gearing up for ZIKV – Interagency effort

II) Georgia – Fred Koehle
   a) A very wet year
   b) Low arboviral year

III) Maryland – Kyle Brinson
   a) Top 3 species
      1) *Aedes sollicitans*
      2) *Culex salinarius*
      3) *Aedes albopictus*
   b) Arboviruses
      1) No EEE
      2) WNV
         (i) 33 pools
         (ii) 45 human cases, with 5 deaths
         (iii) 2 equine
   c) Working on a plan of action for ZIKV
   d) Control
      1) 192,896 acres treated
         (i) Larviciding and adulticiding combined
         (ii) Increasing Larviciding
      2) Increasing biological control
      3) OMWM
         (i) 884 impacted acres
         (ii) Annual maintenance
   e) Lots of school education programs

IV) North Carolina – Joe Andrews
   a) Rainfall
      1) May-Aug varied from average to mild drought
      2) Sept-Dec was well above average
   b) Temperature
      1) Average until Oct
      2) Above normal for rest of year

c) Mosquito activity
    1) Average in the Spring for most of the State
    2) Below average for central part of State
    3) Above average in coastal area
    4) Arbovirus activity
        (i) WNV – 4 cases
        (ii) LAC – 10 cases
        (iii) EEE – 5 veterinary cases
        (iv) Travel related
            (a) Malaria
            (b) DEN
            (c) CHIK
            (d) ZIKV
    5) Mosquito control
        (i) 94 programs still active
        (ii) DHHS has created two new Medical Entomology positions for DPH
    6) NCMVCA held its 50th annual conference in 2015

V) Pennsylvania – Tom Smith
    a) WNV
        1) Mosquitoes
            (i) 50 species identified
            (ii) Gravid trap is primary means of surveillance
        2) arboviruses
            (i) Human cases – 30
            (ii) 2 positive horses
            (iii) 2689 positive pools with 18,000 pools tested
        3) Incorporating a VI Index GIS calculator to help target control
    b) Black fly suppression
        1) 36 participating counties
            (i) 3 main drainage basins
            (ii) Treat rivers within drainage areas
        2) Aerial control
            (i) Starts in April
            (ii) Funding issues prevent applications
    c) Ticks
        1) Task Force formed
            (i) Lyme Disease awareness
            (ii) Lyme found in every county
        2) Waiting on funding

VI) South Carolina – Travis Shealy
    a) Massive flooding in October
    b) WNV
        1) Birds – 2
        2) Humans -2 (asymptomatic blood donors)

3) Mosquitoes – 2 pools

c) CHIK
   1) 2 confirmed, 1 probable
   2) All travel-related

d) DEN
   1) 2 confirmed, 2 probable
   2) All travel-related

e) EEE
   1) 6 equines
   2) no human cases

f) LAC – one human case

g) Flavivirus
   1) 1 confirmed human case
   2) Travel-related
   3) Tested positive for DEN and ZIKV

h) Lots of Flanders and Flanders variants detected

i) http://www.scdhec.gov/mosquitoes
   1) ZIKV task Force
   2) Working on educational outreach

j) SCMCA meeting – www.scmca.net

VII) Tennessee – Ture Carlson

a) WNV
   1) 1 veterinary case
   2) 3 human cases, no deaths
   3) 695 positive pools out of 5282 tested

b) SLE
   1) 11 mosquito pools
   2) human cases?

c) LAC – 1 human case

d) Exotics (imported)
   1) CHIK – 6
   2) DEN – 8

e) Mild season

VIII) Virginia – Ann Herring

a) Above average rainfall

b) WNV
   1) 23 human cases
   2) 3 blood donor positives
   3) 1 equine
   4) 892 positive mosquito pools
   5) Sentinel chickens

c) EEE
   1) No human cases
   2) 3 equine

3) 53 positive pools
4) Sentinel chickens

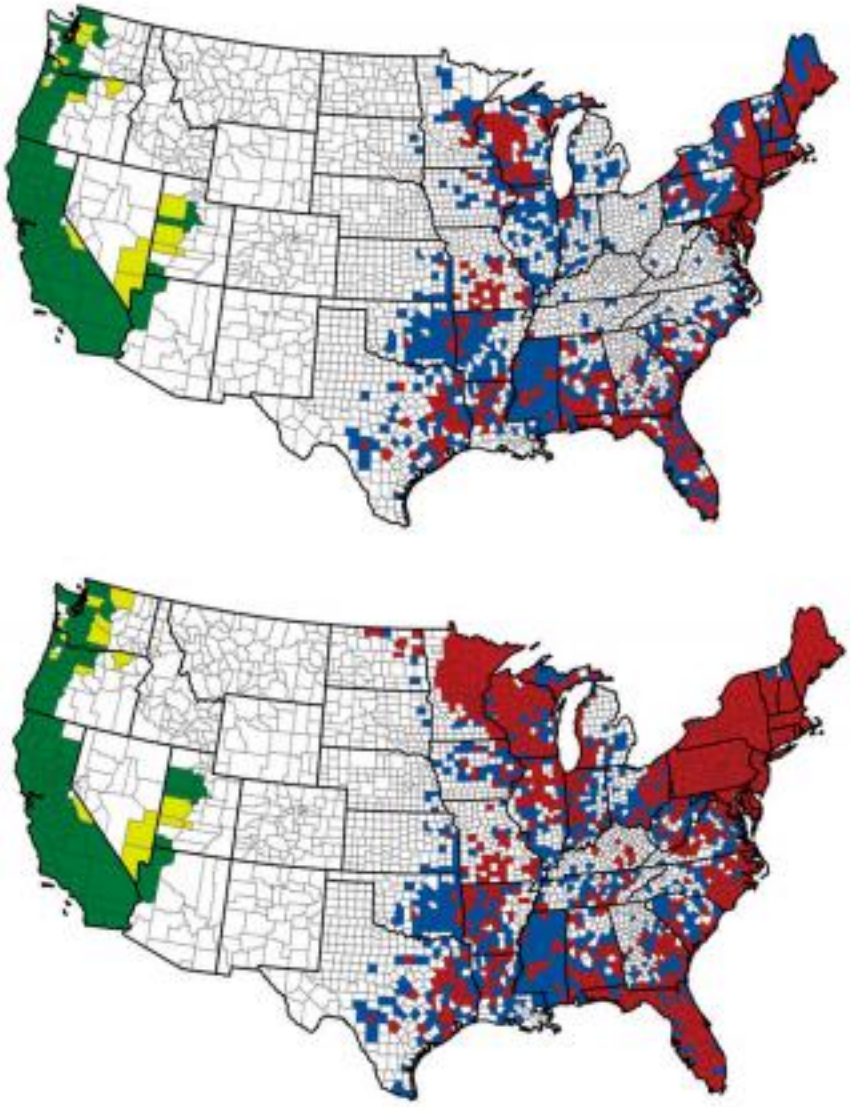
d) Exotics
1) CHIK – 24
2) DEN – 24
3) ZIKV – 2

e) Ticks
1) 1540 Lyme
2) 96 Ehrlichiosis
3) Other

IX) West Virginia – Eric Dotseth

a) Mosquito activity
1) 5 new species detected
2) Weekly sampling in LAC (May-Sept) areas
3) Infection rates
(i) 37 WNV+
(ii) No human cases
4) LAC
(i) 4 human cases
(ii) None found in mosquitoes
5) Exotics
(i) CHIK – 0
(ii) DEN – 4
(iii) Malaria – 2

b) Ticks
1) Disease
(i) Tularemia - 0
(ii) Lyme – 280
(a) Endemic counties
(b) Added 5 new ones in 2015
(c) Increasing throughout state
(d) Response
(i) Physician education
(ii) Tick surveillance
(iii) Collaboration with veterinarians
(iv) DNR Deer Ectoparasite Survey - discontinued
(iii) SFGR - 10
(iv) Ehrlichiosis – 6
2) Ticks
(i) Eisin maps - Eisen, RJ. et al. County-Scale Distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the Continental United States. J Med Entomol. 2016; doi:10.1093/jmetjv237



(ii) Ticks are spreading
(iii) Looking at rodent reservoirs