Arthropod-Borne Animal Diseases Research Unit
2018 Update

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Arthropod-Borne Animal Diseases Research Unit
Center for Grain and Animal Health Research
Manhattan, Kansas
ABADRU Mission

Identify and solve major endemic, emerging, and exotic arthropod-borne disease challenges in U.S. livestock
ABADRU Research

Supported by two ARS National Programs

- **Animal Health (NP103)**
  - Orbivirus Pathogenesis, Epidemiology, and Control Measures
  - Rift Valley Fever Pathogenesis, Epidemiology, and Control Measures
  - Japanese Encephalitis Virus Prevention and Mitigation Strategies
  - Ecology of Vesicular Stomatitis Virus (VSV) in North America

- **Veterinary, Medical, and Urban Entomology (NP104)**
  - Ecology and Control of Insect Vectors
ABADRU Personnel

Research Leader
- *Vacant*

Scientists
- Stephen Behan – Veterinary Medical Officer
- Lee Cohnstaedt – Research Entomologist
- Barbara Drolet – Research Microbiologist
- Scott McVey – Center Director, Supervisory VMO
- Dana Mitzel – Research Molecular Biologist
- Dana Nayduch – Research Molecular Biologist
- Leela Noronha – Research Veterinary Medical Officer
- William Wilson – Acting Research Leader, Research Microbiologist
- *Vacant – Research Entomologist*
- *Vacant – Computational Biologist*
Objectives:
Determine vector biology and environmental maintenance of orbiviruses to inform future surveillance programs.

Identify determinants of orbiviral replication in vertebrate and invertebrate hosts.
**BTV/EHDV Bovine Serology Multiplex FMIA**  
(Fluorescent Microsphere Immunoassay)

**FMIA validation with experimental and field outbreak sera**

**NEXT:** In collaboration with Sam Wisely (Univ FL), we will develop a multiplex EHDV FMIA for white-tailed deer. It will be a BTV/EHDV differential and able to discern the EHDV serotype(s) to which the deer have been exposed. Assay will be transferred to UFL. Data will be used to inform EHDV surveillance efforts in WTD.
Transcriptome response of *C. sonorensis* to EHDV-2 infection revealed effect on nervous system and tissue integrity, especially vision, olfaction, sensory + memory.

2401 differentially expressed genes:

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<th>Log₂ FC</th>
<th>953 up (40%)</th>
<th>1448 down (60%)</th>
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n=29 genes upregulated: 8 vision, 9 olfaction, 10 other sensory functions, 16 related to brain function, memory or learning

n=122 genes downregulated: 62 vision, 35 olfaction, 32 other sensory functions, 59 related to brain function, memory or learning

GO enriched KEGG pathways

Downregulation of multiple genes involved with axon guidance, cell cytoskeleton and cell adherens/tissue integrity

Possible mode of dissemination and/or modulation of midge behavior?
**In situ Temporal-Spatial Virus-Host Interaction Studies**

**EHDV in *Culicoides* midges**

Midgut Replication

Disseminated Replication

Competence threshold

Blood meal

EIP

**NEXT**: In collaboration with Luis Rodriguez, we will be using similar techniques to examine how vesicular stomatitis virus genetic variations affect vector competence to predict which Mexican VSV strains pose a risk of incursion into the U.S.
Rift Valley Fever Pathogenesis, Epidemiology, and Control Measures

Objectives:
Identify factors associated with Bunyaviridae (Rift Valley Fever virus) infections, pathogenesis, and maintenance in arthropod vector and vertebrate animal hosts

Identify epidemiological and ecological factors affecting the inter-epidemic cycle and disease emergence caused by Bunyaviridae (Rift Valley Fever virus)
DIVA compatible RVFV diagnostics

A. Gn target- before challenge
B. Np target- before challenge

C. Gn target- after challenge
D. Np target- after challenge

Evaluation of Fluorescence Microsphere Immunoassay for Detection of Antibodies to Rift Valley Fever Virus Nucleocapsid Protein and Glycoproteins


Department of Diagnostic Medicine and Pathobiology, College of Veterinary Medicine, Kansas State University, Manhattan, Kansas, USA
Arthropod-Borne Animal Diseases Research Unit, USDA, ARS, Manhattan, Kansas, USA

## RVF in WTD

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*RVF in White-Tailed Deer (Odocoileus virginianus) in Infectious Disease Research*

*Using White-tailed Deer (Odocoileus virginianus) in Infectious Disease Research*
Objective:

Identify factors associated with Flavivirus infections, pathogenesis, and maintenance in vectors and animal hosts to inform prevention and mitigation strategies.
Japanese encephalitis virus epidemiological modeling

- If introduced JEV is a significant threat to US agriculture and epidemiological modeling will identify the key transmission factors guide disease management strategies.
- Identified the epidemiological role of likely mosquito vector species and vertebrate reservoirs world-wide.
- Quantified the pathogen transmission parameters of the mosquito vectors for use in epidemiological models.
Japanese encephalitis virus pig studies

North American domestic pigs are susceptible to experimental infection with Japanese encephalitis virus

So Lee Park1,2, Yan-Jang S. Huang1,2, Amy C. Lyons1,2, Victoria B. Ayers1,2, Susan M. Hettenbach2, D. Scott McVey4,3, Kenneth R. Burton4,3, Stephen Higgs1,2, and Dana L. VanLandingham1,2

Shedding of Japanese Encephalitis Virus in Oral Fluid of Infected Swine

Amy C. Lyons1,2, Yan-Jang S. Huang1,2, So Lee Park1,2, Victoria B. Ayers1,2, Susan M. Hettenbach2, Stephen Higgs1,2, D. Scott McVey4,3, Leela Noronha3, Wei-Wen Hsu4, and Dana L. VanLandingham1,2
Ecology and Control of Insect Vectors

Objectives

Perform risk assessment of bacterial pathogen transmission by house flies

Determine biological characteristics of mosquito vectors influencing animal health in a changing climate

Develop methods to reduce biting midge transmission of animal pathogens
This was an invited protocol article describes how the bioassay arena can be used to evaluate photo attraction in the lab prior to costly and time consuming field trials.

The arena and protocol have been used to evaluate mosquito, biting midge, psocids, house flies, flour beetles, and most recently Hessian flies. This bioassay is currently being used in Thessaloniki, Greece during Dr. Cohnstaedt’s sabbatical to evaluate photo attraction for animal pests/disease vectors (biting midges, phlebotomine sand flies, and biting midges) and agricultural pest (olive fly).
Transcriptome response of *M. domestica* to high and low doses of *Salmonella* shows dose-dependent immune response to ingestion of pathogen and revealed new AMPs

- Dose dependent expression of 9 antimicrobial peptides (AMPs) and 2 neg regulators
- “Threshold” dose for AMP induction – flies do not respond as much to the lower amount of bacteria – use feedback mechanism
- Impact on vector potential: Low doses of bacteria may pass right through fly and will be excreted

(Log$_{10}$ CPM = normalized counts per million reads)

- 7 of 9 AMPs that were upregulated with high dose belong to Attacin superfamily
- Discovery of new group of glycine-rich AMPs in flies (“glypeps”)

*DE with HD *Salmonella* ingestion*
Thank you