Perspectives on the Mosquitoes of Wisconsin and the Upper Midwest

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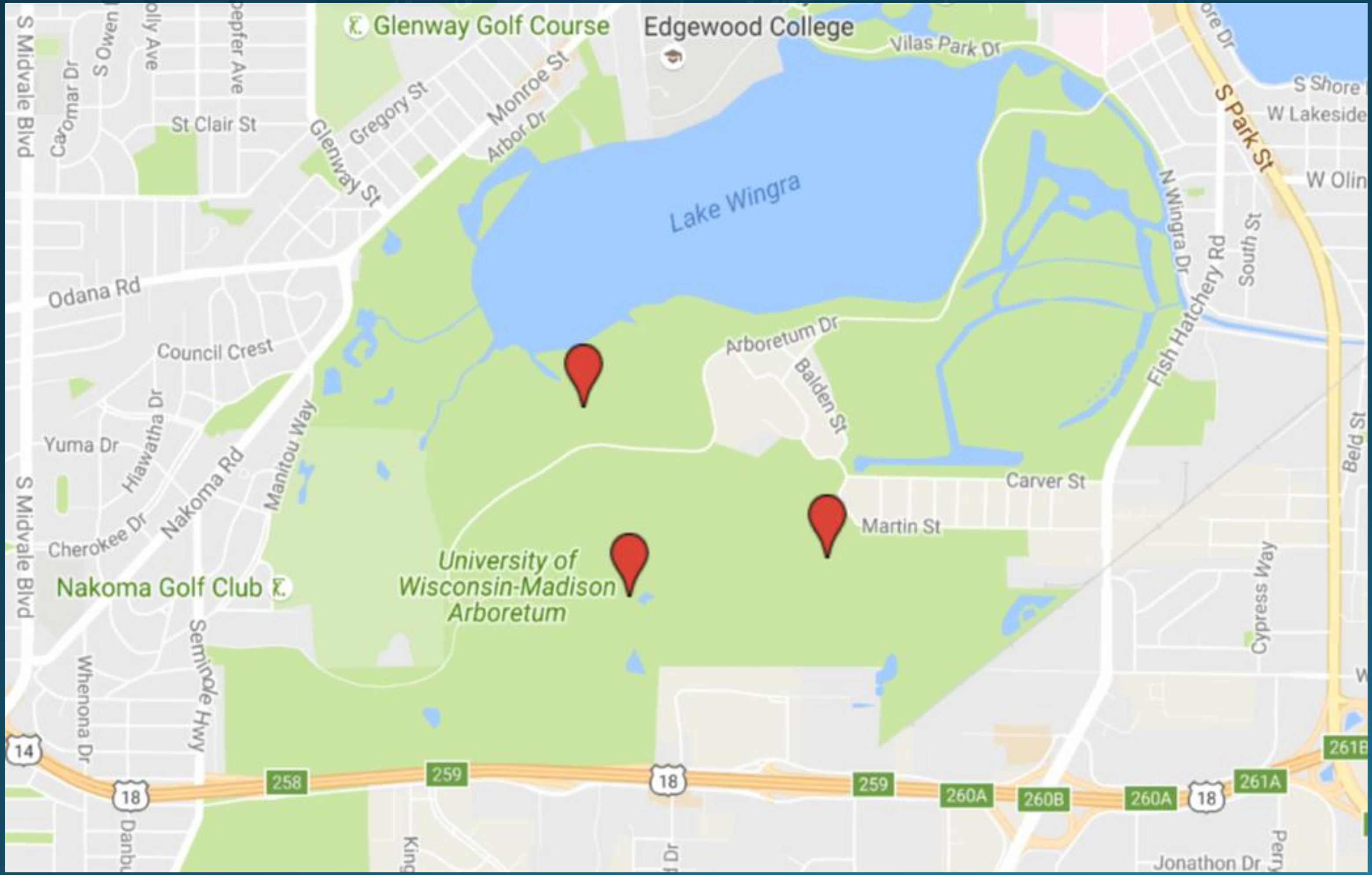
Where do we get the data on mossies in the Upper Midwest?

- Universities
  - Land Grant Universities, in particular, with Departments of Entomology and faculty with expertise in Medical Entomology
- State Government
  - Departments of Public Health/Health/Health Services
  - State Medical Entomologist (State of Illinois)
- Mosquito Abatement Districts
  - Tax-based – present in MN, IL, MI – not in IA or WI

For example, biodiversity assessment of the UW-Madison Arboretum 2016-



UNIVERSITY OF WISCONSIN–MADISON
Arboretum
Restoring Land and Enriching Lives

Biodiversity assessment of the UW-Madison Arboretum 2016-

- Three trapping sites:
  - CDC-light traps baited with CO_2
  - From 4 pm to 9 am (17 hours)
- Mosquitoes identified to species:
  - Vouchers deposited in the WIRC

WISCONSIN
INSECT
RESEARCH
COLLECTION

Figure 4. Total number of collected mosquitoes (circle sizes represent percentage of total)

Biodiversity assessment of the UW-Madison Arboretum 2016-

21 species collected:

Aedes cinereus

Aedimorphus vexans vexans

Anopheles (Anopheles) perplexens

Anopheles (Anopheles) punctipennis

Anopheles (Anopheles) quadrimaculatus s.l.

Anopheles (Anopheles) smaragdinus

Coquillettidia (Coquillettidia) perturbans

Culex pipiens

Culex restuans

Culex territans

Culex salinarius

Culiseta (Culiseta) inornata

Hulecoeteomyia japonica japonica

Ochlerotatus (Culicada) canadensis canadensis

Ochlerotatus (Ochlerotatus) trivittatus

Ochlerotatus punctor

Ochlerotatus sticticus

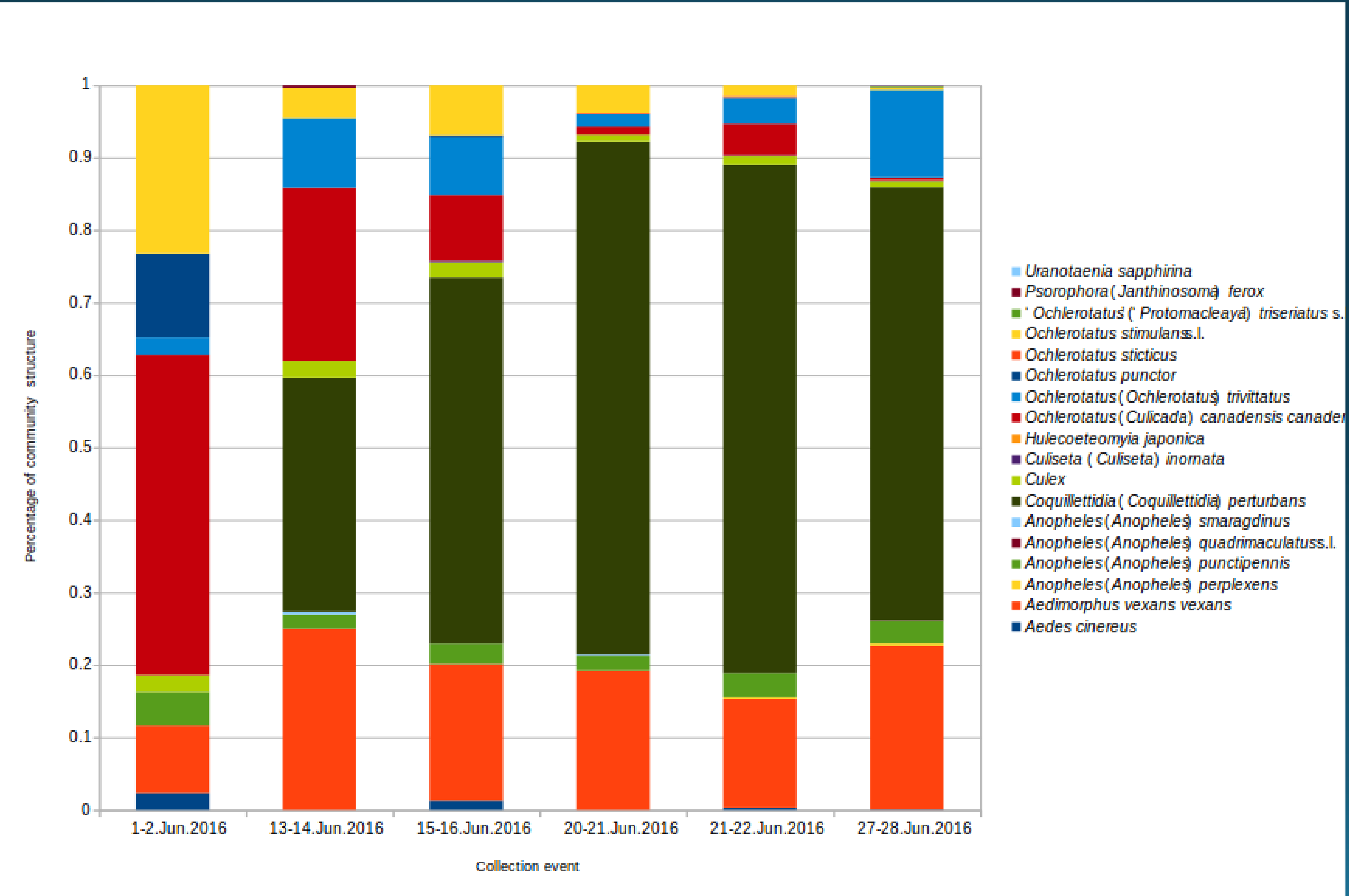
Ochlerotatus stimulans s.l.

'Ochlerotatus' ('Protomacleaya') triseriatus

Psorophora (Janthinosoma) ferox

Uranotaenia sapphirina

Biodiversity assessment of the UW-Madison Arboretum 2016-



A catalog of mosquitoes – WI and IA

- WISCONSIN
- Museum specimens and published papers reveal
    - 61 species

- IOWA
- Surveillance data from 1966-present reveal
    - 55 species of mosquito

State-state examples of mosquito surveillance strategies

Wisconsin and Iowa

Arbovirus Surveillance in Wisconsin

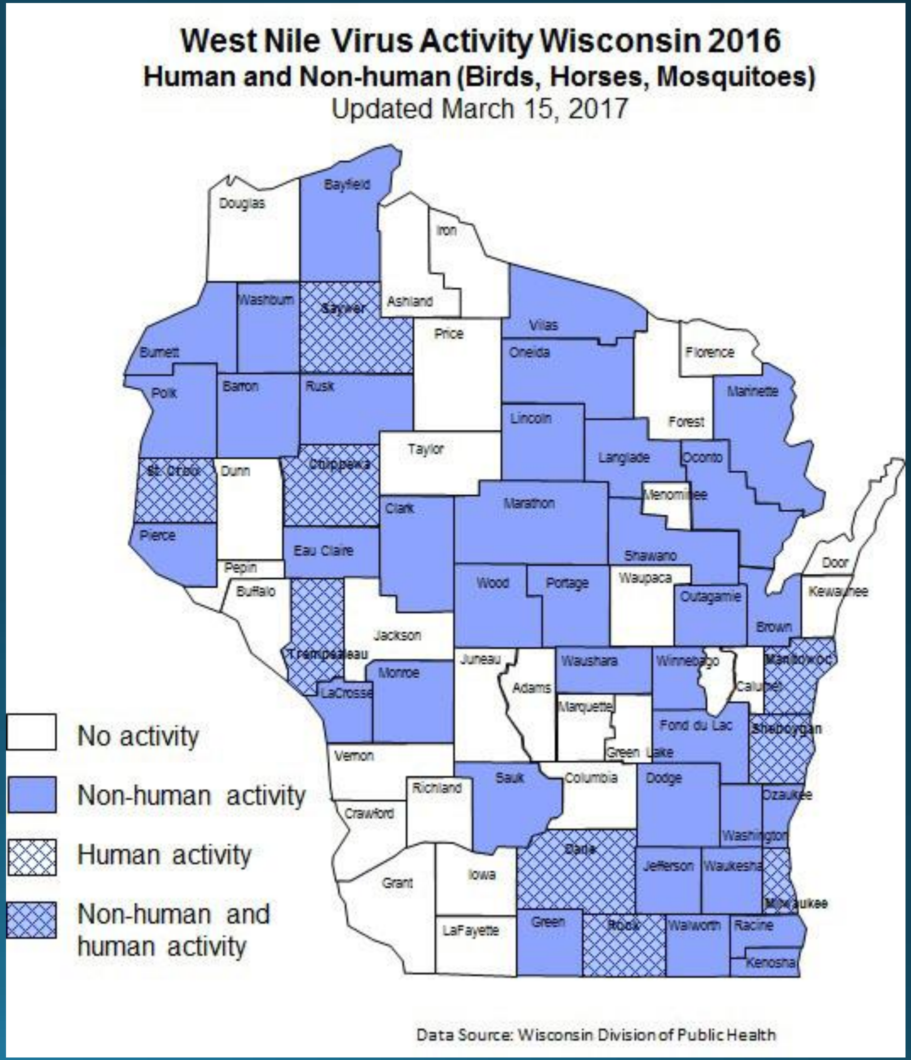
- Partnership between SM Paskewitz laboratory (Department of Entomology, UW-Madison) and WI Department of Health Services

2016 Annual Wisconsin Summary Data
Positive WNV Cases - Updated March 15, 2017

Avian (bird)	59
Equine (horse)	7
Mosquito pools	11
Human confirmed	12
Human probable*	0
Deaths **	2
Hospitalizations	10
Counties reporting WNV activity	45

* Probable cases have presumptive positive laboratory results without confirmatory testing at CDC.

** The deaths are included among the confirmed and probable cases.

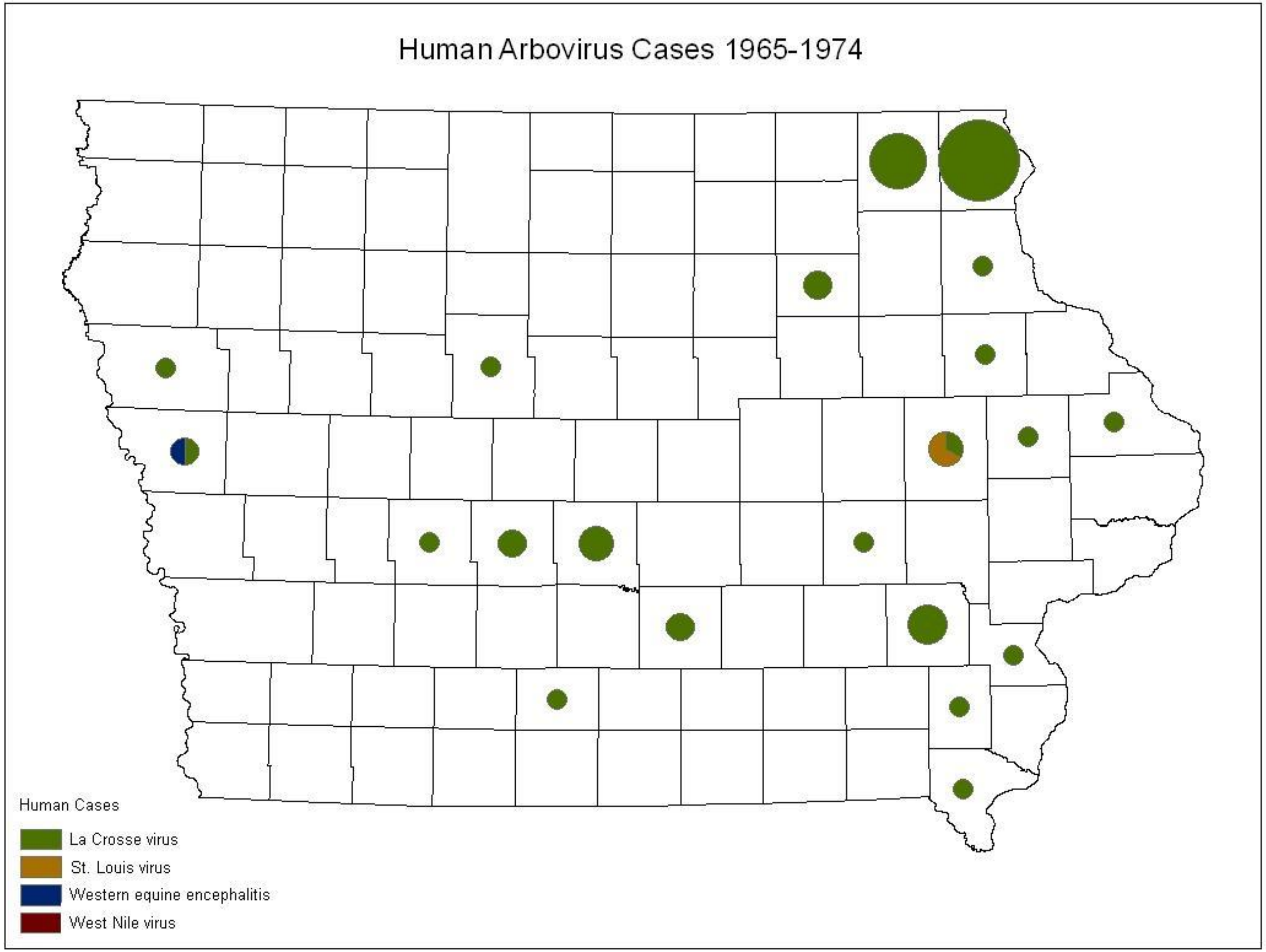


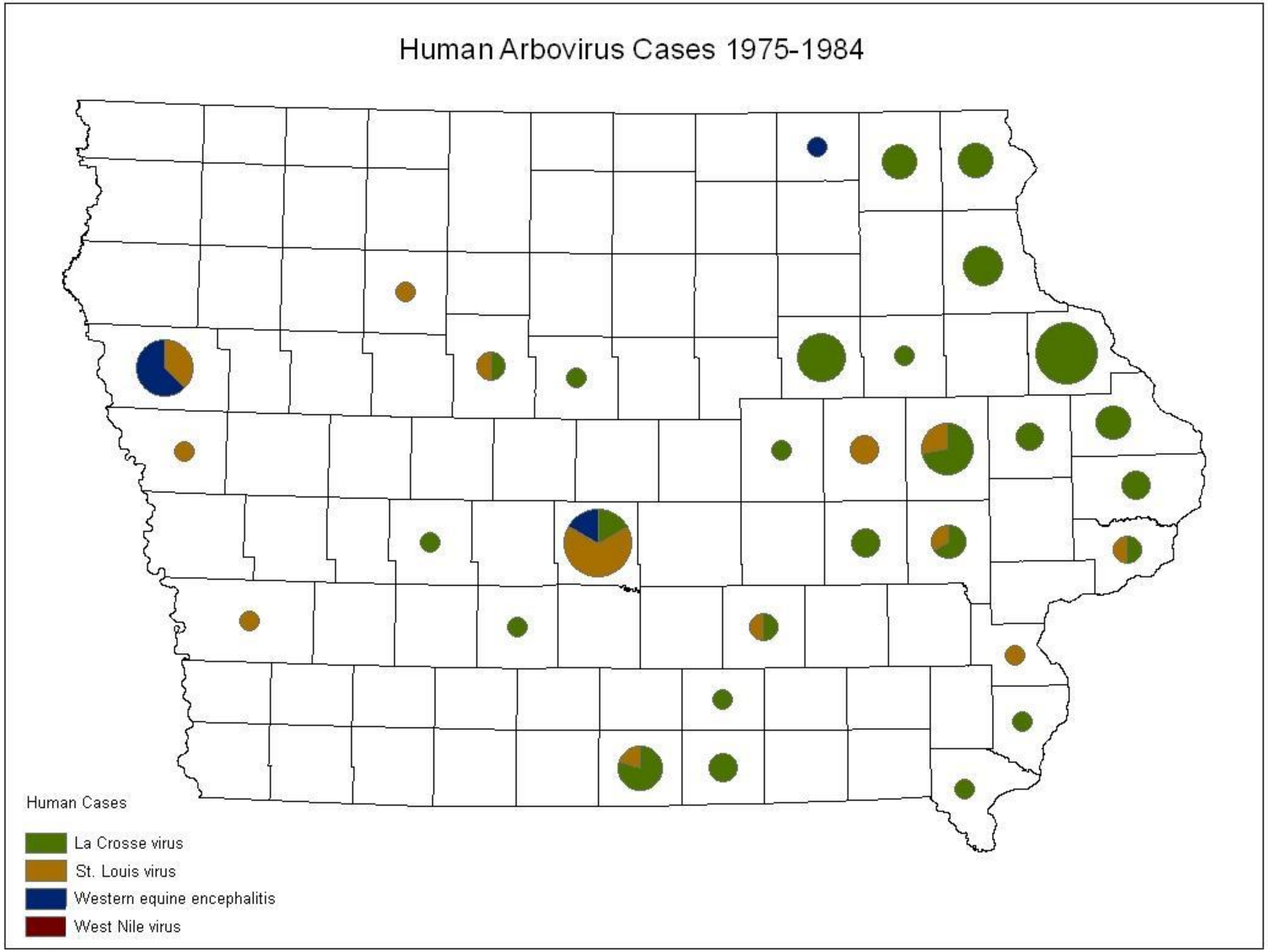
Arbovirus Surveillance in Iowa

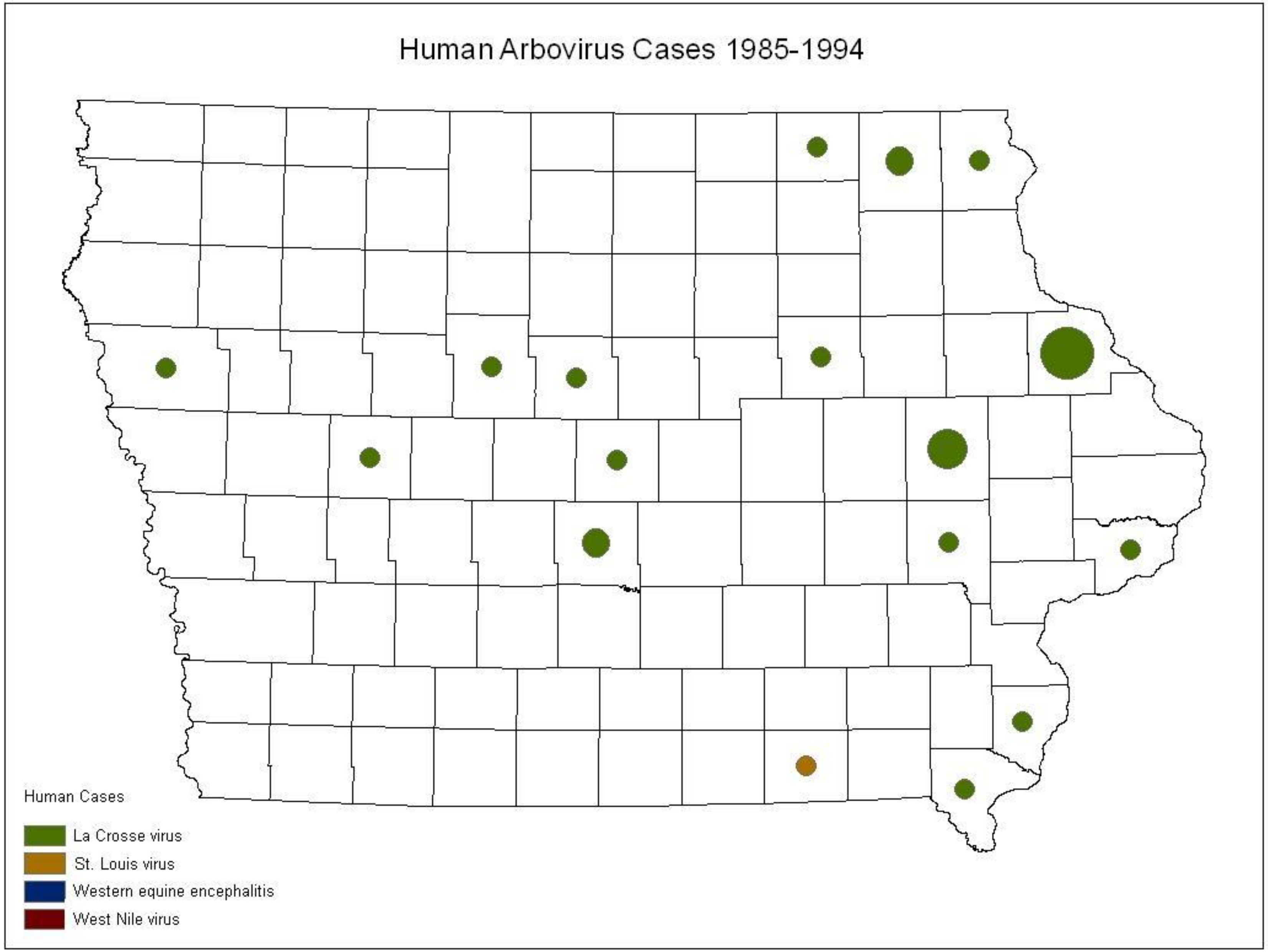
- Initiated in 1966
  - Wong et al. (1970) Arbovirus encephalitis surveillance in Iowa. *Health Lab Sci* 7(3): 117-123.
  - Operated continuously in the absence of consistent tax-based support
    - Shoulders of giants
    - College of Agriculture and Life Sciences, ISU
    - Agricultural Experiment Station
    - Iowa Department of Public Health
    - Centers for Disease Control
- Has involved:
  - Sentinel program for vertebrate exposure

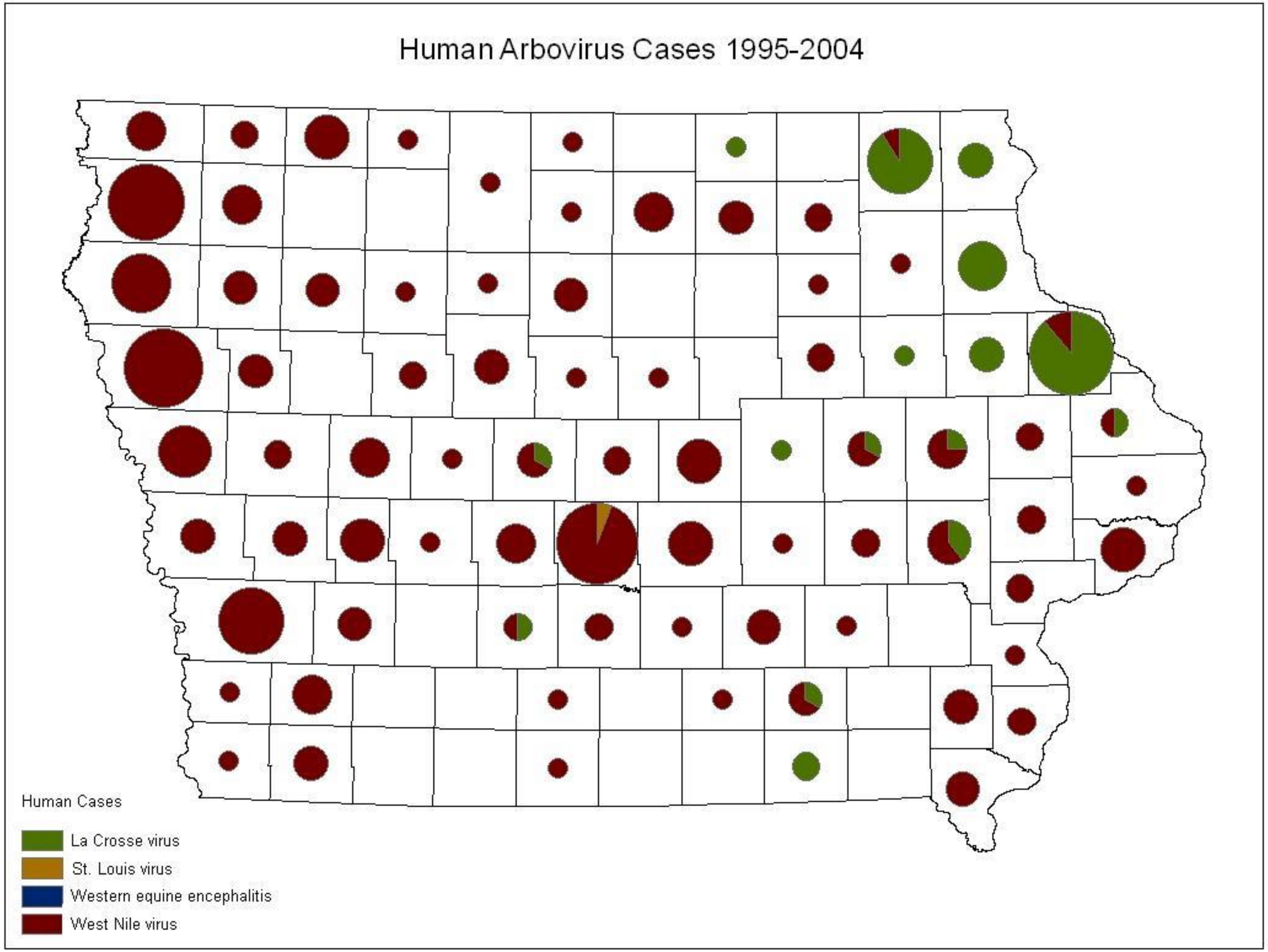
Arbovirus Surveillance in Iowa

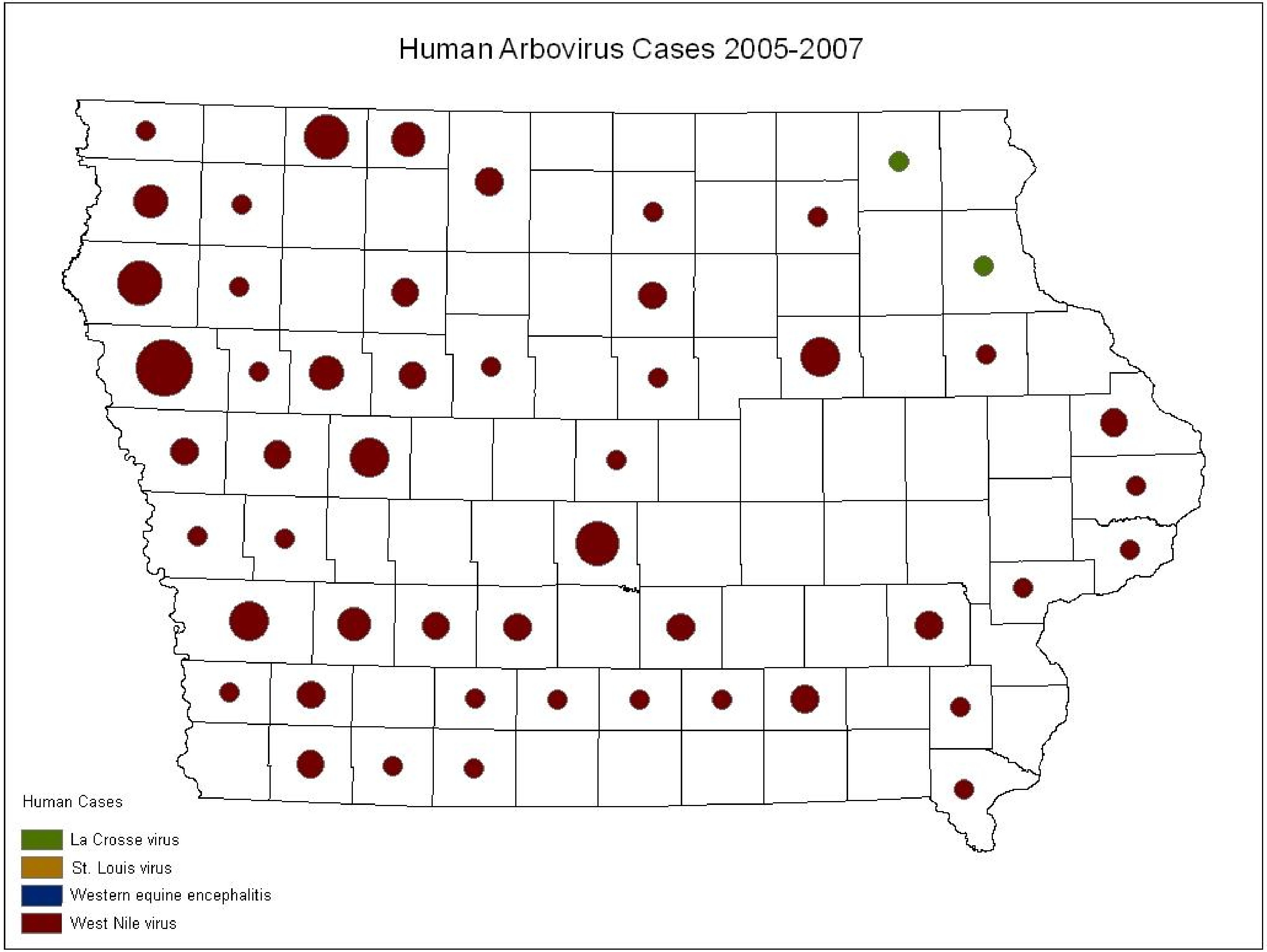
- Comprehensive approach. . .
  - Epidemiologic investigations
    - Case follow-up and reporting
      - Data from 1966-2007 show sweeping arbovirus epidemics over time

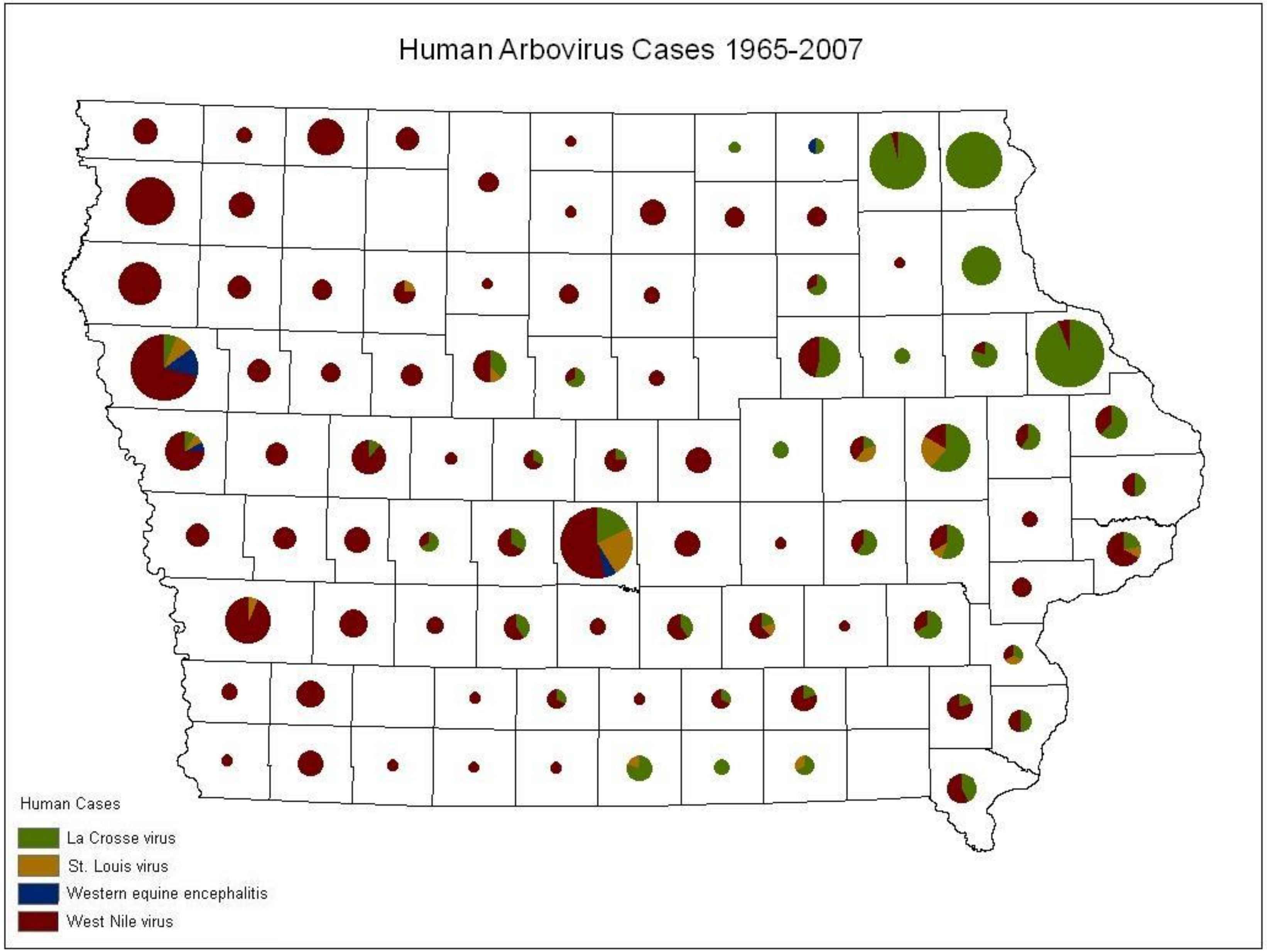

Human Arbovirus Cases 1965-1974
Human Cases
La Crosse virus
St. Louis virus
Western equine encephalitis
West Nile virus


Human Arbovirus Cases 1975-1984
Human Cases
La Crosse virus
St. Louis virus
Western equine encephalitis
West Nile virus


Human Arbovirus Cases 1985-1994
Human Cases
La Crosse virus
St. Louis virus
Western equine encephalitis
West Nile virus


Human Arbovirus Cases 1995-2004
Human Cases
La Crosse virus
St. Louis virus
Western equine encephalitis
West Nile virus


Human Arbovirus Cases 2005-2007
Human Cases
La Crosse virus
St. Louis virus
Western equine encephalitis
West Nile virus


Human Arbovirus Cases 1965-2007
Human Cases
La Crosse virus
St. Louis virus
Western equine encephalitis
West Nile virus

Arbovirus Surveillance in Iowa

- Comprehensive approach. .
  - Trapping and processing mosquitoes
    - Species composition, abundance, seasonal distribution
    - Virus isolation or identification

  - Sentinel program for vertebrate exposure

Trapping. . .

Arbovirus Surveillance – Sentinel Chickens

- Flocks cared for by local Public and Environmental Health agencies
- Chicken bled once/week and serum tested for arbovirus antibodies

The invaluable nature of a long-term mosquito surveillance program and dataset

Richness, diversity, abundance, phenology of mosquito species

Decades of Mosquito Presence and Abundance Data

VECTOR-BORNE DISEASES, SURVEILLANCE, PREVENTION

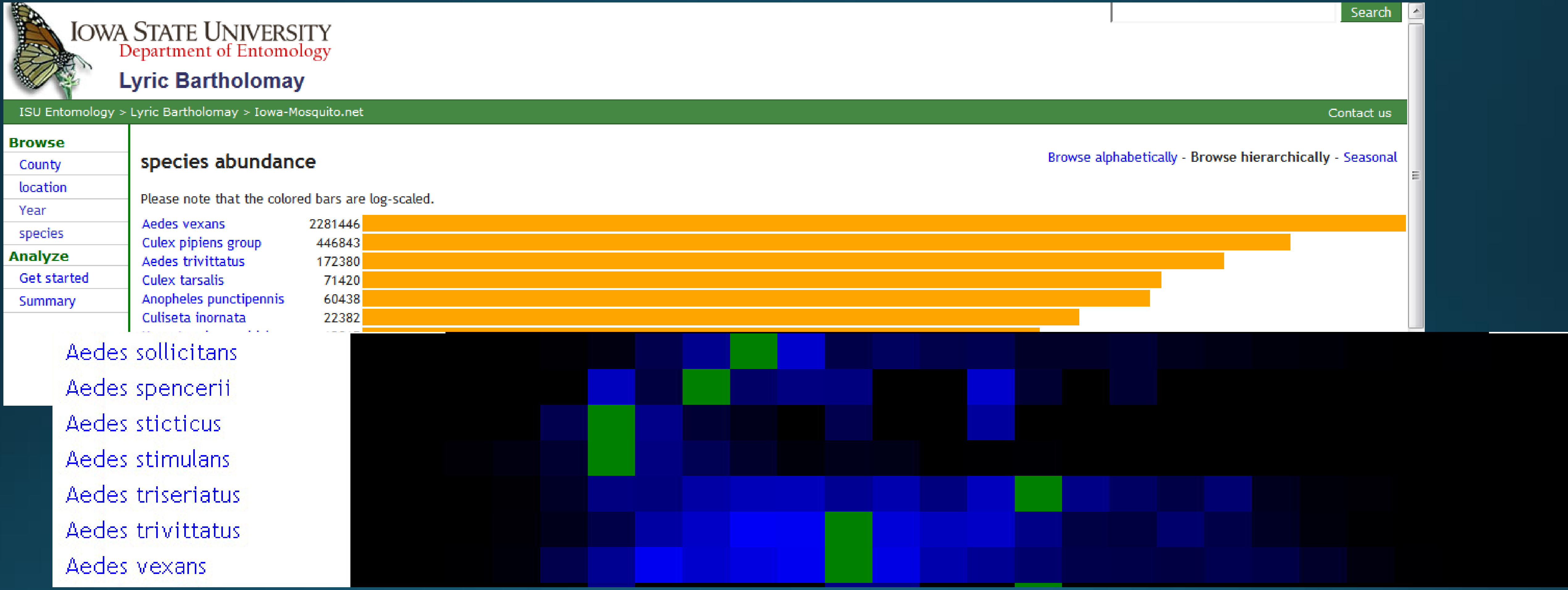
A Web-based Relational Database for Monitoring and Analyzing Mosquito Population Dynamics

YVES SUCAET,[1,2] JOHN VAN HEMERT,[1,2] BRAD TUCKER,[3] AND LYRIC BARTHOLOMAY[3]

J. Med. Entomol. 45(4): 775–784 (2008)

ABSTRACT Mosquito population dynamics have been monitored on an annual basis in the state of Iowa since 1969. The primary goal of this project was to integrate light trap data from these efforts into a centralized back-end database and interactive website that is available through the internet at http://iowa-mosquito.ent.iastate.edu. For comparative purposes, all data were categorized according to the week of the year and normalized according to the number of traps running. Users can readily view current, weekly mosquito abundance compared with data from previous years. Additional interactive capabilities facilitate analyses of the data based on mosquito species, distribution, or a time frame of interest. All data can be viewed in graphical and tabular format and can be downloaded to a comma separated value (CSV) file for import into a spreadsheet or more specialized statistical software package. Having this long-term dataset in a centralized database/website is useful for informing mosquito and mosquito-borne disease control and for exploring the ecology of the species represented therein. In addition to mosquito population dynamics, this database is available as a standardized platform that could be modified and applied to a multitude of projects that involve repeated collection of observational data. The development and implementation of this tool provides capacity for the user to mine data from standard spreadsheets into a relational database and then view and query the data in an interactive website.

http://www.iowa-mosquito.net



mosquito.ent.iastate.edu/browse_species_.php

Sucaet, VanHemert, Tucker and Bartholomay (2008) *J Med Entomol*

Journal of the American Mosquito Control Association, 30(2):119–121, 2014

SCIENTIFIC NOTE

A TAXONOMIC CHECKLIST OF THE MOSQUITOES OF IOWA

BRENDAN M. DUNPHY, WAYNE A. ROWLEY AND LYRIC C. BARTHOLOMAY[1]

Department of Entomology, Iowa State University, Ames, IA 50011

ABSTRACT. The last published report of the mosquito species composition present in the state of Iowa was published in 1969 and included 43 species in 8 genera. Since that time, reassessment of specimens in the Iowa State Insect Collection and annual mosquito surveillance efforts have yielded 12 new species records, bringing the total to 55 species in 8 genera. In addition to providing an updated taxonomic checklist for the state of Iowa, abundance information is provided for each species using specimen counts from New Jersey light trapping events that span 45 years.

[1] Each species is listed alphabetically according to genus and has been assigned an abundance rating based on total specimens collected by New Jersey light trapping (NJLTs) events that took place between 1969 and 2013, with the following delineations: extremely abundant (>1,000,000), very abundant (100,000–999,999), abundant (10,000–99,999), common (1,000–9,999), uncommon (100–999), rare (10–99), very rare (1–9), and extremely rare (never collected by NJLTs, only by other traps).

Vector status – Genus *Aedes*

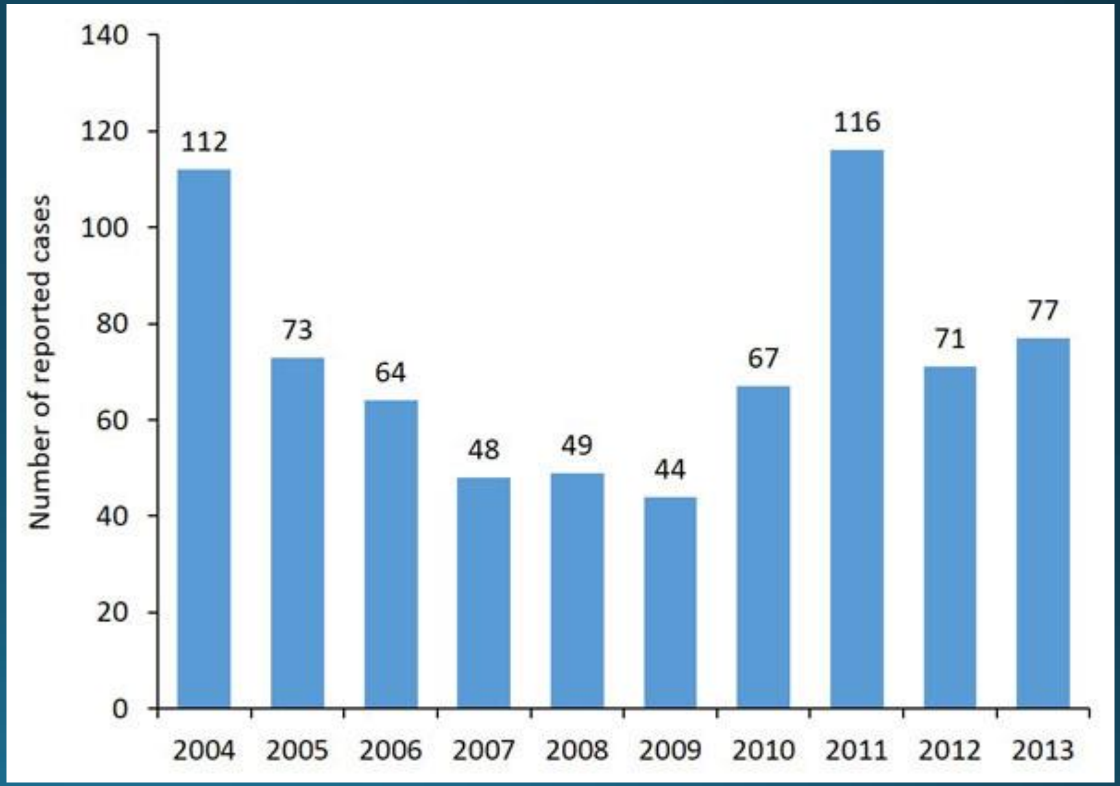
Table 1. Mosquitoes of Iowa according to genus, collection frequency, and whether or not specimens have been collected annually since 1st capture in New Jersey light trapping events from 1969 to 2013.[1]

	Species	Collection frequency	Annual
Genus *Aedes* Meigen			
1	*Aedes* (*Aedes*) *cinereus* Meigen	Rare	–
✷ 2	*Ae.* (*Aedimorphus*) *vexans* (Meigen)	Extremely abundant	+
✷ 3	*Ae.* (*Finlaya*) *japonicus japonicus* (Theobald)	Common	+
4	*Ae.* (*Ochlerotatus*) *atropalpus* (Coquillett)	Rare	–
5	*Ae.* (*Och.*) *aurifer* (Coquillett)	Very rare	–
6	*Ae.* (*Och.*) *campestris* (Dyar and Knab)	Rare	–
7	*Ae.* (*Och.*) *canadensis canadensis* (Theobald)	Uncommon	+
8	*Ae.* (*Och.*) *dorsalis* (Meigen)	Common	+
9	*Ae.* (*Och.*) *dupreei* (Coquillett)	Very rare	–
10	*Ae.* (*Och.*) *fitchii* (Felt & Young)	Extremely rare	–
11	*Ae.* (*Och.*) *flavescens* (Müller)	Very rare	–
12	*Ae.* (*Och.*) *implicatus* (Vockeroth)	Extremely rare	–
13	*Ae.* (*Och.*) *nigromaculis* (Ludlow)	Common	+
14	*Ae.* (*Och.*) *punctor* (Kirby)	Very rare	–
15	*Ae.* (*Och.*) *riparius* (Dyar and Knab)	Extremely rare	–
16	*Ae.* (*Och.*) *sollicitans* (Walker)	Common	+
17	*Ae.* (*Och.*) *spencerii spencerii* (Theobald)	Rare	–
18	*Ae.* (*Och.*) *sticticus* (Meigen)	Abundant	+
19	*Ae.* (*Och.*) *stimulans* (Walker)	Uncommon	–
✷ 20	*Ae.* (*Och.*) *trivittatus* (Coquillett)	Abundant	+
21	*Ae.* (*Protomacleaya*) *hendersoni* (Cockerell)	Uncommon	+
22	*Ae.* (*Pro.*) *triseriatus* (Say)	Common	+
23	*Ae.* (*Stegomyia*) *albopictus* (Skuse)	Very rare	–

Vector status – *Aedes triseriatus*

Aedes triseriatus – the Eastern tree hole mosquito

La Crosse virus neuroinvasive disease cases reported by year, 2004–2013



LaCrosse Encephalitis & LACV

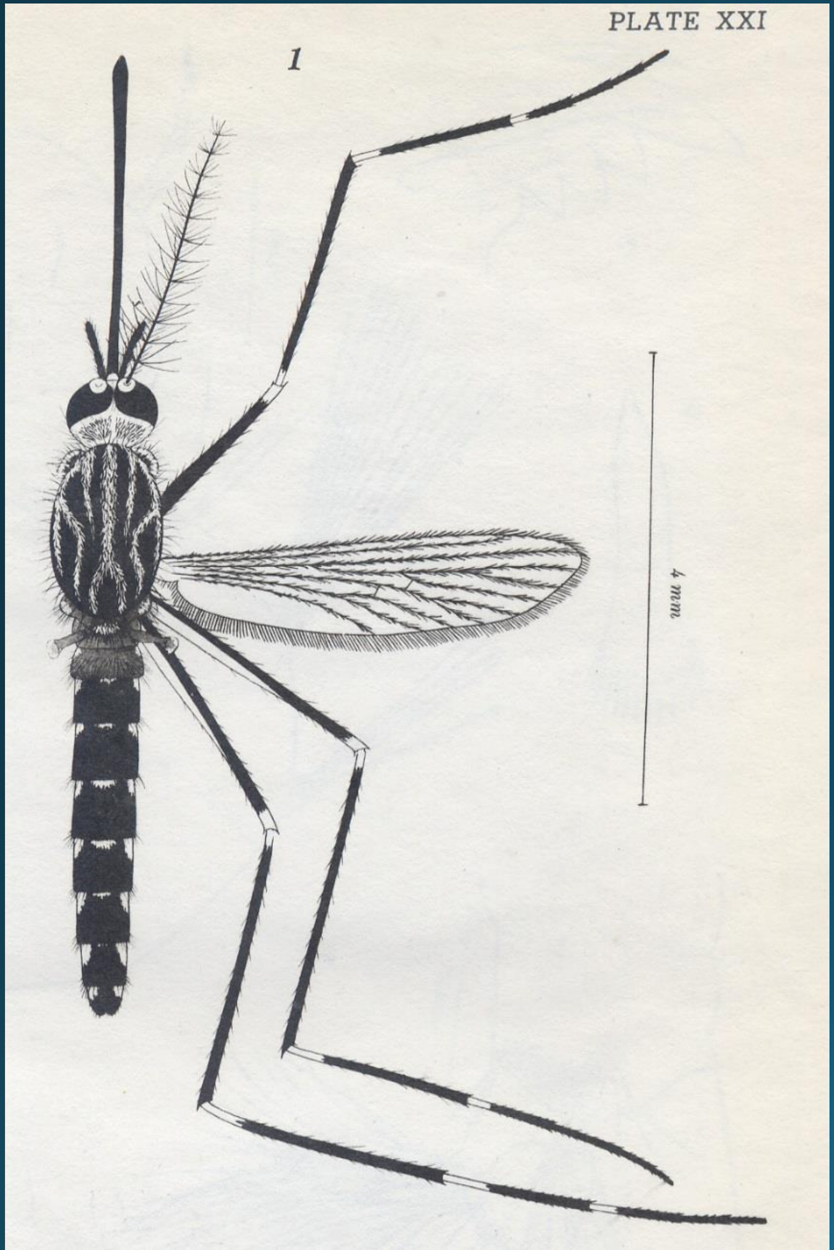
- A leading cause of infectious pediatric encephalitis
- Most often seen in Midwestern and Mid-Atlantic states
- Prior to WNV, most commonly reported arbovirus in U.S.

  - Long-term consequences of infection
    - Seizures
    - Learning disabilities
    - Cognitive defects

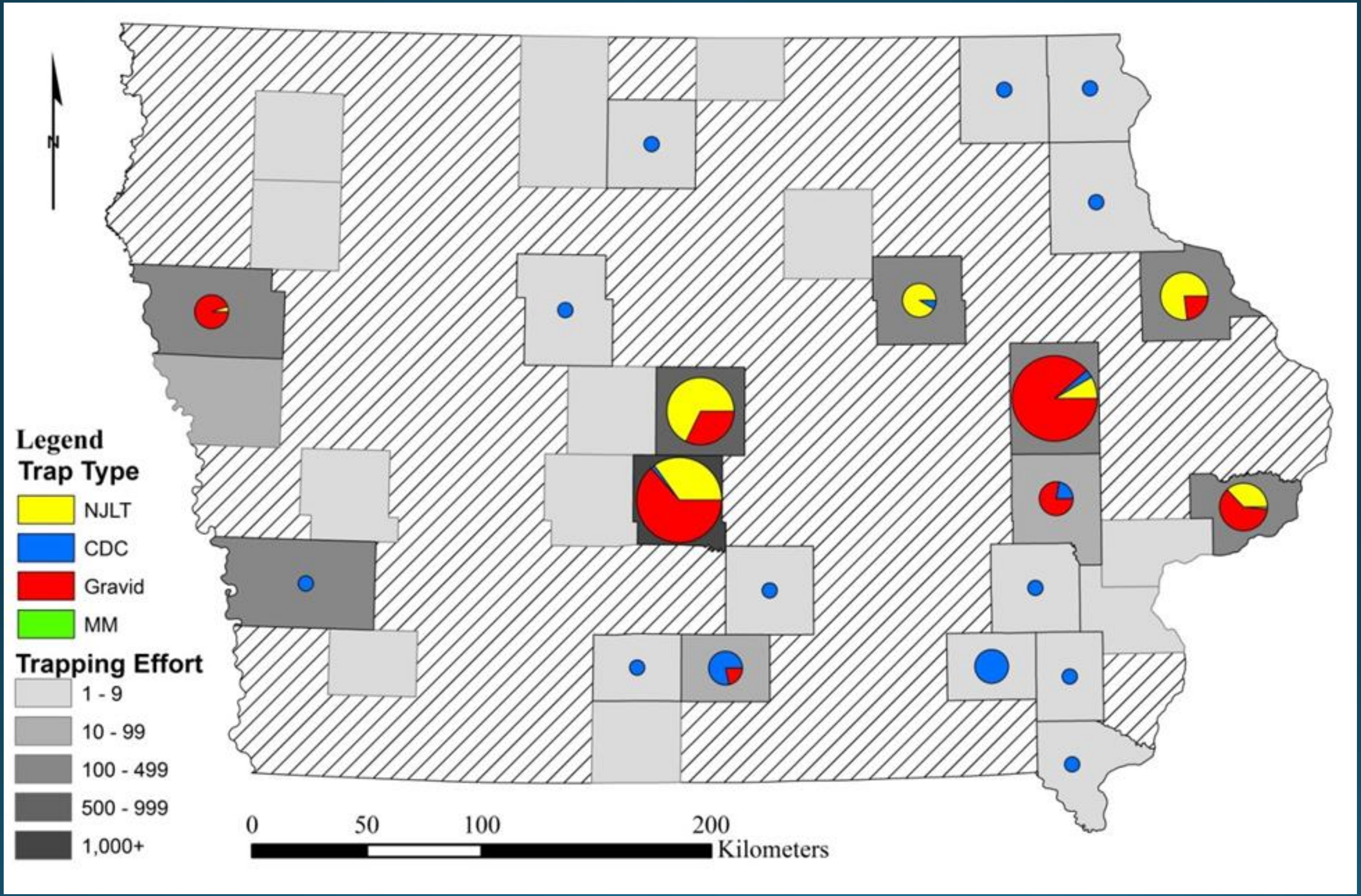
Boy dies from LaCrosse encephalitis

Fifteen-year-old Christopher Doyle died Aug. 11 2006 from LaCrosse encephalitis. He died just 10 days before he was to start his freshman year at North Side High School. Fort Wayne, IN.

Aedes japonicus first discovered in Iowa in 2007



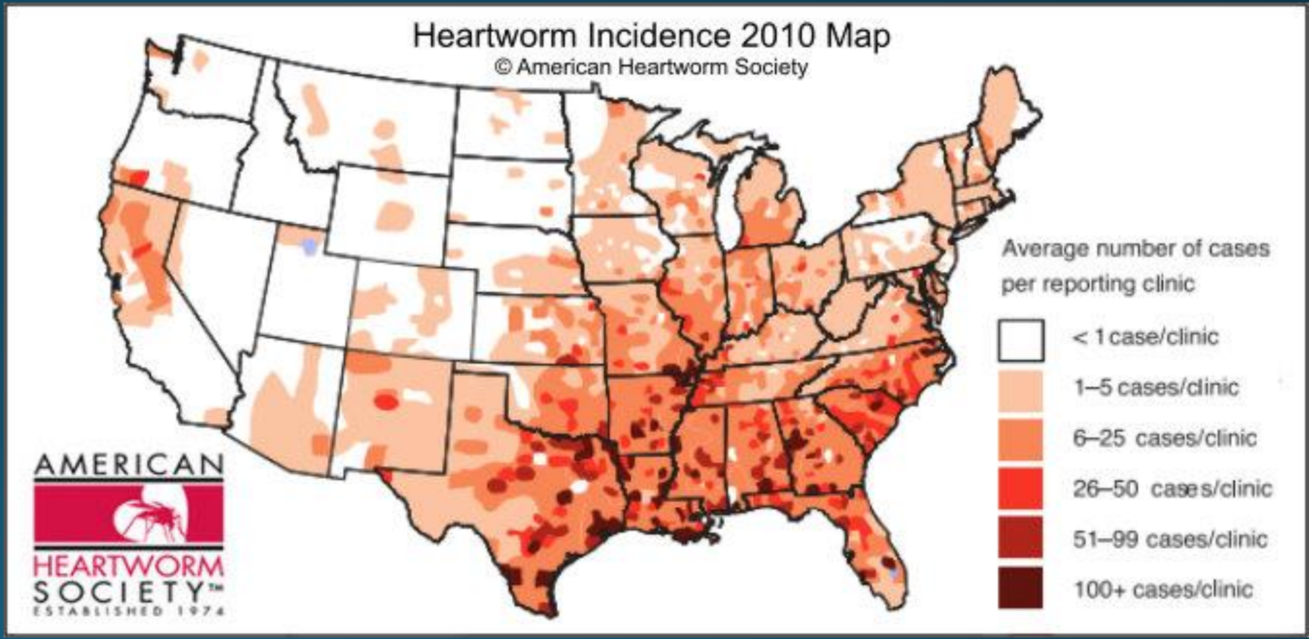
http://www.nih.go.jp/niid/entomology/picture/japonicus/japonicus03.jpg



Ae. japonicus 2007-2014

Vector status – *Aedes trivittatus*

Aedes trivittatus



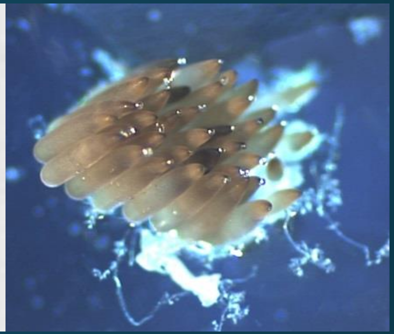
Vector status – *Aedes vexans*???

Aedes vexans

Vector status – Genus *Culex*

Genus *Culex* Linnaeus

31	*Culex* (*Culex*) *pipiens* Linnaeus	Very abundant	+
32	*Cx.* (*Cux.*) *quinquefasciatus* Say	Very rare	–
33	*Cx.* (*Cux.*) *restuans* Theobald	Very abundant	+
34	*Cx.* (*Cux.*) *salinarius* Coquillett	Abundant	+
35	*Cx.* (*Cux.*) *tarsalis* Coquillett	Abundant	+
36	*Cx.* (*Melanoconion*) *erraticus* (Dyar and Knab)	Uncommon	+
37	*Cx.* (*Neoculex*) *territans* Walker	Common	+



Culex pipiens– the Nortern house mosquito

Culex tarsalis

Vector status – *Culex tarsalis* - Iowa

Genus *Culex* Linnaeus			
31	*Culex* (*Culex*) *pipiens* Linnaeus	Very abundant	+
32	*Cx.* (*Cux.*) *quinquefasciatus* Say	Very rare	–
33	*Cx.* (*Cux.*) *restuans* Theobald	Very abundant	+
34	*Cx.* (*Cux.*) *salinarius* Coquillett	Abundant	+
35	*Cx.* (*Cux.*) *tarsalis* Coquillett	Abundant	+
36	*Cx.* (*Melanoconion*) *erraticus* (Dyar and Knab)	Uncommon	+
37	*Cx.* (*Neoculex*) *territans* Walker	Common	+

Culex tarsalis

Abstract

Background: West Nile virus (WNV) emerged as a threat to public and veterinary health in the

Landscape, demographic, entomological, and climatic associations with human disease incidence of West Nile virus in the state of Iowa, USA

John P DeGroote*[1], Ramanathan Sugumaran[1], Sarah M Brend[2], Brad J Tucker[3] and Lyric C Bartholomay[3]

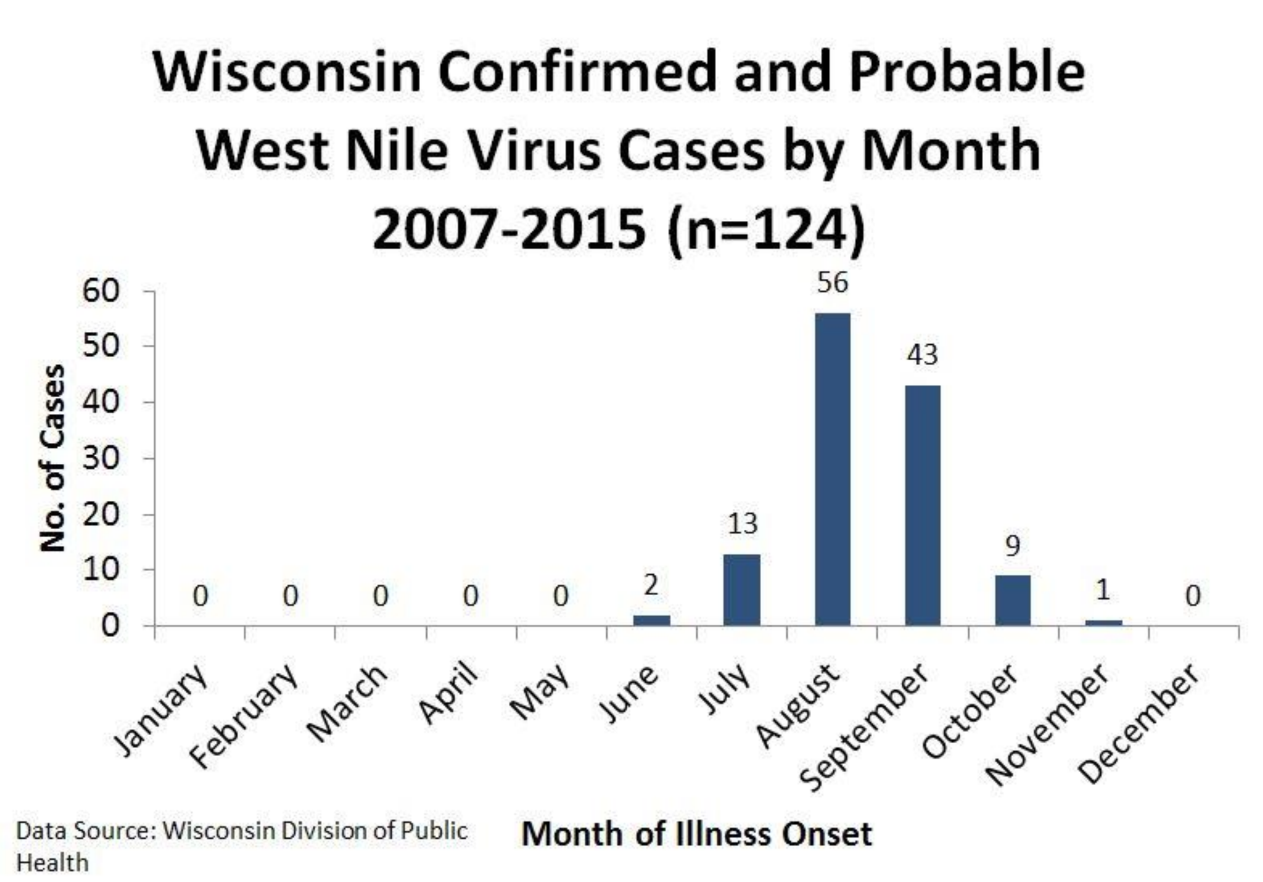
Center, Geography Department, University of Northern Iowa, Cedar Falls,
d [3]Department of Entomology, Iowa State University, Ames, IA, USA

h WNV disease incidence had significantly lower
scape variables showing differences included stream
ns, presence of irrigation, and presence of animal
erences in the annual means of precipitations, dew
year of WNV disease incidence and the prior year,
lysis for each parameter. However, the differences

disease incidence by census block groups in Iowa
, and climatic associations. Our results indicate that multiple ecological WNV transmission dynamics are most likely taking place in Iowa. In 2003 and 2006, drier conditions were associated with WNV disease incidence. In a significant novel finding, rural agricultural settings were shown to be strongly associated with human WNV disease incidence in Iowa.

Vector status – *Culex pipiens* - Wisconsin

Culex pipiens– the Northern house mosquito



Vector status – Genus *Anopheles*

Genus *Anopheles* Meigen

24	*Anopheles* (*Anopheles*) *barberi* Coquillett	Rare	+
25	*An.* (*Ano.*) *crucians* Wiedemann	Extremely rare	–
26	*An.* (*Ano.*) *earlei* Vargas	Extremely rare	–
27	*An.* (*Ano.*) *punctipennis* (Say)	Abundant	+
28	*An.* (*Ano.*) *quadrimaculatus* Say	Common	+
29	*An.* (*Ano.*) *walkeri* Theobald	Common	+

Anopheles quadrimaculatus

Anopheles punctipennis

CDC | CDC Home | Search | Health Topics A-Z

MMWR

Weekly

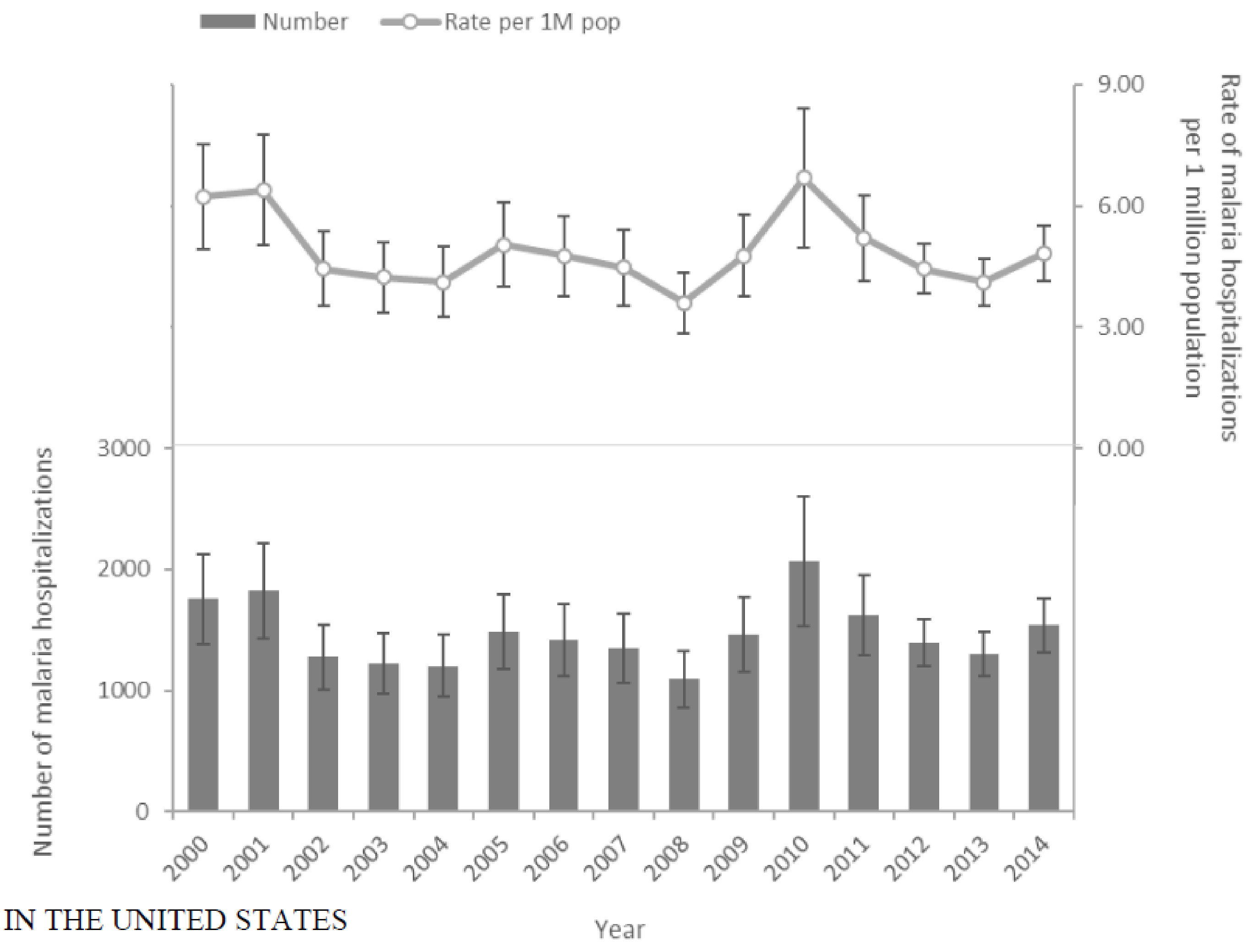
June 09, 2000 / 49(22);495-8

Persons using assistive technology might not be able to fully access information in this file. For assistance, please send e-mail to: mmwrq@cdc.gov. Type 508 Accommodation and the title of the report in the subject line of e-mail.

Probable Locally Acquired Mosquito-Transmitted *Plasmodium vivax*Infection --- Suffolk County, New York, 1999

In the United States, malaria transmission was eliminated in the 1940s, and malaria eradication was certified in 1970 (*1*). Since then, 60 small localized outbreaks of probable mosquito-transmitted malaria have been reported to CDC (*2--6*). Before 1995, the number of imported malaria cases reported to the Suffolk County (New York) Department of Health Services ranged from zero to eight per year. Since 1995, seven to 17 cases per year have been reported. In all of these cases, a history of residing in or traveling to an area with endemic malaria outside the United States was confirmed. This report describes the investigation of two cases of *Plasmodium vivax* malaria that occurred in Suffolk County in August 1999; the patients had no history of travel outside of the United States.

Figure 1



l estimates based on weighted frequencies.

Article in press – AJTMH - as of 4/25/2017!

MALARIA HOSPITALIZATIONS IN THE UNITED STATES

Malaria-Related Hospitalizations in the United States, 2000–2014

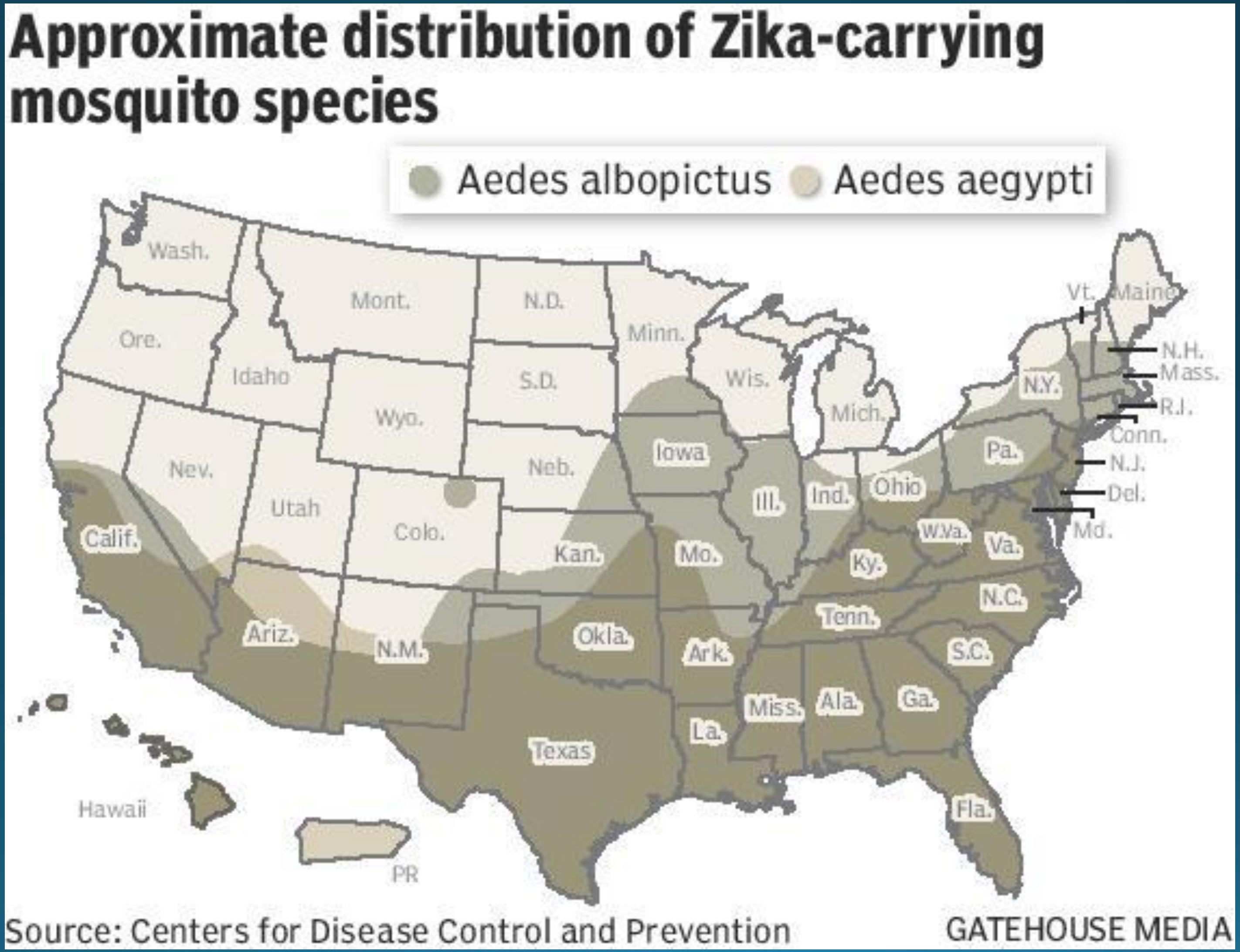
Diana Khuu,[1,2] Mark L. Eberhard,[3] Benjamin N. Bristow,[1] Marjan Javanbakht,[1] Lawrence R. Ash,[1] Shira C. Shafir,[1,4] and Frank J. Sorvillo[1]*

Vector Capacity examples/summary. . .

Mosquito spp.	Pathogens
Aedes triseriatus	LACV, WNV
Ae. trivittatus	*D. immitis*
Ae. japonicus	WNV, SLEV, LACV, EEEV
Anopheles quadrimaculatus and *An. punctipennis*	Human malaria, JCV?
Culex pipiens	WNV, SLEV
Cx. tarsalis	WNV, SLEV, WEEV

New and emerging infections:
Zika

What is the threat in the Upper Midwest?



Public Health Entomology @ UW-Madison: protecting communities from Zika

- Surveillance for the vectors
- Reduce mosquito population

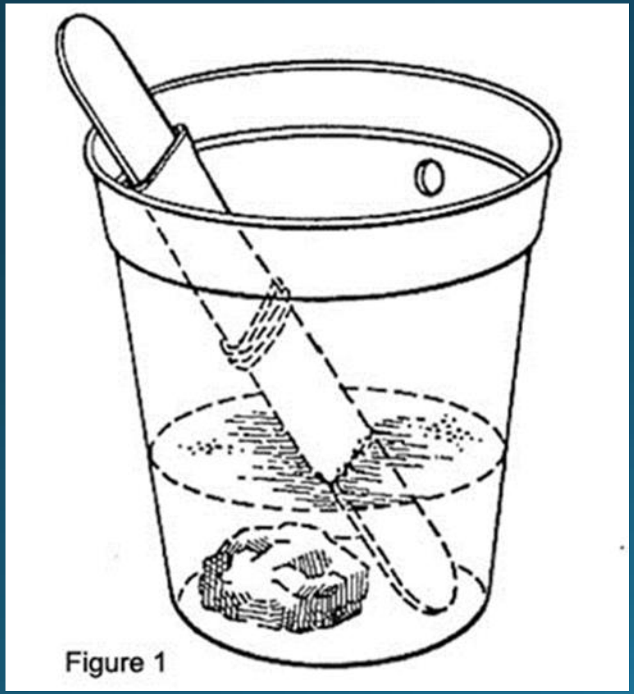


Figure 1

After 1 week:

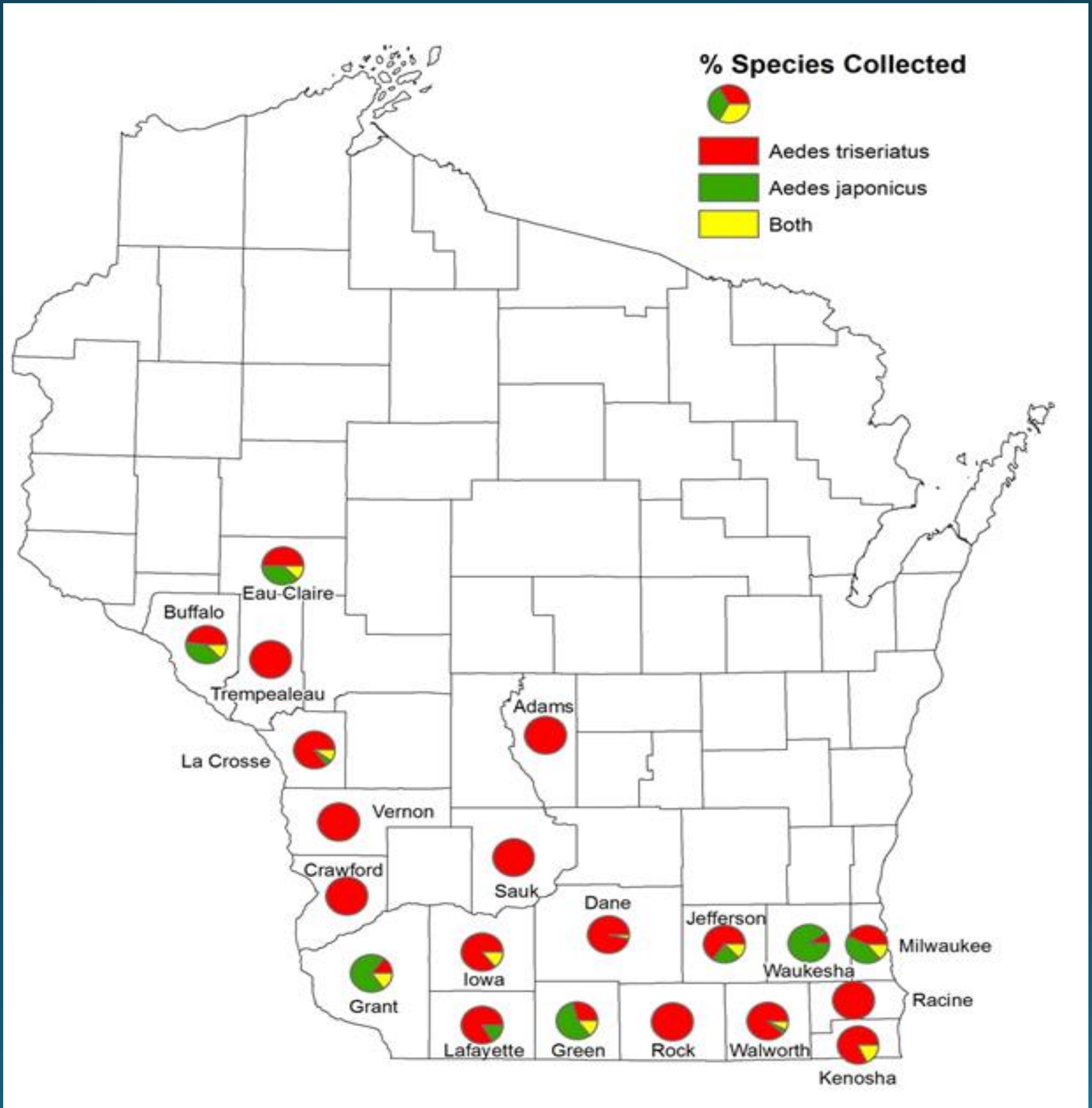
- Check for eggs on sticks
- Dump out water to eliminate any mosquito larvae
- Replace water
- Replace stick (only if eggs are present)

Eggs of *Aedes albopictus* on the egg sticks

Might be a lot or a few
Like small grains of dirt
Will mostly stay attached to stick

Send it in if you aren't sure
If no eggs are seen, leave the stick and just replace the water

Results



% Species Collected
Aedes triseriatus
Aedes japonicus
Both
Eau Claire
Buffalo
Trempealeau
La Crosse
Adams
Vernon
Crawford
Sauk
Dane
Jefferson
Waukesha
Milwaukee
Grant
Iowa
Racine
Lafayette
Green
Rock
Walworth
Kenosha

Will be on the lookout for invasion/establishment!

TABLE 1 Twentieth century invasions by container-inhabiting mosquitoes into the United States

Species	Regions: Donor	Regions: Recipient	Transport	Date	Key reference
Aedes albopictus	Japan	Texas	Tires	1985	77
Aedes atropaplus	Eastern United States	Illinois, Indiana, Nebraska, Ohio	Tires	1970–1980	12
Aedes bahamensis	Bahamas	South Florida	Tires	1986	145
Aedes japonicus	Japan	Connecticut, New Jersey, New York	Tires	1998	149
Aedes togoi	Asia	Pacific NW	Ships	1940–1950	11
Culex biscaynensis	Caribbean (?)[a]	South Florida	Bromeliads	?	142
Toxorhynchites brevipalpis	E. Africa	Hawaii	Biocontrol	1950s	194
Toxorhynchites amboinensis	Pacific region	Hawaii	Biocontrol	1950s	194
Wyeomyia mitchellii	Caribbean or Florida	Hawaii	Bromeliads	1970s	183

[a]It remains unclear whether this recently described species (223) was introduced in exotic bromeliads to south Florida or is, rather, an indigenous species that had previously escaped recognition despite intensive mosquito collecting in the state.

Lounibos, LP (2002) *Invasions by Insect Vectors of Human Disease.* Ann Rev Entomol 47:233-266.

From a state-centric to a regional approach

Midwest Regional Center of Excellence for Vector-Borne Disease

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The Upper Midwestern Center of Excellence for Vector-borne Diseases

MCE-VBD

- University of Wisconsin-Madison
- Iowa State University
- Michigan State University
- University of Illinois
- Loyola University

- Minnesota Department of Health
- Departments of Public Health
  - Iowa
  - Illinois
  - Michigan
  - Minnesota
  - Wisconsin
- Advisory Boards
  - Scientific
  - Public Health

MCE-VBD

Training

Communities of Practice

Applied Research

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Certificate in Public Health Entomology

Internships for undergraduates - field work experiences

Workshops and Training events for current practitioners

MCE-VBD Training

Certificate in Public Health Entomology

Offered to trainees at any level – BS, MS, MPH, MD, DVM, current PH

Granted by the MCE-VBD; Advisory Board oversight

Competencies/experiences:

- Course in Public Health/Medical Entomology/VBD
- Vector Identification – Surveillance – IR monitoring
- Pesticide applicator licensure
- Field experience

MCE-VBD Communities of Practice in Public Health

- Paid interns to work with Public Health
- Annual Conference
- Shared surveillance data
- Public Health Advisory Board

MCE-VBD Communities of Practice in Public Health

- Survey of current vector control providers and practices
- Insecticide resistance surveillance and training
- Enhanced vector surveillance
- Design for sustainability

MCE-VBD Research and Innovation

Predictive modeling

Efficacy of Mosquito Control

Integrated Tick Management Approach

Novel Insecticide/Acaricide/Repellent Development

MCE-VBD Research and Innovation

Optimization of mosquito trapping

Development of rapid and inexpensive diagnostics

Human/vector interactions and exposure risks

Emerging pathogens

Perspectives on the Mosquitoes of Wisconsin and the Upper Midwest

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Pathobiological Sciences
Susan Paskewitz
Entomology
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