

Tarrant County Public Health



North Texas Regional Laboratory

WEST NILE VIRUS IN TARRANT COUNTY, TX

HISTORY AND OUTBREAK AFTERMATH

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Presentation Overview

- West Nile virus (WNV) characteristics and history
- WNV hosts, vectors, and transmission
- Mosquito surveillance at Tarrant County Public Health
- WNV testing process
- Tarrant County historic WNV data
- 2012 WNV outbreak
- Laboratory adaptations after the 2012 outbreak
- Summary

West Nile Virus Characteristics

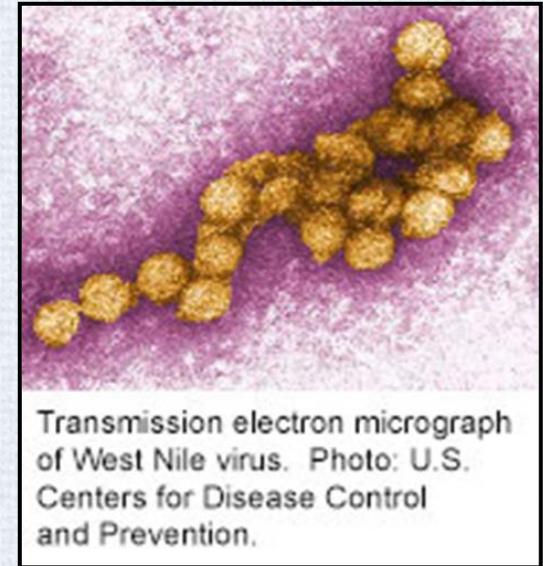
Family: *Flaviviridae*

Genus: *Flavivirus*

Virion: 40-50 nm in diameter
Spherical nucleocapsid
Lipid bilayer envelope

Genome: Positive-sense, single-stranded RNA
~11,000 nucleotides

Examples of other *Flavivirus* members: dengue virus, yellow fever virus, Japanese encephalitis virus, and St. Louis encephalitis virus.



West Nile Disease - Clinical Criteria and Symptoms

West Nile Fever (WNF)

Fever AND

Absence of neuroinvasive disease



West Nile Neuroinvasive Disease (WNND)

Fever AND

Presence of neuroinvasive disease

(meningitis, encephalitis, acute flaccid paralysis)

Common symptoms:

Headache, fatigue, nausea, vomiting, rash

West Nile Disease - Laboratory Criteria

Demonstrate virus presence:

- Isolation of the virus
- Detection of virus-specific antigen
- Detection of virus-specific nucleic acid
- Demonstration of virus-specific antibodies

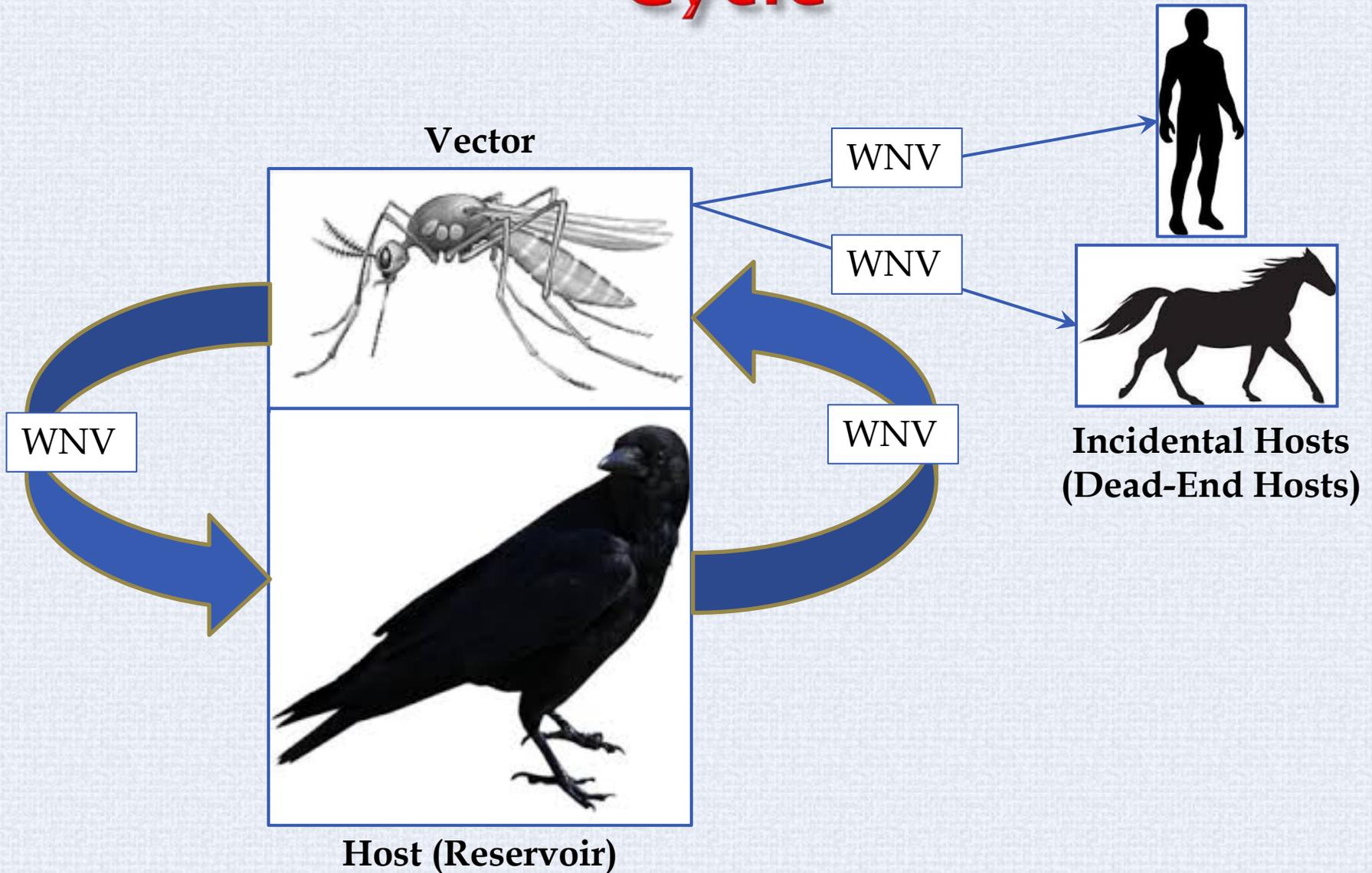


West Nile Virus History

- WNV was first isolated from a human patient with a fever in Uganda in 1937
- Historically, WNV was found in Europe, Africa, the Middle East, and Asia
- In 1999, WNV emerged in North America (New York City) and arrived in Texas in 2002
- Spread to west coast by 2002



West Nile Virus Transmission Cycle



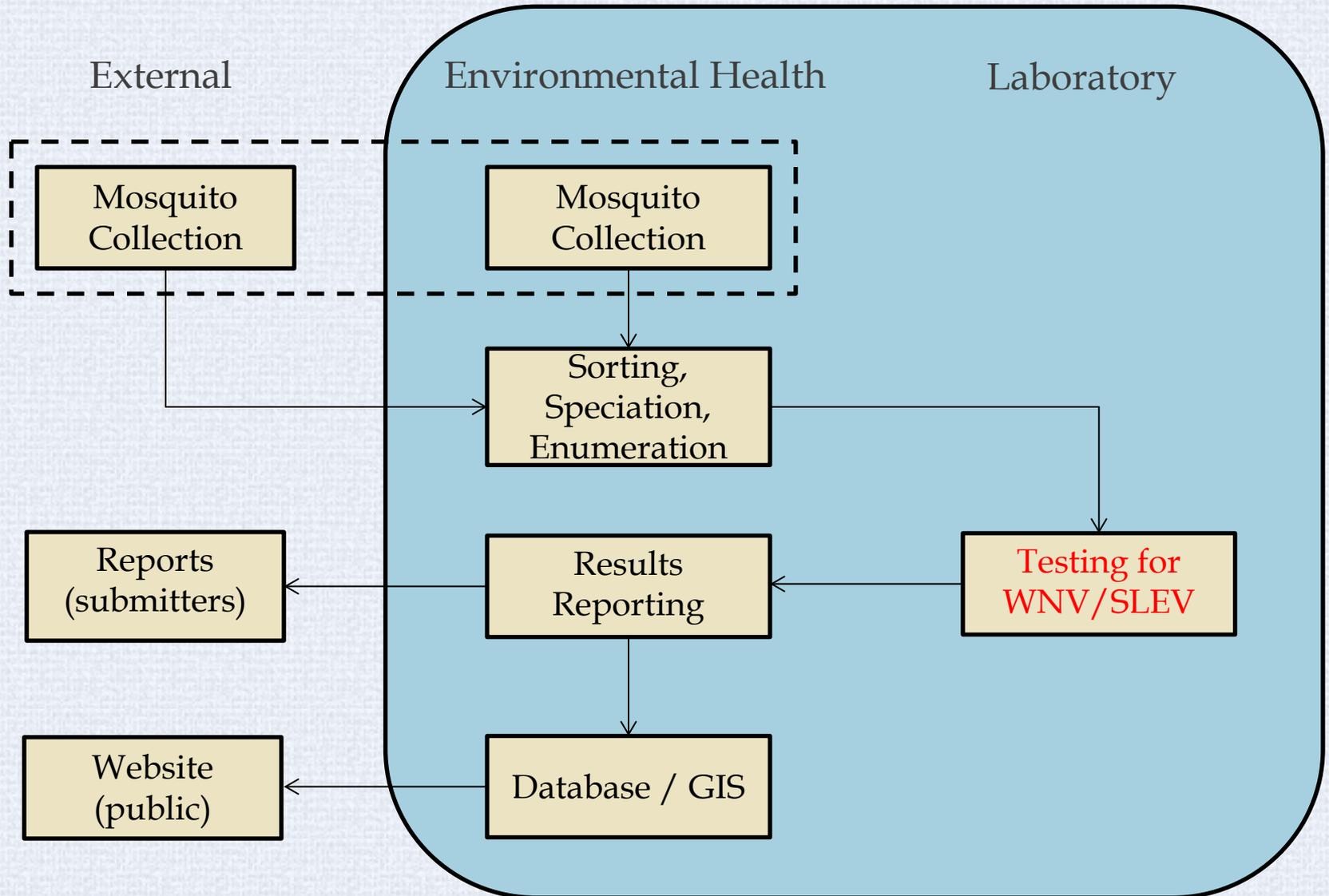
West Nile Virus Timeline - Tarrant County

- | | |
|----------------|---|
| June 2002 | First WNV detection in a mosquito in Tarrant County |
| July 2002 | WNV detected in a bird from Tarrant County |
| August 2002 | First case of human WNV detected in Tarrant County |
| September 2002 | First case of equine WNV detected in Tarrant County |

Using Mosquito Data for Disease Prevention

- Mosquito surveillance allows for early detection of West Nile virus activity
- An increase in human WNV cases is usually seen a few weeks after detection in mosquitoes
- Informed decisions about control tactics can be made based on mosquito data
- Risk assessment calculations, targeted spraying (adulticiding) of positive locations, raise public awareness, education, preventive measures

Tarrant County Mosquito Surveillance



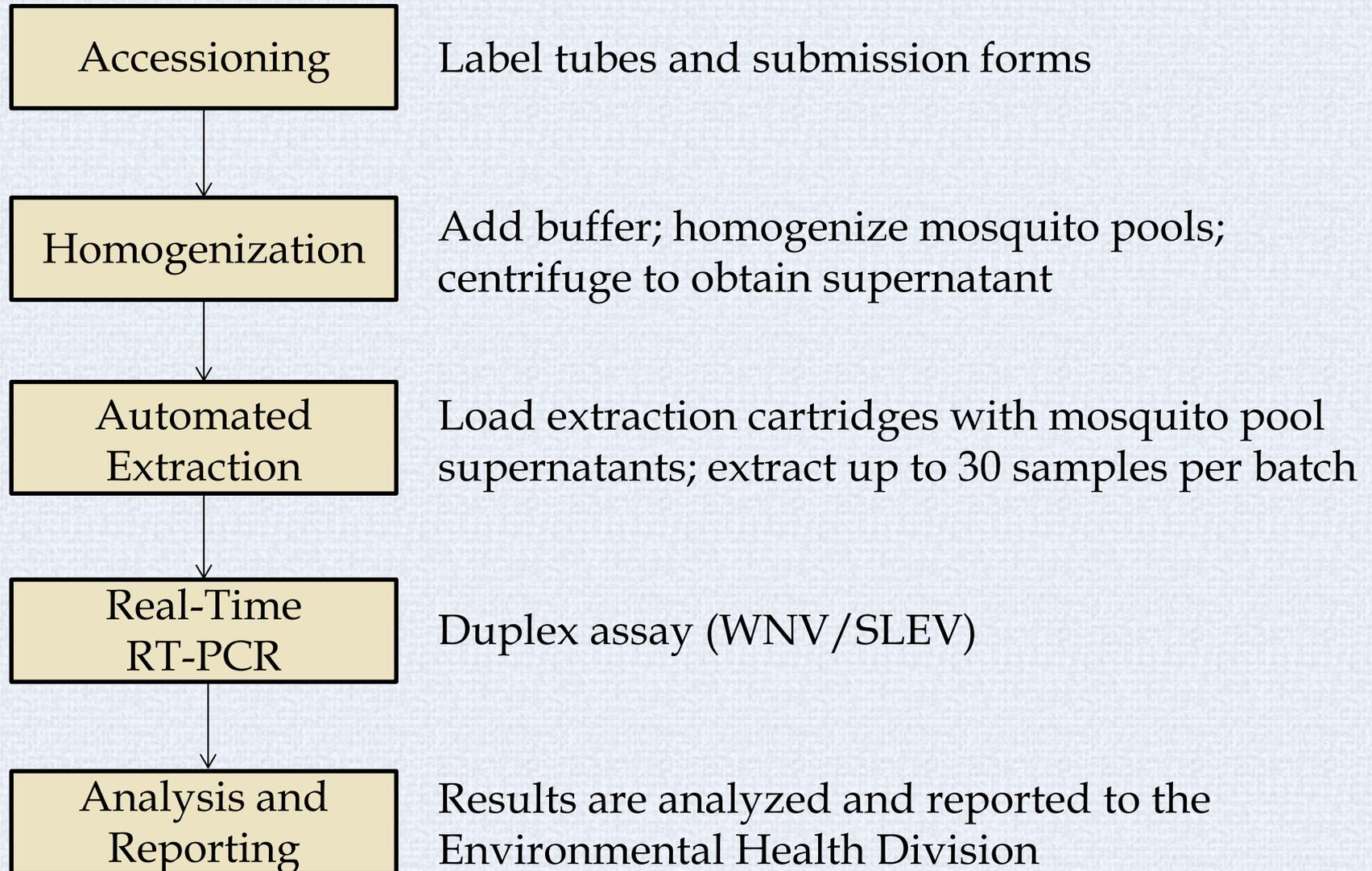
West Nile Virus Testing

- RT-PCR WNV RNA detection
- RAMP Antigen detection
- Serology Detection of immune response
- Cell culture Detection of virus

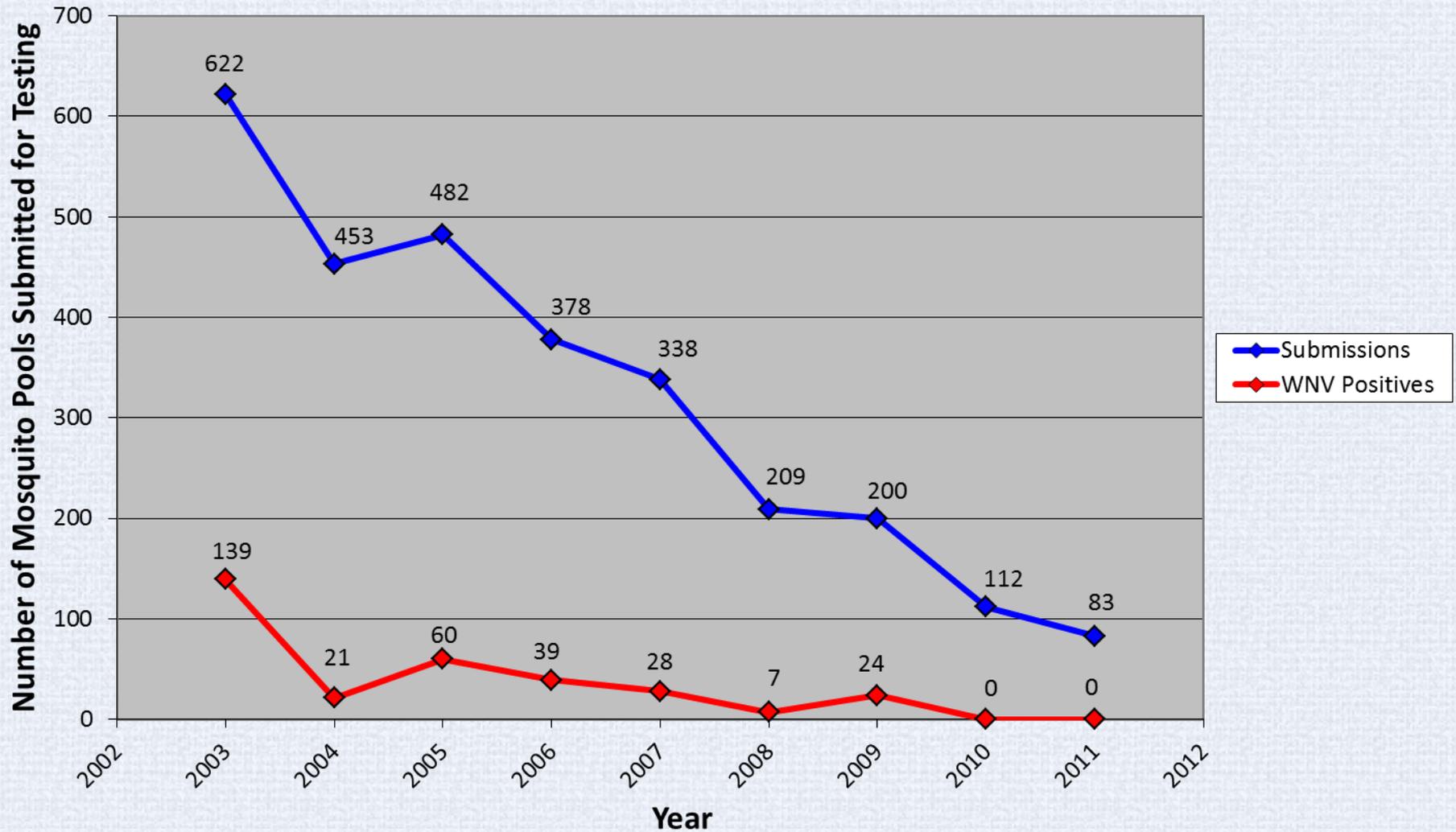
Tarrant County Public Health, NTRL

- RT-PCR only - testing for presence of WNV in mosquitoes

Testing Process Overview

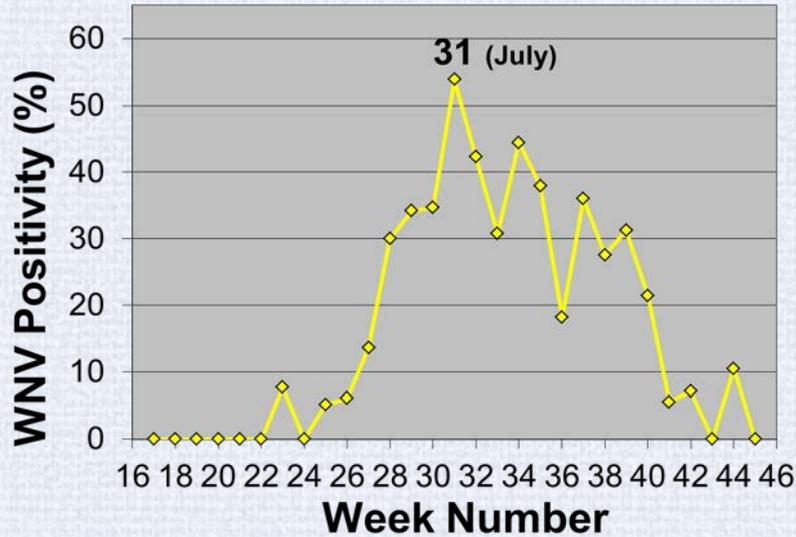


Number of Submissions and WNV Positive Mosquito Pools 2003-2011

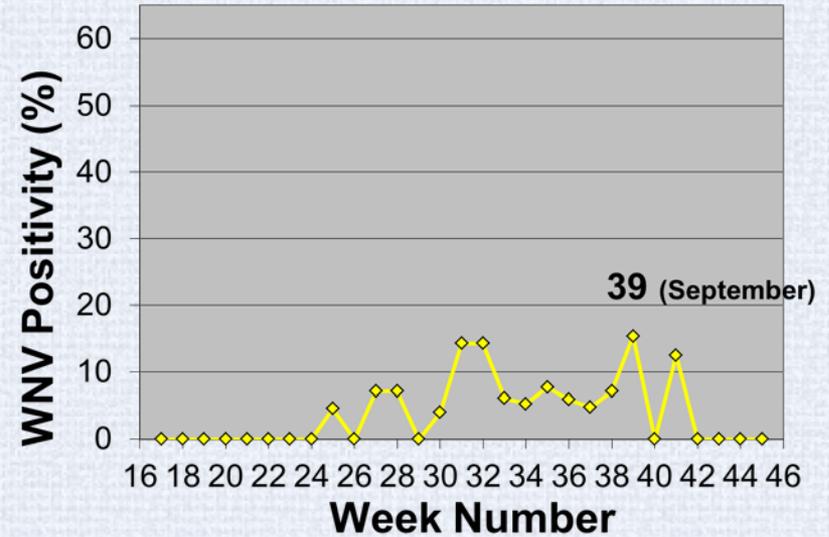


Mosquito Weekly WNV Positivity

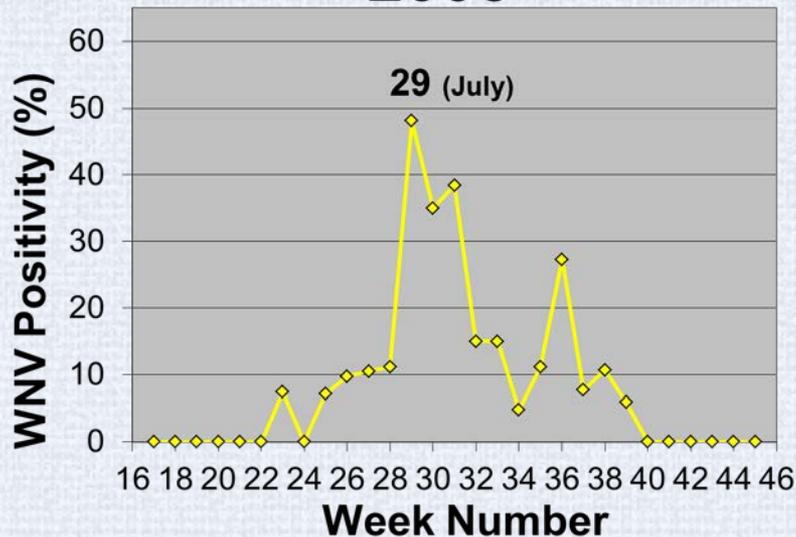
2003



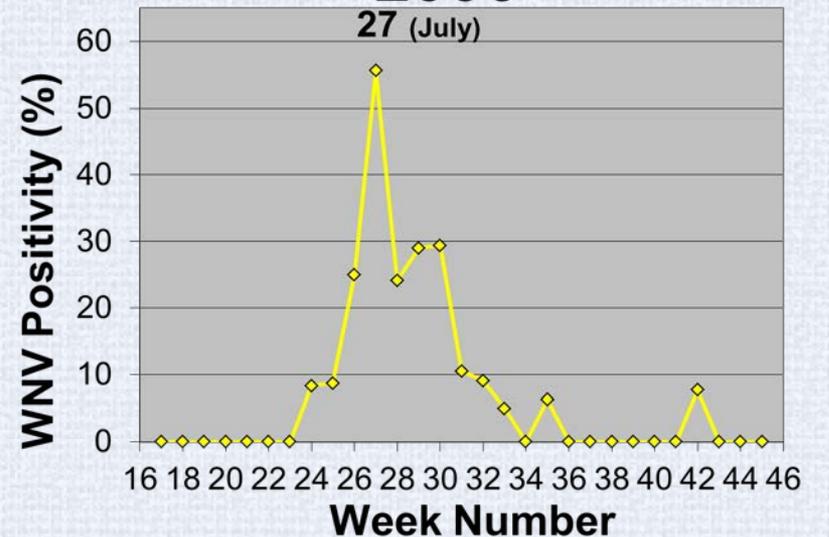
2004



2005

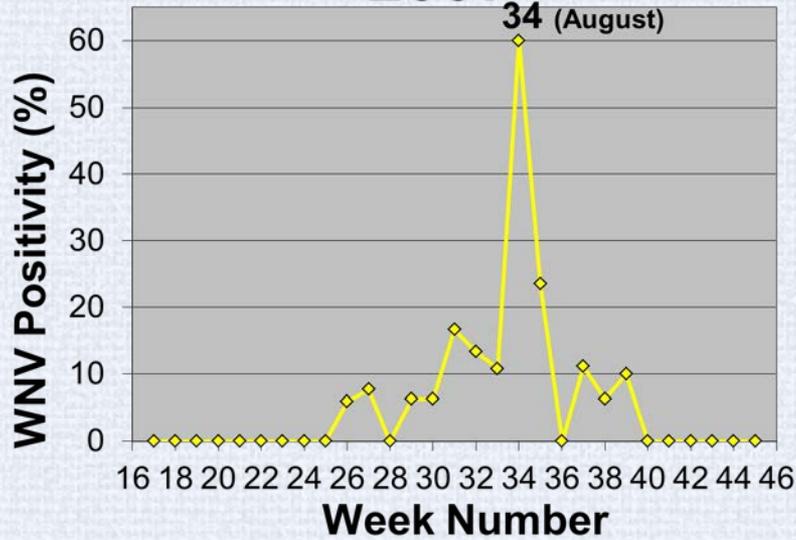


2006

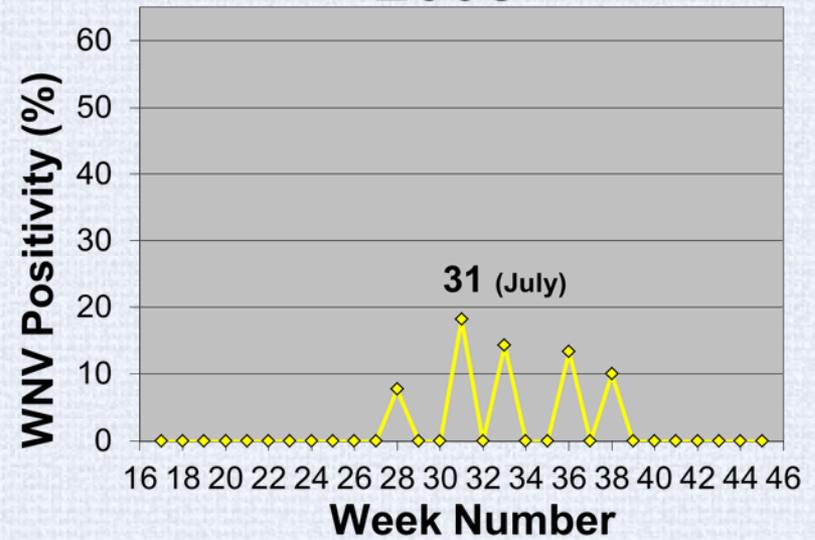


Mosquito Weekly WNV Positivity

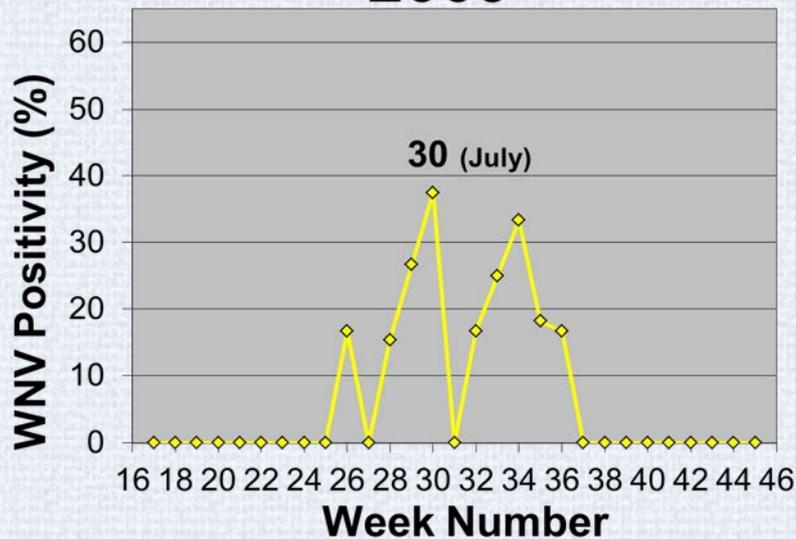
2007



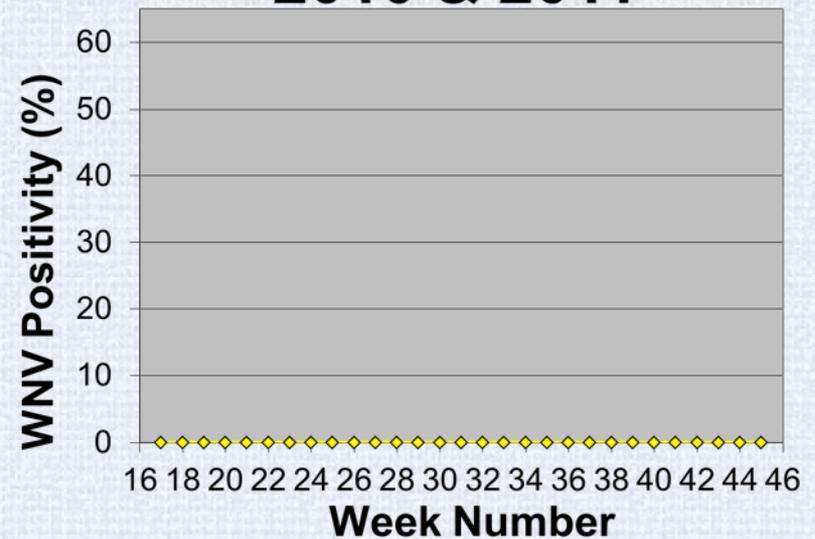
2008



2009



2010 & 2011



Mindset Due to Minor WNV Activity 2010-2011

- No WNV positive mosquitoes detected
- Very few human WNV cases
- No media interest
- Fewer participants / declining sample numbers
- WNV is on its way to totally disappear, and will no longer be a major concern
- Should the WNV surveillance program be decommissioned?

2012 WNV Outbreak

US States with Highest Frequency of WNV Cases, 2012

Rank	State	Total Cases
-	United States	5,387
1	Texas	1,834
2	California	451
3	Louisiana	335
4	Illinois	282
5	Mississippi	249
6	South Dakota	203
7	Michigan	202
8	Oklahoma	187
9	Nebraska	186
10	Colorado	131

Includes the 48 contiguous states and the District of Columbia

Data source: Centers for Disease Control and Prevention



Texas Counties with Highest Numbers of WNV Cases, 2012

Rank	County	Total Cases
-	Texas	1,834
1	Dallas	405
2	Tarrant	280
3	Denton	181
4	Travis	146
5	Collin	76
6	Harris	71
7	McLennan	44
8	El Paso	31
9	Bexar	29
10	Gregg	29

Data source: Collin County Health Care Services, Dallas County Health and Human Services, Denton County Health Department, Tarrant County Public Health, and Texas Department of State Health Services

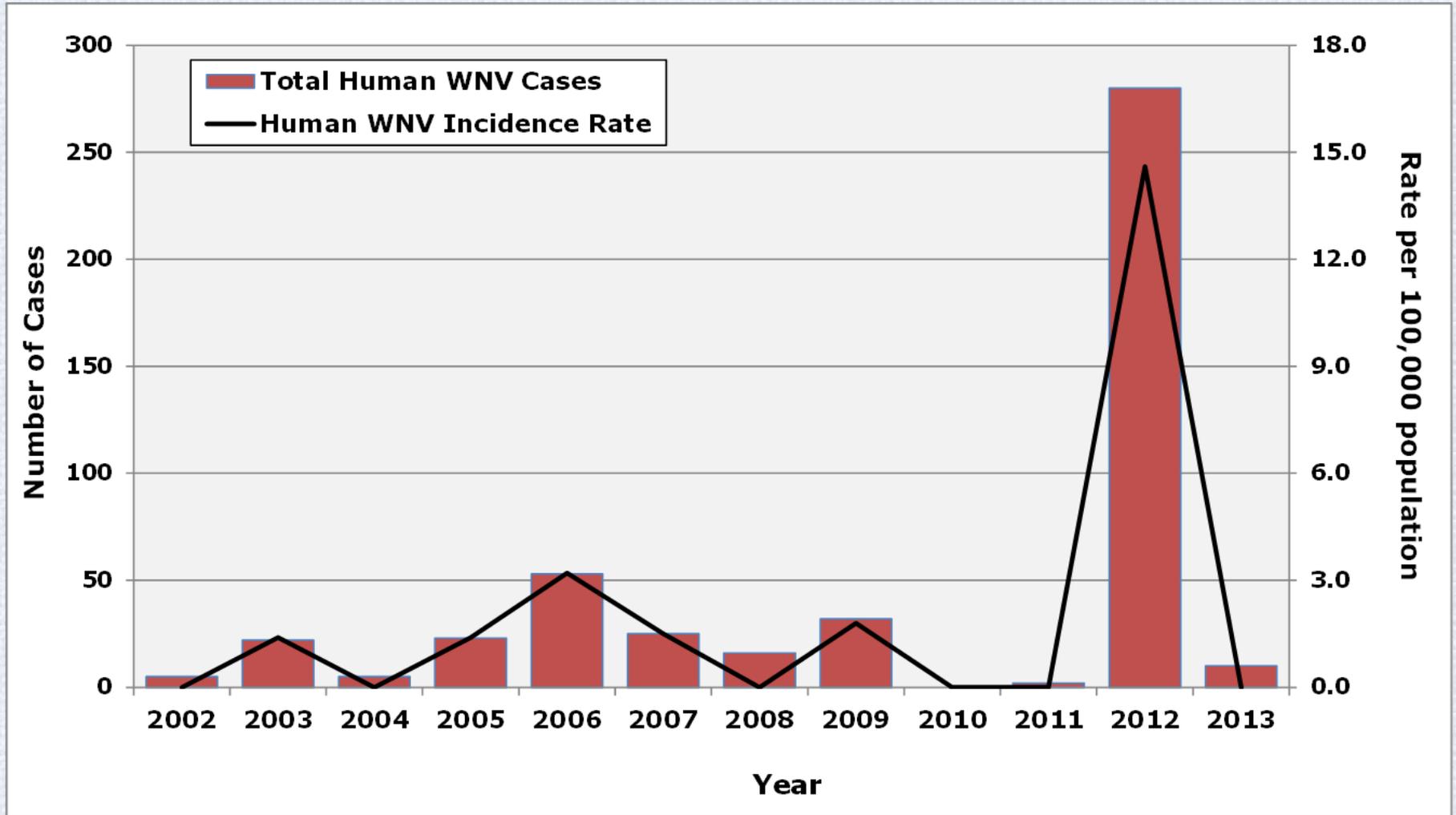
Texas Case Breakdown, 2012

- Human WNF 998 cases
- Human WNND 836 cases
- Human fatalities 86 cases (only 2 cases in 2011)

Tarrant County Case Breakdown

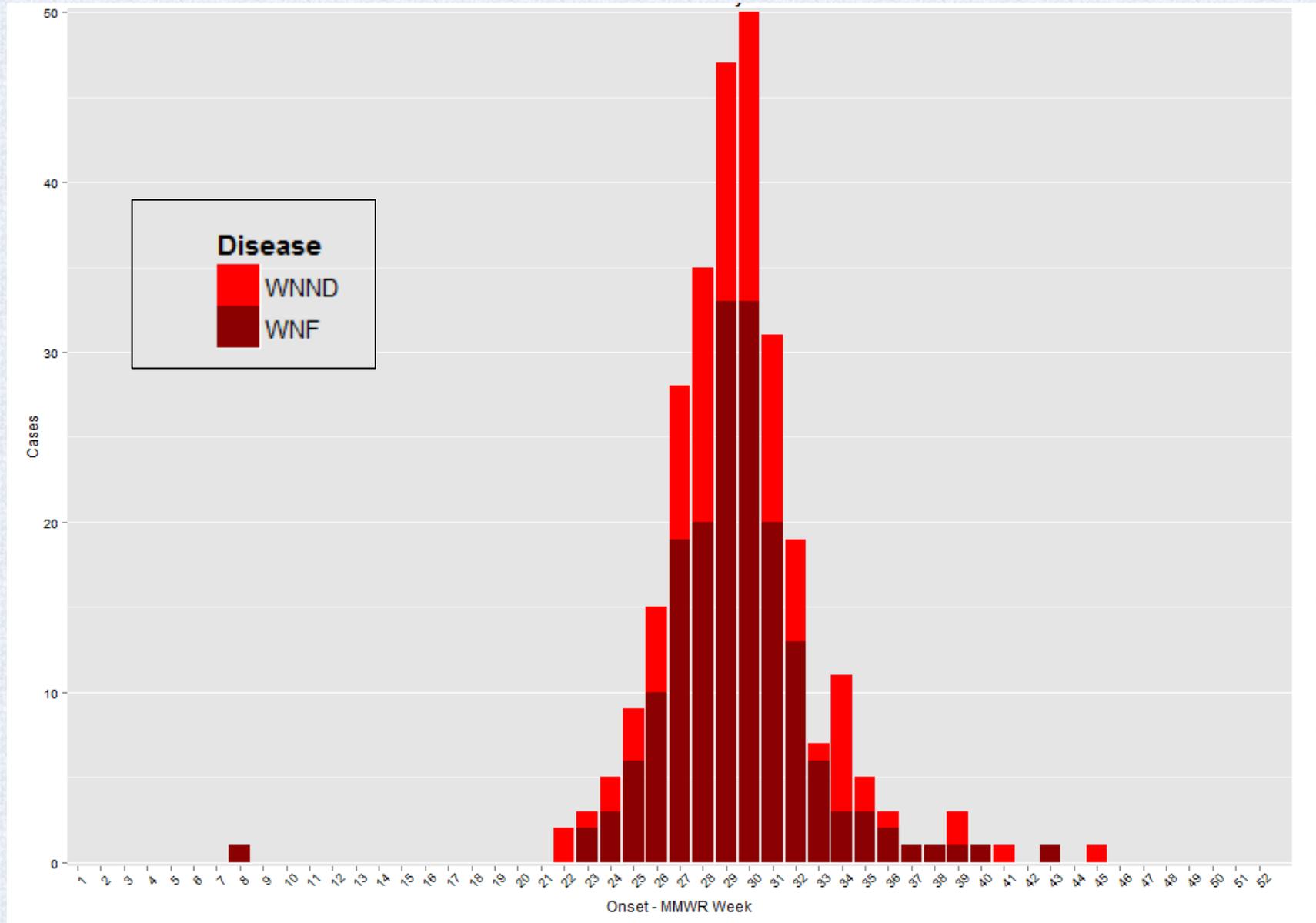
- Human WNF 179 cases
- Human WNND 101 cases
- Human fatalities 11 cases

Tarrant County Human WNV cases, 2002-2013



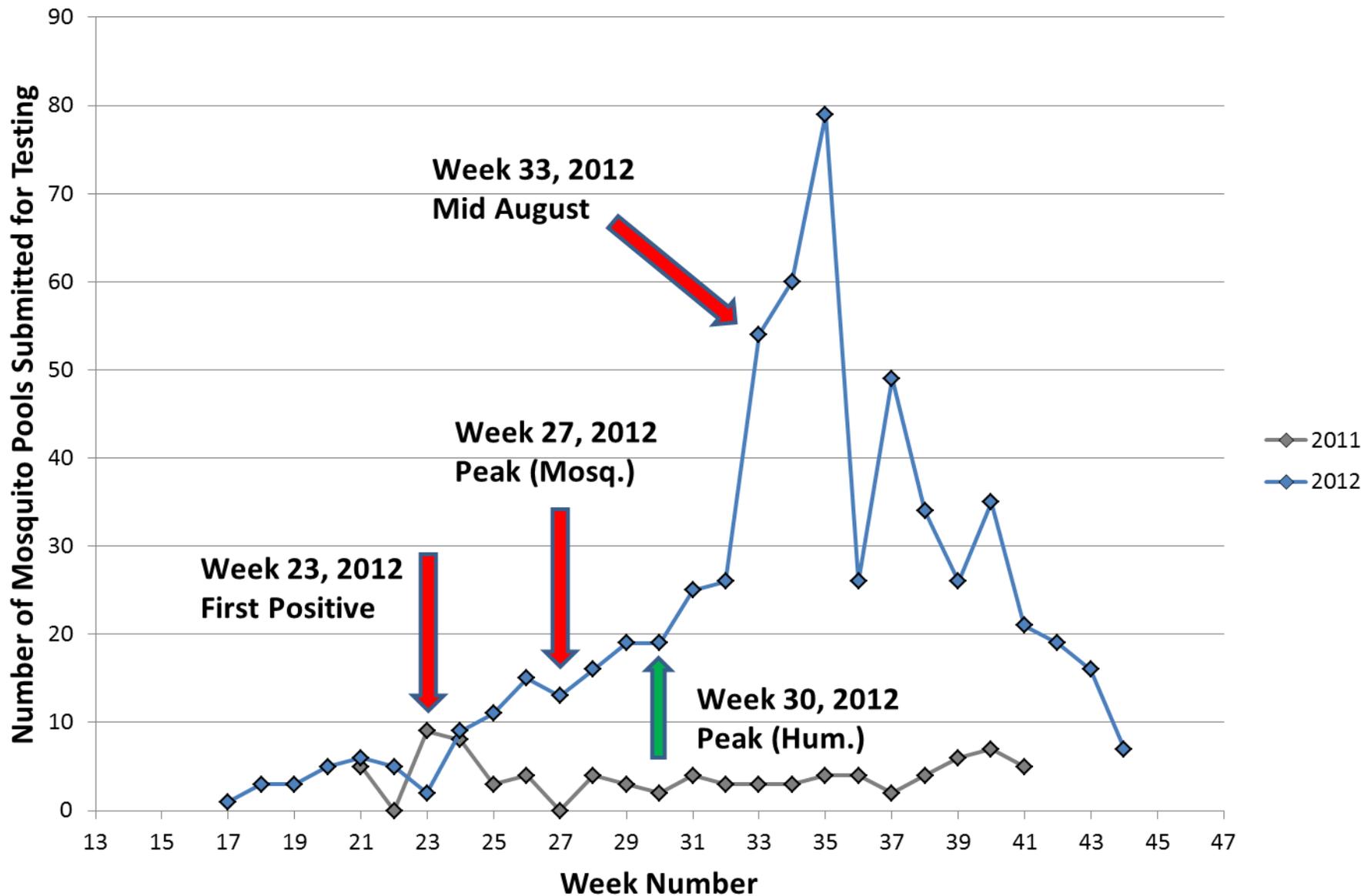
Data source: Division of Epidemiology and Health Information, Tarrant County Public Health

Tarrant County WNV Cases, 2012



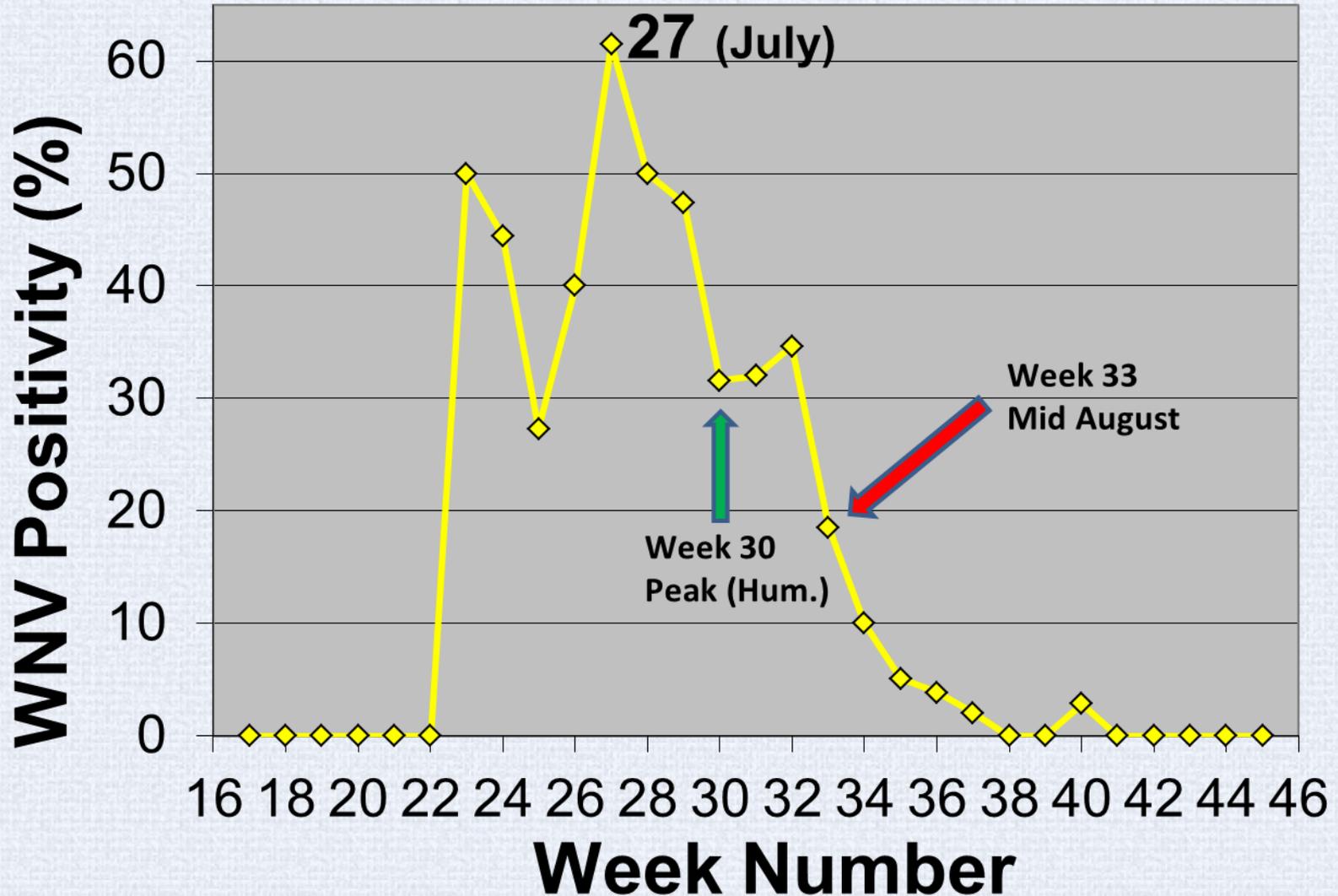
Data source: Division of Epidemiology and Health Information, Tarrant County Public Health

Weekly Mosquito Pool Submissions 2011-2012

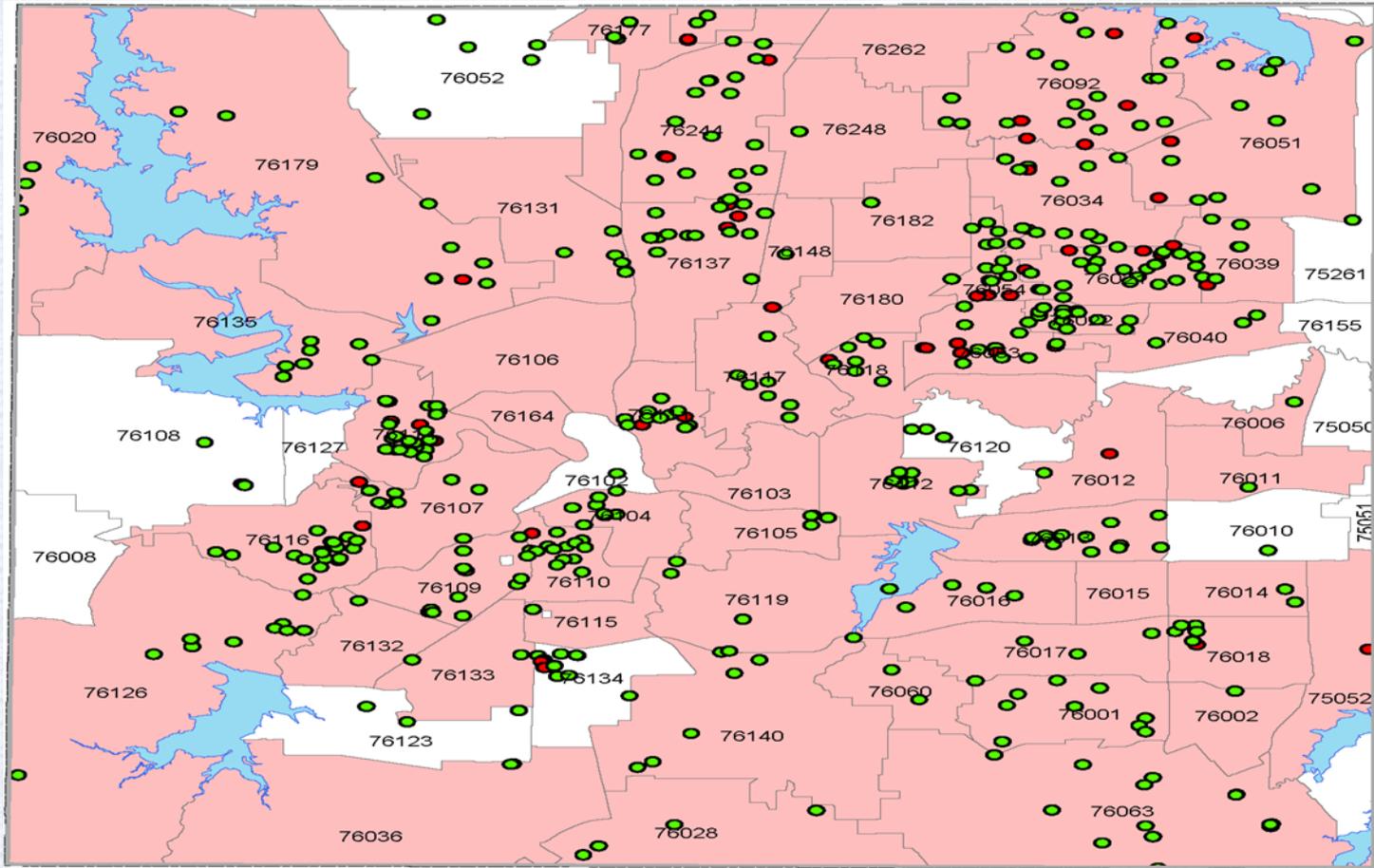


Mosquito Weekly WNV Positivity

2012



Human WNV Cases 2012



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Legend

- Positive Pool (s)
- Negative Pool (s)
- No human case(s)
- Human case(s)
- ☪ Water



1 inch equals 4 miles

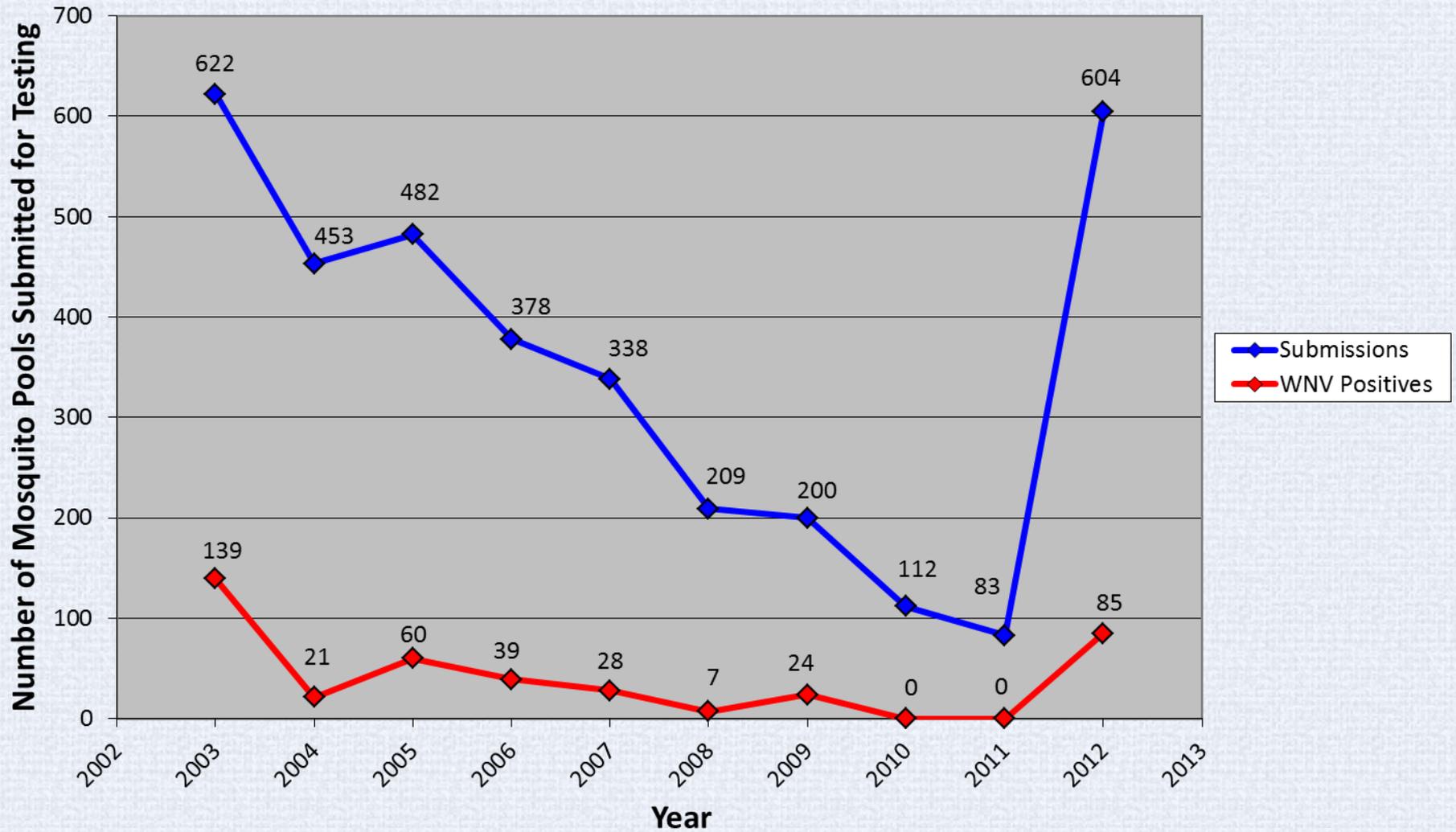


Why the 2012 WNV outbreak?

Complex.....

- Mosquito abundance / WNV infection status
- Vector competence (infected vs. infectious)
- Bird population (infection status, immunity)
- Weather conditions (temperature, rain)
- WNV activity in recent, preceding years?

Number of Submissions and WNV Positive Mosquito Pools 2003-2012





2013 – Outbreak Aftermath

- New interest =>
- Increased budget =>
- Revamped surveillance program

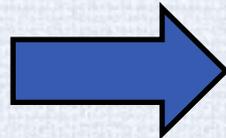
The Lab committed to test up to 200 pools/week

- How to achieve that?

Lab Adaptations Post Outbreak

Homogenization

2012



2013



Hand-held, open tubes,
one tube at a time, BSL-3

2x 24 closed tubes in 40 seconds,
open bench

Lab Adaptations Post Outbreak

Automated Extraction

2012



2013



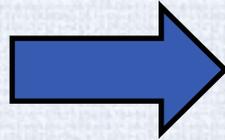
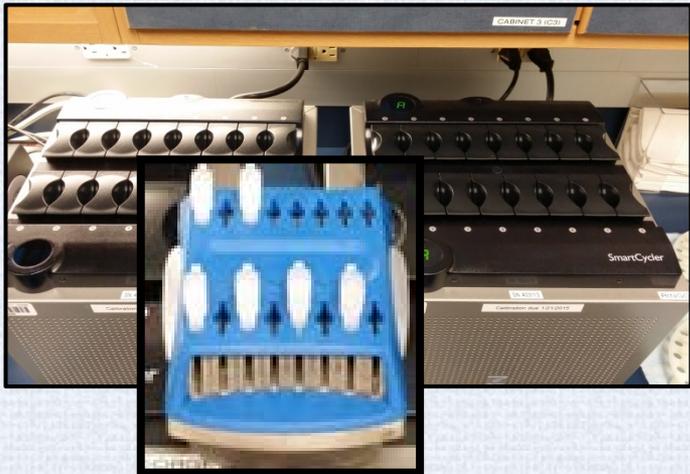
< 30 samples / week

Up to 7x 30 samples / week

Lab Adaptations Post Outbreak

Real-Time RT-PCR

2012



2013



Single tubes, max capacity:
<60 / week

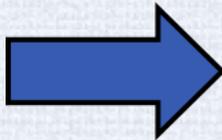
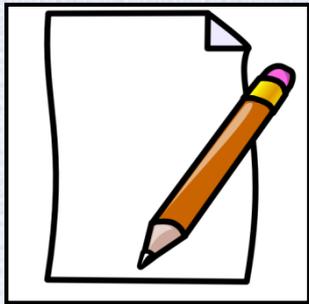
96-well plates, practical
capacity: 200 on 2-3 days

Lab Adaptations Post Outbreak

Streamlined Forms and Paperwork

2012

2013



Tarrant County Public Health Department
North Texas Regional Laboratory

PCR ID: _____

B. PCR Reaction Position

	1	2	3	4	5	6	7	8	9	10	11	12	
A	NTC 1	WS0001-14	WS0009-14	WS0017-14	WS0025-14	WS0031-14	WS0039-14	WS0047-14	WS0055-14		NEG Ctrl (Batch 1)	Pos Ctrl (Batch 1)	WNV/SLEV
B	NTC 2	WS0002-14	WS0010-14										
C		WS0003-14	WS0011-14										

WNV/SLEV Presumptive RT-PCR Setup Worksheet (ABI 7500 Fast Dx)

Number of samples	30
Number of controls	3
Total	33
Plus 12%	37

WNV/SLEV

WNV/SLEV Real-time RT-PCR

Start	3	0
End	15	0
Threshold	5.63E+03	0.00E+00
Reporter	Cy5	FAM
Target	WNV	SLE

Adult Mosquito Surveillance - West Nile and SLE virus Laboratory Results

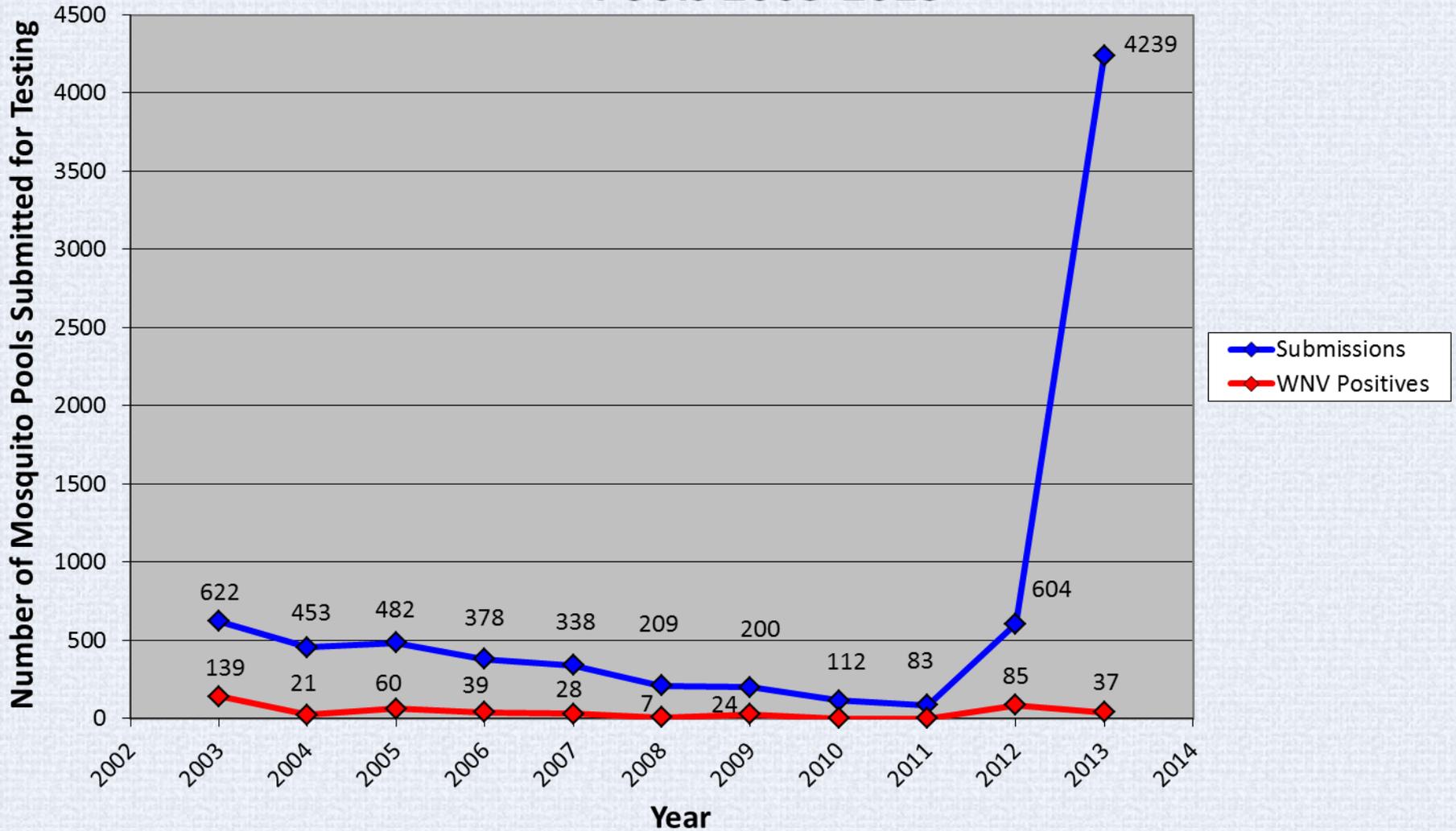
Date of RT-PCR: 5/1/2014

Surveillance ID	Lab ID	WNV Results	SLEV Results
20140501-233	WS0233-14	Negative	Negative
20140501-234	WS0234-14	Negative	Negative
20140501-235	WS0235-14	Negative	Negative
20140501-236	WS0236-14	Negative	Negative
20140501-237	WS0237-14	Negative	Negative
20140501-238	WS0238-14	Negative	Negative
20140501-239	WS0239-14	Negative	Negative

Paper and pen, typing, slow reporting

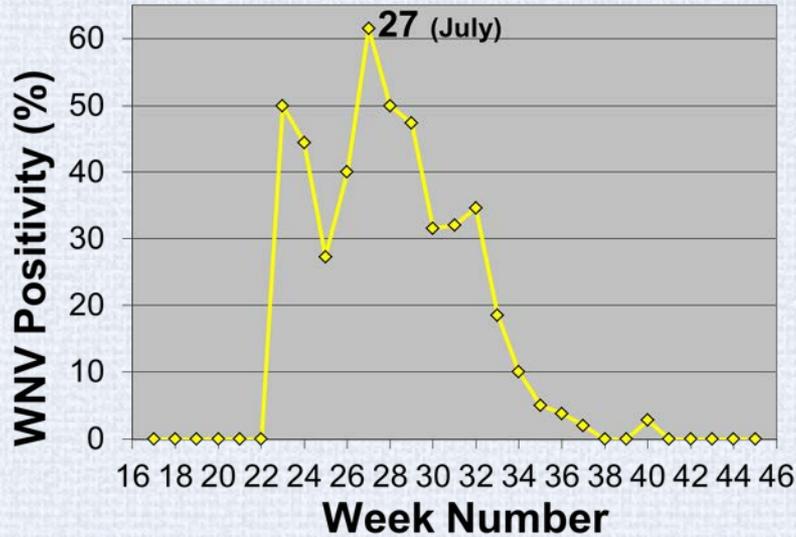
Excel, auto-fill calculations, export and import of data, electronic reports

Number of Submissions and WNV Positive Mosquito Pools 2003-2013

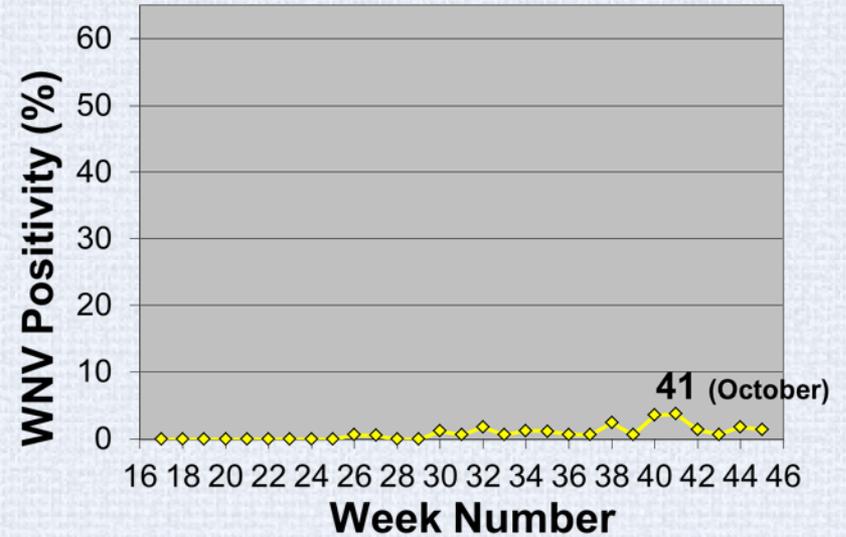


Mosquito Weekly WNV Positivity

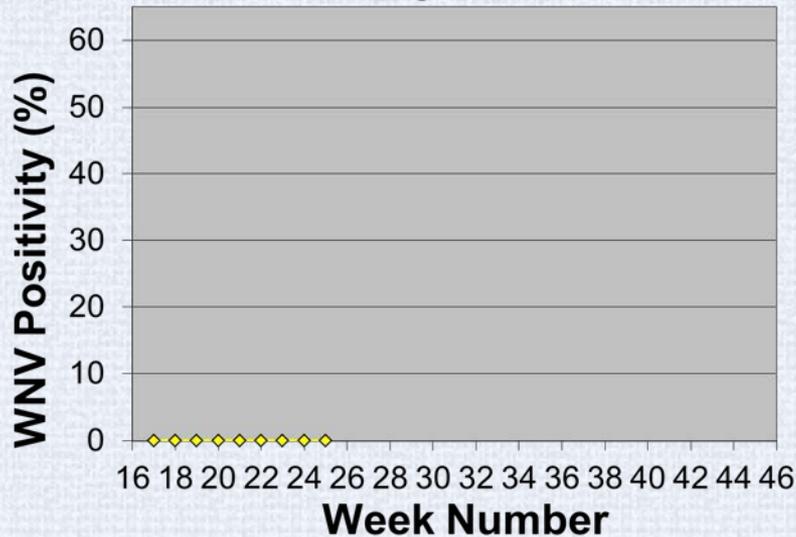
2012



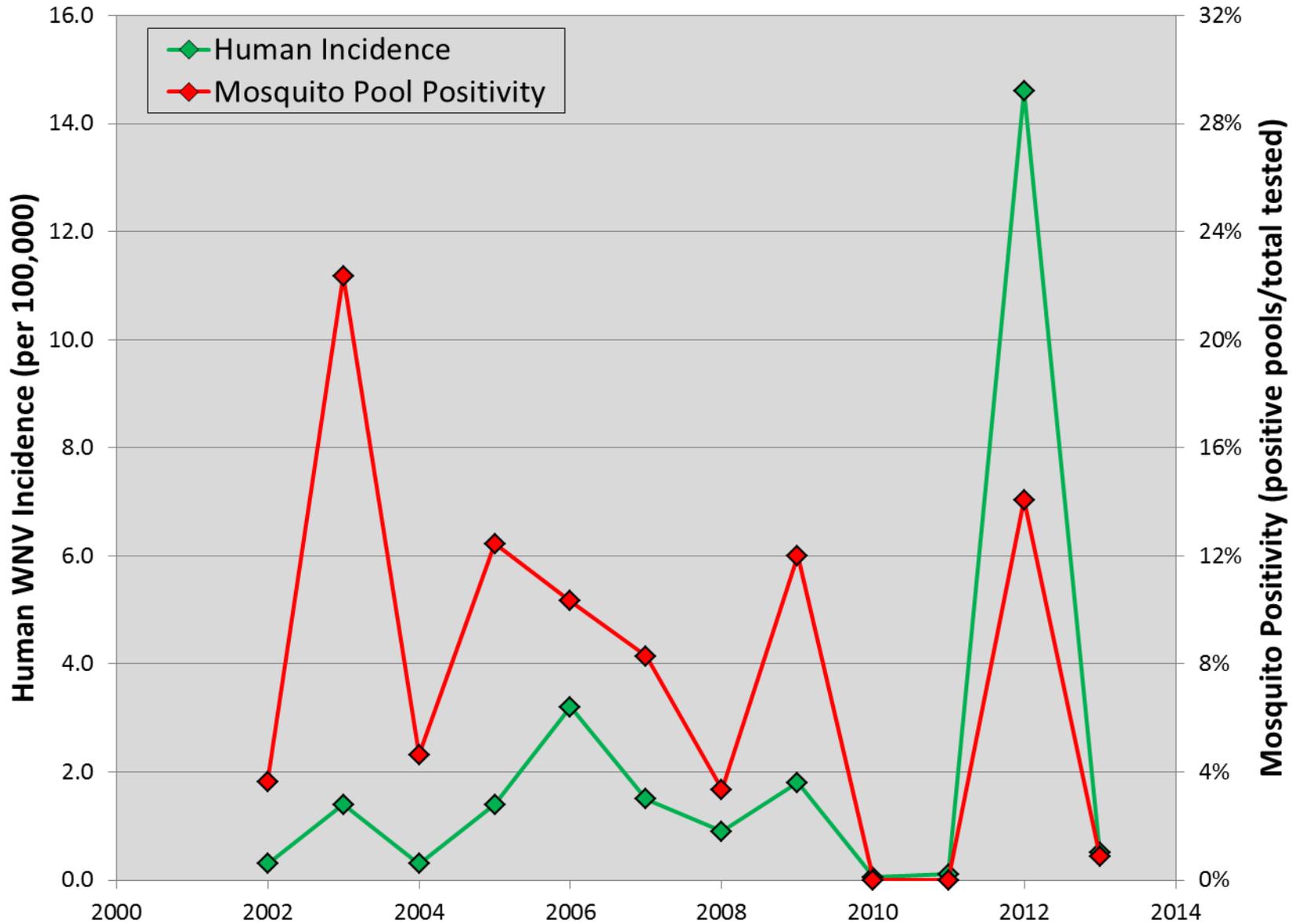
2013



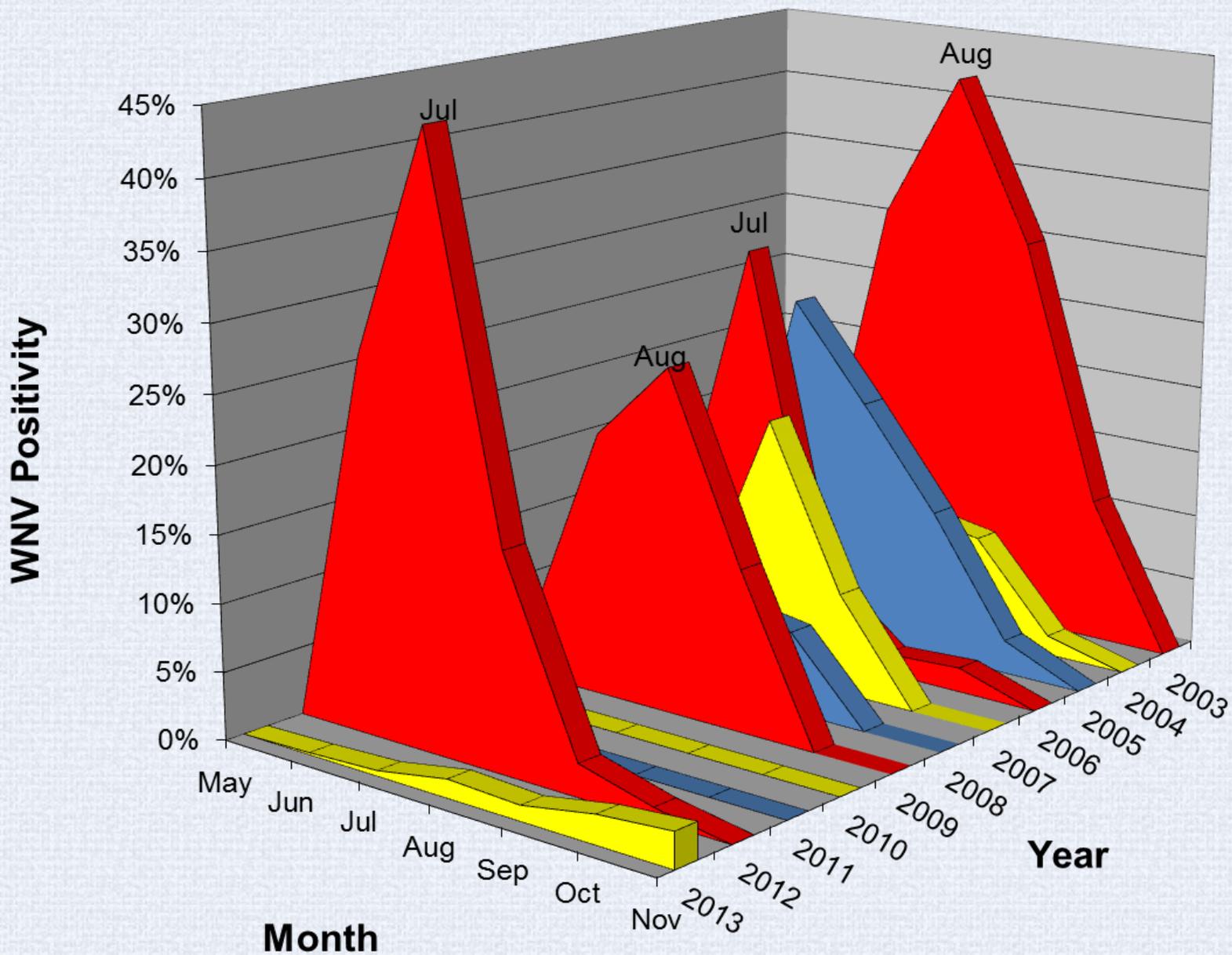
2014



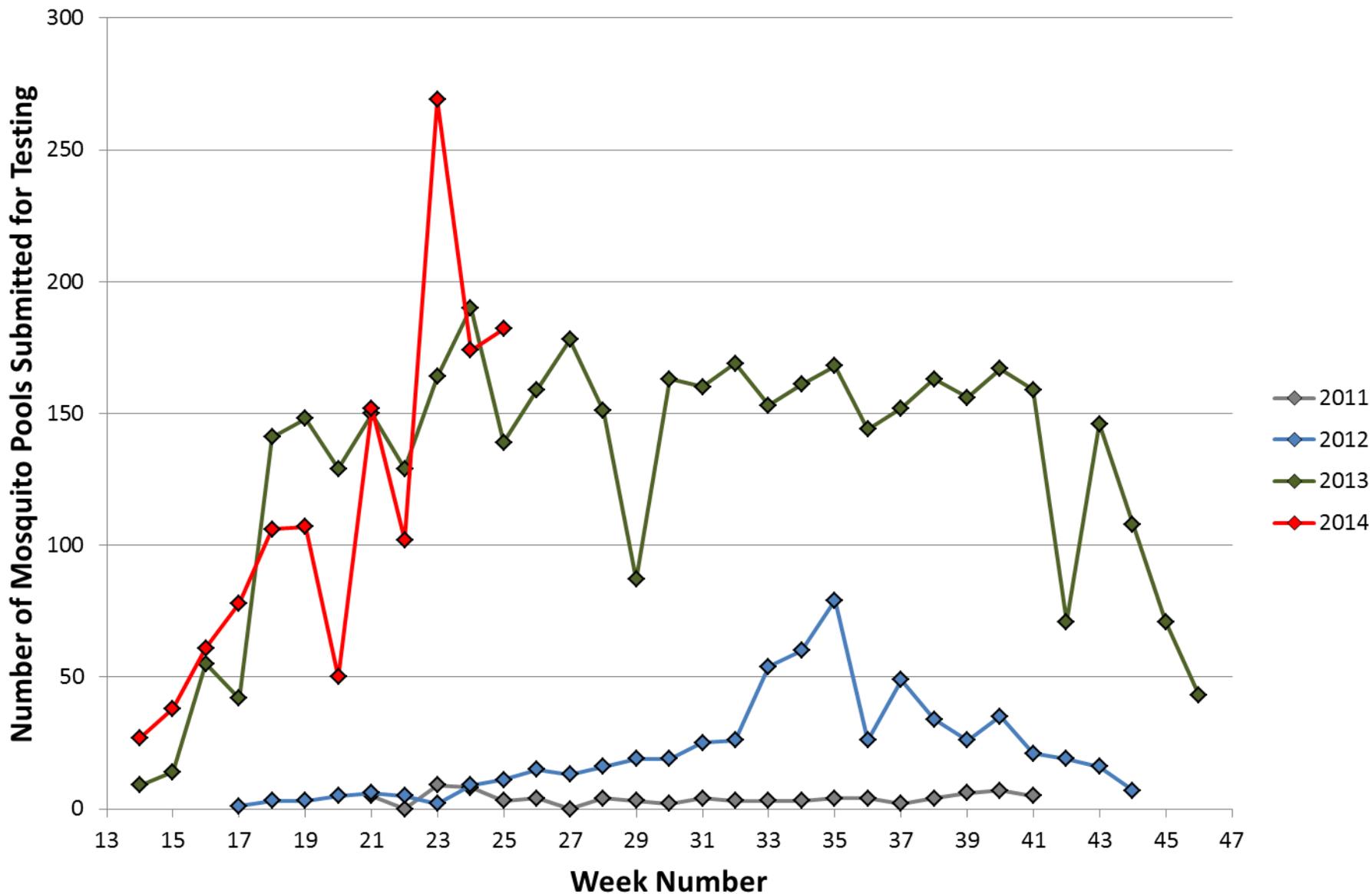
Annual WNV Incidence and Mosquito Pool Positivity



Monthly WNV Positivity 2003-2013



Weekly Mosquito Pool Submissions 2011-2014



Summary

- Mosquito surveillance allows for early detection of West Nile virus activity
- Mosquito data can be used to make risk assessments for informed decisions to reduce human disease
- We are better prepared now to meet testing demands and potential, future outbreaks
- With more and refined WNV data, there will be an opportunity to gain insights
- What will happen with participation over time?

Acknowledgements

Environmental Health

David Jefferson
Nina Dacko
Shannon Solberg
Kristofer Kovach
Michelle Markham

Laboratory

Guy Dixon
Rebecca McMath
Rune-Par Nilsson
Jessica Holloway
Katrina Tschoeke

Epidemiology

Anita Kurian
Russ Jones
Micky Moerbe