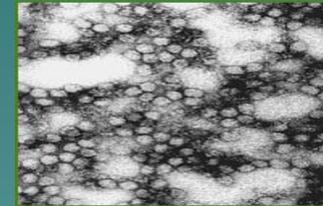


Bird Reservoirs & Mosquito Vector Studies: CDC Epi-Aid 2010

- ◆ CDC Team
- ◆ Nick Komar
- ◆ Nick Panella
- ◆ Aaron Brault
- ◆ Steven Baty
- ◆ MCDPH Team
- ◆ Tricia Wadleigh
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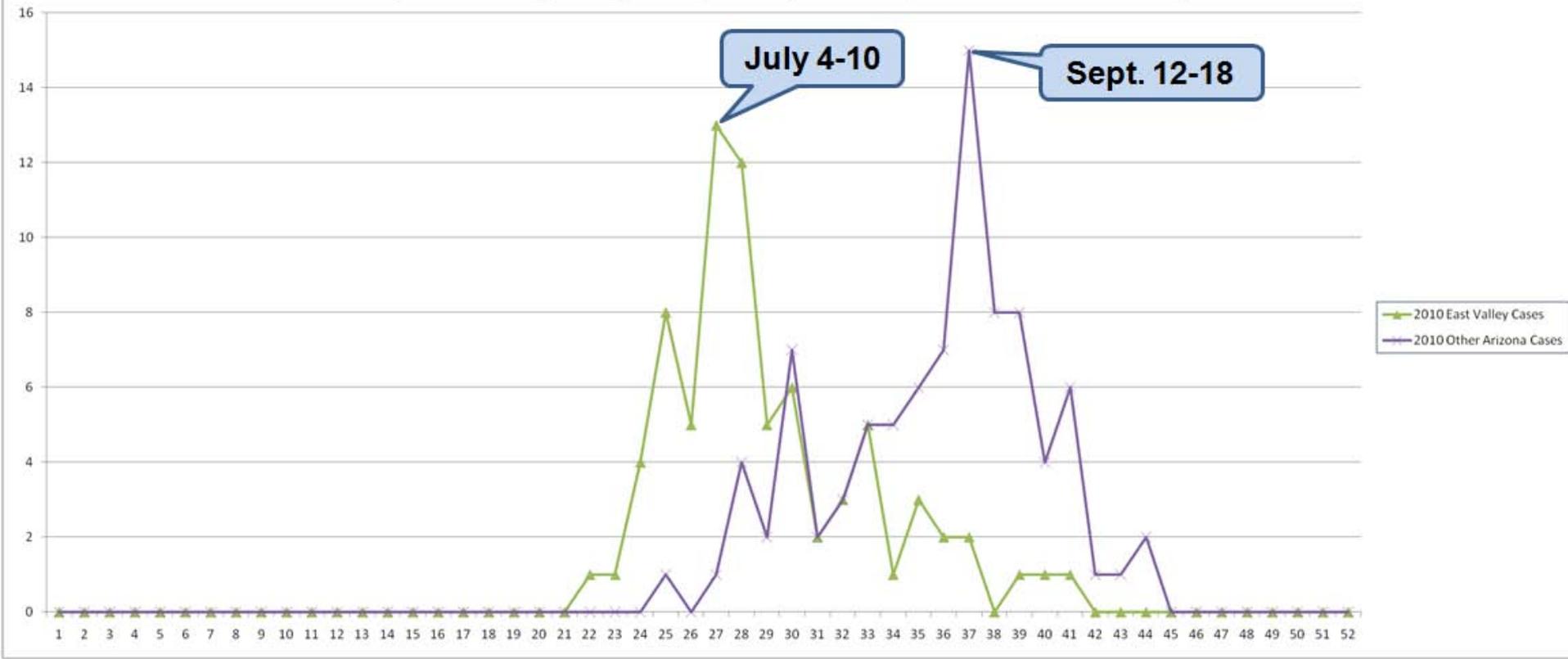


WNV Outbreak, AZ, 2010

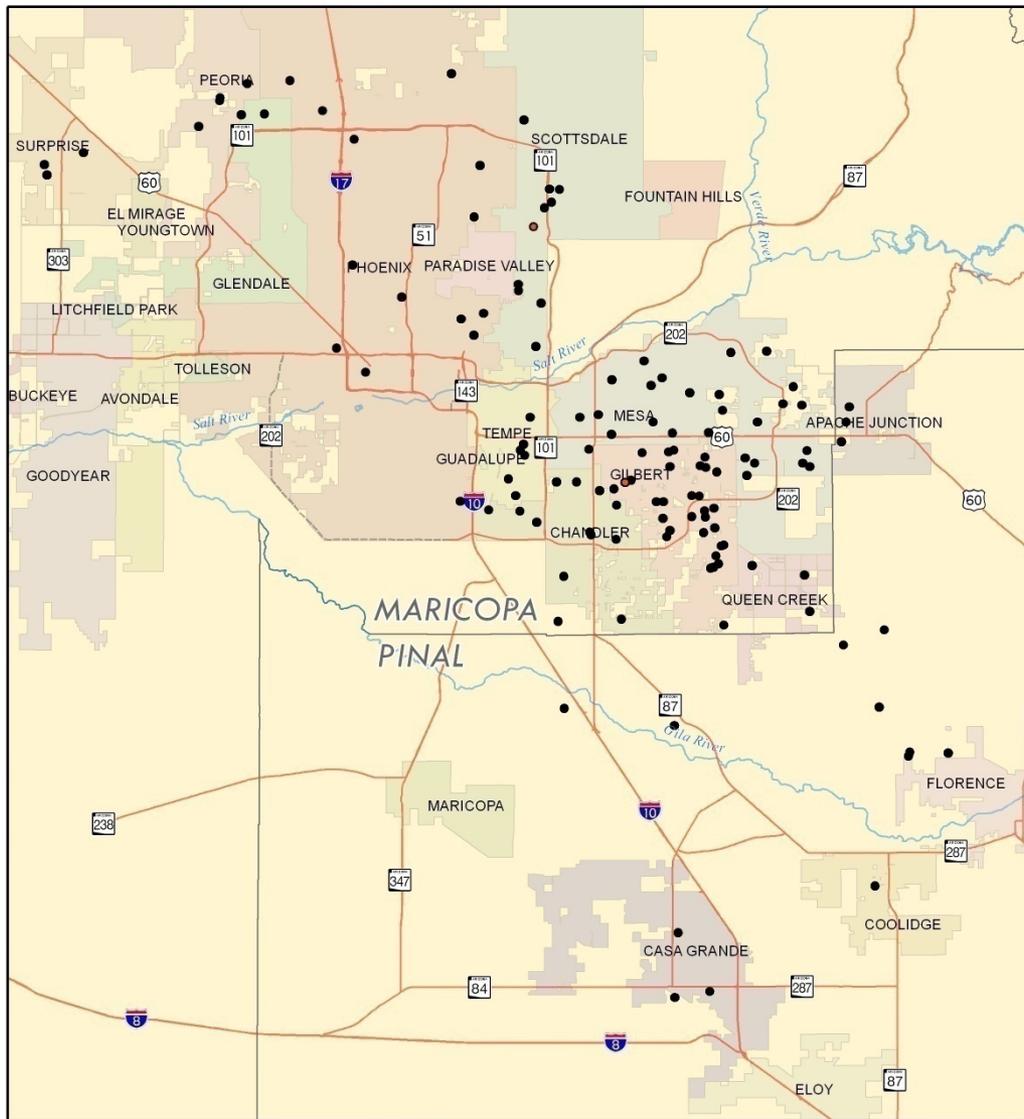
- ◆ AZ – highest case count in the nation!
- ◆ 2010 = 2nd worst year for AZ
- ◆ Intense, sustained (10 weeks!) outbreak occurred in East Valley (EV) of Maricopa Co. Outbreak moved south into Pinal Co.
- ◆ EV outbreak peaked early – July.
- ◆ CDC Epi-Aid is requested.

Epi Curve, WNV, AZ - 2010

WNV Cases in AZ by MMWR Reporting Week, 2010 (East Valley vs. All Other AZ Cases)



Human Cases of West Nile Virus, November 2010



0 5 10 15 20 Miles

West Nile Virus, November 2010

- Previous Cases
- November
- Streams
- Highways

Map Date: February 2011
Source Data: Arizona Department of Health - Infectious Disease



Avian Reservoirs Study

Objectives

- ◆ Measure WNV seroprevalence in common bird species in outbreak zone.
- ◆ Analyze seroprevalence data, bird population data (common species), reservoir competence data (based on WNV viremia data), and mosquito host feeding data to identify important vertebrate amplifying hosts for the 2010 outbreak.

Avian serosurvey

- ◆ Most birds sampled in mid-September
- ◆ Common species targeted



Mourning
Dove
(*Columbiforme*)



Great-tailed
Grackle
(*Passeriforme*)



House
Finch
(*Passeriforme*)



House
Sparrow
(*Passeriforme*)

- ◆ Birds captured with mist nets
- ◆ Blood collected from ulnar or jugular vein
- ◆ Serum tested for anti-WNV antibodies by PRNT

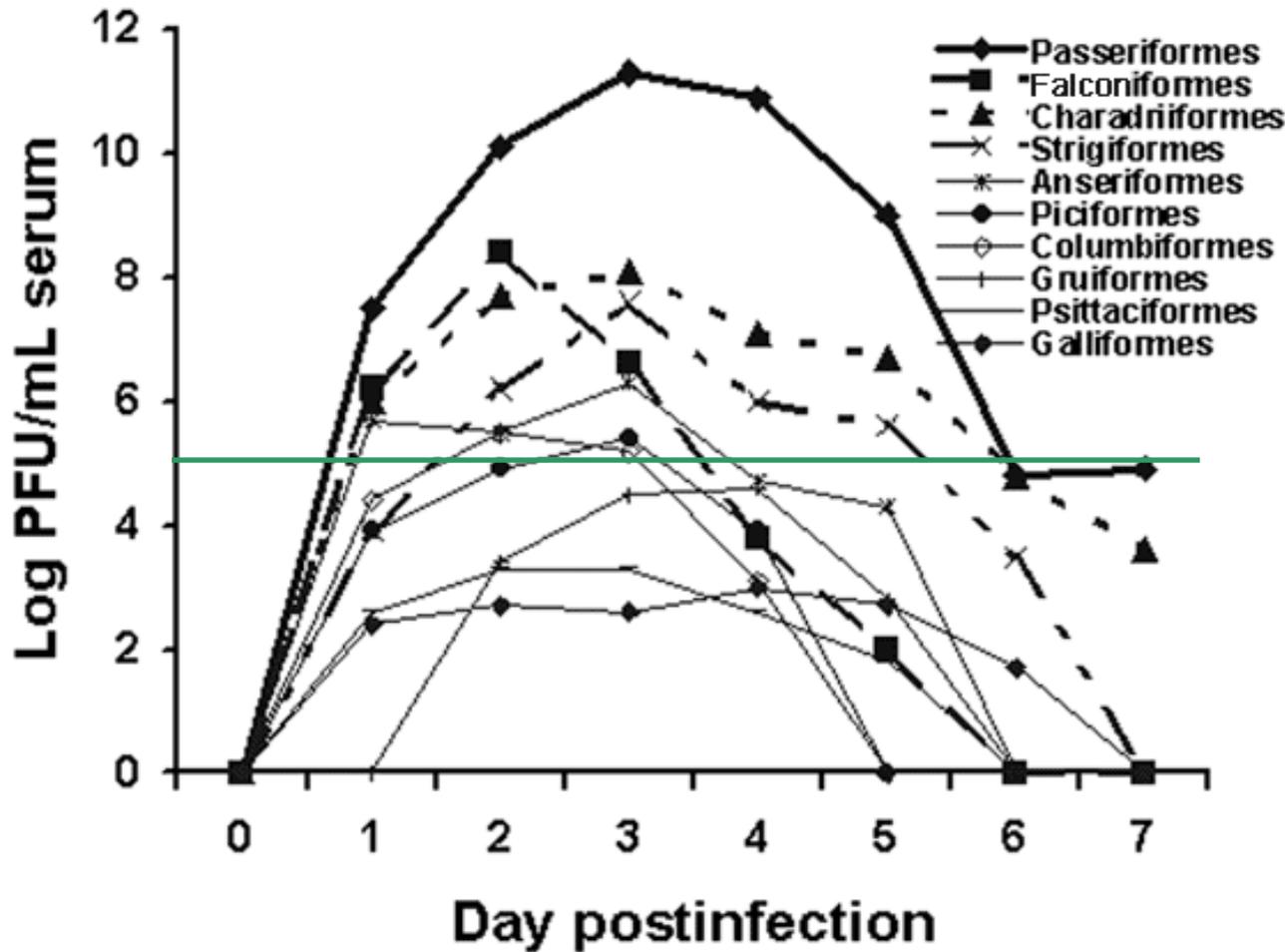


WNV Bird Studies

- ◆ 300+ bird bloods coll - Gilbert & Mesa
- ◆ 12+ avian species
- ◆ Overall - 51 % WNV+
- ◆ Grackles – (5/6) 83%
- ◆ Sparrows – (43/82) 52%
- ◆ Finches – 3/3 (100%)
- ◆ Mourning doves – (26/54) 48%



Bird viremia and WNV



Reservoir competence, $C = SID$

S, susceptibility

I, daily infectiousness

D, Duration of infectious viremia

Units, % of Culex mosquitoes that become infectious

| Species (n) | S | I | D | C | Rel. | Source |
|--------------------------|-----|------|-----|------|------------|----------------------|
| House Finch (2) | 1.0 | 0.32 | 5.5 | 1.76 | 9.3 | Komar et al. 2003 |
| Great-tailed Grackle (4) | 1.0 | 0.28 | 4.5 | 1.28 | 6.7 | Guerrero et al, 2011 |
| House Sparrow (6) | 1.0 | 0.34 | 3.3 | 1.12 | 5.9 | Guerrero et al, 2011 |
| European Starling (6) | 1.0 | 0.12 | 1.8 | 0.22 | 1.2 | Komar et al. 2003 |
| Mourning Dove (3) | 1.0 | 0.11 | 1.7 | 0.19 | 1.0 | Komar et al. 2003 |
| Rock Pigeon (6) | 1.0 | -- | -- | 0 | -- | Komar et al. 2003 |

Mosquito Feeding: Host Preference Studies

- Trap blood-fed mosquitoes
- Perform DNA analysis to identify host species



Who are the mosquitoes feeding on?

Mosquitoes collected in CDC Resting Traps at communal bird roost sites
(mid-September)

| Culex quinquefasciatus (n=92) | Culex tarsalis (n=27) |
|--|------------------------------|
| House Sparrow – 54 | House Sparrow – 11 |
| House Finch – 19 | House Finch – 3 |
| Great-tailed Grackle – 6 | Great-tailed Grackle – 2 |
| Brown-headed Cowbird – 3 | Brown-headed Cowbird – 2 |
| Mourning Dove – 3 | Mourning Dove – 2 |
| Chicken – 2 | White-winged Dove – 2 |
| Red-winged Blackbird – 1 | Curve-billed Thrasher – 2 |
| European Starling – 1 | Eurasian Collared-Dove – 1 |
| Bronzed Cowbird – 1 | House Wren – 1 |
| Curve-billed Thrasher – 1 | Chicken - 1 |
| Inca Dove - 1 | |

Who are the mosquitoes feeding on?

Random Sampling

(Mosquitoes trapped in non-roosting sites)

◆ *Culex tarsalis* (n=7)

- Human (1), Pigeon (1), Mourning Dove (2), White-winged Dove (1), House Finch (1), Turkey (1)

◆ *Culex quinquefasciatus* (n=22)

- Human (3), Chicken(6), House Sparrow (5), House Finch (2), Curve-billed Thrasher (2), Mourning Dove (2), White-winged Dove (1), Eurasian Collared-Dove (1)

“Reservoir capacity”

(Mosquito-inoculation index)
(Vertebrate host contribution)

$$M = \sum P_i i C$$

P, relative population of vertebrate host

i, infection rate

C, reservoir competence

Calculation of Reservoir Capacity (M)

(w/ avian mortality)

Infection rate, $i = s / (1 - m + [s * m])$

s, seroprevalence

m, mortality rate

| Species | P | s | m | i | C | M=Pii C |
|---|------|-----------|------|-----------|------|------------|
| House Finch | 679 | 1.00 | 0.85 | 1.00 | 1.76 | 188 |
| Great-tailed Grackle | 604 | 0.83 | 0.33 | 0.88 | 1.28 | 94 |
| House Sparrow | 976 | 0.52 | 0.50 | 0.69 | 1.12 | 82 |
| European Starling | 723 | 0.20 * | -- | 0.20 * | 0.22 | 1 |
| Mourning Dove * Estimated from similar species (e.g. cowbird for | 3595 | 0.48 | -- | 0.48 | 0.19 | 25 |
| Rock Pigeon | 944 | 0.48 * | -- | 0.48 * | 0 | 0 |

Avian Studies Comments

- ◆ Multiple calculation methods were applied to measure reservoir competence & capacity to identify the principal amplifying hosts.
- ◆ Different methods yielded similar results.
- ◆ CDC took into account bird host abundance, seroprevalence data, viremia data, and vector mosquito feeding preference data.

Avian Studies Summary

- ◆ House sparrows and house finches stand out as WNV amplifiers in the East Valley outbreak.
- ◆ Grackles & doves are also important when accounting for their abundance.

Avian Studies Questions

- ◆ What effects do heavy concentrations of birds in roosts (e.g. grackles) have on human WNV risk?
- ◆ What impact does increasing numbers of invasive species (e.g. Eurasian collared doves) have on WNV transmission/risk?
- ◆ What impact would overlapping /concurrent infections (WNV & pigeon paramyxovirus) have on birds' viremia and thus reservoir competence? (Both viruses were circulating and infecting birds in Arizona - especially doves).

Grackle Roosts & WNV Risk

- ◆ Hypothesis: # human cases should be higher with closer proximity to roosts.
- ◆ Nick Komar monitored grackle movements and mapped major grackle roosts.
- ◆ He compared numbers of human cases in grackle roost areas vs. non-roost areas.
- ◆ Unexpected result: there was a negative correlation between # human WNV cases and proximity to roosts. Why?

Doves o'plenty in outbreak zone.



Eurasian Collared Doves

- ◆ Nick Panella, CDC – presentation at the 2011 AMCA Meeting.
- ◆ Eurasian collared doves (ECDs) are an invasive species that have been increasing in numbers and expanding in range in the U.S. since 1980s.
- ◆ CDC Laboratory - virus inoculation studies with CO07 and NY99 WNV strains to induce infections in the EDCs to monitor virus levels.

Eurasian Collared Doves

- ◆ Viremia was measured daily.
- ◆ Virus levels peaked at 4.6 – 5.0 pfu/ml serum.
- ◆ Antibody response developed rapidly. Virus was cleared by day six.
- ◆ Reservoir competence for ECDs is slightly less than mourning doves which can exceed viremias of 5.0 pfu/ml.
- ◆ Affects of co-infection of WNV and paramyxovirus is still unknown.

Arizona Doves



Questions?

