A National Surveillance System for West Nile Virus in Zoological Institutions

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Background

- June 2001 meeting
  - The National West Nile virus Zoological Surveillance system working group
- Guidelines: *Surveillance for West Nile Virus in Zoological Institutions*
- One-year pilot study for national zoological surveillance (Aug ’01 – Aug ’02)
- Objectives
  - Affordable/reliable testing for zoos
  - Novel data source for national surveillance
  - Increase relationships btw PH and Zoos/Vet Med

Sampling Scheme

Phase I:

- Begun August 2001 – current
- Solicited tissue/blood samples from **ill/dead** at-risk animals found on zoo grounds (captive/local wildlife)
- At-risk animals = any animal (any taxa) housed outdoors and at risk of mosquito exposure

Sampling Scheme (cont.)

Phase II:

- **Serosurvey** of at-risk animals
  - Entire country w/emphasis on emerging region
- Archived serum/plasma 6 months prior to first known positive in each state
- Opportunistically collected blood samples from **healthy** animals
  - Seropositive follow-up to evaluate long term sequelae of WNV exposure
  - Data on varying susceptibilities and rates of WNV seroconversion in zoo species and indigenous wildlife.

Diagnostics

- Animal Health Diagnostic Laboratory at Cornell University, College of Veterinary Medicine performs all tests required for the project.
- Tissues are tested by RT-PCR and virus isolation
- Serum and plasma tested for virus and/or antibody, depending on history

Looking for Virus

- RT-PCR for WNV
  - Positives confirmed with virus isolation or second independent RT-PCR
- All tissues processed for virus isolation
  - Identification of all viruses observed
    - Avian reovirus

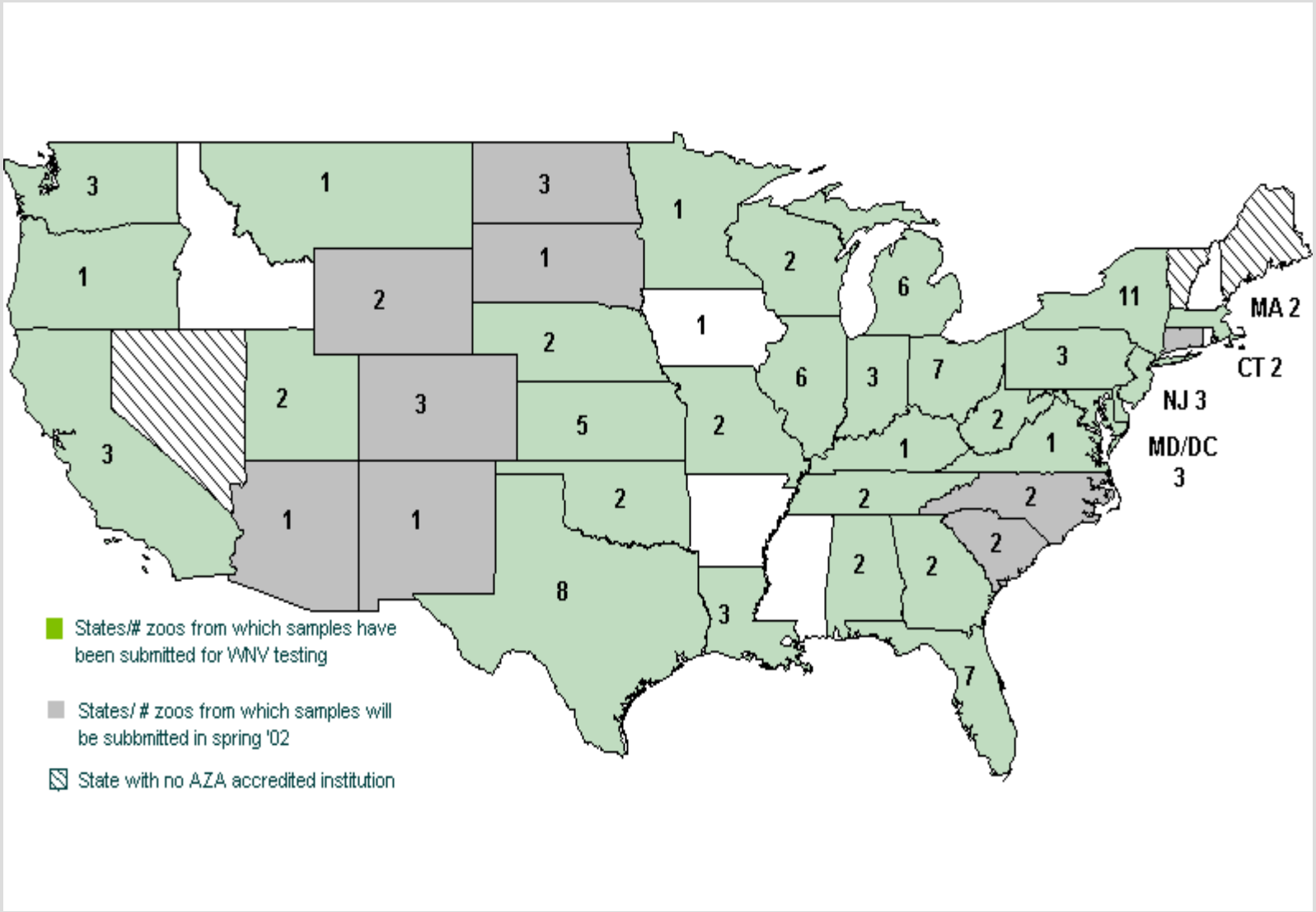
Looking for Antibody

- Screen serum or plasma at 1:40 by PRNT
- Positives are titrated to a dilution of 1:640 against WNV and SLE

Results Aug 1, 2001 – Feb 28, 2002

- Over 1,450 animals tested
  - 967 birds (195 species)
  - 40 equids (8 species)
  - 436 other mammals (110 species)
  - 20 reptiles (6 species)
- 64 participating institutions (20 more will submit in spring ’02)
- 30 states including the District of Colombia

Sample Distribution



State	Avian	Equine	Other Mammal	Herptiles	Total	% of Total
AL	6	0	0	0	6	0.4
CA	28	0	12	0	40	2.8
DC	46	0	1	0	47	3.3
DE	0	0	1	0	1	0.1
FL	93	0	6	5	104	7.2
GA	98	0	26	5	129	8.9
IL	14	0	4	2	20	1.4
IN	28	0	19	0	47	3.3
KS	64	0	0	0	64	4.4
KY	12	0	0	0	12	0.8
LA	34	0	15	0	49	3.4
MA	75	4	48	0	127	8.8
MD	9	1	4	1	15	1.0
MI	1	0	0	0	1	0.1
MN	12	0	0	0	12	0.8
MO	38	0	26	0	64	4.4
MT	1	0	0	0	1	0.1
NE	29	0	2	0	31	2.1
NY	171	2	78	3	254	17.6
OH	25	1	39	4	69	4.8
OK	4	0	0	0	4	0.3
OR	4	0	0	0	4	0.3
PA	74	0	67	0	141	9.8
TN	13	7	18	0	38	2.6
TX	47	8	60	0	115	8.0
UT	7	0	0	0	7	0.5
VA	1	0	0	0	1	0.1
WA	1	0	0	0	1	0.1
WI	27	0	10	0	37	2.6
WV	5	0	0	0	5	0.3
SUM	967	23	436	20	1446	100.0
% of total	66.9	1.6	30.2	1.4	100.0	

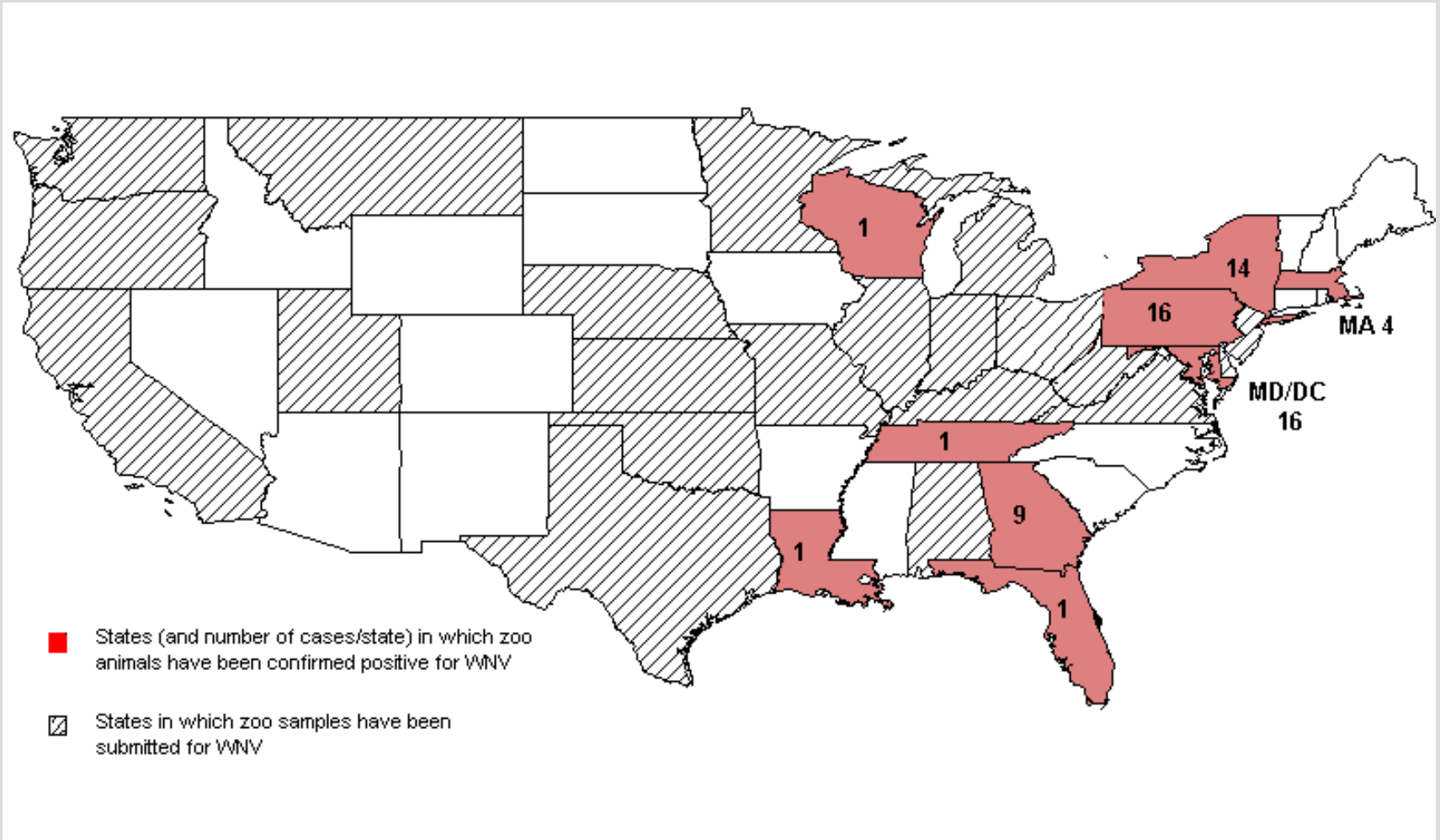
Confirmed Results

- 30 WNV antibody-positive birds (1 wild, 29 captive)
- 29 WNV virus-positive birds (16 wild, 13 captive)
- 1 WNV antibody-positive reptile (captive crocodile monitor)
- 1 captive bird was antibody-positive for St. Louis encephalitis virus (SLE) in GA
- 13 animals (10 avian, 2 mammal, 1 reptile) screened antibody-positive and are currently undergoing confirmatory testing.

Distribution of WNV Positives

- Antibody positive animals - zoos from 9 states
  - FL, GA, LA, MA, MD/DC, NY, PA, TN, WI
- Virus-positive animals - zoos from 4 states
  - MD/DC, GA, NY, PA
- All (antibody and virus) were from known WNV-endemic areas in the United States
- No positive zoo sample has predated the first positive predated the first event in any area

Confirmed Positive Distribution



State	Spp.	W/D	WNV Pos type	End point
DC/MD	1 Crow	W	Antibody	160
DC/MD	12 Crow	W	Virus	
DC/MD	1 Crocodile Monitor	D	Antibody	>=640
DC/MD	1 Crow	W	Antibody	20
DC/MD	1 Magpie	D	Virus	
FL	1 Crowned crane	D	Antibody	40
GA	4 Chilean Flamingo	D	Virus	
GA	1 Tawny Owl	D	Virus	
GA	1 Turaco	D	Antibody	>=640
GA	2 Wattled Crane	D	Antibody	320
GA	1 Wattled Curassow	D	Antibody	320
LA	1 Marabou Stork	D	Antibody	320
MA	1 Bald Eagle	D	Antibody	>=640
MA	1 Barnacle Goose	D	Antibody	320
MA	1 Saddle Billed Stork	D	Antibody	>=640

State	Spp.	W/D	WNV Pos type	End point
NY	1 American Kestrel	D	Virus	
NY	1 Chilean Flamingo	D	Virus	
NY	3 Crow	W	Virus	
NY	1 Flamingo	D	Antibody	80
NY	1 Golden Eagle	D	Antibody	360
NY	2 Pelican	D	Antibody	80
NY	3 Penguin	D	Virus	
NY	1 Snowy Owl	D	Antibody	40
NY	1 Snowy Owl	D	Virus	
PA	1 Bald Eagle	D	Antibody	320
PA	2 Flamingo	D	Antibody	40, >=640
PA	1 Goose spp.	D	Antibody	40
PA	1 Greater Magellan goose	D	Antibody	80
PA	2 Humboldt Penguin	D	Antibody	320
PA	9 Humboldt Penguin	D	Antibody	>=640
TN	West African Crowned Crane	D	Antibody	>=640
WI	Demoiselle crane	D	Antibody	>=640

Clinical Illness

- 6 (21%) WNV virus-positive captive animals exhibited clinical signs of illness
  - 23 (79%) were found dead in exhibits or on zoo grounds.
- 6 (20%) WNV antibody-positive animals presented with neurologic clinical signs (including one wild crow and the crocodile monitor)
  - 24 (80%) were found through serosurvey.

Inconclusive Results

- 7 captive animals (6 birds, 1 African wild dog) were WNV antibody-positive upon screening but could not be conclusively classified as WNV or SLE upon end-point titration
- 4 captive birds WNV virus-positive by PCR were not confirmed by virus isolation
- 1 captive bird that was WNV antibody-negative but WNV virus-positive

Other Interesting Findings

- 6 wild crows found culture-positive for an unidentified virus of the family Reoviridae
- 6 birds were shipped to one institution from Africa with weakly positive antibody titers to WNV found in serum samples archived during quarantine.

Reporting Structure

- Results reported to submitting institution and central zoo database
- Submitting institutions required to report to local PH
  - Local PH code and incorporate data into national system
- Validation survey in progress
  - 30 institutions validated

Conclusions

- Phase I and II have:
  - Created/strengthened relationships between zoos and local/state health officials for the detection/reporting of a zoonotic disease threat.
  - Provided data to the public health system
  - Given zoos an avenue for testing endangered species
- Future Directions:
  - This project created a framework that may be applied to other biologic threats of concern.
  - Regional diagnostic centers
  - Vaccination

Working Group Members

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