

White Nose Syndrome in Bats

Implications for Cave and Mine Management in California



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Willamette National Forest

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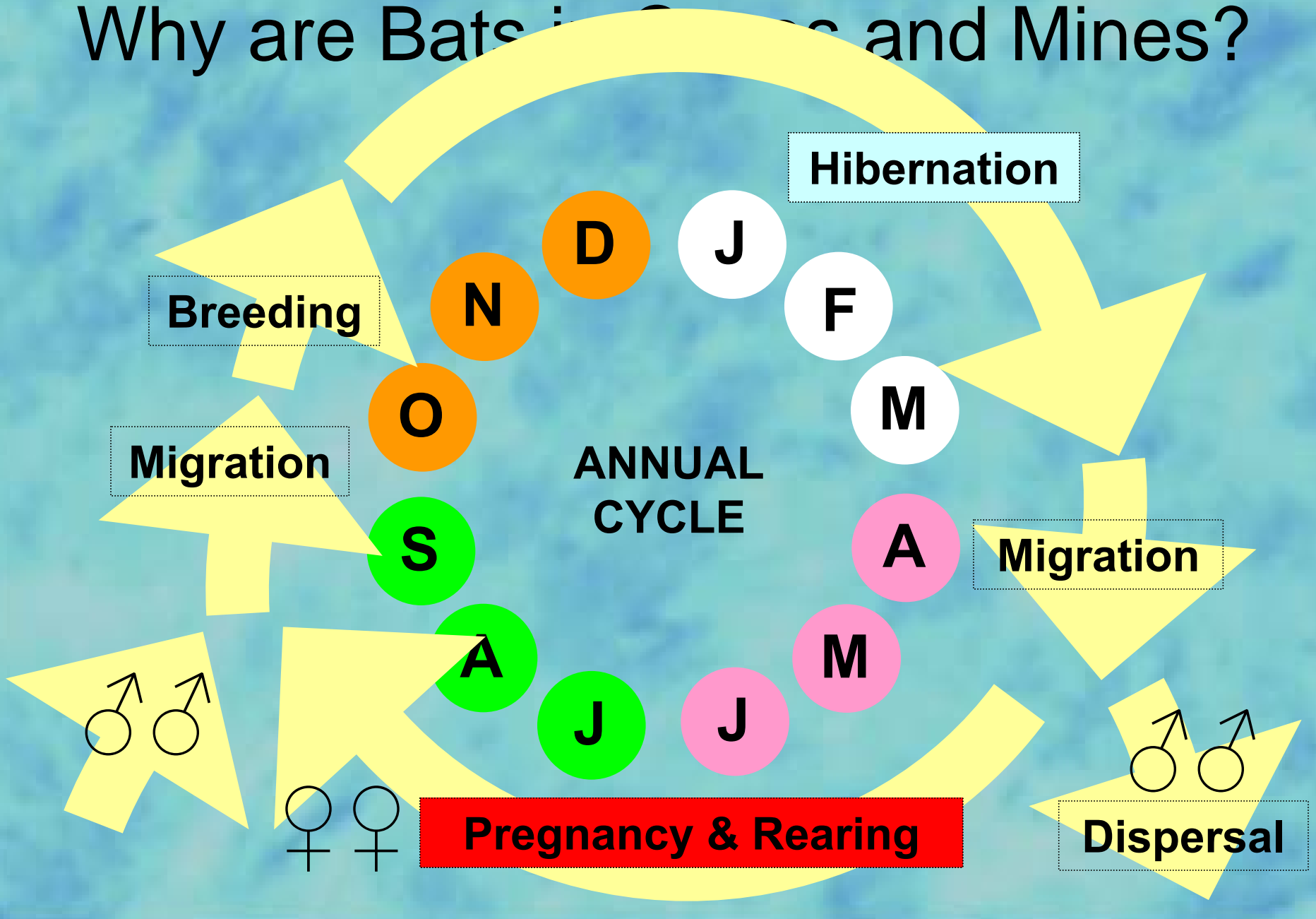
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Joe Szewczak, Humboldt State University

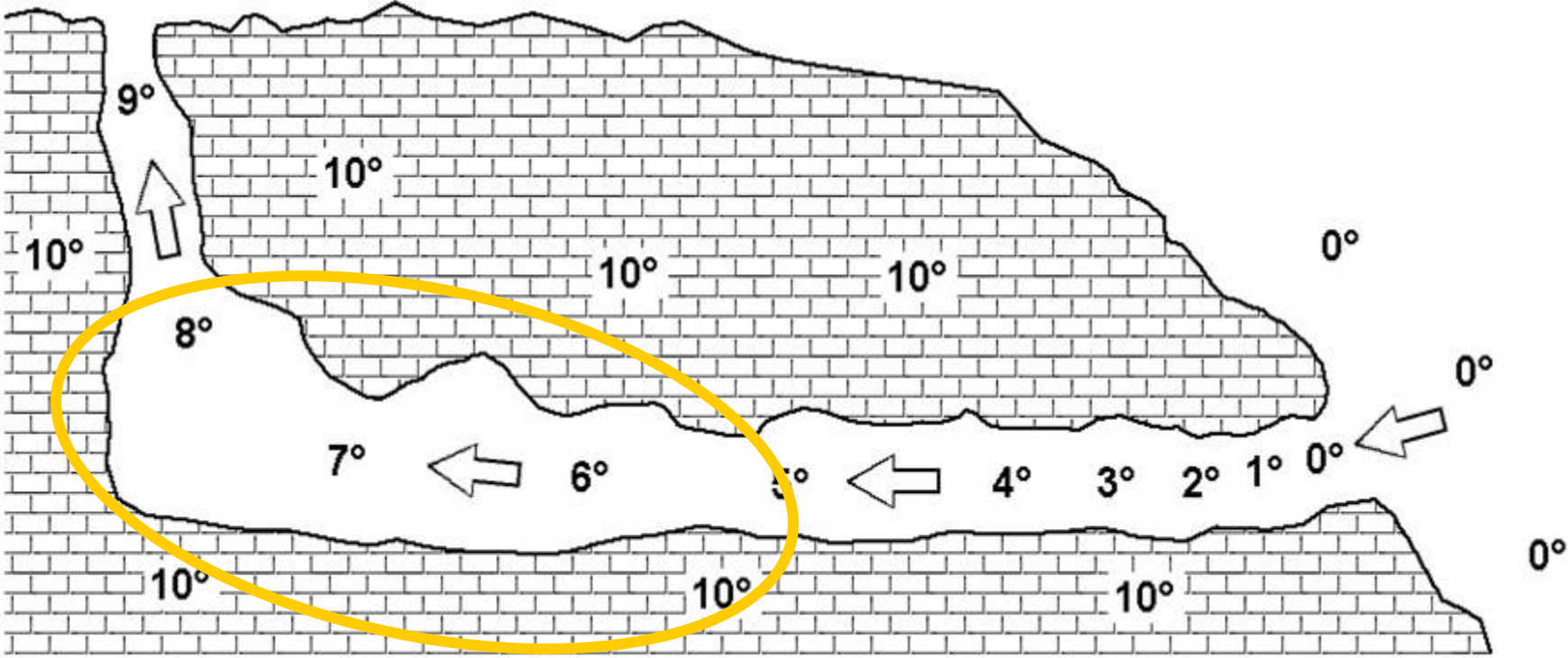
Outline

- Why are Bats in Mines and Caves?
- White Nose Syndrome
 - Discovery and Early History
 - Geographic Progression
 - Pathology and Transmission
- Planning for WNS in California

Why are Bats in Mines and Mines?



Cold, Stable Temps for Hibernation



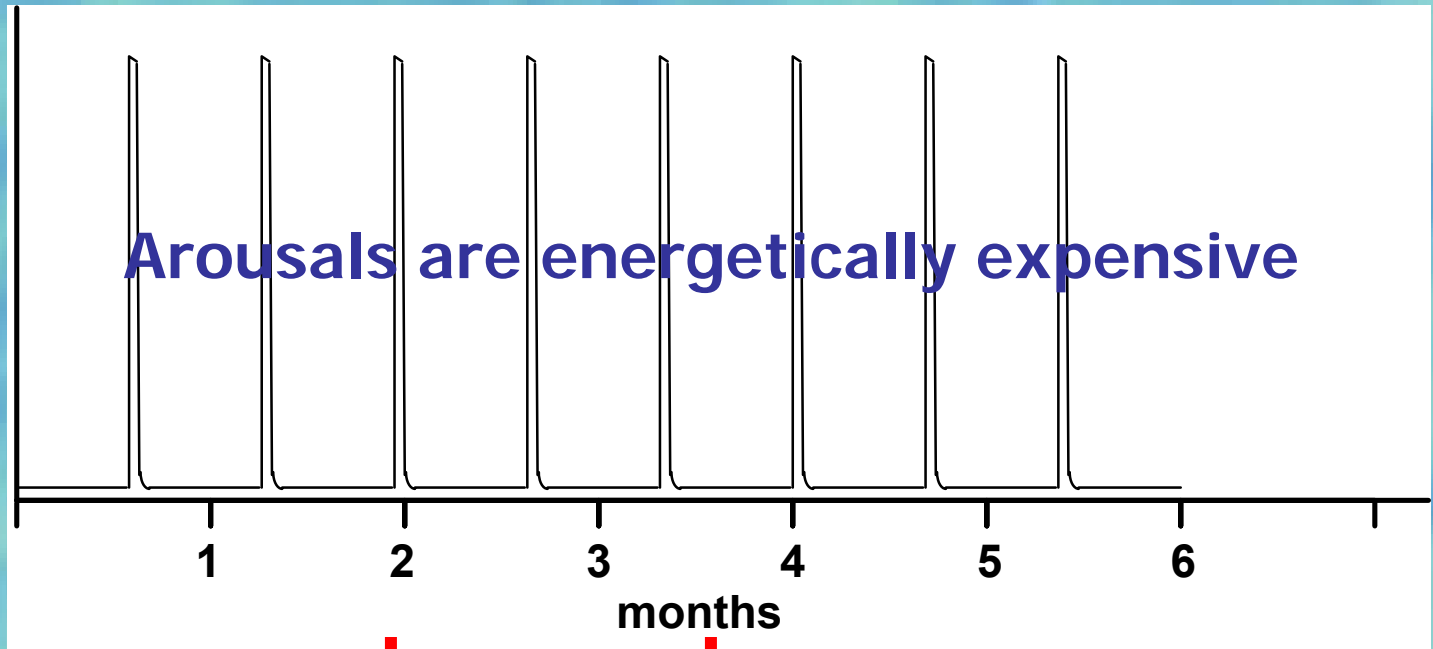
Eptesicus fuscus in torpor



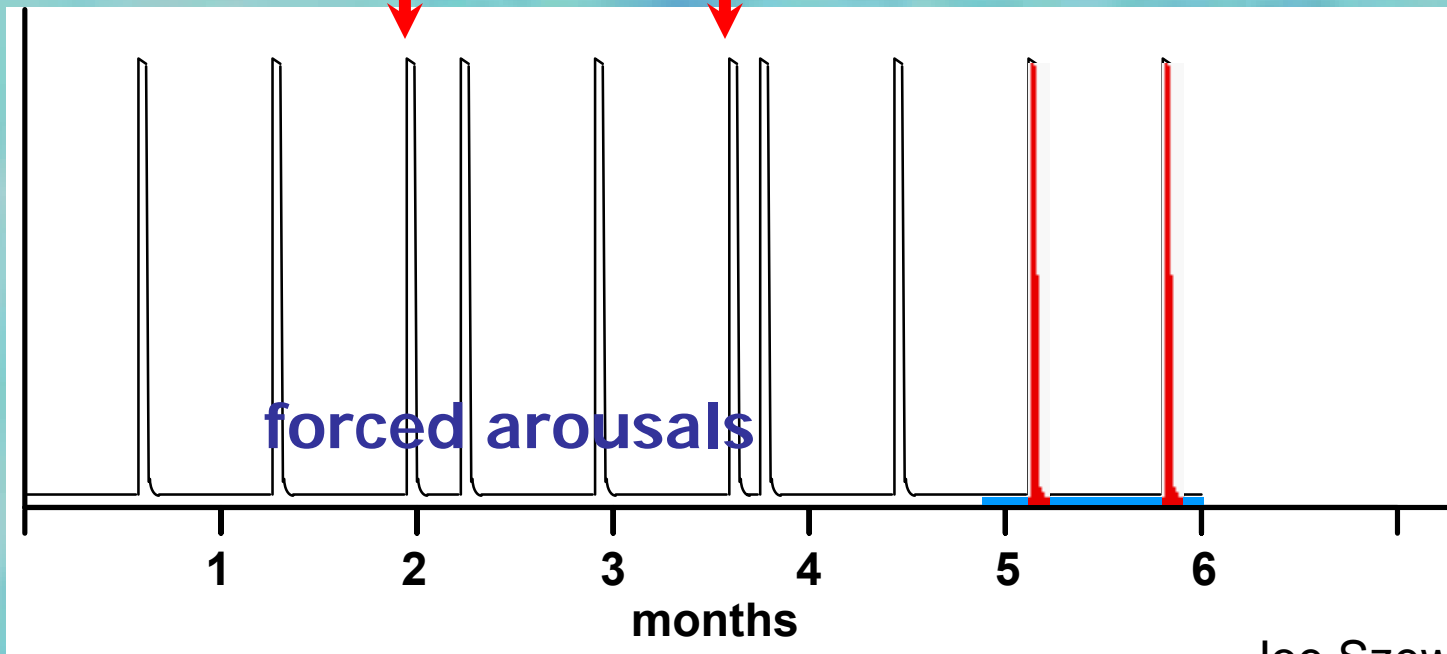
**At 5°C uses
6.6 mg fat/day**

10 g fat → 4.1 years!

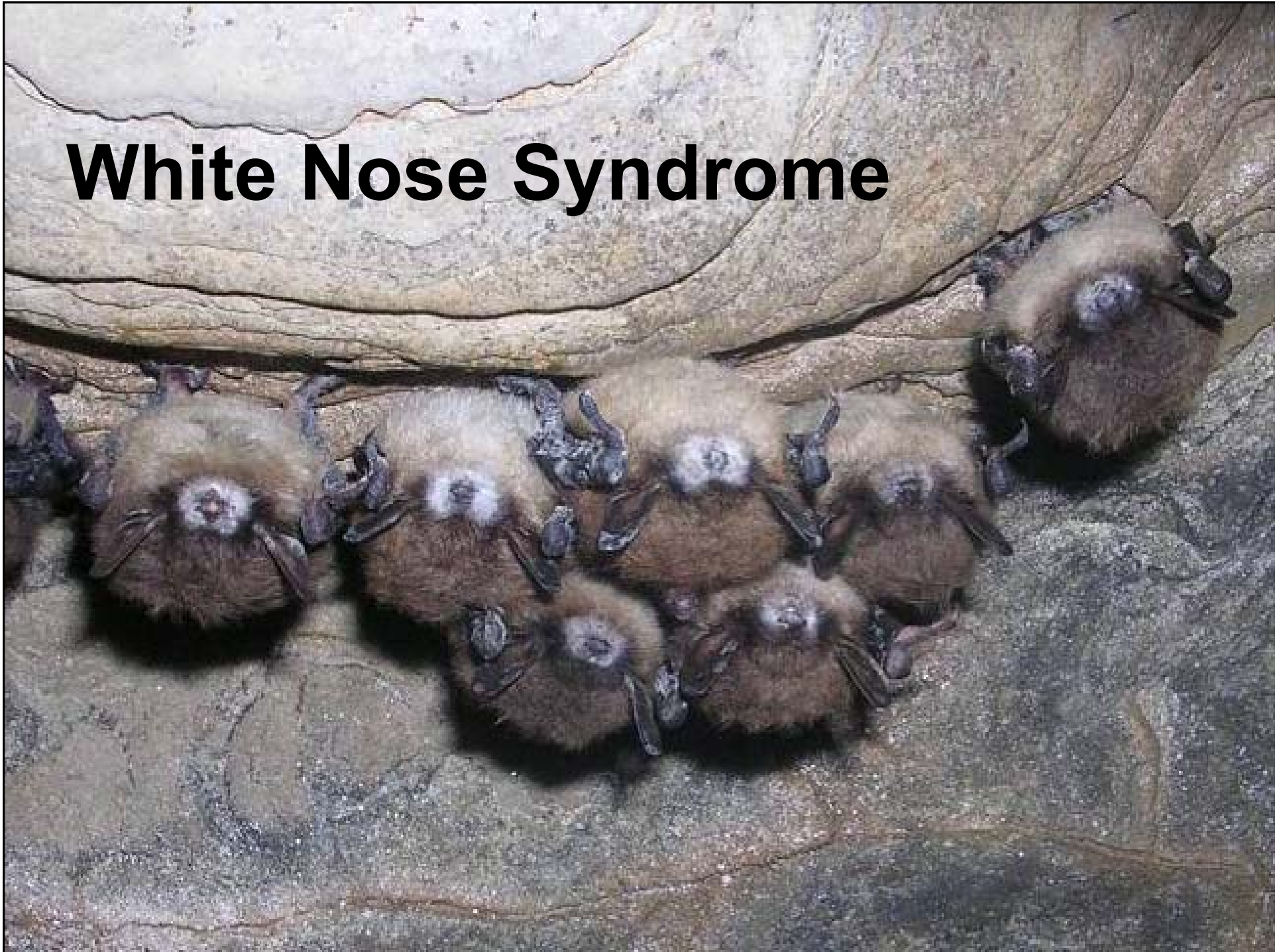
Metabolic Rate
(Energy/Time)



Metabolic Rate
(Energy/Time)



White Nose Syndrome



The Starting Point



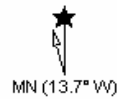
2006

16 February 2006
Howe Cave

- Caves not searched
- Caves with WNS 2006



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Howe Cave - 2/16/2006



Photos by Paul Rubin

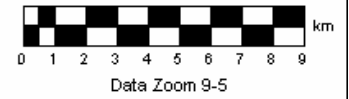
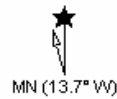
2007

Late January 2007

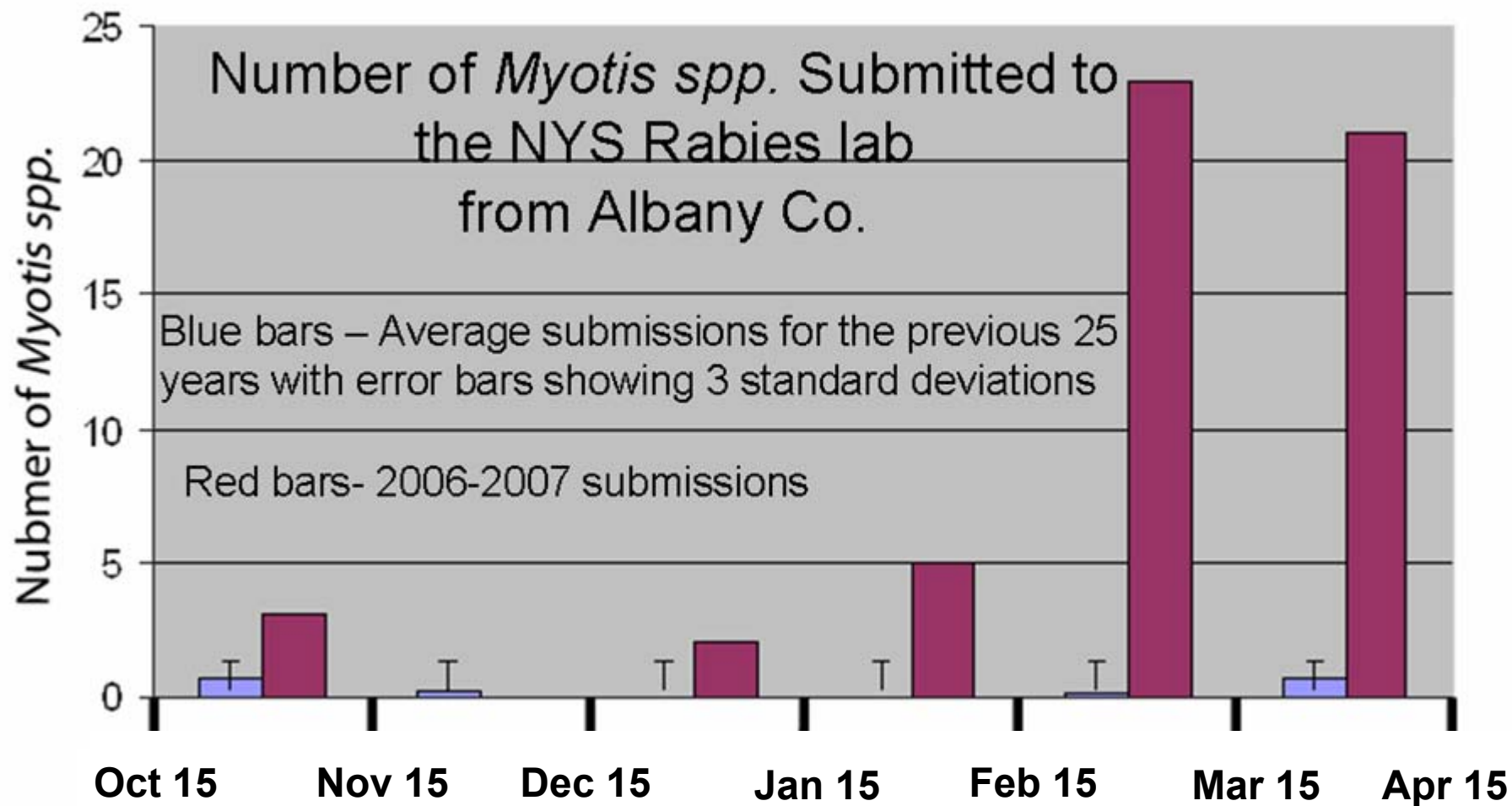
- Caves not searched
- Caves with WNS 2006
- Caves with WNS 2007



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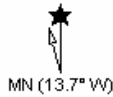
2007

14 March 2007
Hailes Cave

- Caves not searched
- Caves with WNS 2006
- Caves with WNS 2007

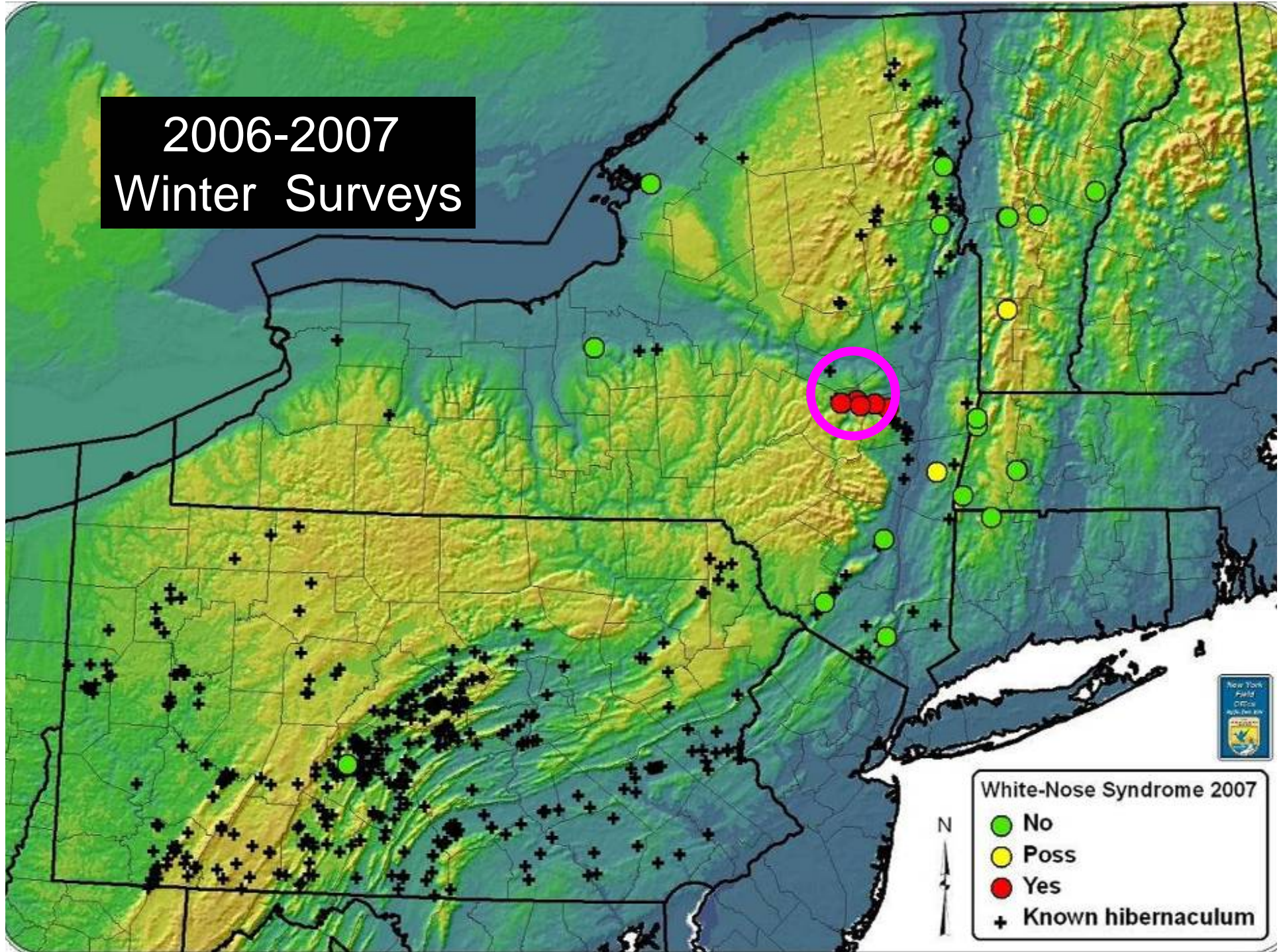


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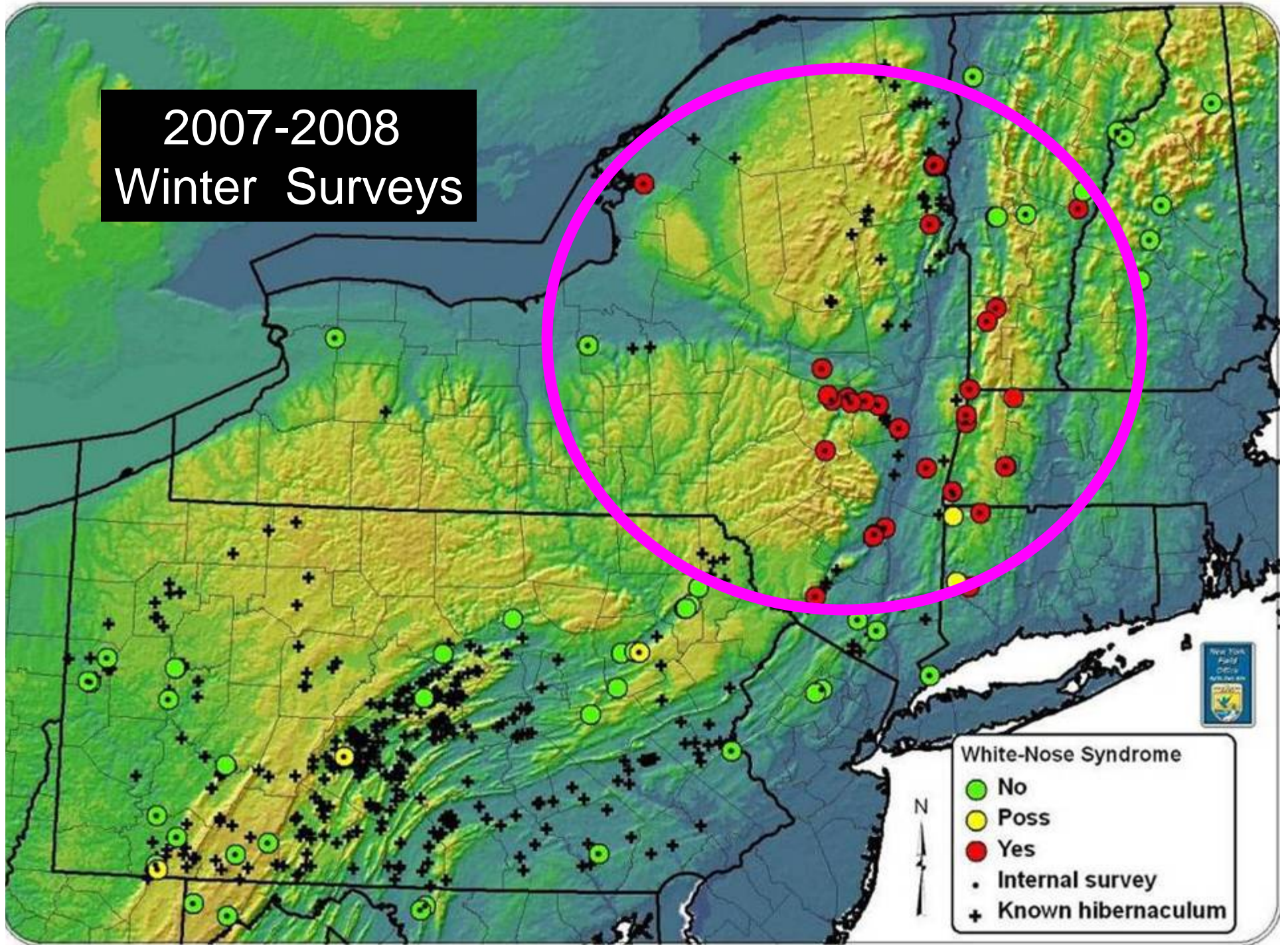




2006-2007 Winter Surveys



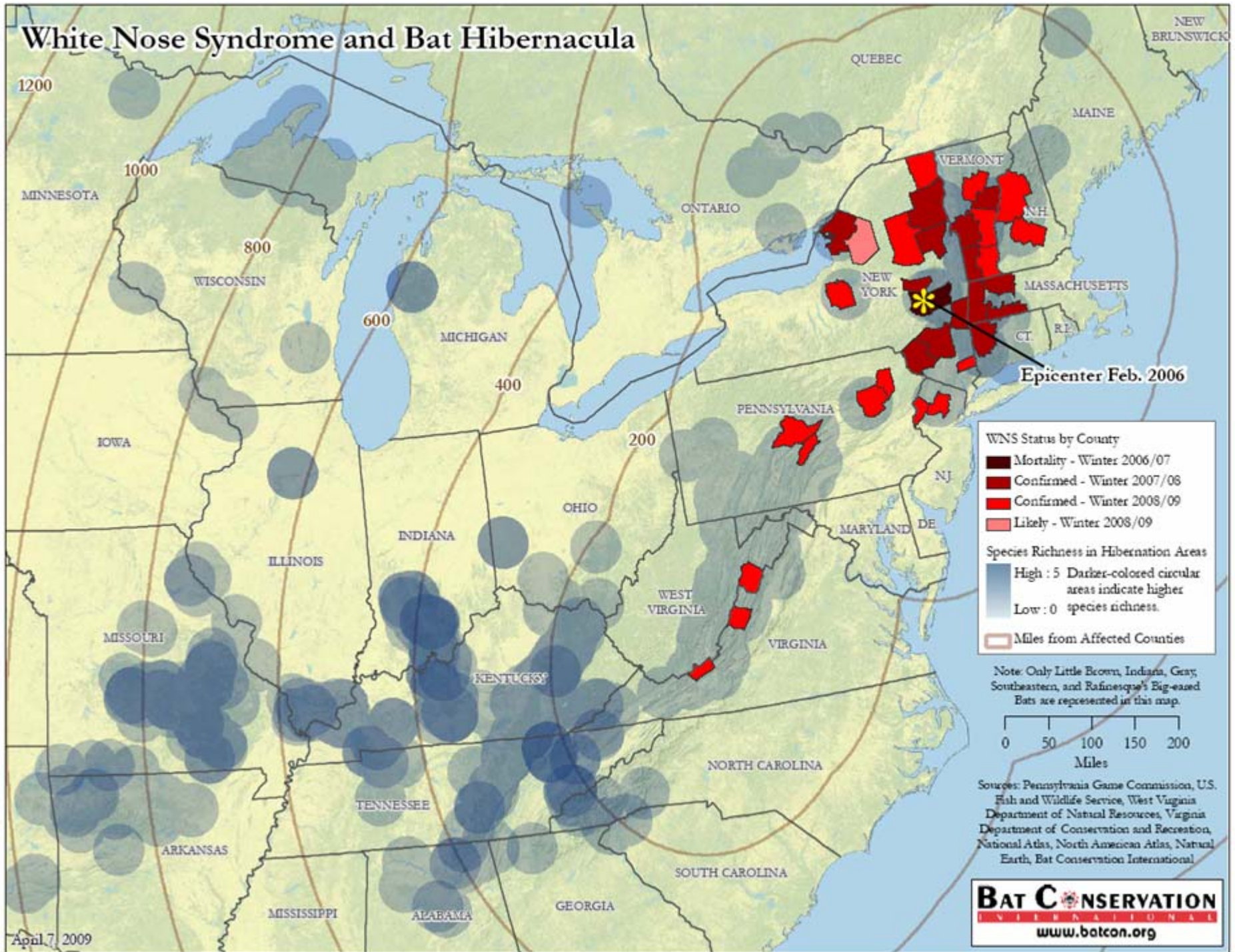
2007-2008 Winter Surveys






Colony Declines

<u>Site</u>	<u>Pre WNS (year)</u>	<u>2007/2008</u>	<u>% Decline</u>
Hailes Cave	16,134 (2005)	1,443	90%
Gages Cavern	968 (1985)	88	91%
Knox Cave	1,948 (2001)	336	81%
Schoharie Caverns	1,329 (2006)	38	97%
Howe Cave	577 (1986)	77	87%
Barytes Cave	1,521 (2005)	1	100%



White Nose Syndrome and Bat Hibernacula



04/07/09
Bat White Nose Syndrome (WNS)
Occurrence by County*

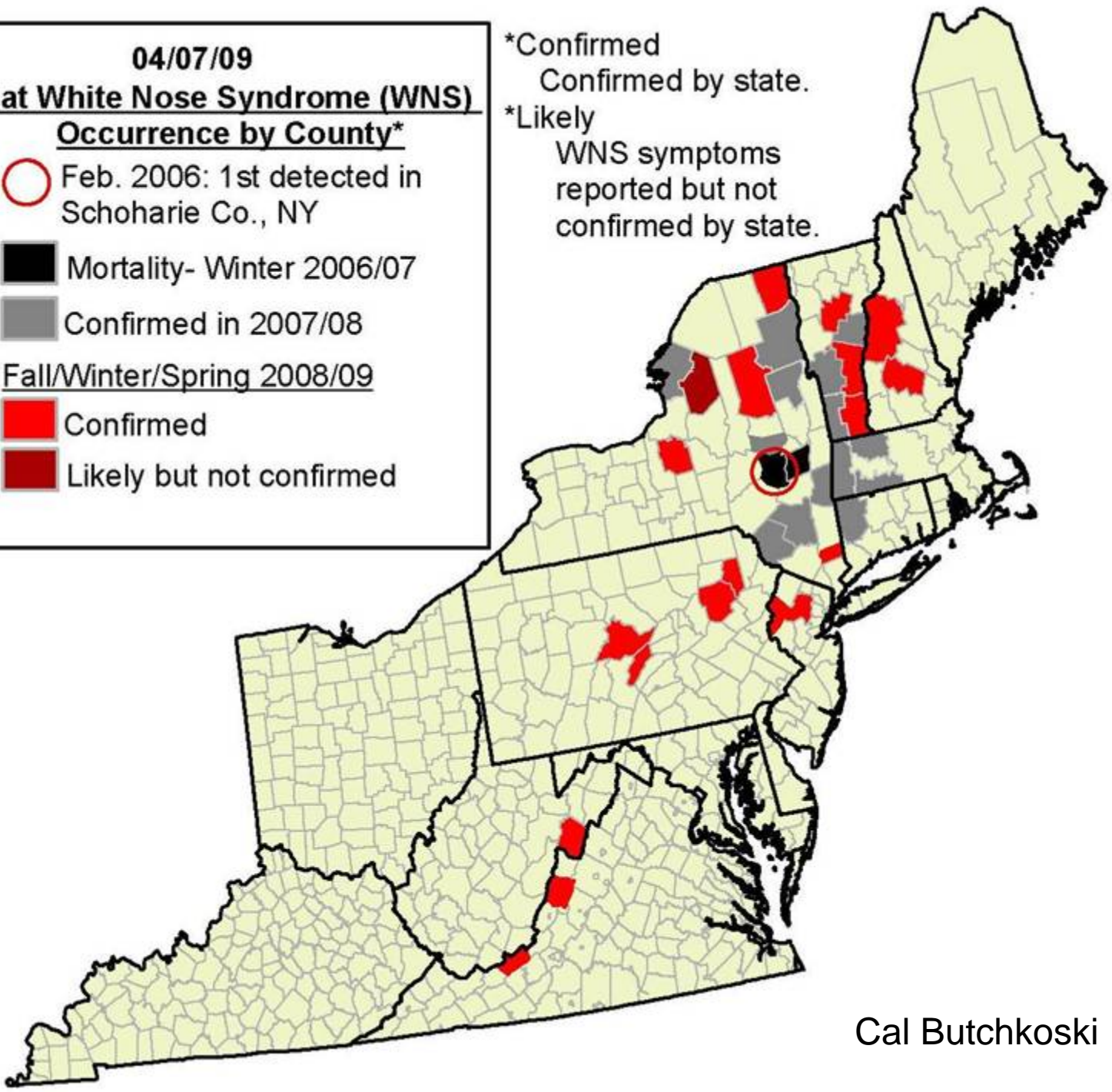
-  Feb. 2006: 1st detected in Schoharie Co., NY
-  Mortality- Winter 2006/07
-  Confirmed in 2007/08

Fall/Winter/Spring 2008/09

-  Confirmed
-  Likely but not confirmed

*Confirmed
 Confirmed by state.

*Likely
 WNS symptoms reported but not confirmed by state.



Cal Butchkoski

03/02/10
Bat White Nose Syndrome (WNS)
Occurrence by County*

○ Feb. 2006: 1st detected in Schoharie Co., NY

■ Mortality- Winter 2006-2007

Fall/Winter/Spring

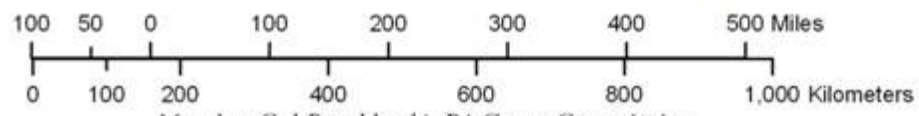
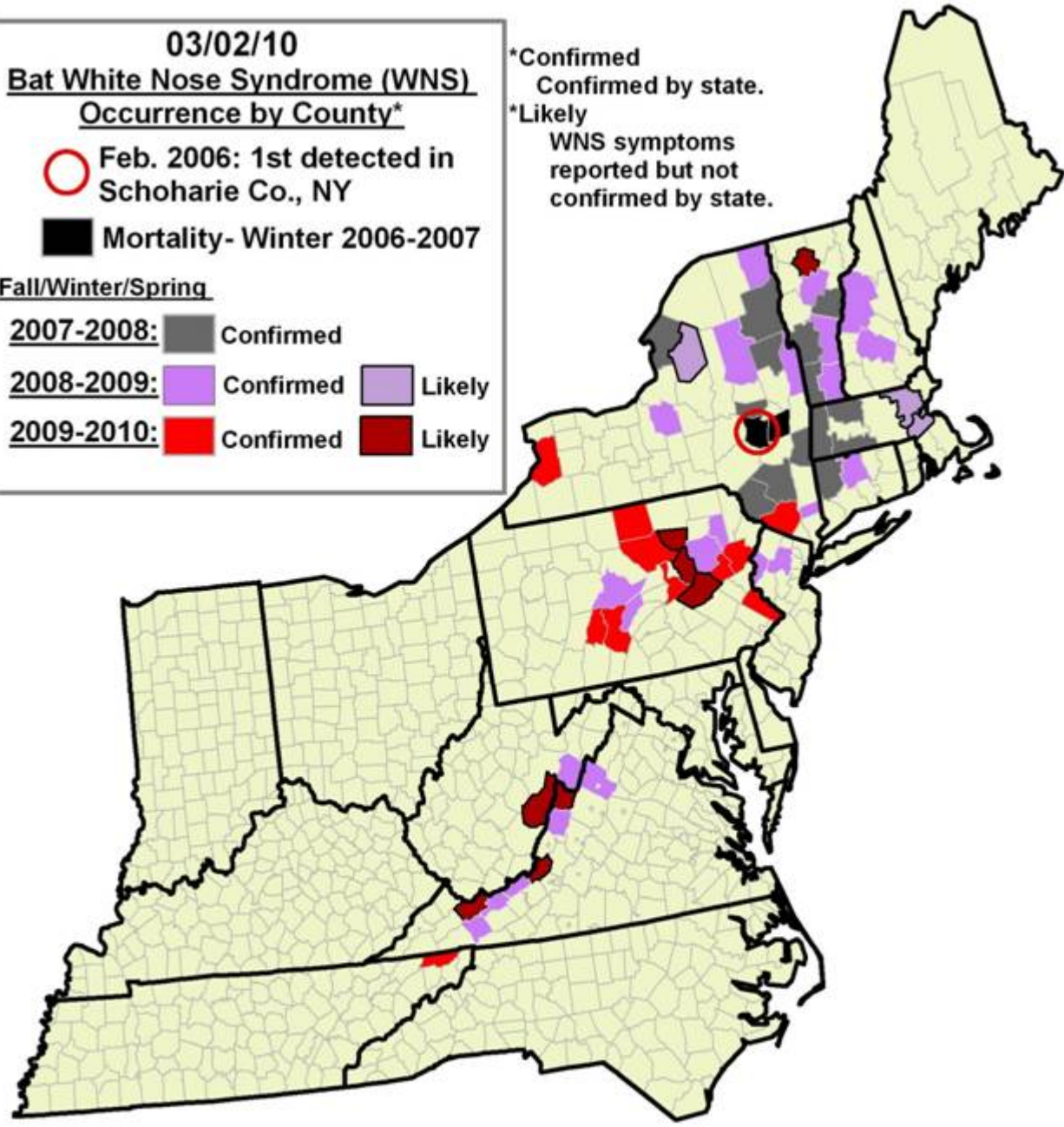
2007-2008: ■ Confirmed

2008-2009: ■ Confirmed ■ Likely

2009-2010: ■ Confirmed ■ Likely

*Confirmed
 Confirmed by state.

*Likely
 WNS symptoms reported but not confirmed by state.



Map by: Cal Butchkoski, PA Game Commission

Cal Butchkoski

03/15/10
Bat White Nose Syndrome (WNS)
Occurrence by County*

○ Feb. 2006: 1st detected in Schoharie Co., NY

■ Mortality- Winter 2006-2007

Fall/Winter/Spring

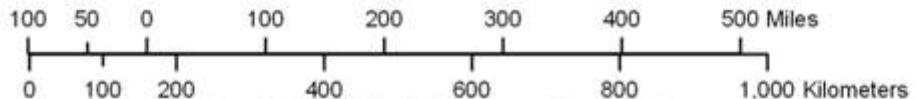
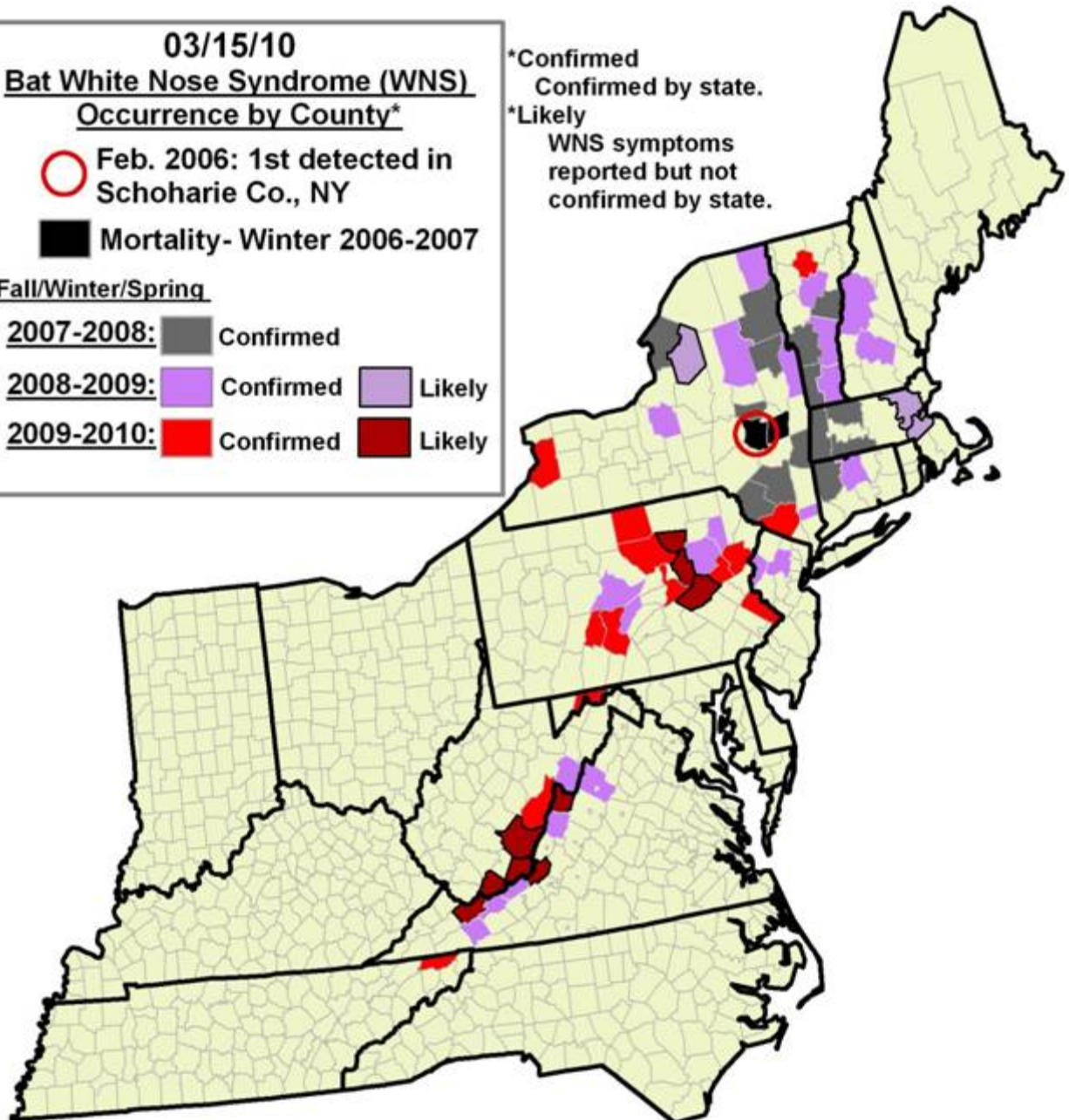
2007-2008: ■ Confirmed

2008-2009: ■ Confirmed ■ Likely

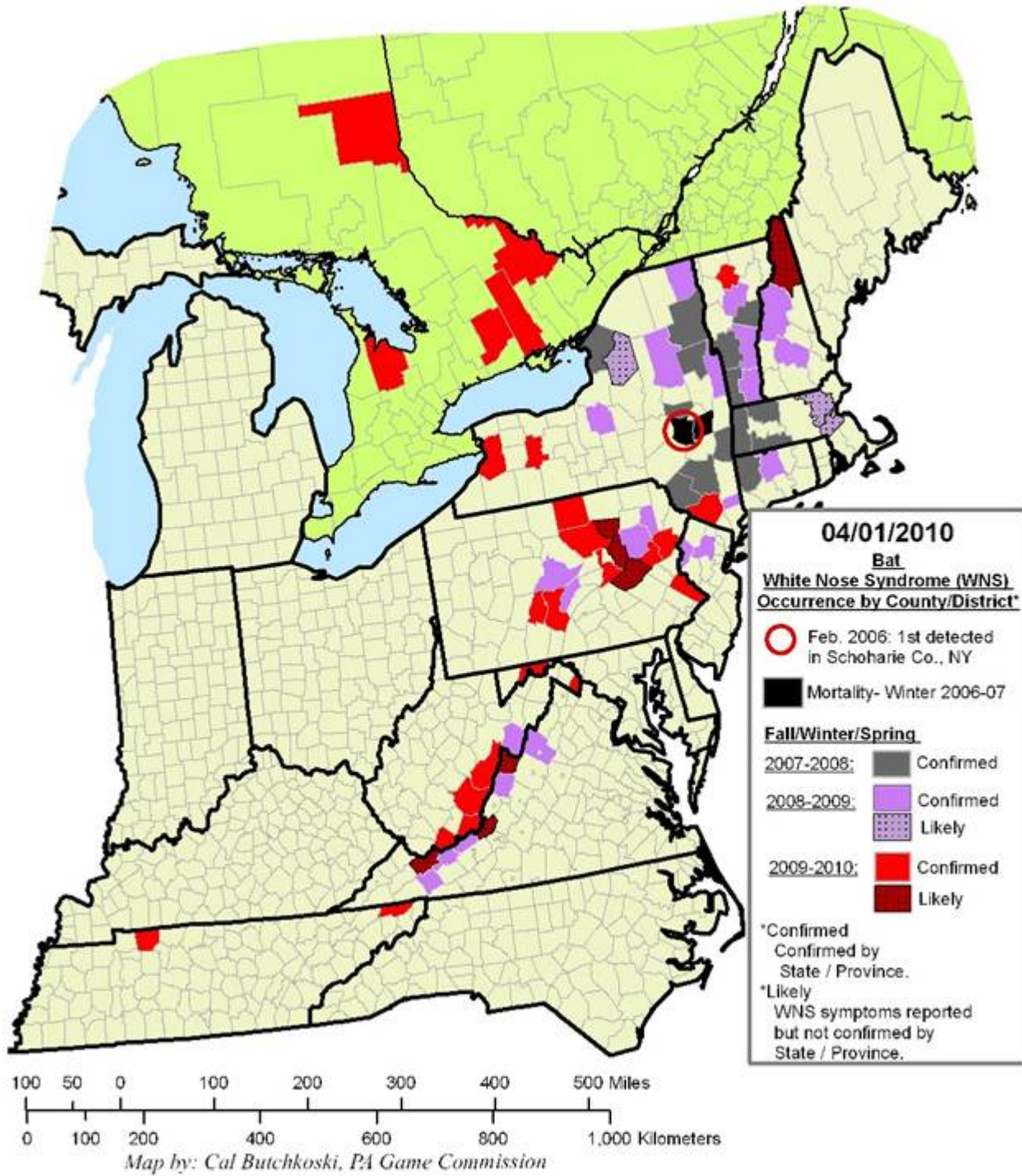
2009-2010: ■ Confirmed ■ Likely

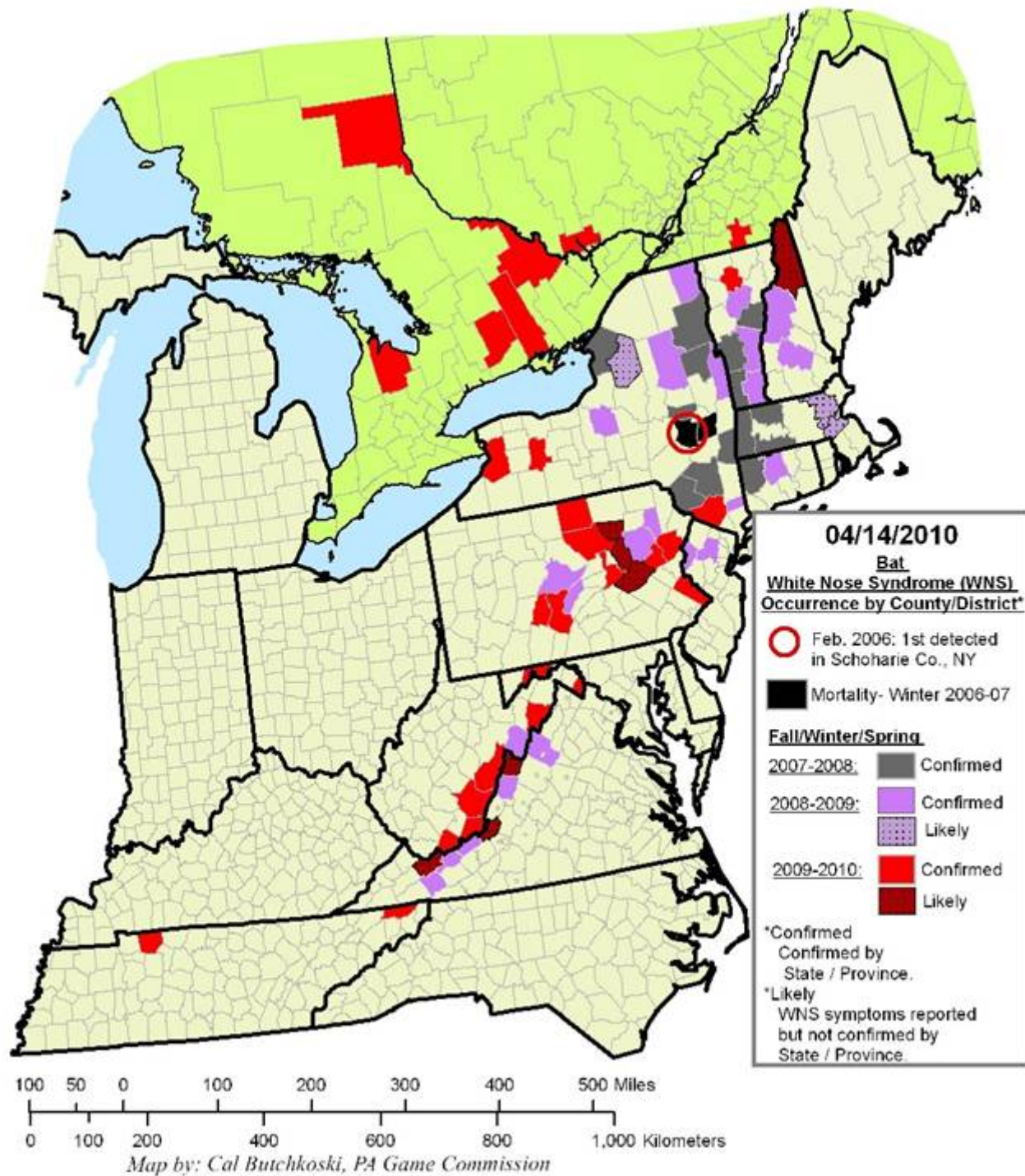
*Confirmed
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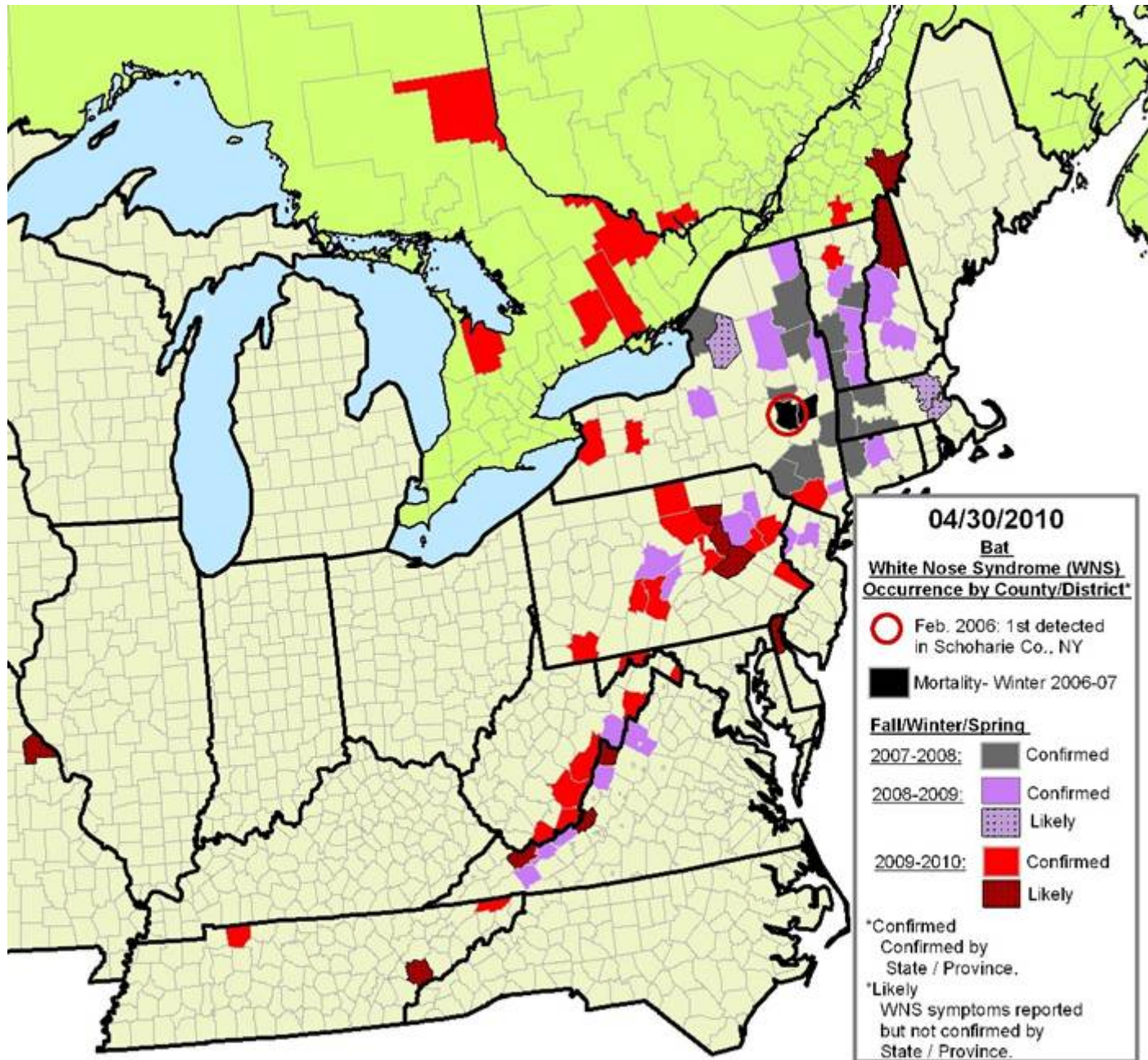
*Likely
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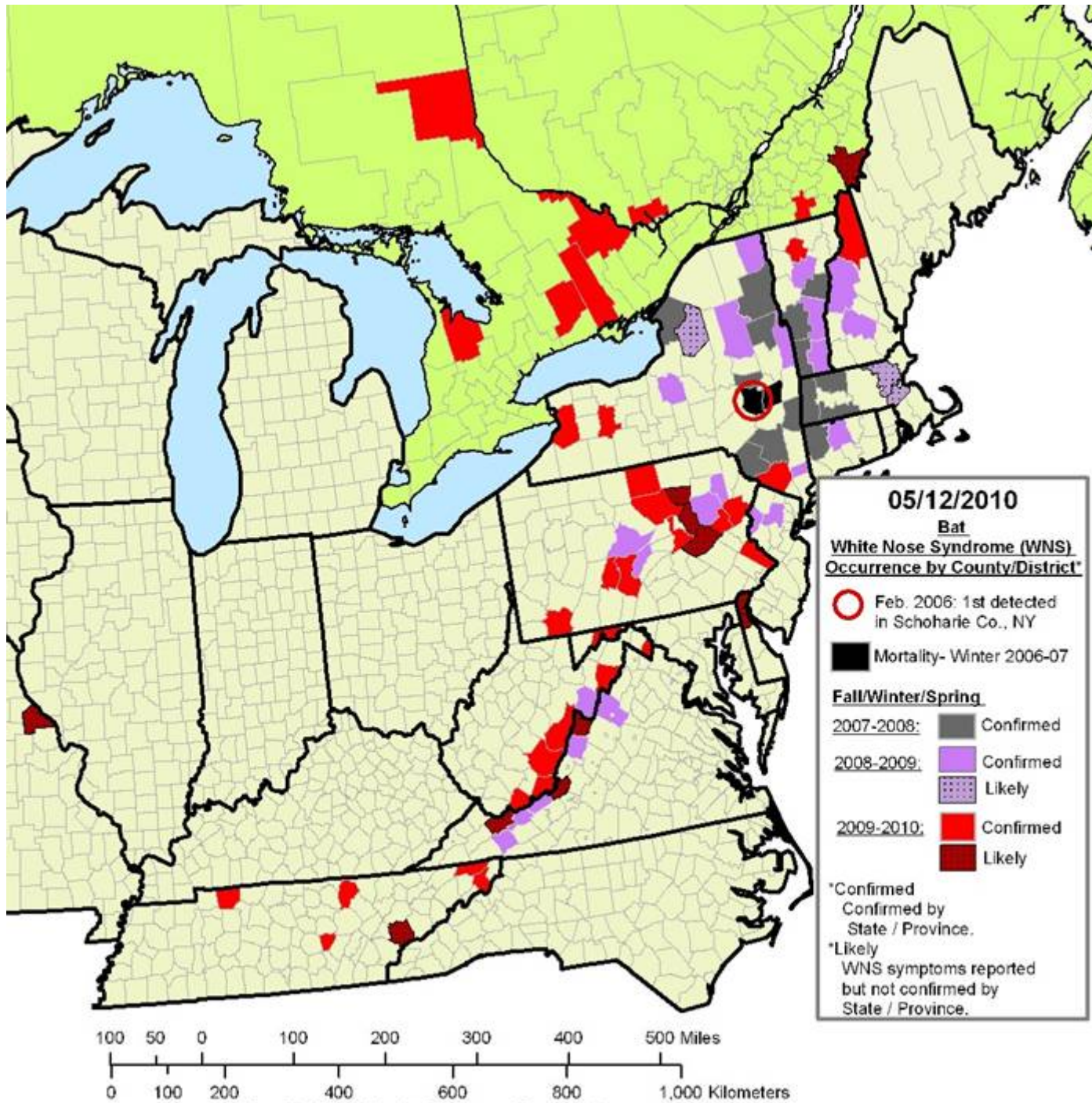




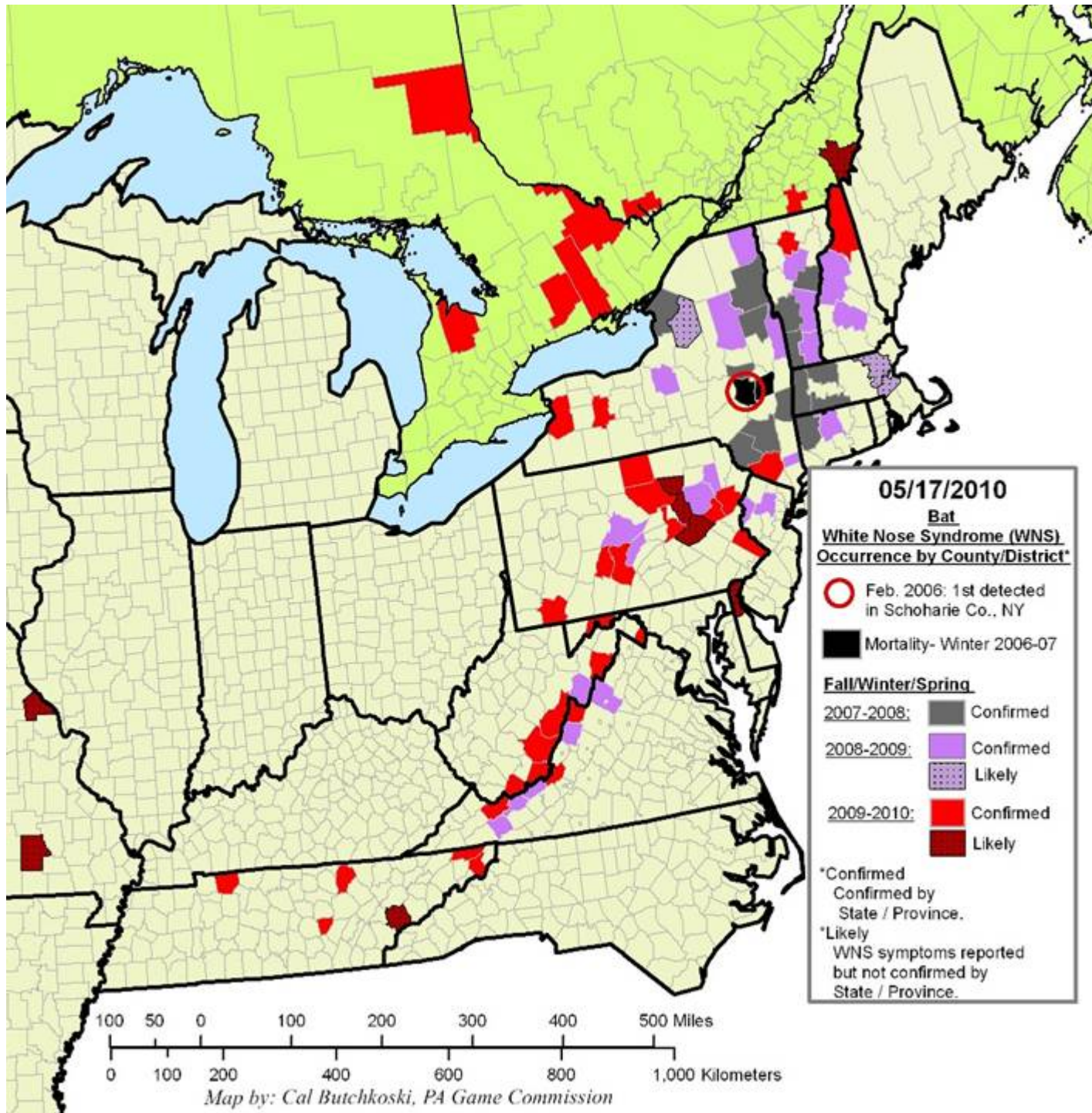


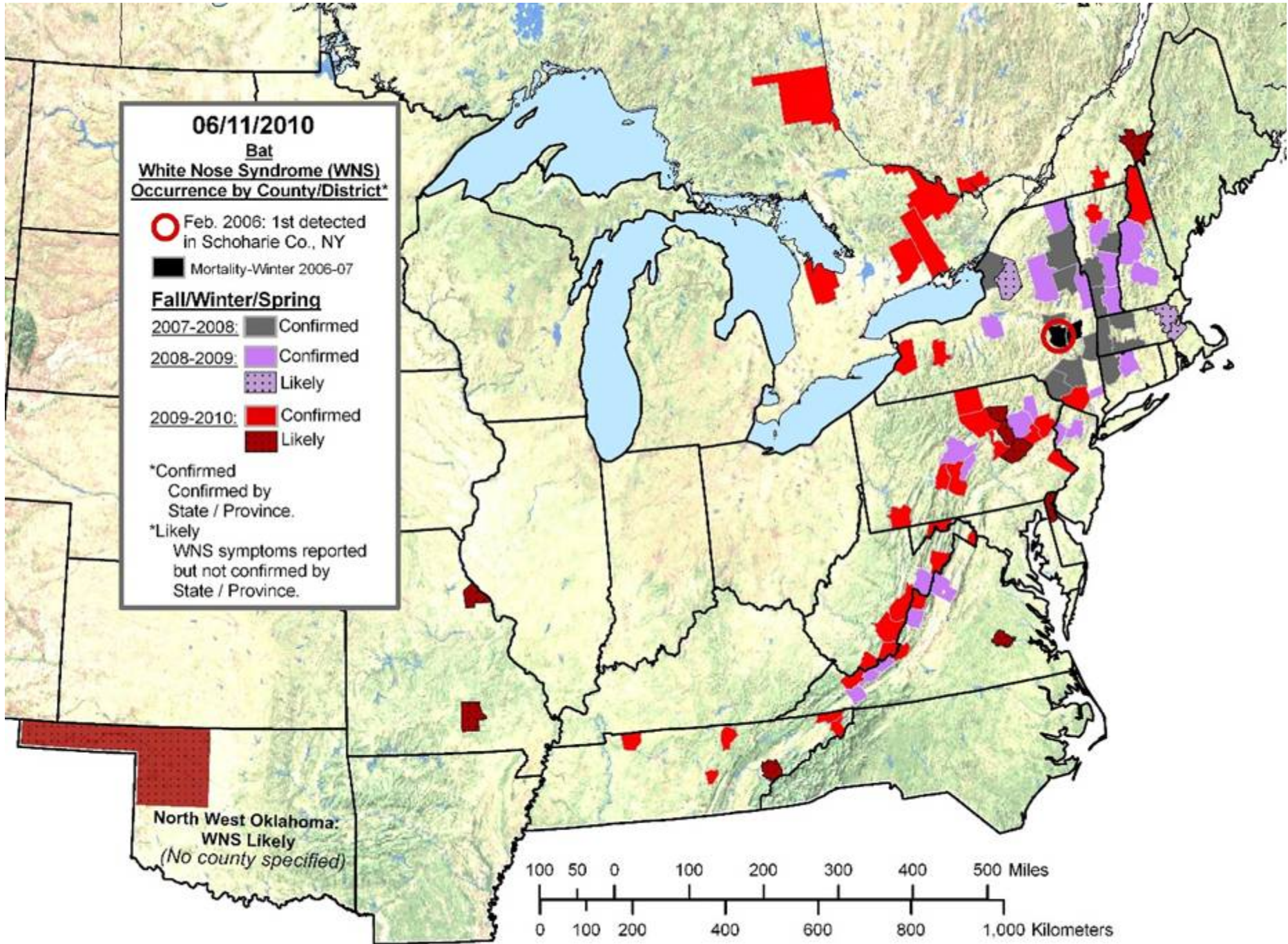
100 50 0 100 200 300 400 500 Miles
0 100 200 400 600 800 1,000 Kilometers

Map by: Cal Butchkoski, PA Game Commission

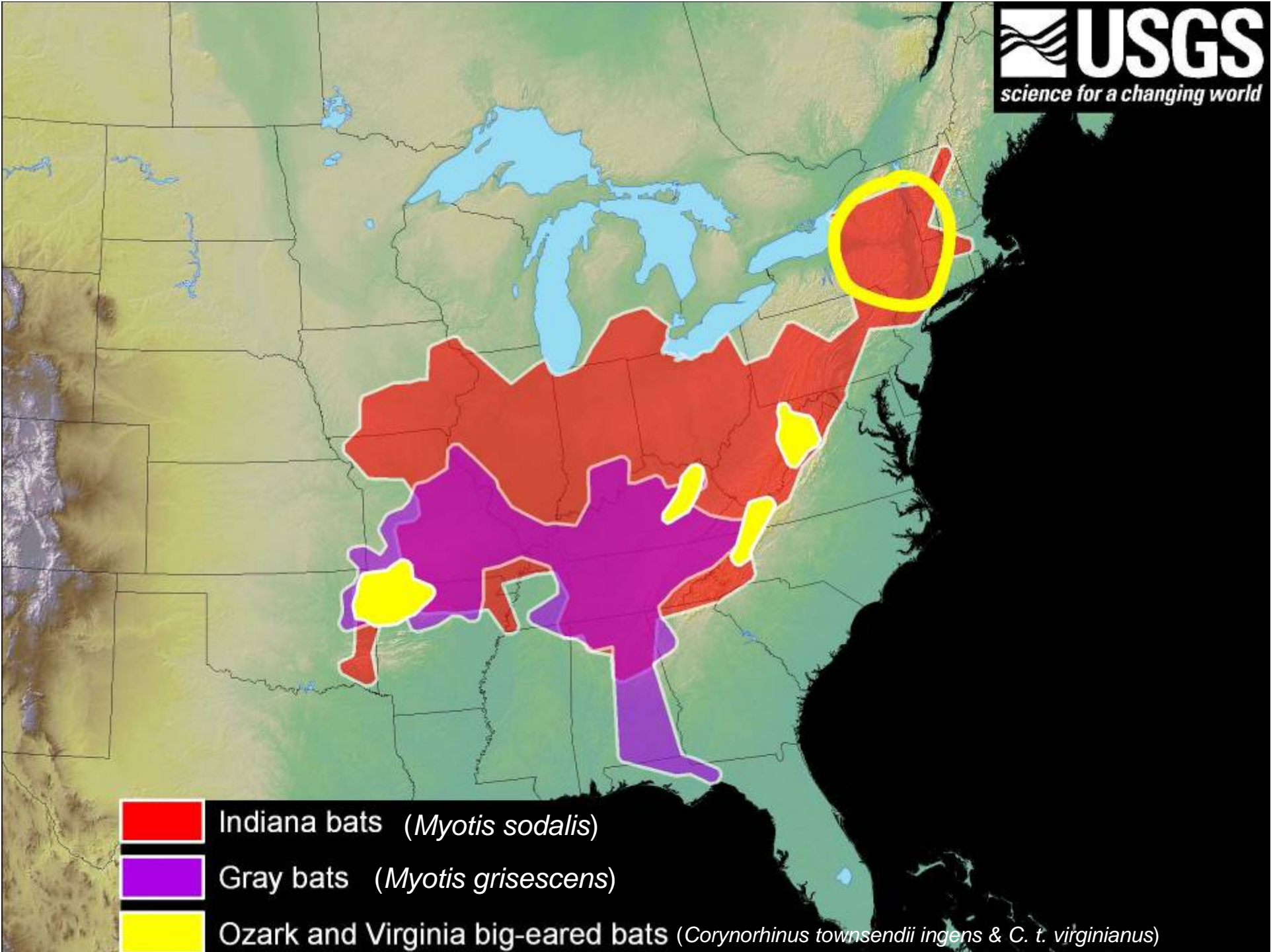


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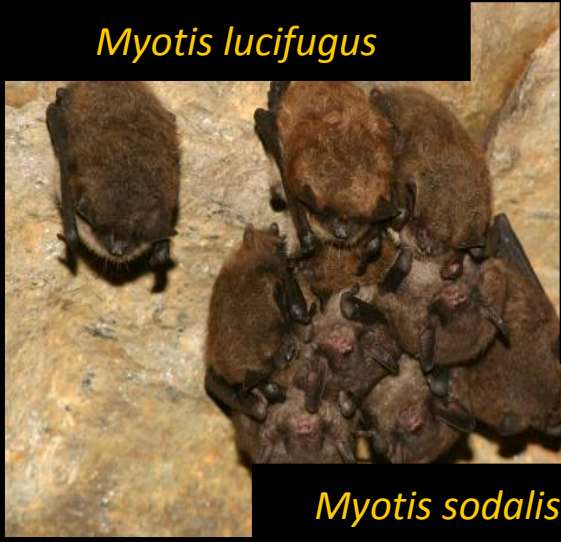




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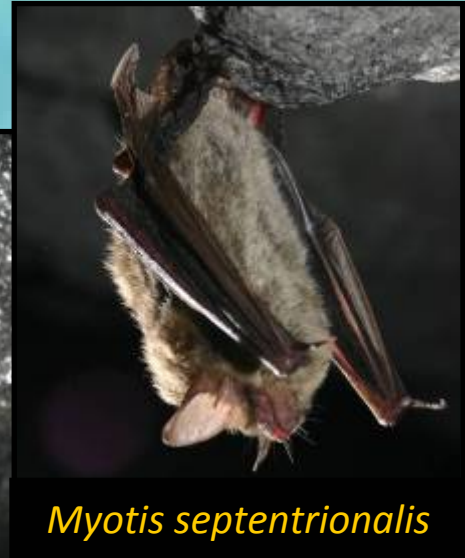
Myotis lucifugus



Myotis leibii



Perimyotis subflavus



Myotis septentrionalis

Myotis sodalis



Eptesicus fuscus



Myotis velifer



Myotis grisescens



Myotis austroriparius



New York Department of Environmental Conservation

New York Fish and Wildlife

Bat Conservation International

National Speleological Society

Bucknell University

Pennsylvania Game Commission

New York State Health Department

Cornell University

Boston University

US Fish and Wildlife Service

USGS National Wildlife Health Center

Northeastern Cave Conservancy

Fordham University

Center for North American Bat Research and Conservation

Vermont Fish and Wildlife

Indiana State University

University of Winnipeg

Southern Michigan University

Massachusetts Fish and Wildlife

US Forest Service

Wisconsin Fish and Wildlife

Columbia University

USGS Fort Collins Science

Quebec Ministry of Natural Resources

Ontario Ministry of Natural Resources

Connecticut Fish and Wildlife

Missouri State University

US Army Corp of Engineers

Disease Investigation

- Many WNS bats were emaciated
- Proximal cause of death likely starvation
- Parasites – negative
- Virus – negative
- Bacteriology – some secondary infections
- Fungus...



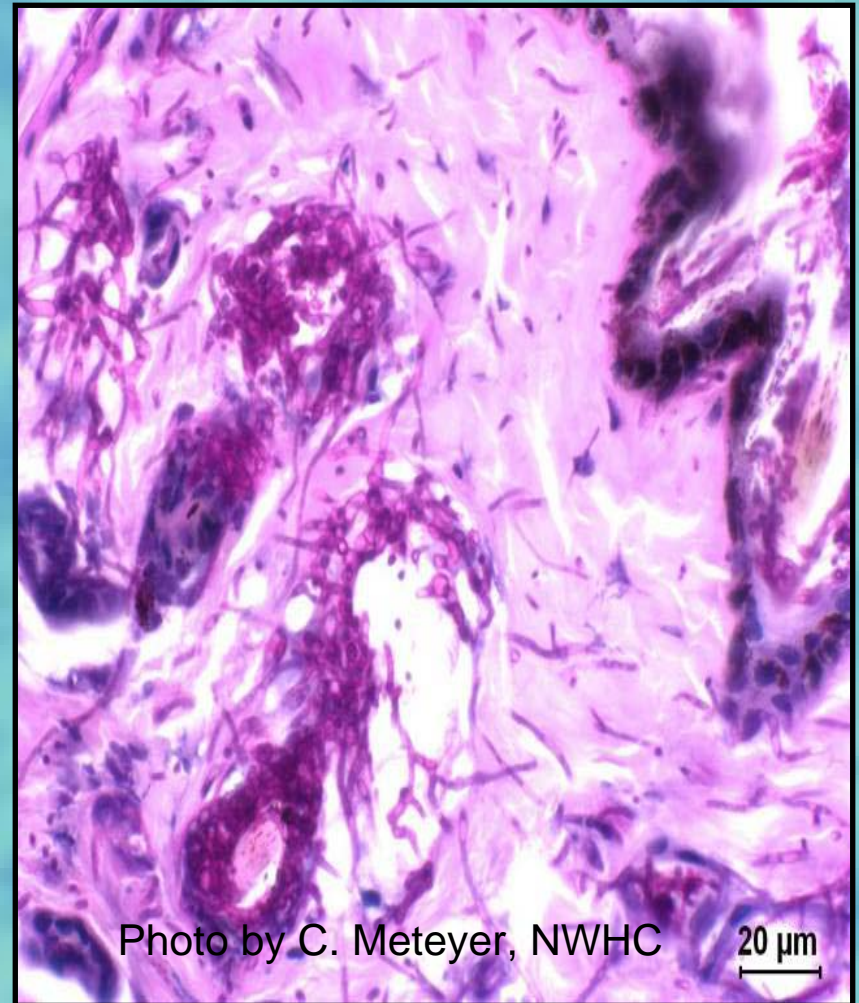
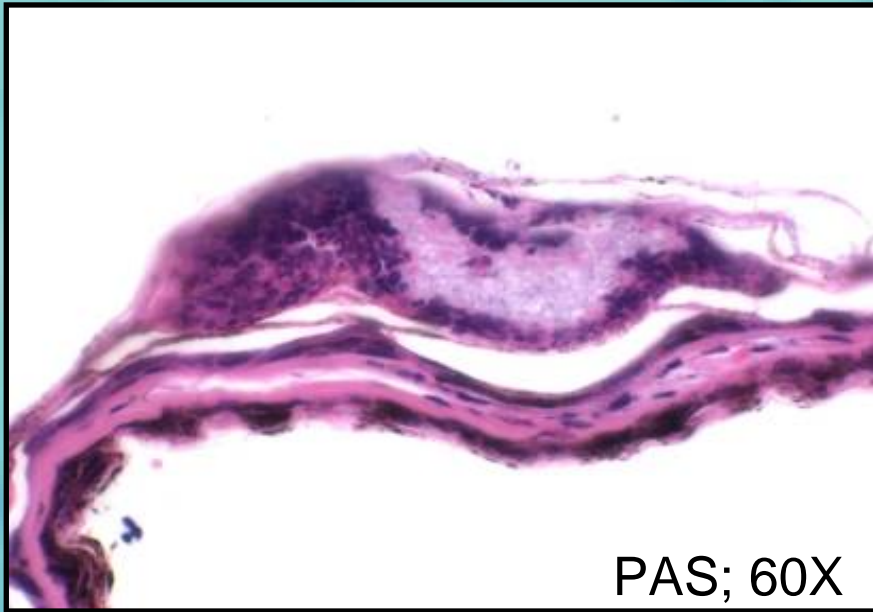
Fungus

- Mixed results from initial culture trials



Fungus

- Mixed results from initial culture trials
- Fungal hyphae and conidia in bat tissues



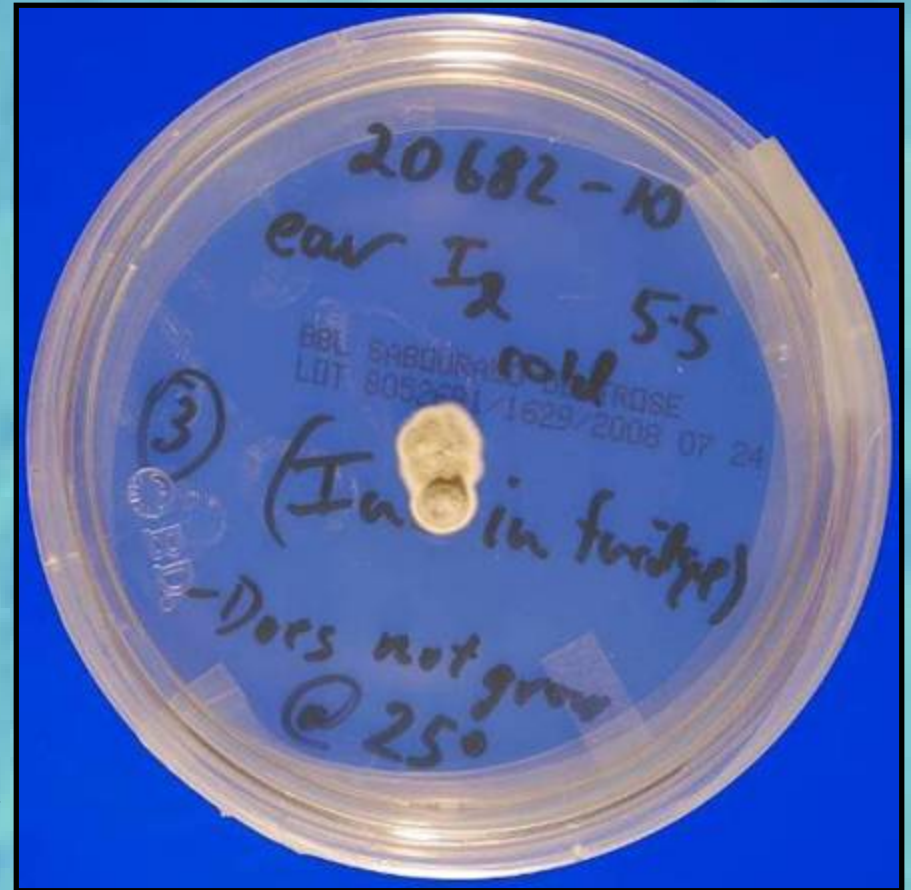
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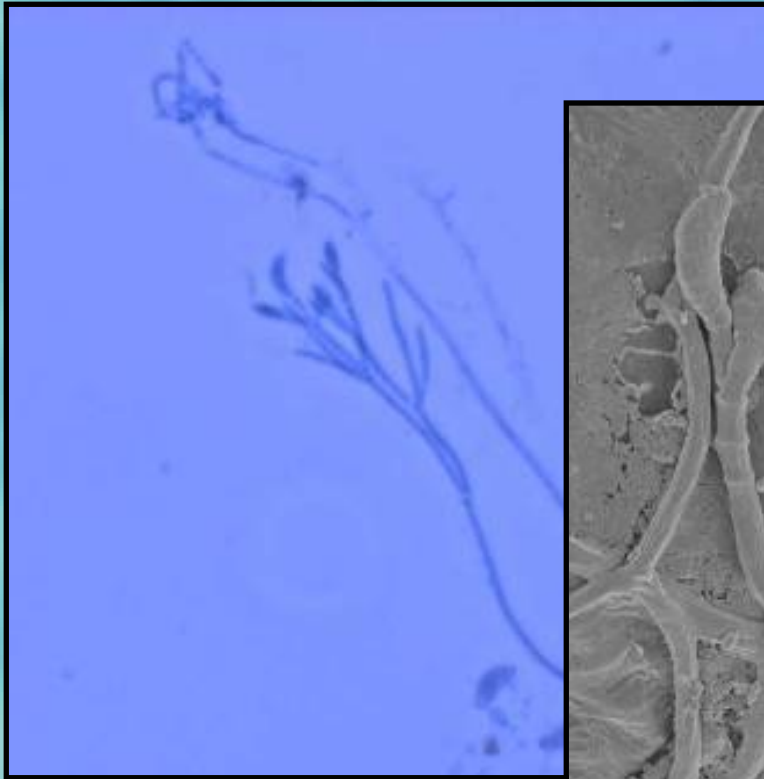


Fungus

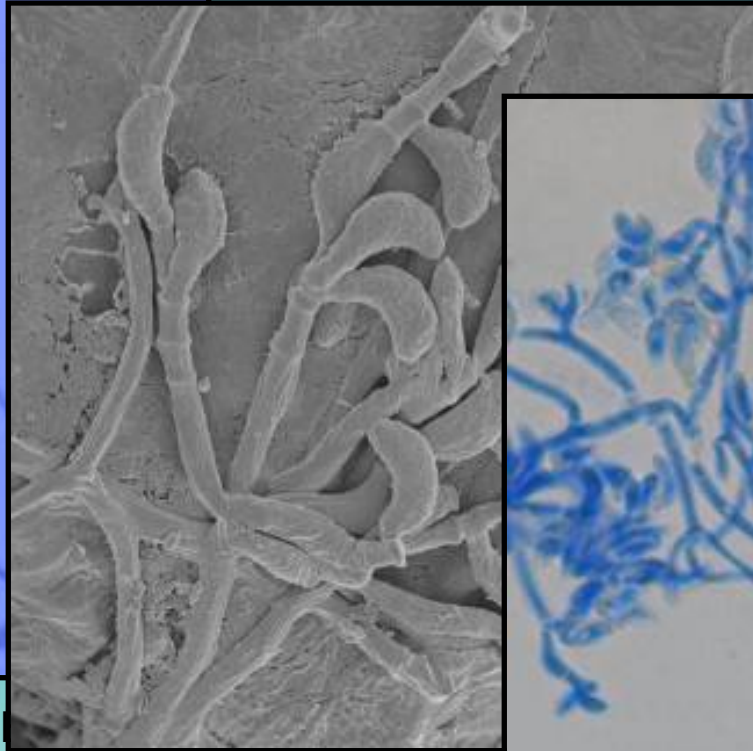
- Mixed results from initial culture trials
- Fungal hyphae and conidia in bat tissues
- Psychrophile: Cold-habitat obligate
 - Optimum growth 5°-15°C
 - Upper growth limit at 23°C
- Relative of *Geomyces*
- *Geomyces destructans*



Geomyces destructans



Direct Scraping from
NYS DOH
Photo by M. Behr



Fixed Bat Muzzle
NYS DOH

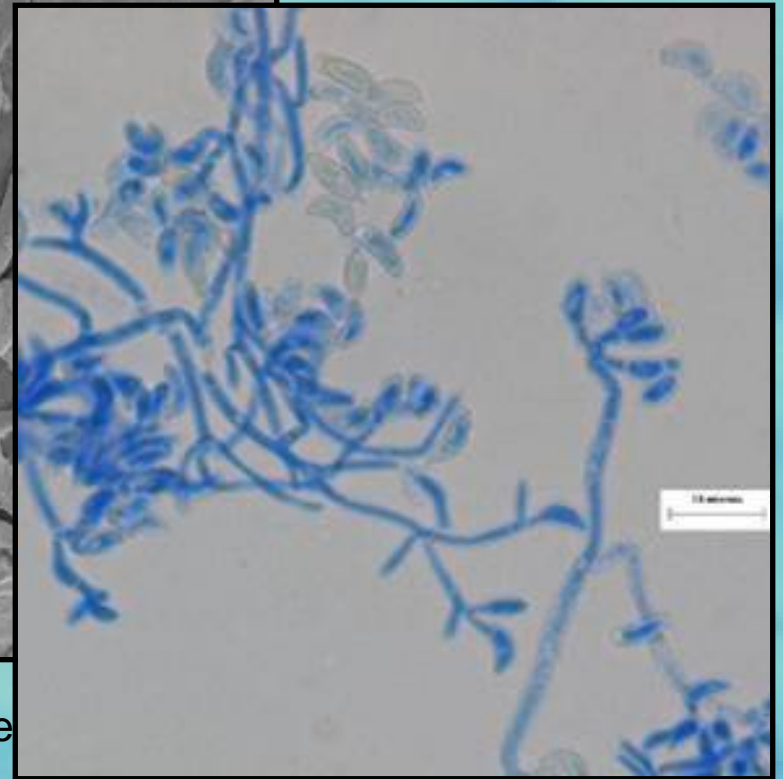


Photo by D. Springer and M. Behr

NWHC Cold Isolate
Photo by D. Blehert, NWHC



Al Hicks

Current Theory

- A consistent causal agent among affected sites is *Geomyces destructans* (Gd)
- Consistent pathology includes emaciation
- Gd likely alters hibernation patterns → energy depletion
- Potential and extent of fungus dispersal or other agents related to WNS are unknown
- WNS is spreading at a frightening rate

Recent Insights

- WNS-affected caves retain infectious fungus after all bats are killed
- Gd can be cultured from from cave air, soils, bat feces, and clothing and gear
- Bat-to-bat transmission confirmed
- WNS lesions heal during active season
- Diet (fatty acid composition) may affect susceptibility to Gd

Recent Insights

- Gd isolated from hibernacula in Europe (“present since at least the 1980s”)
- There are effective decontaminants for gear and clothing
- There is no effective treatment or vaccine for bats
- MaxEnt model has been produced to model likely areas of spread
- Rate of spread is increasing (450 km/year)

When will it arrive in California?

Approximately 1500 km



Human Transmission of WNS



People may bring WNS here before bats do

Western Bat Hibernacula

- Mostly small (10 – 100 bats)
- Widely dispersed (and unknown) locations
- Effect on disease dynamics?

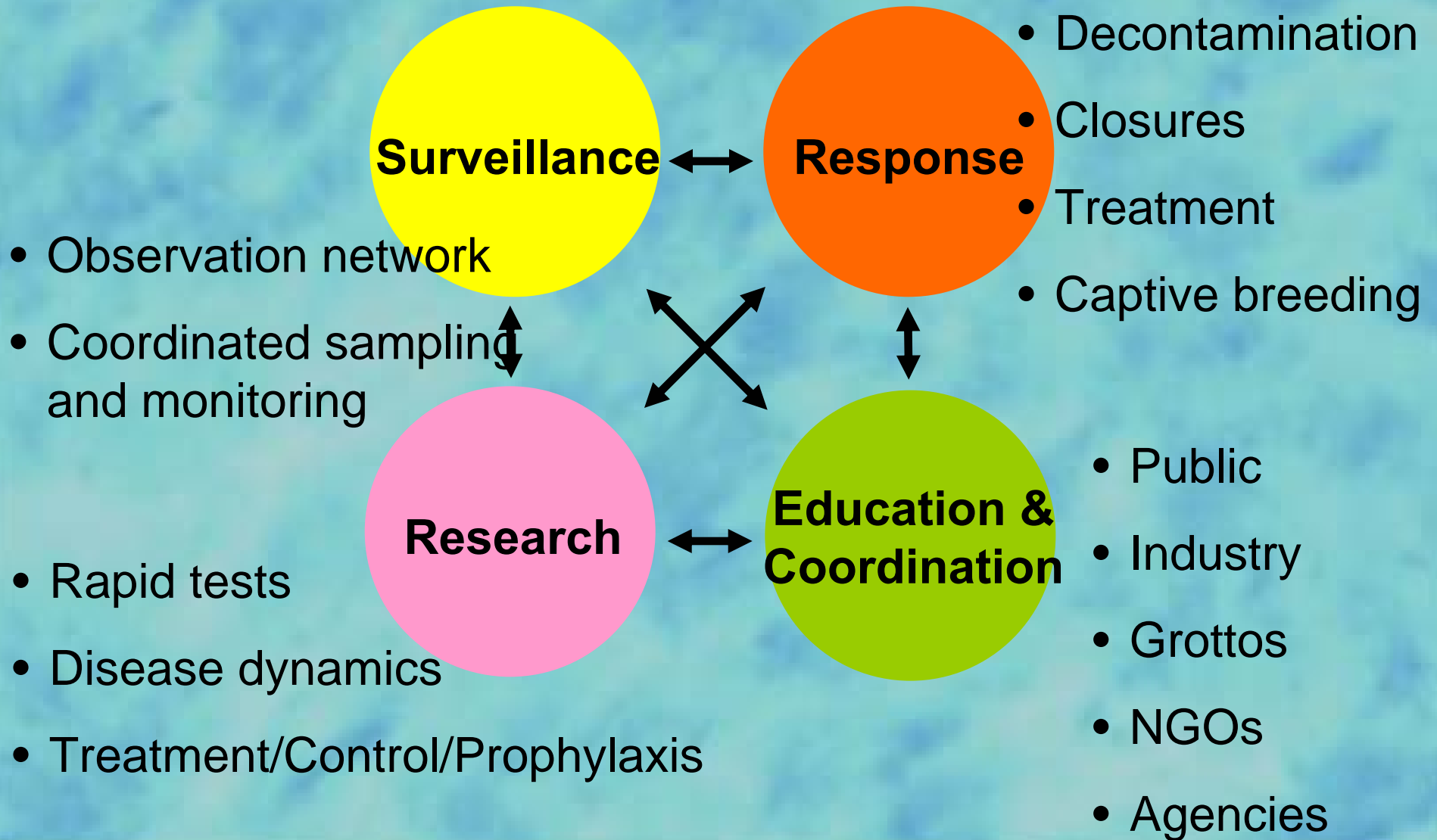


J. Neiland

Planning Efforts

- National Plan
 - USFWS, States, USGS, NWHC, BCI, NSS, NPS, USFS, Universities
- State Plans
 - MO, NC, TN
- Agency Plans
 - NPS
 - USFS
- Unit Plans
 - Individual management units

Plan Components



For More Information...

- USFWS WNS Website
 - <http://www.fws.gov/WhiteNoseSyndrome/>
- Western Bat Working Group WNS Website
 - <http://www.wbwg.org/conservation/whitenosesyndrome/whitenose.html>
- Bat Conservation International WNS Website
 - <http://www.batcon.org/index.php/what-we-do/white-nose-syndrome.html>
- Scott Osborn, CDFG sosborn@dfg.ca.gov
- Pat Ormsbee, USFS pormsbee@fs.fed.us