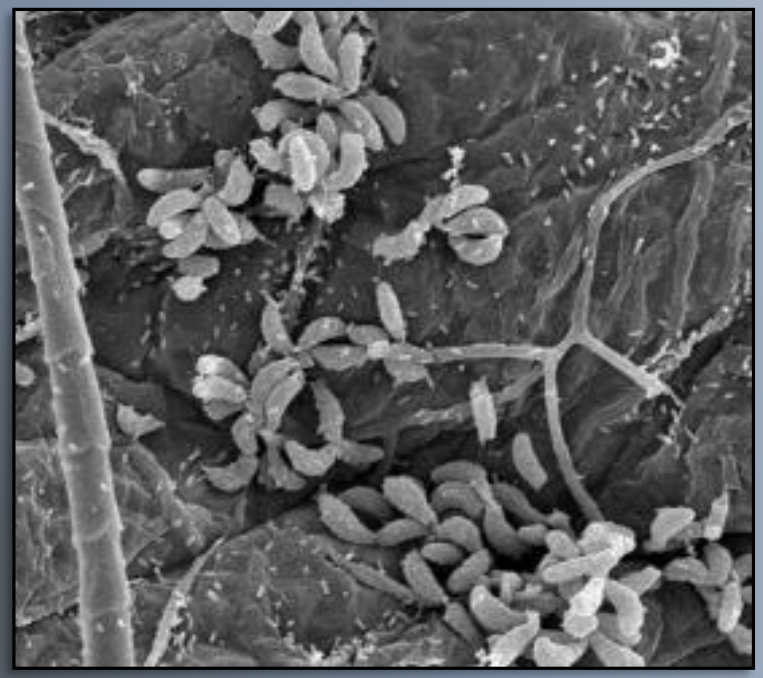
The detection in California of low levels of *Pseudogymnoascus destructans (Pd)* (the fungus that causes white-nose syndrome in bats)



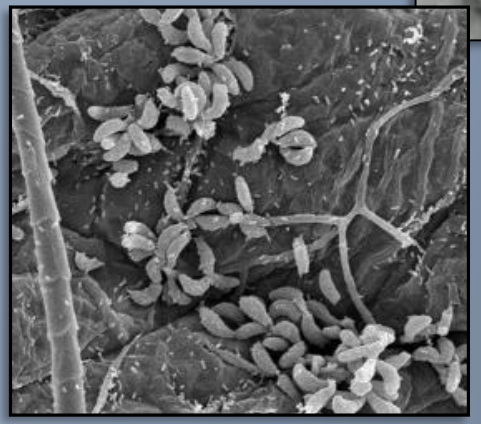
Bronwyn Hogan

U.S. Fish and Wildlife Service

November 14, 2019

Overview

- Bat life history
- White-Nose Syndrome
- *Pd* detection in CA
- What we can do



Chiropteran Diversity

Worldwide: >1,410 species
North America: 45 species
California: 25 species

California Bats

Townsend's Big-eared Bat
(Corynorhinus townsendii)

Big brown Bat
(Eptesicus fuscus)

Pallid Bat
(Antrozous pallidus)

Silver-haired Bat
(Lasionycteris noctivagans)

Little Brown Bat
(Myotis lucifugus)

Yuma Bat
(Myotis yumanensis)

Long-legged Bat
(Myotis volans)

Brazilian Free-tailed Bat
(Tadarida brasiliensis)

Western Small-footed Bat
(Myotis ciliolabrum)

Hoary Bat
(Lasiurus cinereus)

Western Red Bat
(Lasiurus blossevillii)

Canyon Bat
(Parastrellus hesperus)

VALUE TO HUMANS AND ECOSYSTEMS

Pollinators of desert flowers, agave, cocoa, banana, mango, and guava!

Seed dispersal (fruit bats) in tropical ecosystems

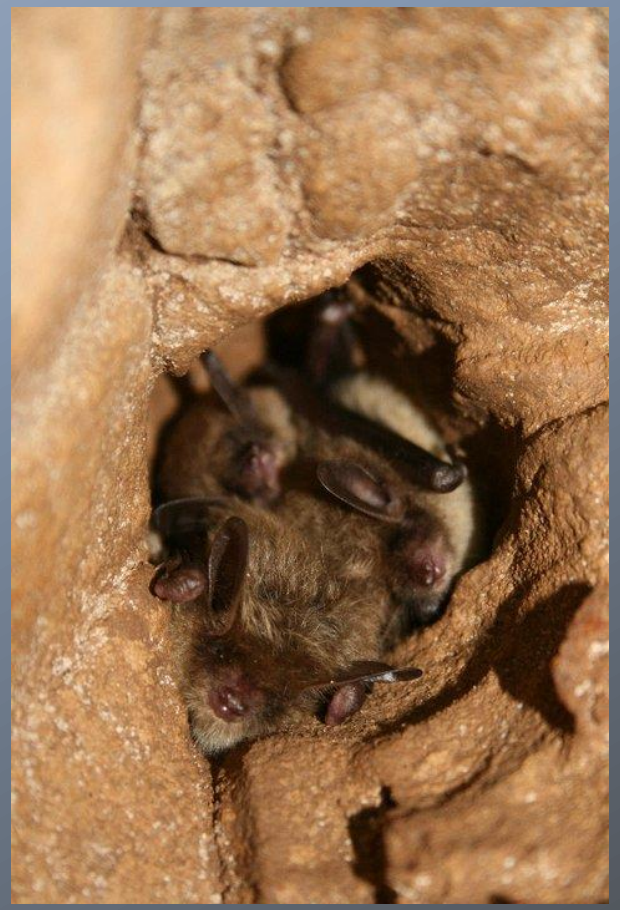
Pest control: $3 billion annual value to U.S. agriculture

Single bat can eat hundreds of insects each night!

Provide organic fertilizer and ecosystem nutrient transfer

What to bats do when insects aren’t available?

- Migration
- Torpor
  - Generally shorter duration
  - Way to conserve energy during periods of bad weather and unavailable food
- Hibernation
  - Longer term, seasonal strategy
  - Way to conserve energy when highly seasonal weather and prey availability
  - Changes in immune system function



Things that may harm bats

White-nose Syndrome

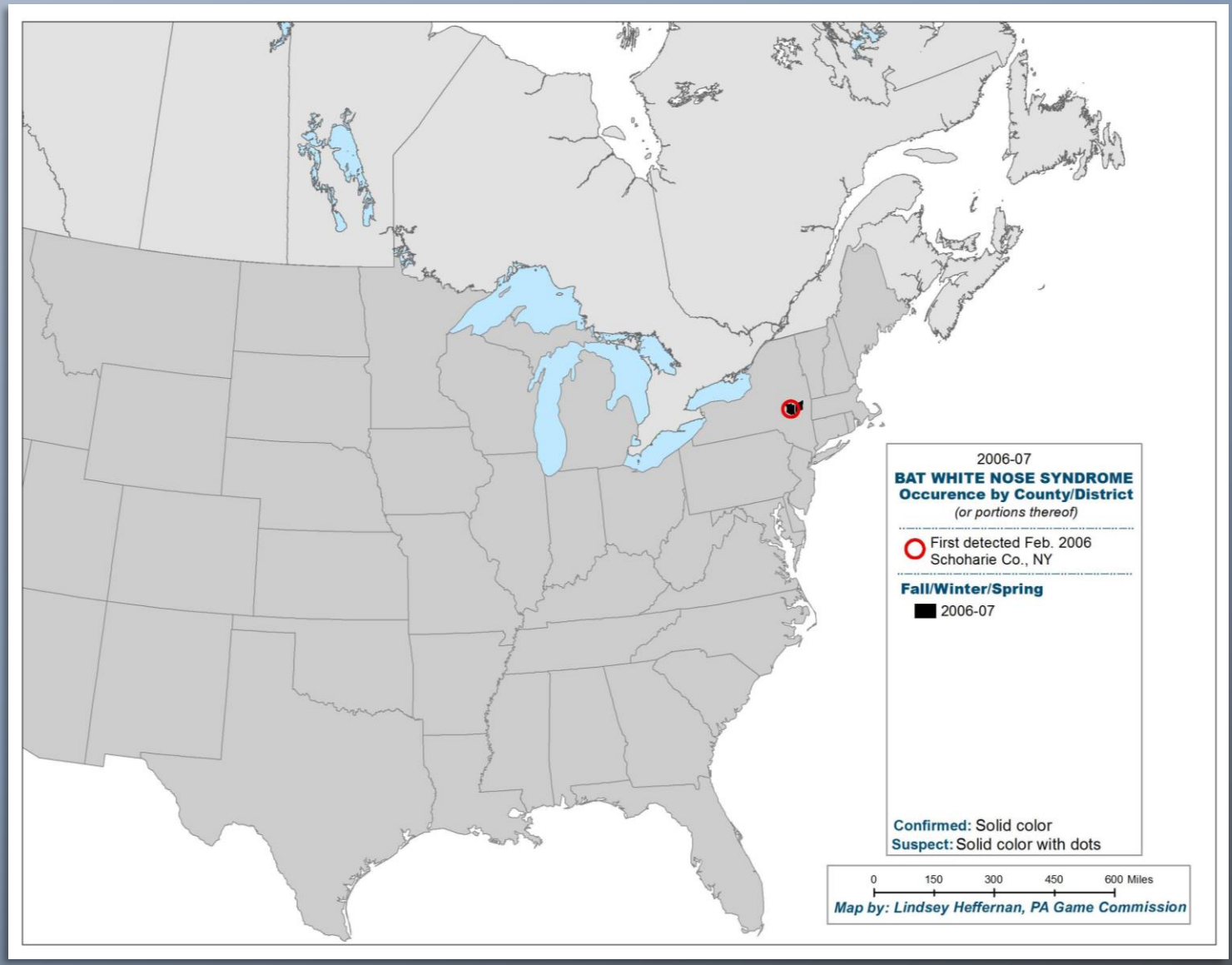
Disease of hibernating bats caused by fungus *Pseudogymnoascus destructans* (*Pd*)

- Cold-loving fungus (4-14 C. >90% relative humidity)
- Invasive pathogen, likely of foreign origin
- Transmitted primarily via bat-to-bat and environment-bat interactions

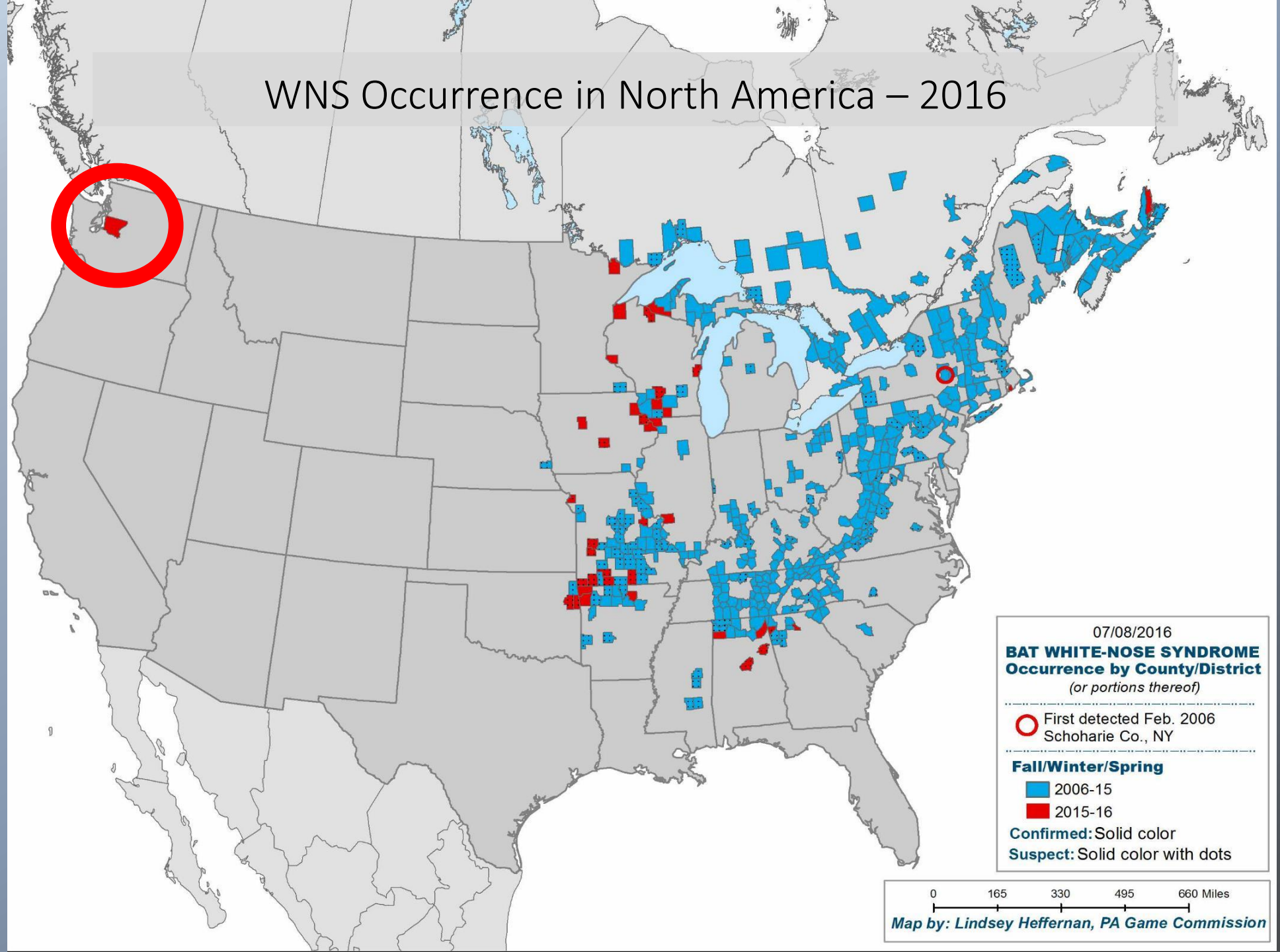
It continues to spread through North America

- Disease has been found in 33 states and 7 Canadian provinces
- Evidence of Pd (but not the disease yet) in six states including CA
- Severity varies among individuals and species
- Management actions focused on containment and conservation

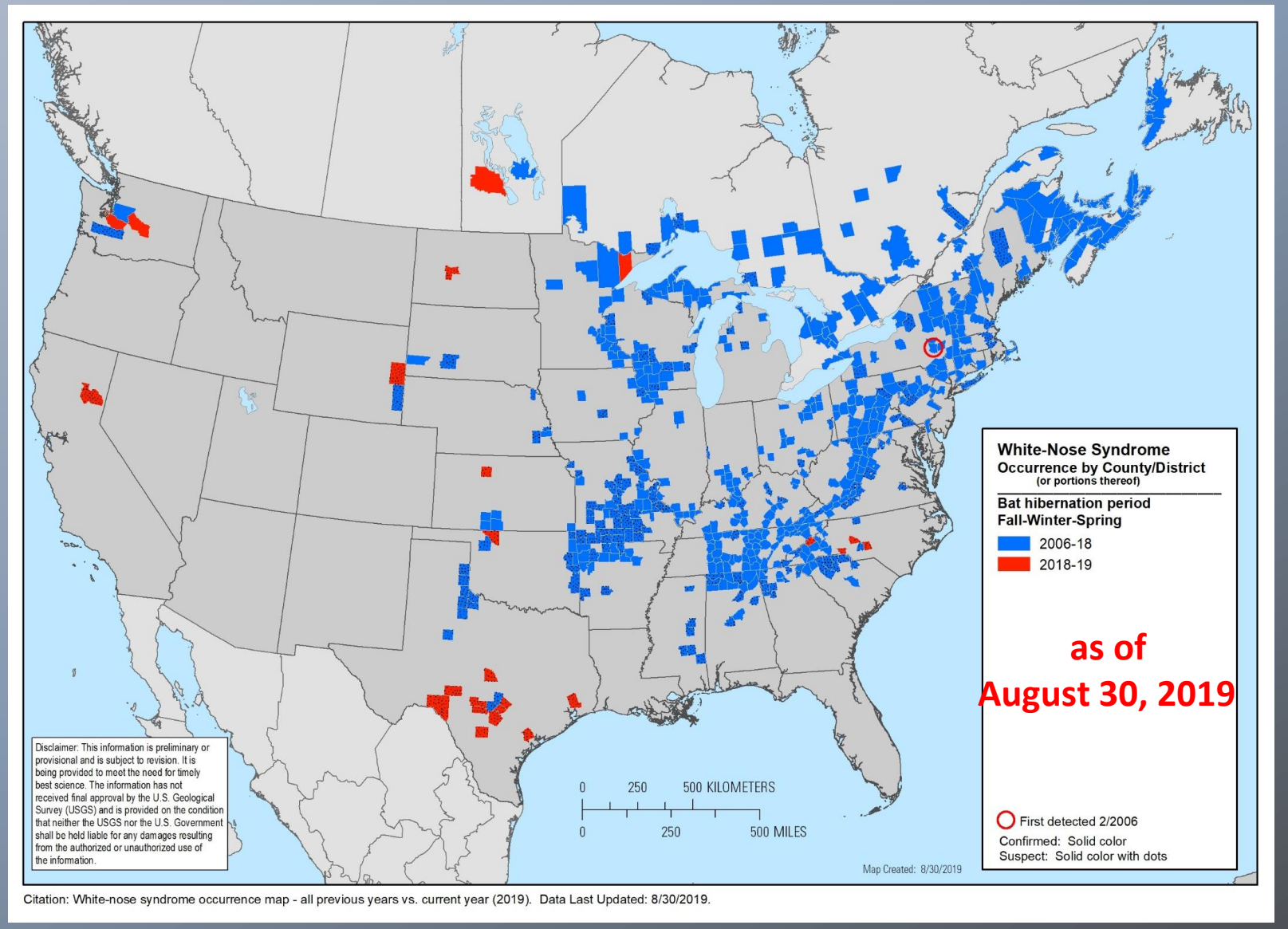
The beginning…



WNS Occurrence in North America – 2016



Current Spread



Citation: White-nose syndrome occurrence map - all previous years vs. current year (2019). Data Last Updated: 8/30/2019.

13 Species Confirmed with WNS in North America

Little brown bat

Northern long-eared bat *

Tri-colored bat

Indiana bat *

Big brown bat

Gray bat *

Eastern small-footed bat

Southeastern bat

Yuma bat

Cave bat

Long-legged bat

Western long-eared bat

Fringed bat

Photos: Merlin Tuttle, Bat Conservation International

6 additional species found with the fungus and no disease

Eastern Red Bat

Silver-haired Bat

Western small-footed bat

Townsend's Big-Eared Bat
(including Virginia and Ozark)

Rafinesque's big-eared bat

Mexican free-tailed bat

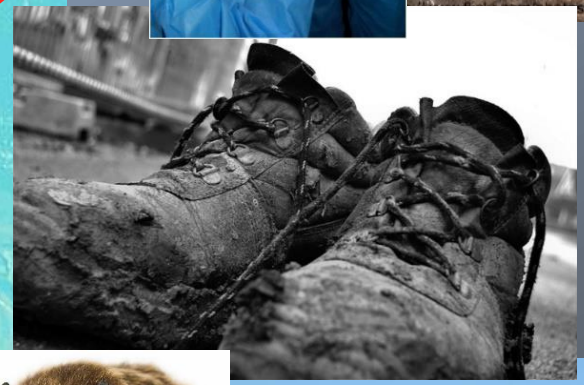
Photos: Merlin Tuttle

Pd Probably Came to the US from Europe

Pd origin

Puechmaille et al. (2011)

Hoyt et al. (2017)



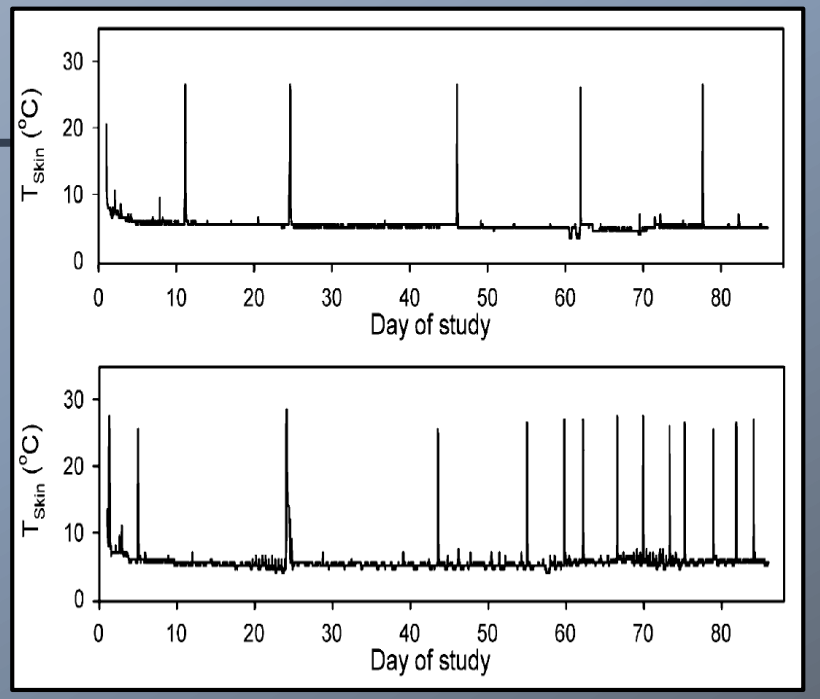
Why are bats vulnerable?

- Hibernators
- Microclimate
- Immunosuppressed during hibernation*
- Limited energy resources
- Clustering and swarming behavior promotes transmission

Causes of mortality

Causes a cascade of physiological processes through winter, often leading to death

- Frequent arousal
- Starvation
- Predation



- Wing Damage & Homeostasis
  - Dehydration
  - Circulation & Respiration
  - Thermoregulation

Cryan PM, et al.: Wing pathology of white-nose syndrome in bats suggests life-threatening disruption of physiology. BMC Biology 2010, 8:135

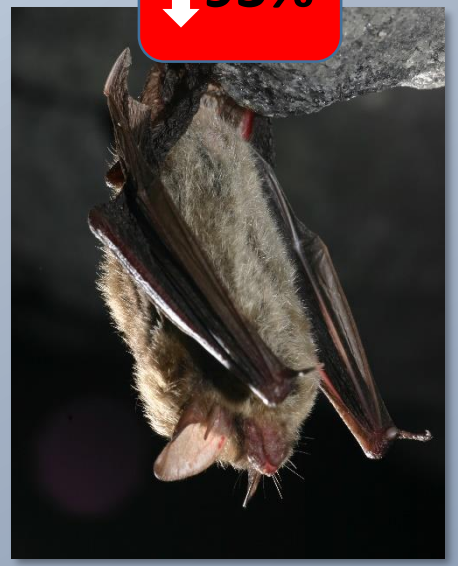
Damaged Wing Membranes

High occurrence of scarred and necrotic wings at summer colonies near affected hibernacula

Documented Population Declines Through 2018

- Counts from over 560 hibernacula in 24 States and Quebec

93%

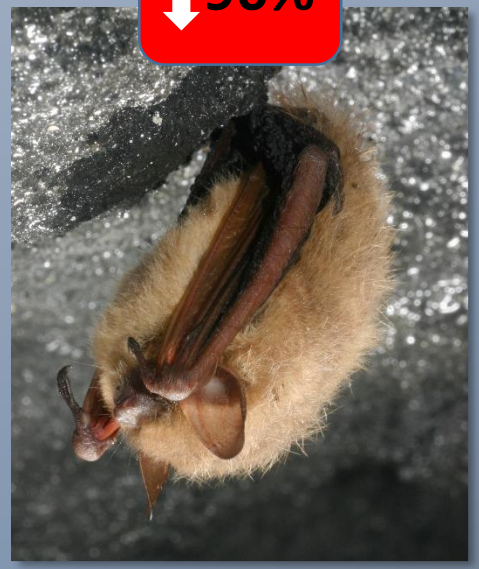


Little brown bat

99%

Northern long-eared bat*

96%

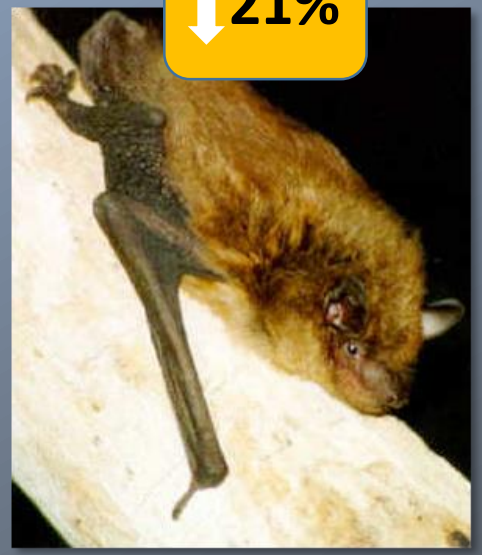


Tri-colored bat

90%

Indiana bat*

21%



Big brown bat

From Cheng et al., *in prep*

National Plan

A strategic approach to managing WNS

Goal: Defeat WNS and recover bat populations…

Spatially and ecologically specific approach:

Address the leading edge – vaccine, probiotics, antifungals, UV light;

***Defend the WNS-free* area** – containment (decontamination);

Save our Survivors – management guidance for rehabilitation, wildlife conflict, transportation, forestry

Primary Areas of Response

1. **<u>Containment</u>:** Slow the spread by reducing risk of human-assisted transmission

2. **<u>Research</u>:** Improve our understanding of disease mechanisms to facilitate conservation

3. **<u>Management tools</u>:** Reduce impact of the disease and improve survival

4. **<u>Outreach</u>:** Inform natural resource managers, the public, stakeholders, and the conservation community

Types of Tools Under Investigation

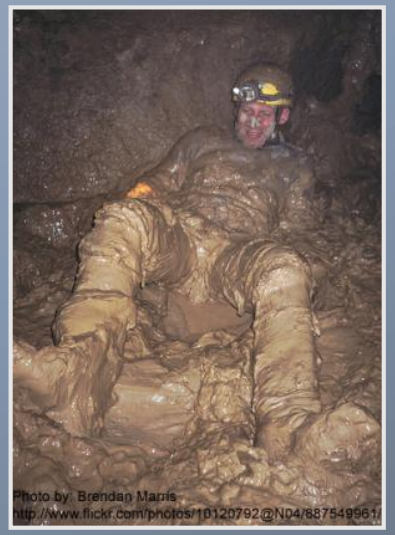
- Microbial & biological antifungals
- Vaccine
- Probiotics
- Temp./Humidity modification
- Gene silencing or therapy
- UV light
- Habitat improvement

Treatment and management strategies

Is there a Cure?

Outreach and Guidance

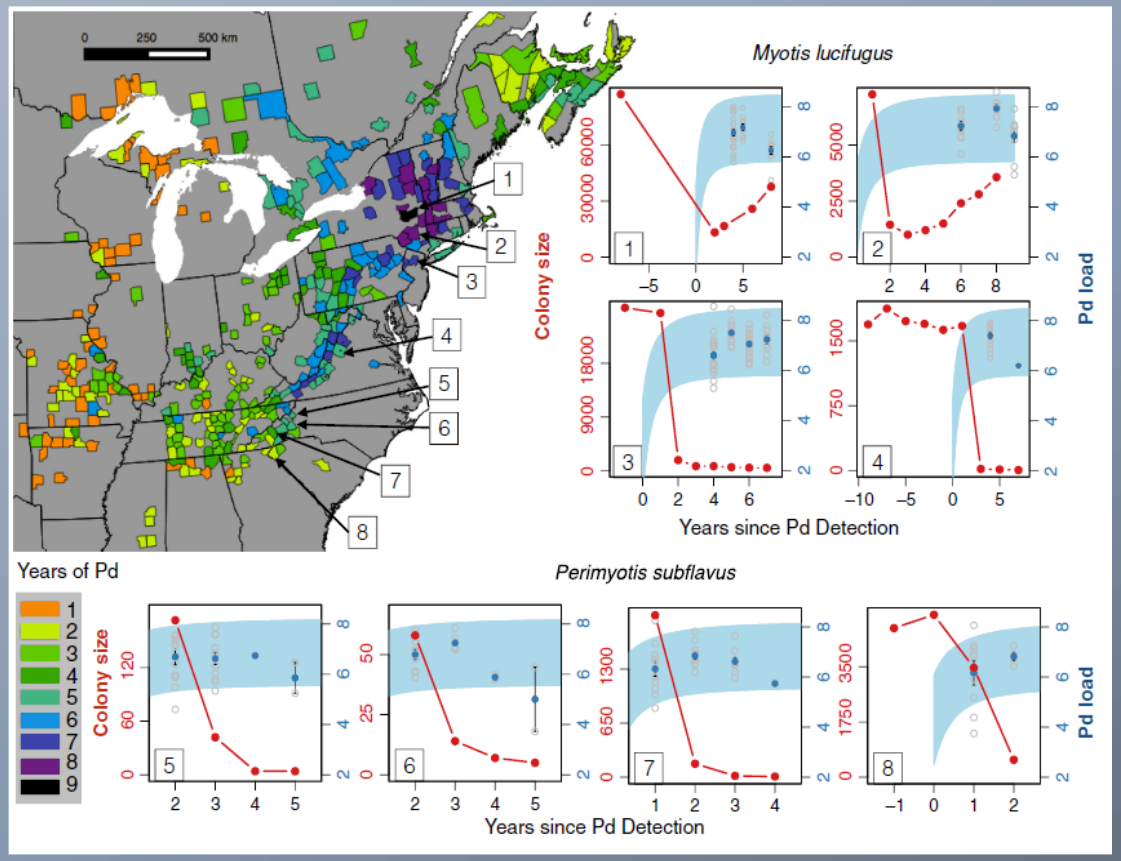
- Cave access guidance
- Decontamination guidance
- NWCO, Rehab, Forest Management guidance
- Transportation agency guidance (for bridges with bats)
- Captive management recommendations
- NABat report & implementation - baseline in non-WNS areas, trends over time in WNS areas



www.whitenosesyndrome.org

Hope for Survivors

Damaged wings can heal
Some bats are persisting post-WNS



Frick et al. 2017

Fuller et al. 2011

California Response Strategy

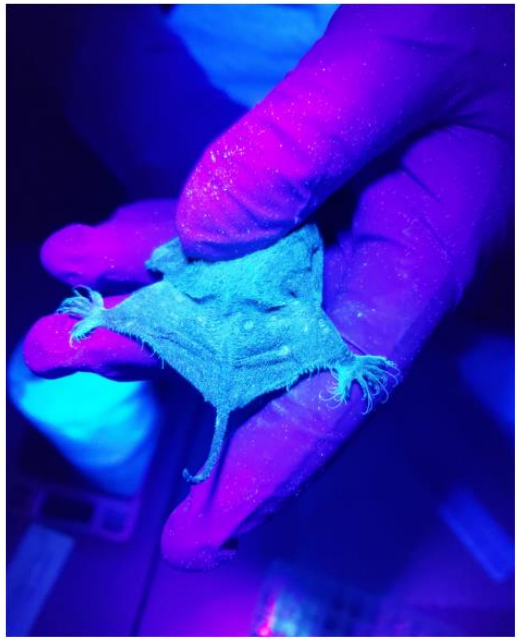
Multi-agency response:
USFWS, CDFW, USFS, NPS, USGS, BLM, CA State Parks

Detection of low levels of *Pd* in California

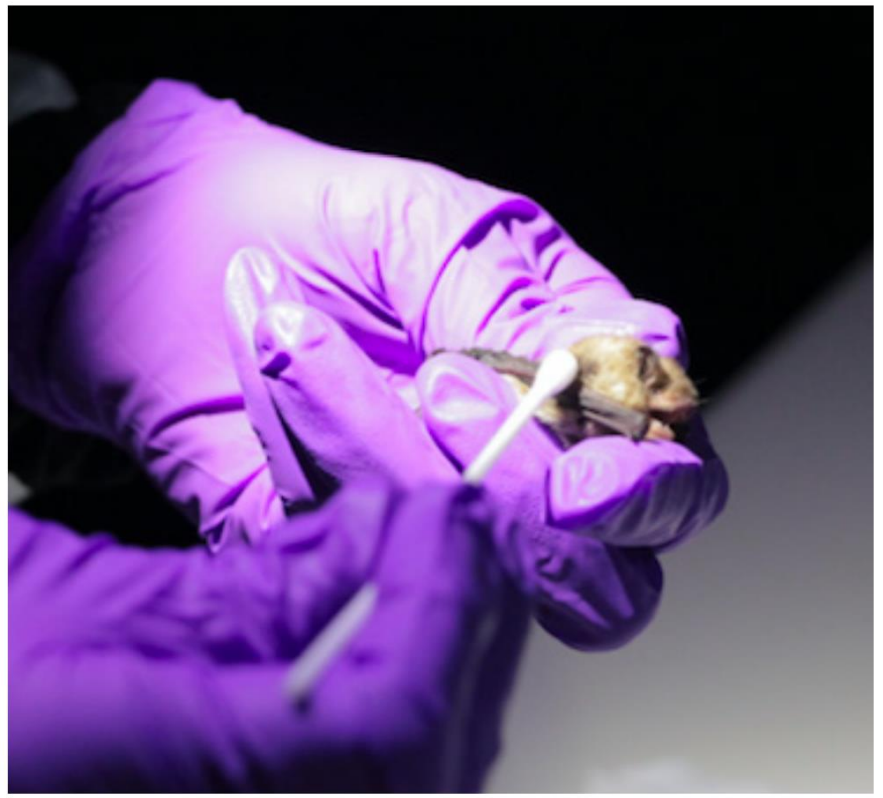
Chester, CA (Plumas County)

2018: swab from one bat had low-level (CT value of >37) *Pd*

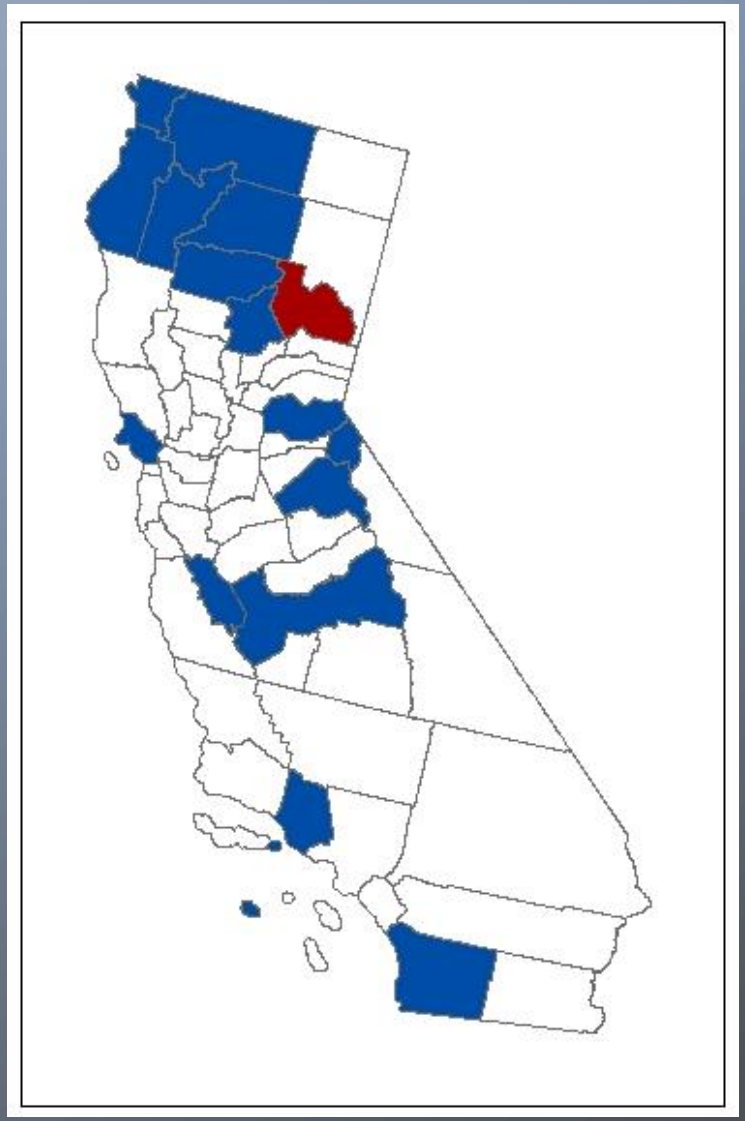
2019: swabs from three different bats had low-level *Pd*



Tail membrane and feet of a Brazilian free-tailed bat (*Tadarida brasiliensis*) under UV light to check for presence of Pd at Whiskeytown National Recreation Area. Note the extra toe hairs on the edges of the feet, which is a unique feature of this species. Photo by Katrina Smith



Klamath Inventory and Monitoring staff swab a bat wing. The sample will later be tested for *Pseudogymnoascus destructans*, the fungus that causes white-nose syndrome. Photo by Emily Lind



Additional surveillance is ongoing in various locations indicated in blue

Change in Pd Status the Following Year

Pd Detection Status	Pd Detection Status the Following Winter		
	Pd negative (all Ct > 40)	? (all Ct 37-40)	Pd positive (some Ct < 37)
Pd negative (all Ct > 40)			
? (all Ct 37-40)			
Pd positive (some Ct < 37)			

Change in Pd Status the Following Year

		Pd Detection Status the Following Winter			
		Pd negative (all Ct > 40)	? (all Ct 37-40)	Pd positive (some Ct < 37)	Totals:
Pd Detection Status	Pd negative (all Ct > 40)	90 60%	28 19%	32 21%	150
	? (all Ct 37-40)				
	Pd positive (some Ct < 37)				

Change in Pd Status the Following Year

		Pd Detection Status the Following Winter						
		Pd negative (all Ct > 40)		? (all Ct 37-40)		Pd positive (some Ct < 37)		Totals:
Pd Detection Status	Pd negative (all Ct > 40)	90	60%	28	19%	32	21%	150
	? (all Ct 37-40)	6	26%	3	13%	14	61%	23
	Pd positive (some Ct < 37)							

Change in Pd Status the Following Year

		Pd Detection Status the Following Winter						
		Pd negative (all Ct > 40)		? (all Ct 37-40)		Pd positive (some Ct < 37)		Totals:
Pd Detection Status	Pd negative (all Ct > 40)	90	60%	28	19%	32	21%	150
	? (all Ct 37-40)	6	26%	3	13%	14	61%	23
	Pd positive (some Ct < 37)	4	5%	2	3%	72	92%	78

Response Strategy

Decontamination, Outreach, and Consistent Messaging

White-Nose Syndrome in Bats

Protect the bats!
Clean your gear.

Change or clean your gear if you have visited a place where bats roost: caves, mines, barns, bridges and forests.

- **Remove** all dirt from shoes and caving gear
- **Wipe or soak** caving gear (see back for instructions*)
- **Wash** yourself and your clothes
- **Repeat** process when traveling outside the local area

A fungal disease called white-nose syndrome (WNS) is killing millions of bats. The fungus can travel from cave to cave on shoes, clothing and caving gear.

*To clean vertical caving gear (ropes, harnesses, etc.) consult whitenosesyndrome.org

White-Nose Syndrome in Bats

WNS Cleaning Instructions

Wipe or soak caving gear using any of the following methods:
(clothing, shoes, hats, helmets, lights, cameras, backpacks, kneepads, gloves)

Method	Contact Time	Caving gear
Hot water at least 131°F (55°C)	Soak 20 mins	Clothes, kneepads, gloves
60% isopropyl alcohol	Wipe/spray/soak Effective on contact	All caving gear
3% hydrogen peroxide	Wipes/spray/soak Effective on contact	All caving gear (Warning! Discolors fabric)
Clorox wipes or bleach	Wipe 4 mins ***or*** Soak 10 mins	All caving gear (Warning! Discolors fabric)
Lysol IC Quaternary Disinfectant	Soak 10 mins	Hard nonporous items (helmet, rubber boots)

Response Strategy

Reporting Tools

Report a sick or dead bat (CDFW)

www.wildlife.ca.gov/conservation/laboratories/wildlife-investigations/monitoring/wns/report

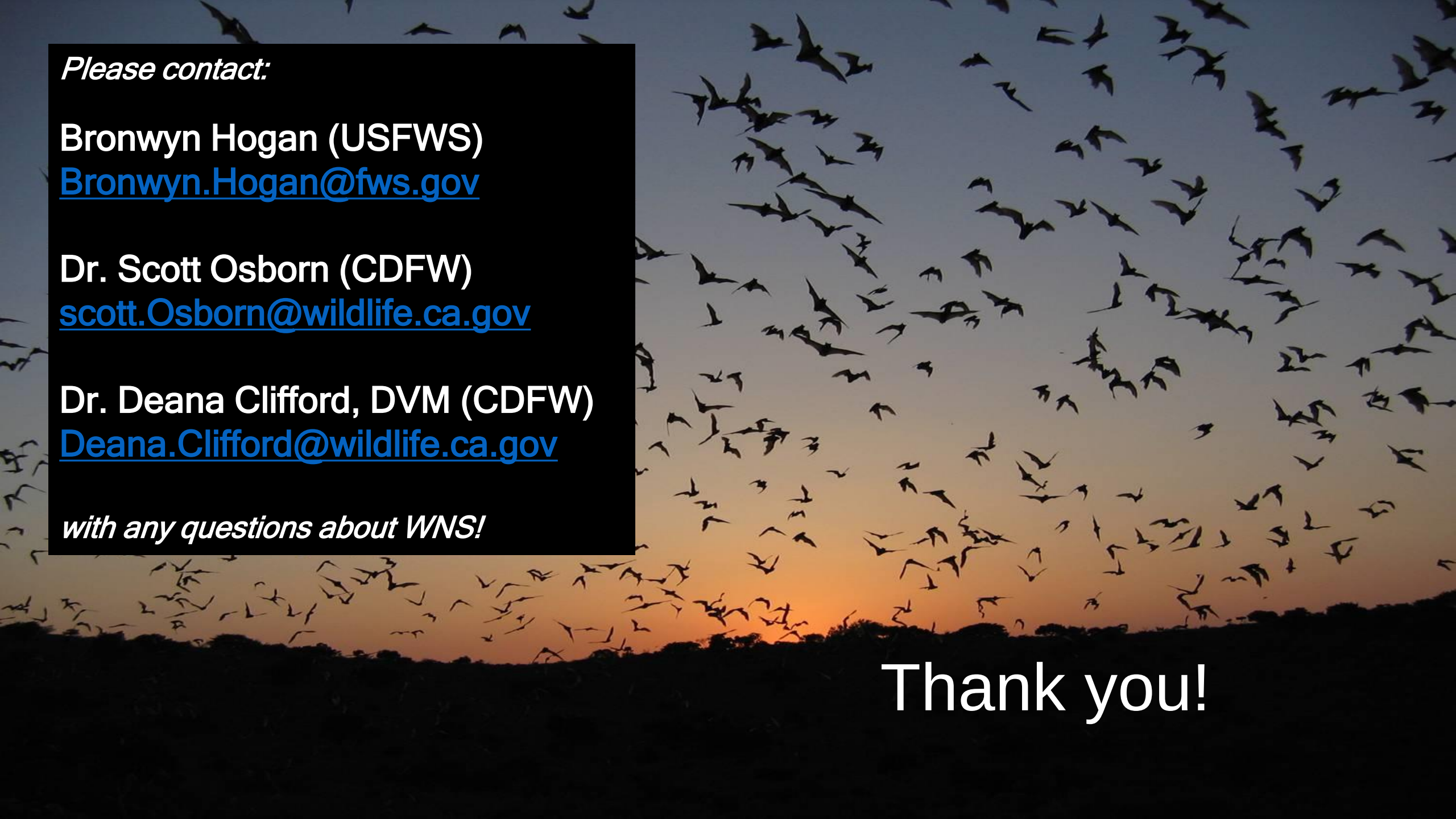
Roost Reporting Tool in progress

CDFW lead; spring 2020 release

North American Bat Tracker

Crowdsource bat reporting tool

Up to $20,000 awarded per winning idea



Please contact:

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Dr. Scott Osborn (CDFW)
scott.Osborn@wildlife.ca.gov

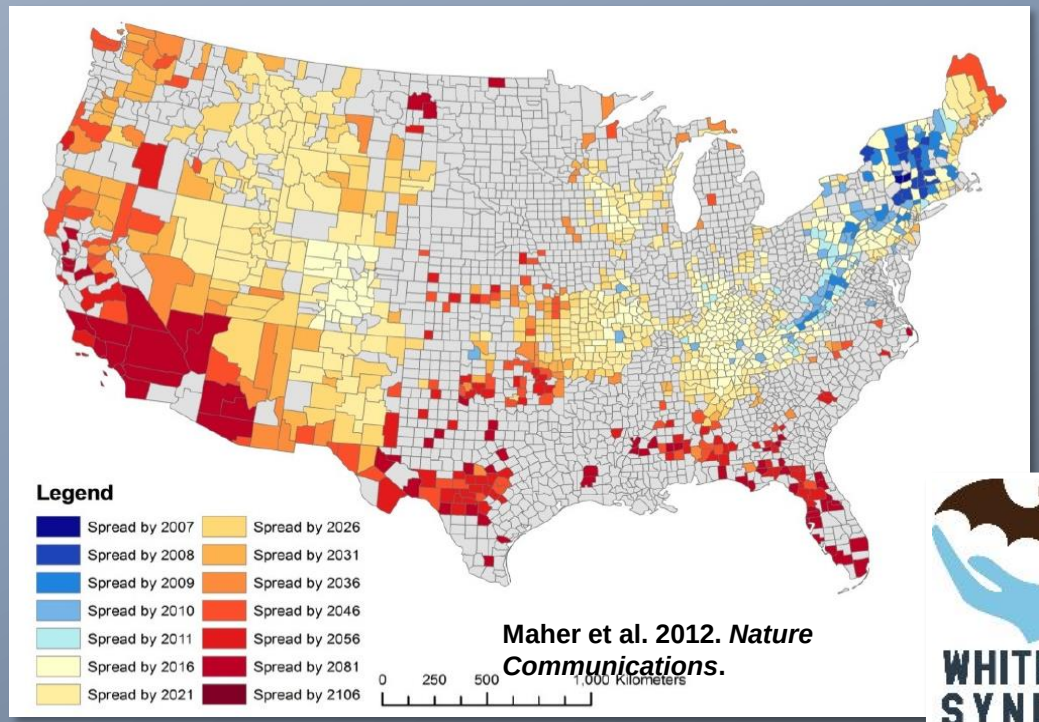
Dr. Deana Clifford, DVM (CDFW)
Deana.Clifford@wildlife.ca.gov

with any questions about WNS!

Thank you!

Future of White-nose Syndrome

- The fungus will continue to spread
- All hibernating bat species potentially at risk
- Long-term impacts to bat population dynamics uncertain
  - BUT we have hope for survivors and the future



Maher et al. 2012. *Nature Communications*.

WHITE-NOSE SYNDROME RESPONSE TEAM

U.S. FISH & WILDLIFE SERVICE