Assessment of Bat Occupancy and Activity Levels Using Acoustic and Visual Encounter Surveys and Mitigating Impacts to Bats

Mine Design, Operations, and Closure Conference
May 1st 2012, Fairmont Hot Springs, Montana

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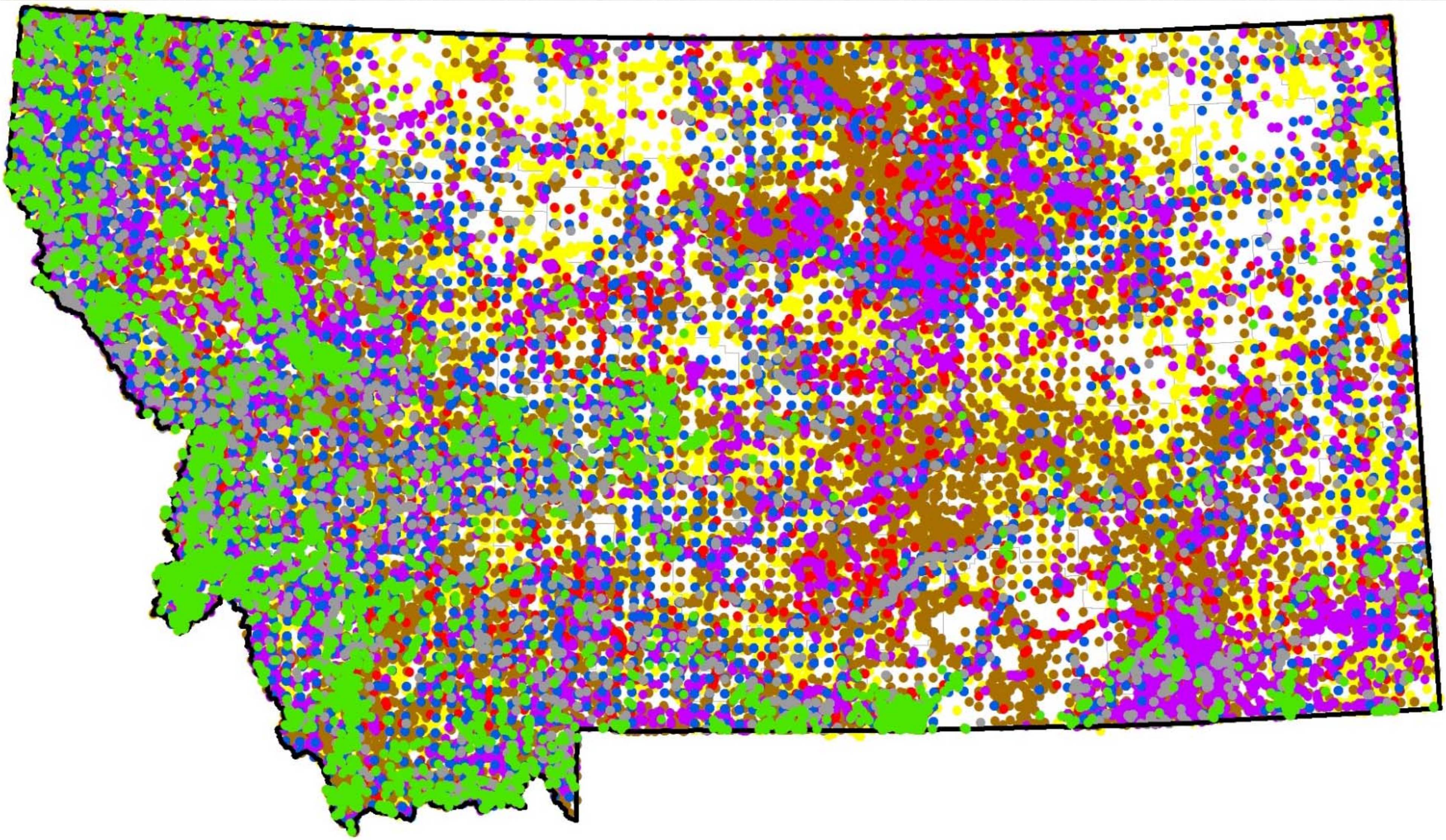
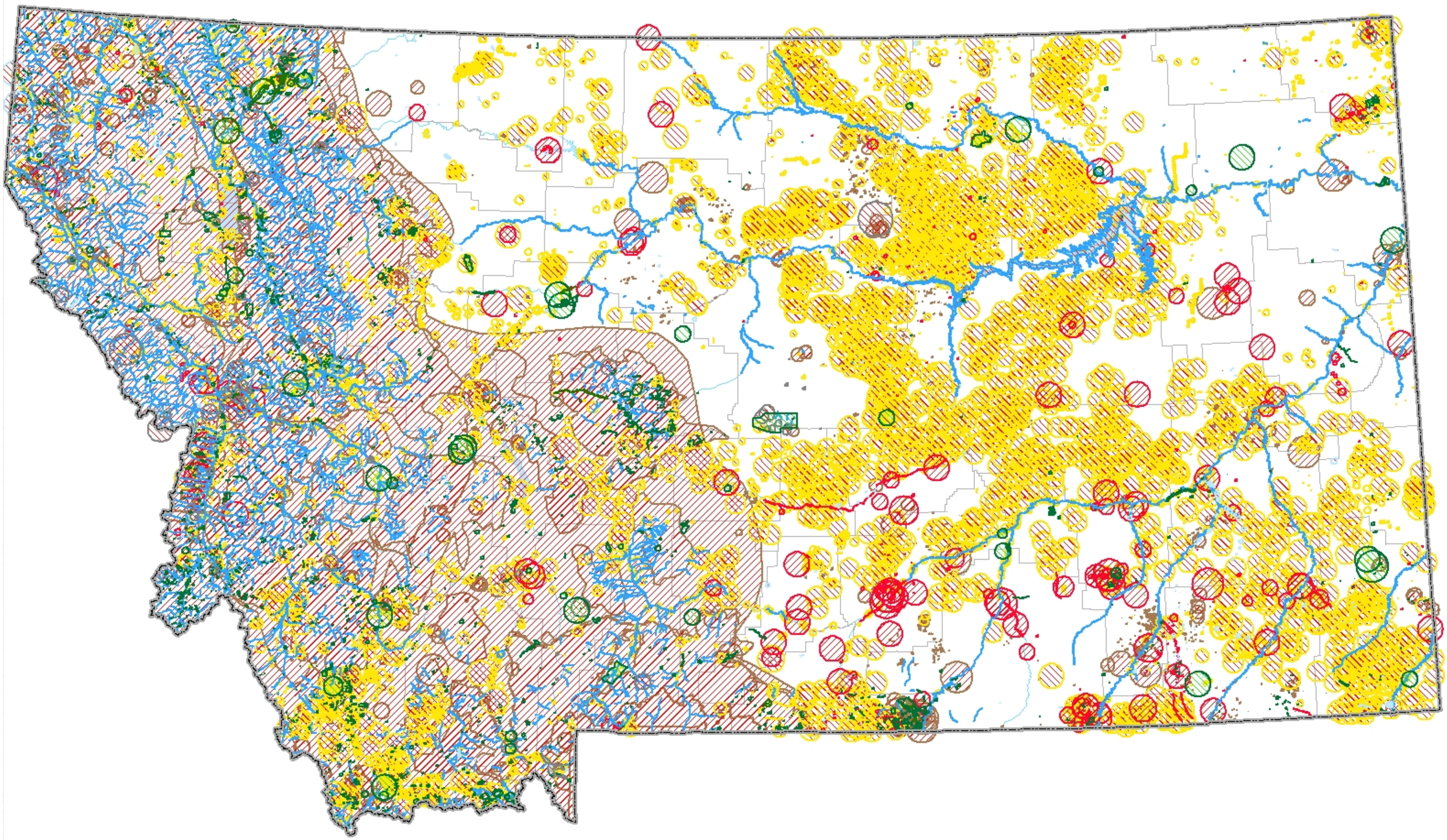
MONTANA
Natural Heritage
Program
http://mtnhp.org

Statewide Observations

* Animals = 1,274,350 * Plant SOC = 7,394

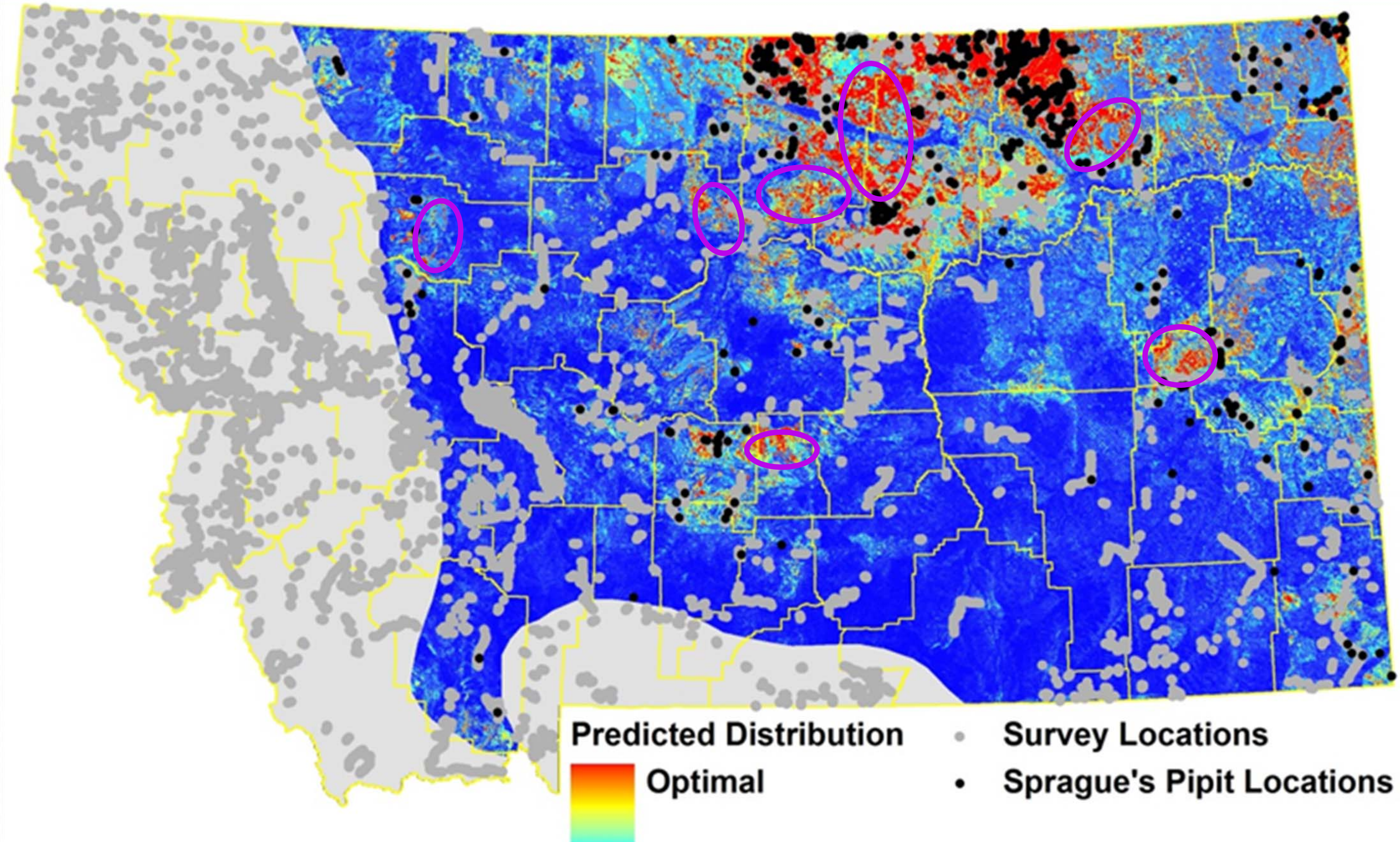


Species of Concern Occurrence Locations



Predicted Distribution Models & Survey Locations

Surveys Needed!



* 138,864 structured survey locations (e.g., bat acoustic, bird point count, small mammal trapping)

White-Nose Syndrome

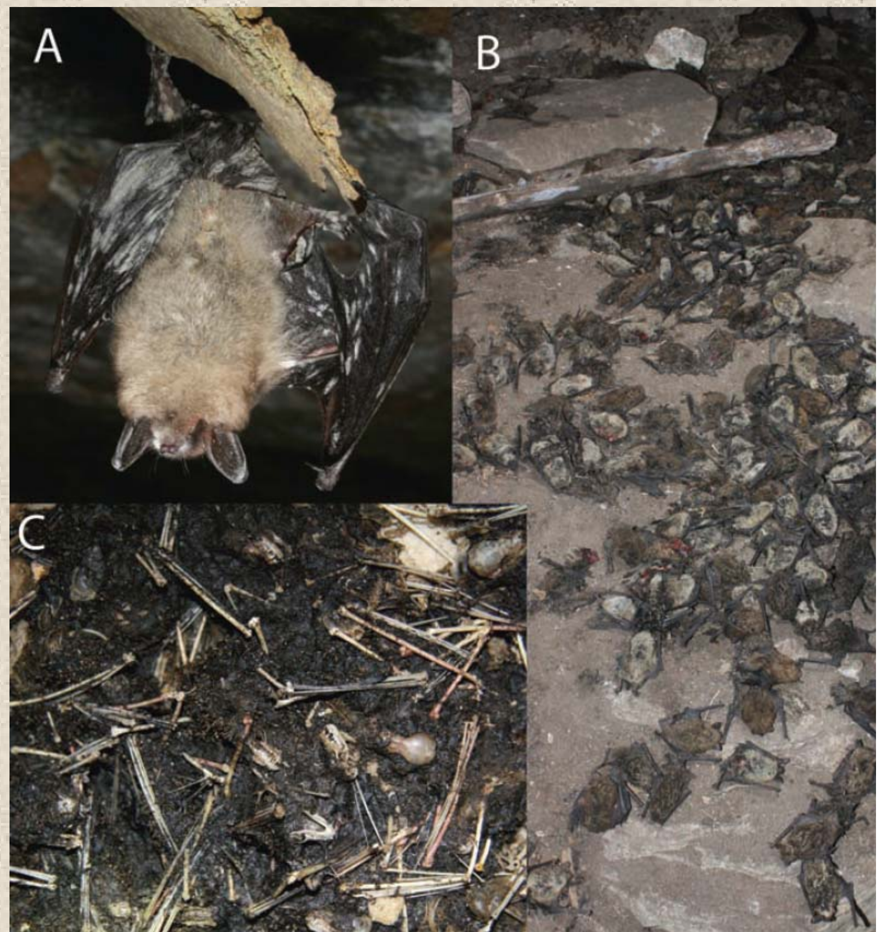
For Latest Info: http://www.fws.gov/whitenosesyndrome/

- Has killed 5.7 to 6.7 million bats in N.A. since 2006

  (USFWS January 17, 2012 news release)

- Caused by cold-adapted fungus: *Geomyces destructans*

  (Lorch et al. 2011, Nature 480: 376-378)



(Frick et al. 2010, Science 329: 679-682)

Wind Energy Development

- Of North America's 45 bat species, mortalities of 11 have been detected at wind energy facilities (Kunz et al. 2007)

- 75% of documented mortalities have been of migratory foliage roosting species: Hoary Bat, Eastern Red Bat, and Silver-haired Bat (Kunz et al. 2007, Frontiers in Ecology and the Environment 5(6): 315-324)

Figure 2. The three species of migratory tree bats most frequently killed at wind turbine facilities in North America. (a) Hoary bat (Lasiurus cinereus), *(b) eastern red bat* (L borealis), *and (c) silver-haired bat* (Lasionycteris noctivagans)

- 7 Montana bat species have had documented mortalities at wind energy facilities in North America and at least 3 species have documented mortalities at Montana wind energy facilities (Kunz et al. 2007, Poulton and Erickson 2010, Judith Gap Final Report)

- Most bats are killed on nights with low wind speed (< 6 m/s where wind turbine cut-in speeds are typically 3.5 - 4.0 m/s) (Arnett et al. 2008, JWM 72(1): 61-78)

- Fatalities increase before or after storm fronts (Arnett et al. 2008, JWM 72(1): 61-78)

- Highest fatalities during late summer and early fall (Arnett et al. 2008, JWM 72(1): 61-78)

- Mortalities are often skewed toward males (Arnett et al. 2008, JWM 72(1): 61-78)

Direct Collision versus Barotrauma

- Direct contact with turbine blade in 50% of fatalities
- 90% of bat fatalities involve internal hemmoraging
- Pressure drops of 5-10 kPa with tip speeds of 55-80 m/s

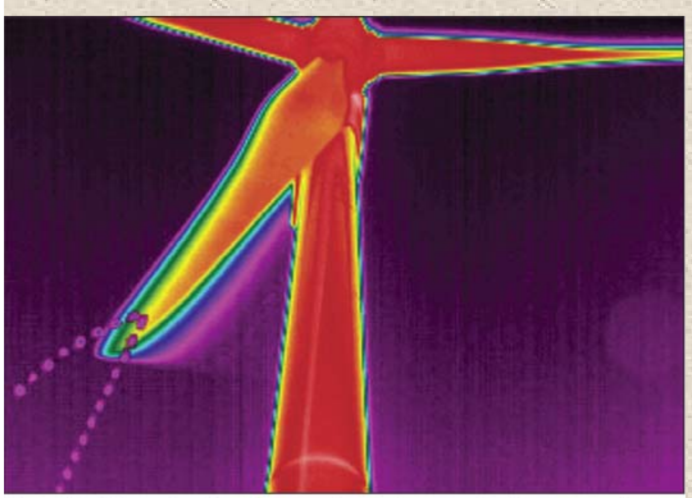
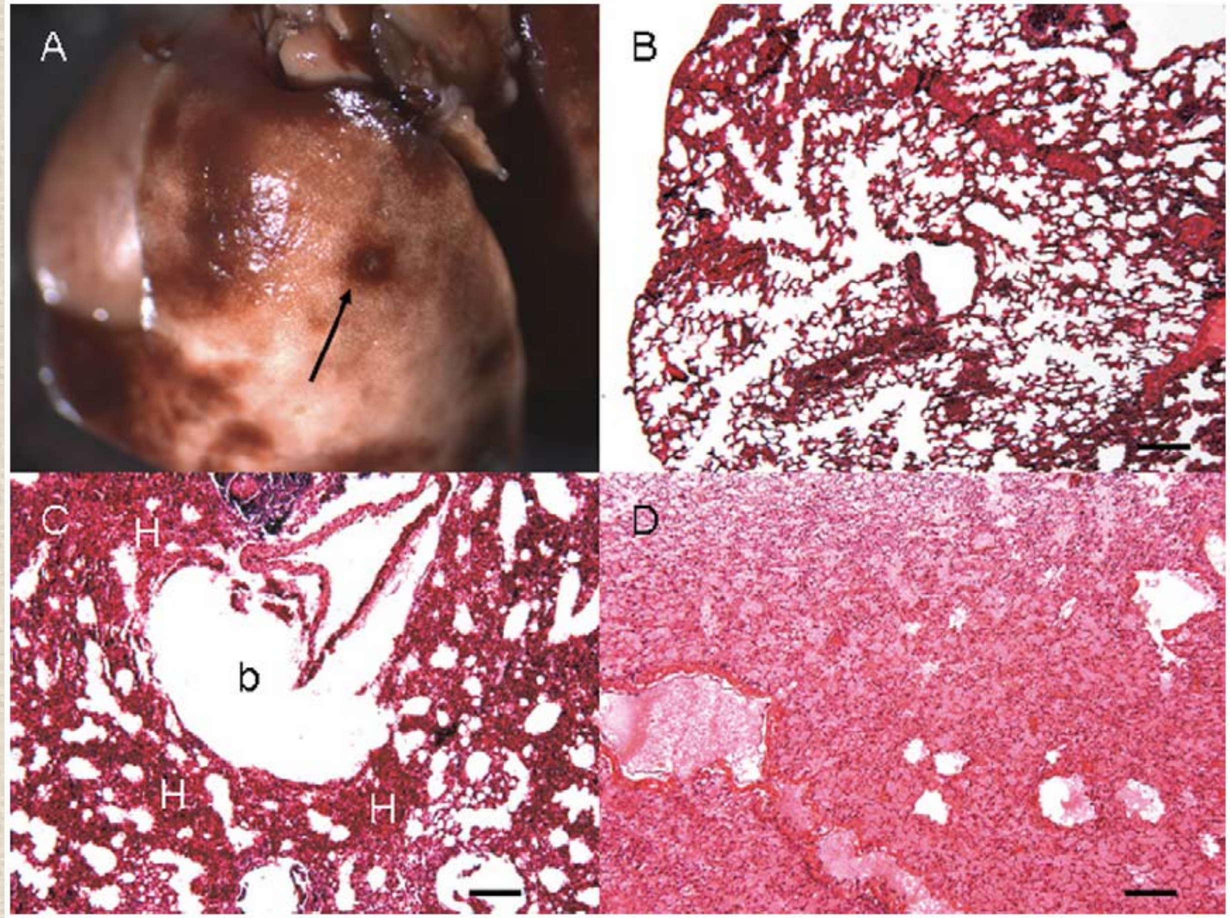


Figure 3. *Thermal infrared image of a modern wind turbine rotor, showing the trajectory of a bat that was struck by a moving blade (lower left).*

(Kunz et al. 2007, Frontiers in Ecology and the Environment 5(6): 315-324)

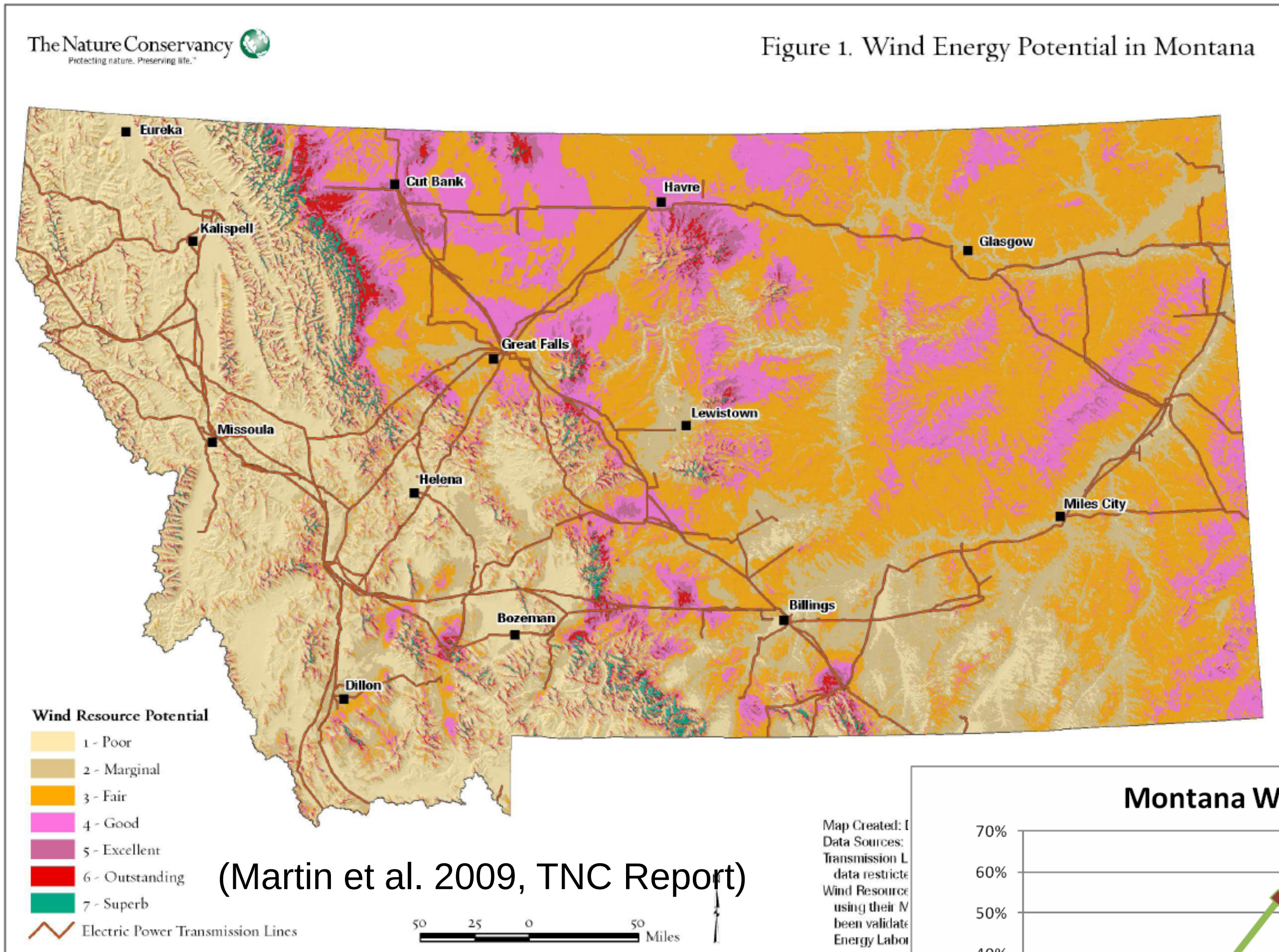


(Baerwald et al. 2008, Current Biology 18(16): R695-R696)

Figure 1. Pulmonary barotrauma in bats killed at wind turbines.

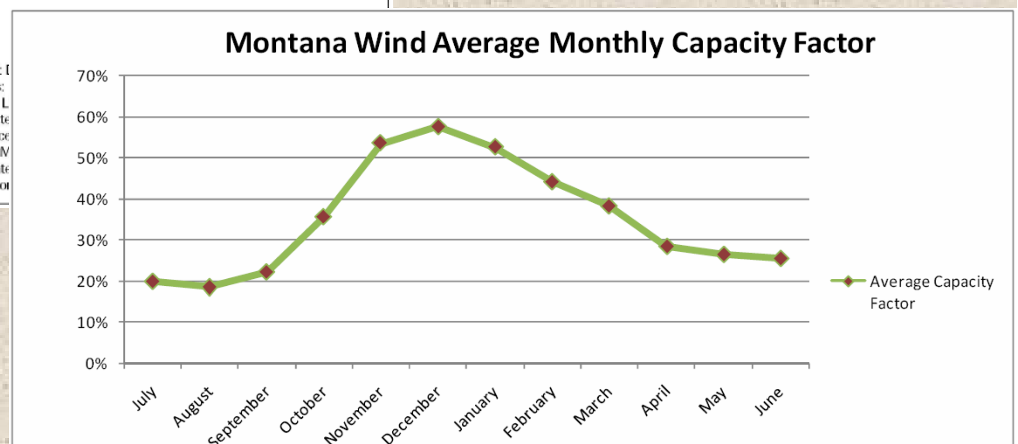
(A) Formalin-fixed *L. noctivagans* lung with multifocal hemorrhages and a ruptured bulla with hemorrhagic border (arrow). Histological sections of bat lungs stained with hematoxylin and eosin (100X). (B) Normal lung of an *L. noctivagans*. (C) Lung of *Eptesicus fuscus* found dead at a wind turbine with no traumatic injury. There is extensive pulmonary hemorrhage (H), congestion, and bullae (b). (D) Lung of *L. cinereus* found dead at a wind turbine with a fracture of the distal ulna and radius. 90% of the alveoli and airways are filled with edema. Bar = 100 µm.

Wind Energy Development and Bats



(Martin et al. 2009, TNC Report)

- **30 miles from transmission corridor is limit of economic viability**



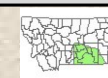
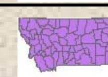
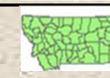
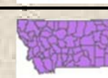
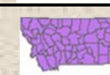
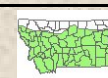
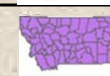
(Energy Strategies 2010)

- **Migratory pathways?**
- **Migration timing?**

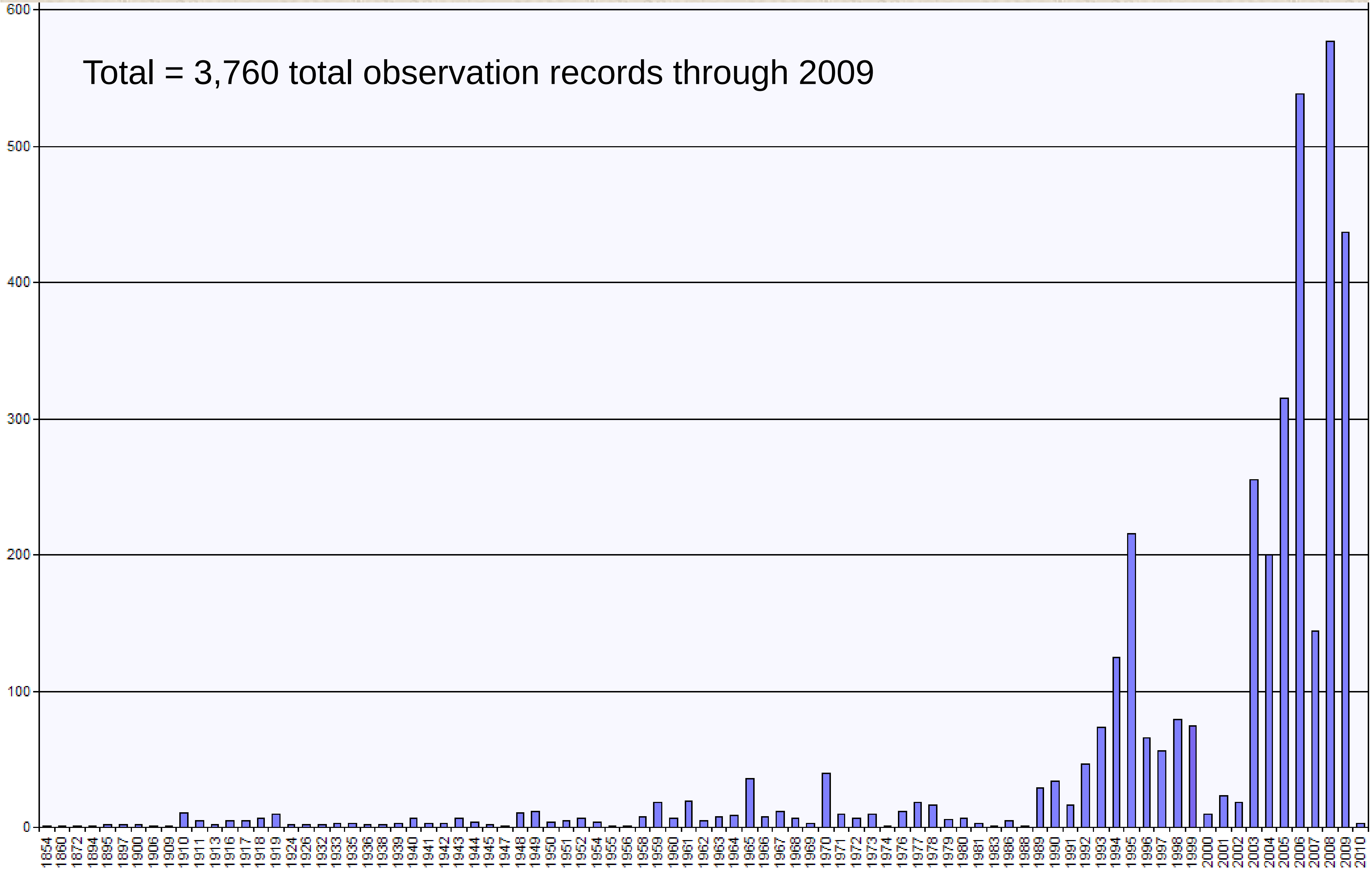
Major Bat Conservation Issues

Wind Turbine Impacts Documented

White-Nose Syndrome and Wind Turbine Impacts Documented

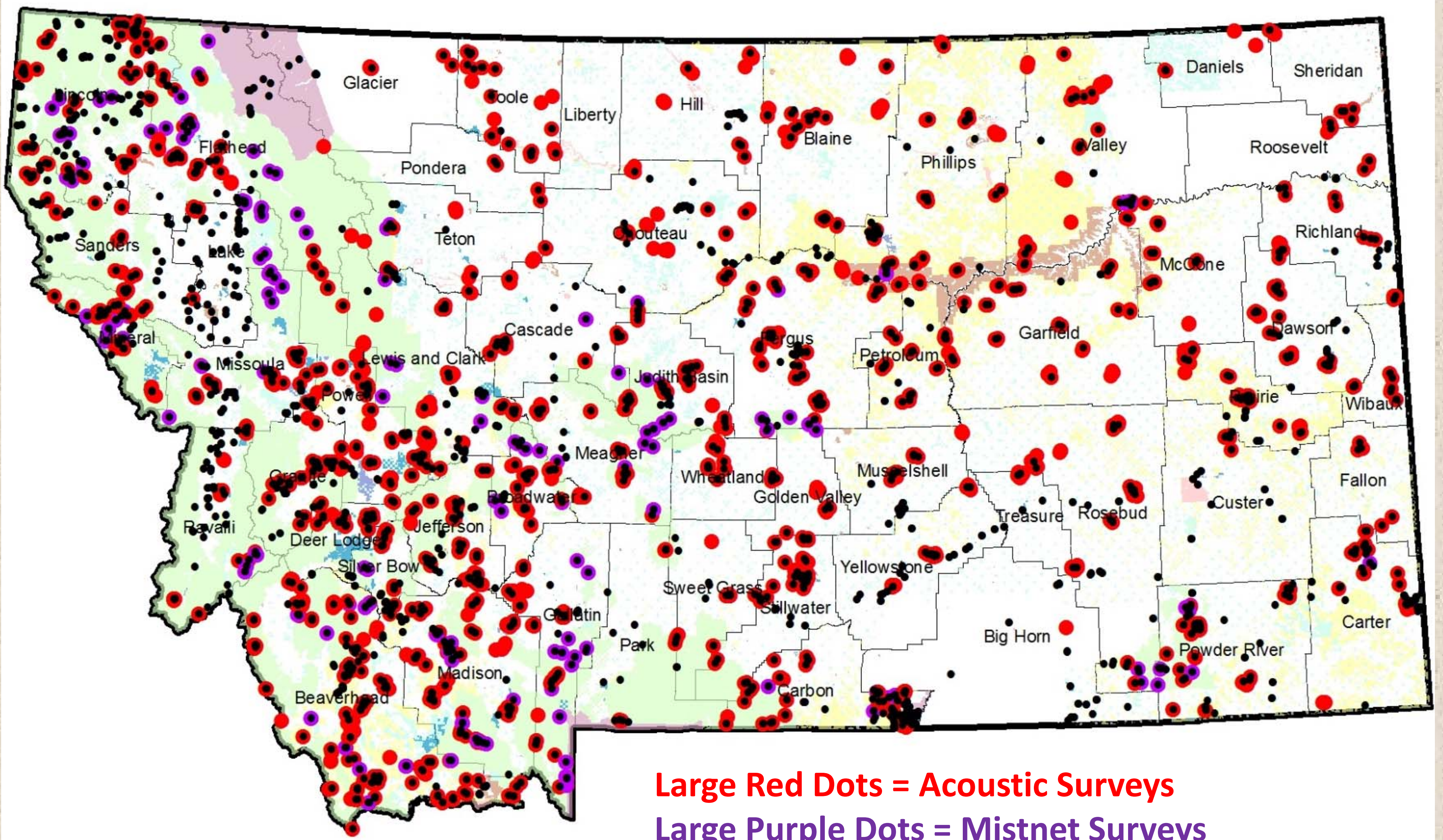
Common Name	Scientific Name	4-Code	MT Range/No. Recs	
Pallid Bat	*Antrozous pallidus*	**ANPA**		41
Townsend's Big-eared Bat	*Corynorhinus townsendii*	**COTO**		212
Big Brown Bat	*Eptesicus fuscus*	**EPFU**		674
Spotted Bat	*Euderma maculatum*	**EUMA**		30
Silver-haired Bat	*Lasionycteris noctivagans*	**LANO**		966
Eastern Red Bat	*Lasiurus borealis*	**LABO**		17
Hoary Bat	*Lasiurus cinereus*	**LACI**		777
California Myotis	*Myotis californicus*	**MYCA**		137
Western Small-footed Myotis	*Myotis ciliolabrum*	**MYCI**		576
Long-eared Myotis	*Myotis evotis*	**MYEV**		762
Little Brown Myotis	*Myotis lucifugus*	**MYLU**		1,070
Northern Myotis	*Myotis septentrionalis*	**MYSE**	**?**	2
Fringed Myotis	*Myotis thysanodes*	**MYTH**		106
Long-legged Myotis	*Myotis volans*	**MYVO**		294
Yuma Myotis	*Myotis yumanensis*	**MYYU**	**?**	?

Montana Bat Observations Through 2009



Summer Acoustic and Mist Netting Data

***5,584 records between May 16 and September 30**



Large Red Dots = Acoustic Surveys

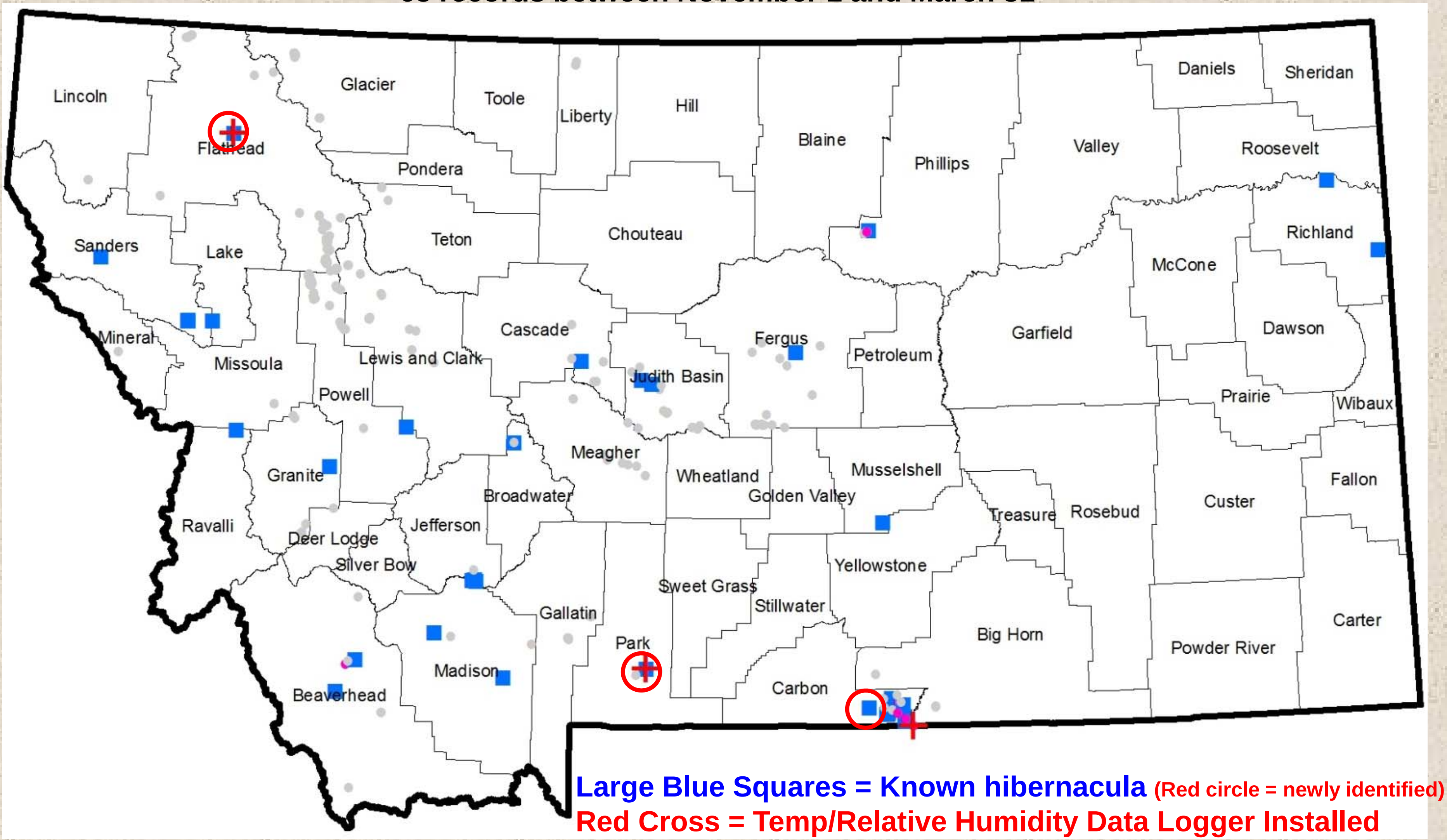
Large Purple Dots = Mistnet Surveys

Small Black Dots = Bat detections

*5,678 bat records as of 2/25/12

Winter and Cave/Mine Data

***63 records between November 1 and March 31**



Large Blue Squares = Known hibernacula **(Red circle = newly identified)**

Red Cross = Temp/Relative Humidity Data Logger Installed

Small Gray Dots = Caves

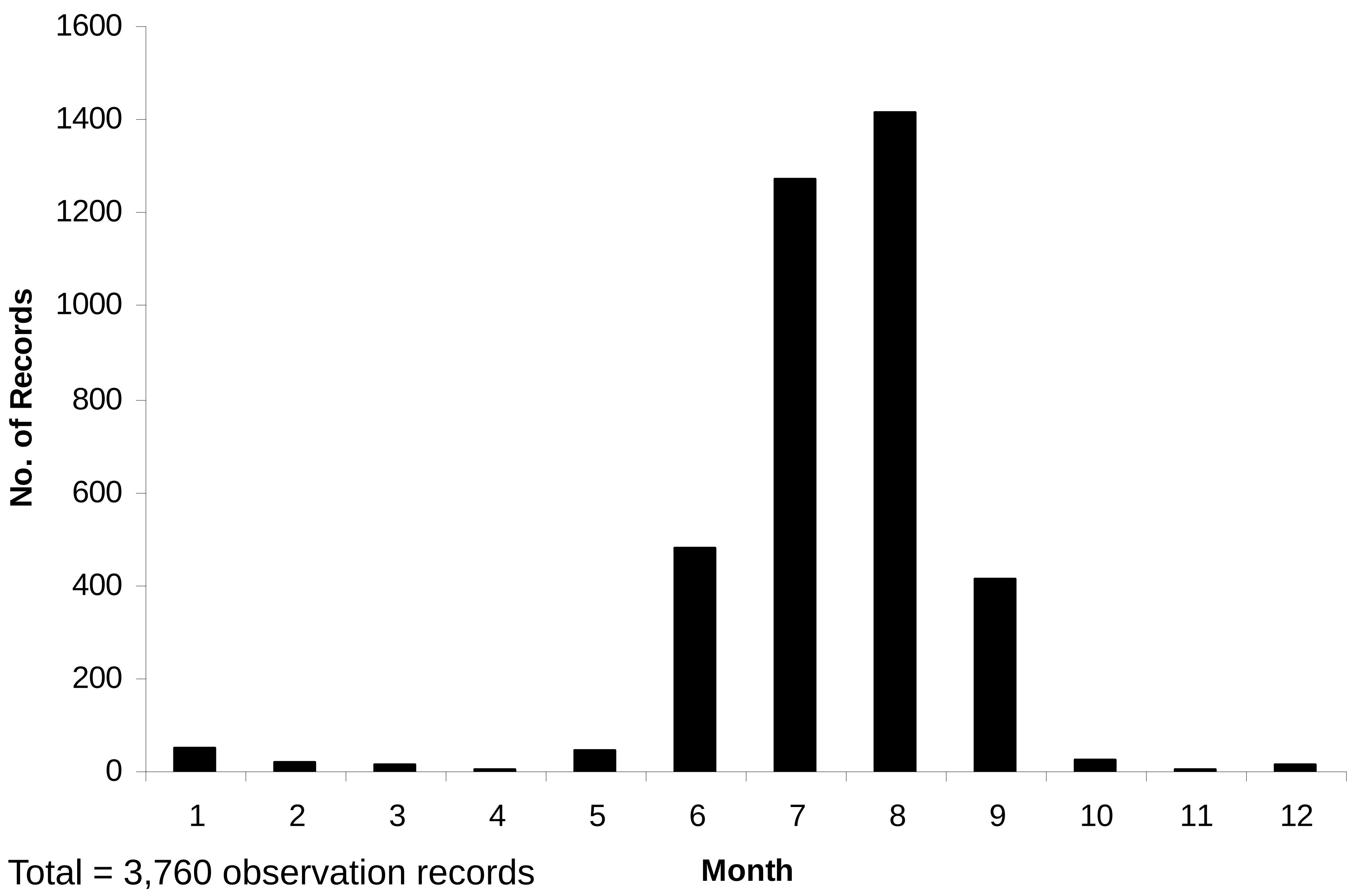
Small Pink Dots = Caves/Mines with bat activity recorded

Spring and Fall Bat Data

April to mid-May = 11 records

October = 20 records

Montana Bat Observations by Month



Filling the Data Gaps

Roost Surveys

Mistnet Surveys

Acoustic Surveys

Winter Habitat Assessments

Rock Outcrop Surveys

Bats detected in day roosts at 10% of rock outcrops surveyed

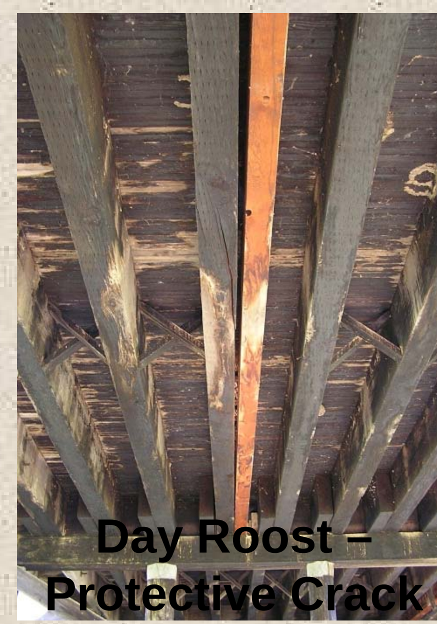
Pallid Bat, Big Brown Bat, Long-eared Myotis, Western Small-footed Myotis

Bridge Surveys

Droppings & Urine Stains

Bats in Crevices

Night Roosts – Open Warm Faces

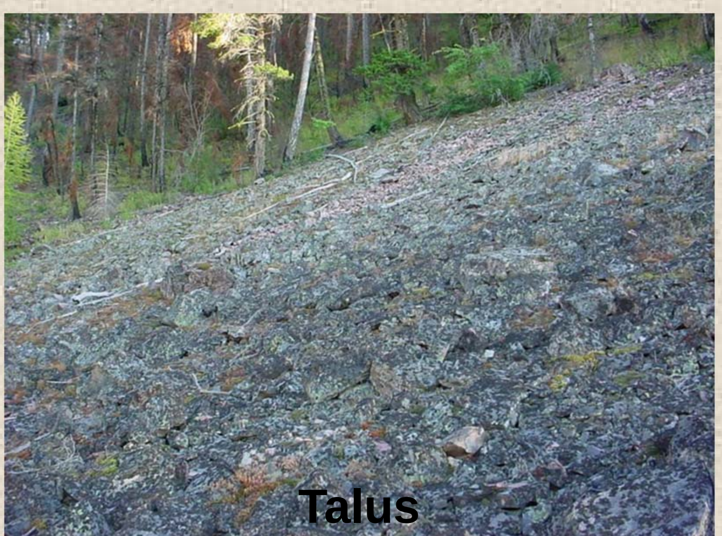


Day Roost – Protective Crack

Other Roosts

Buildings

Caves and Mines

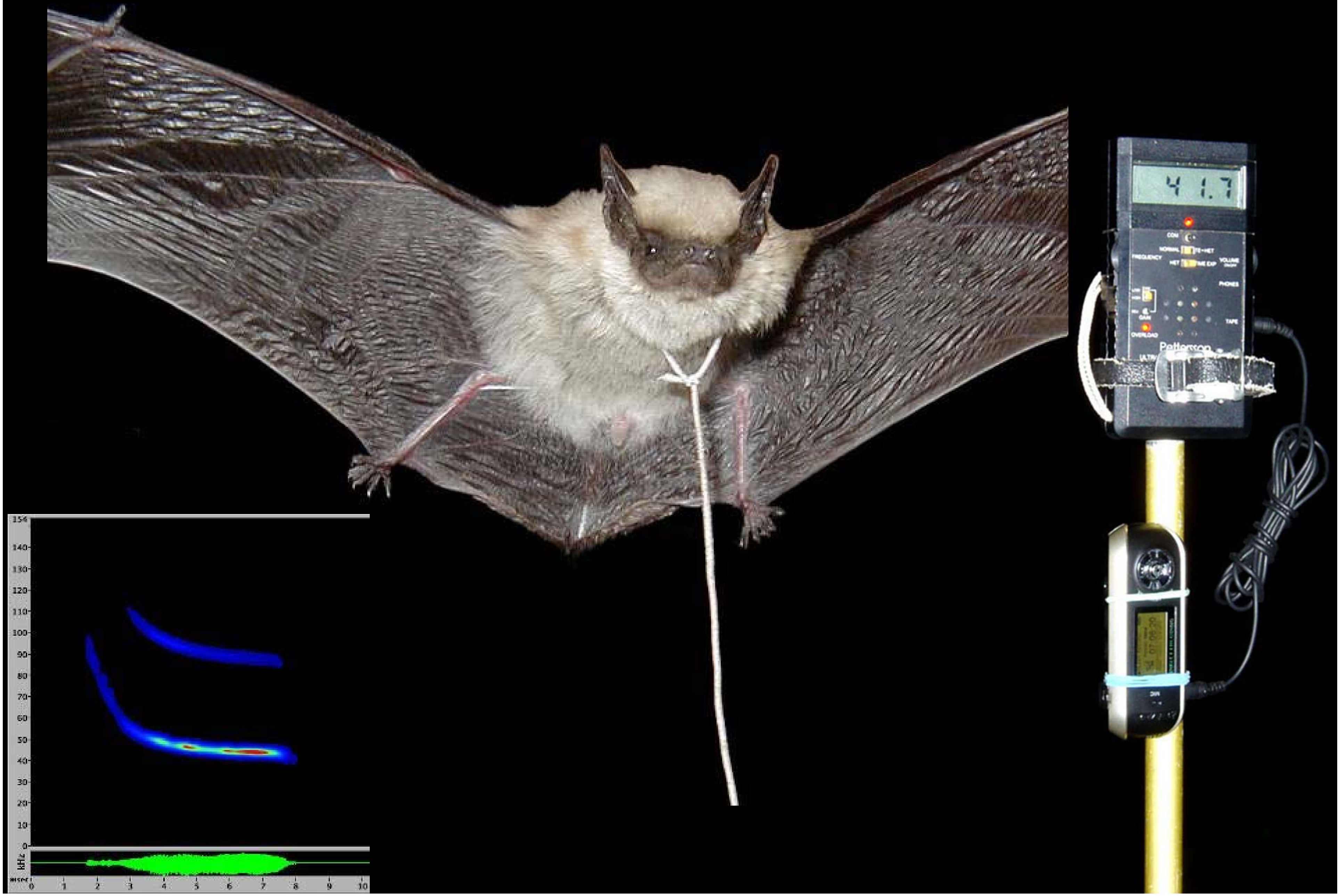


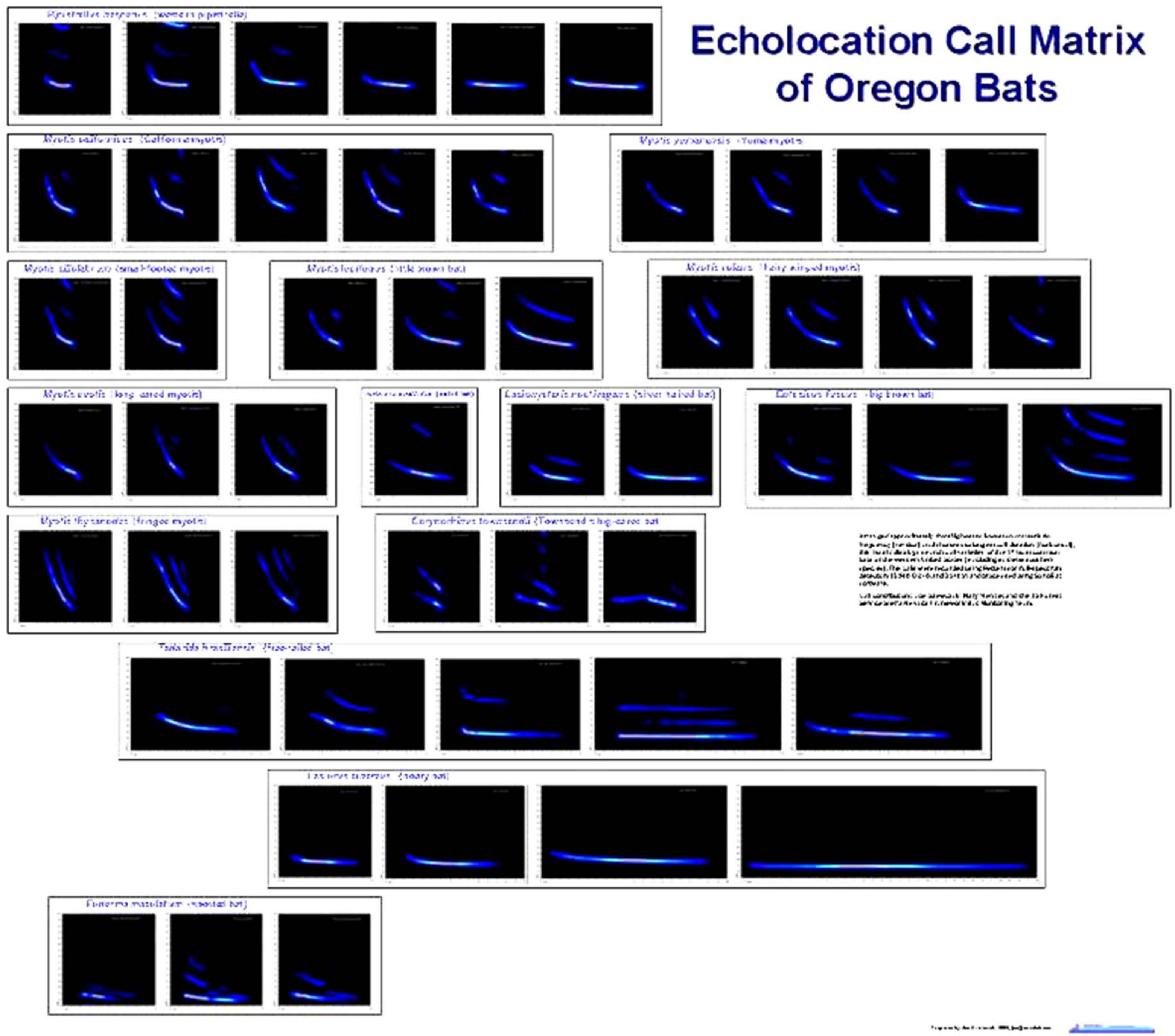
Talus

In Snags and Under Loose Bark

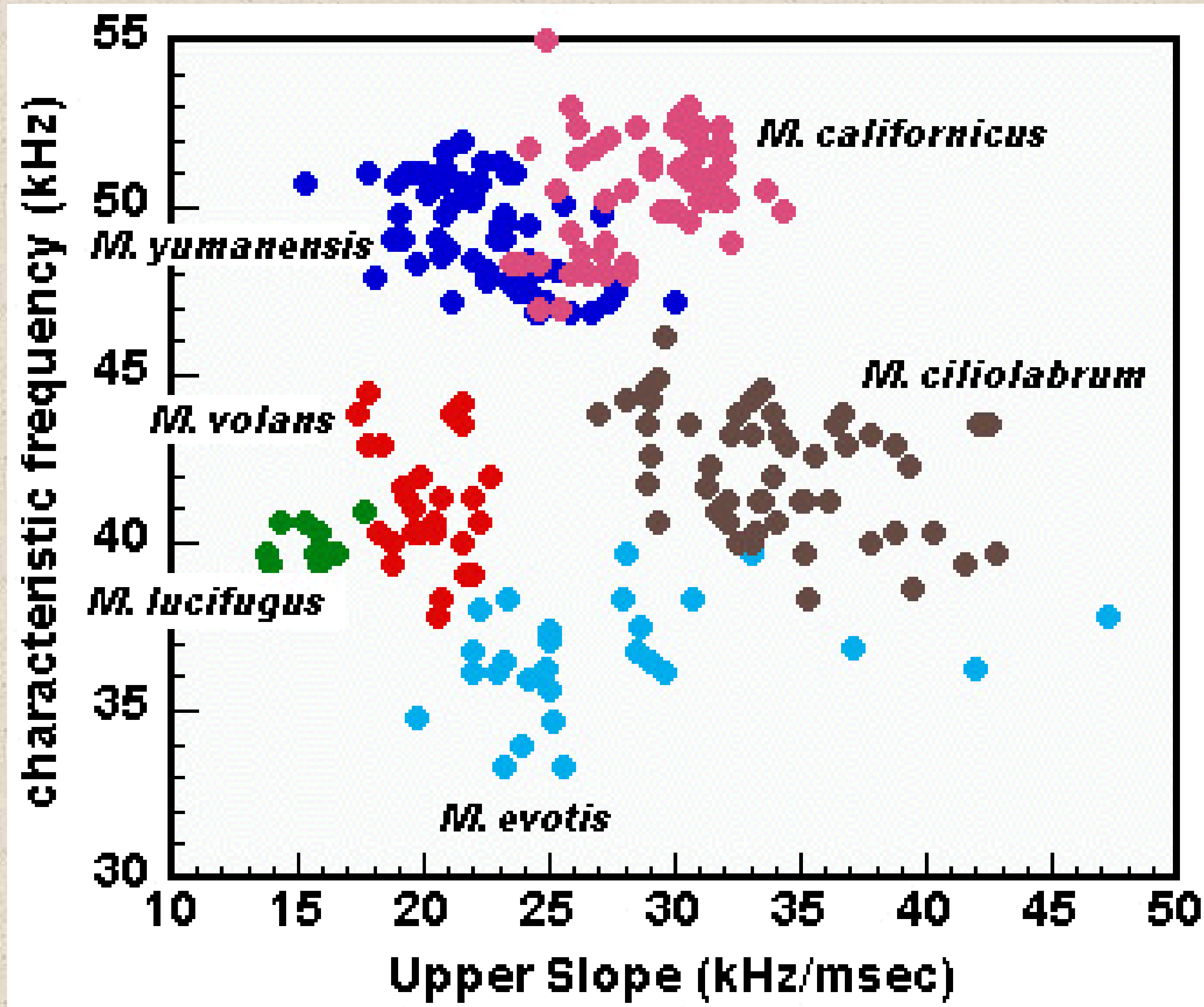
Mistnet and Harp Trap Surveys

Acoustic Surveys




Echolocation Call Matrix
of Oregon Bats

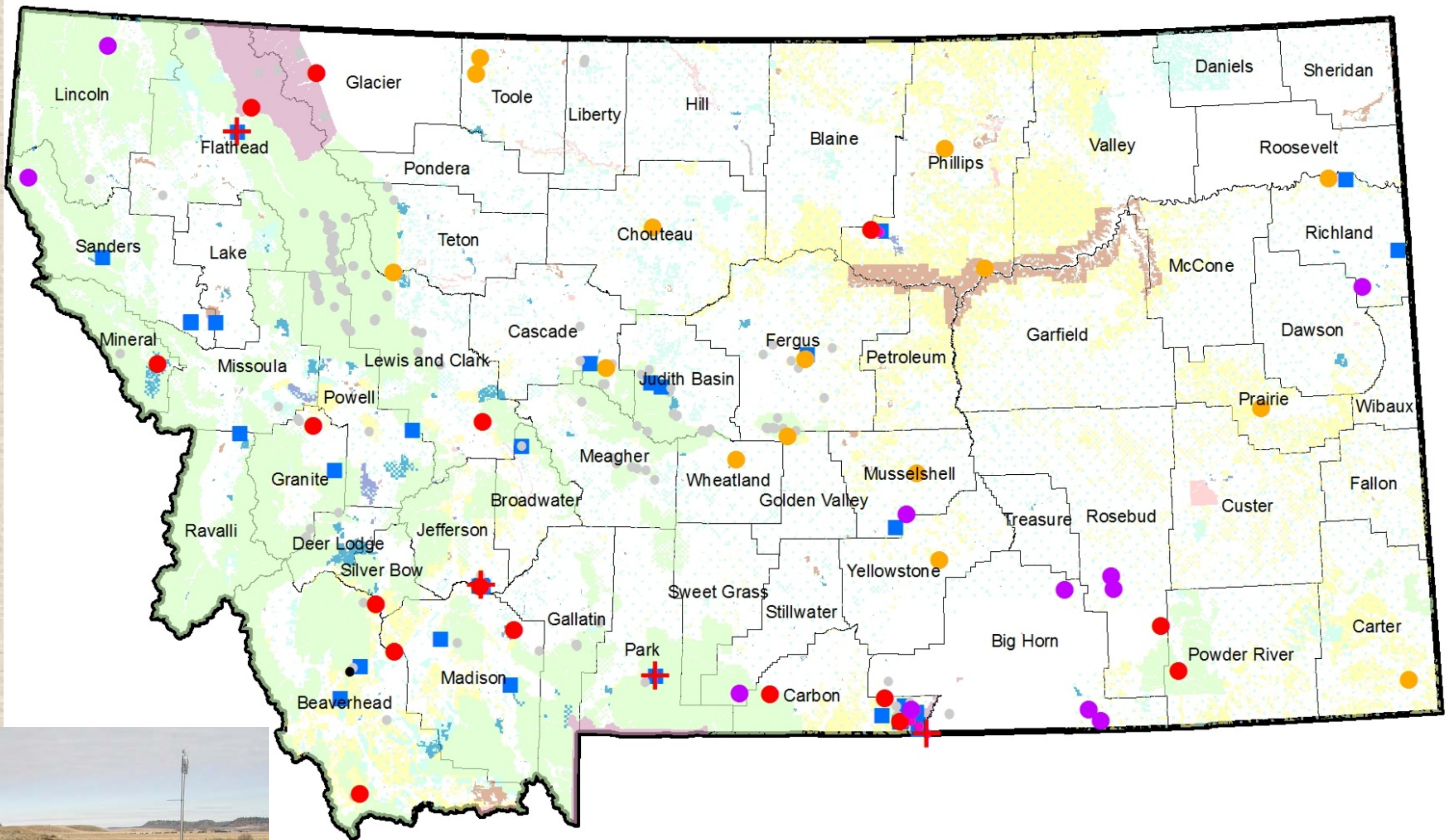
Differentiating Between Species



Detection Rates - Mistnetting vs. Acoustic Survey

Species	Overall Percent Detection Rate	
	Acoustic n=36[a]	Mist-net n=60[b]
Little Brown Myotis (*Myotis lucifugus*)	83.3	15.0
Western Long-eared Myotis (M*yotis evotis*)	63.9	33.3
Fringed Myotis (M*yotis thysanodes*)	**16.7**	**5.0**
Long-legged Myotis (M*yotis volans*)	19.4	33.3
California Myotis (M*yotis californicus*)	8.3*	8.3
Western Small-footed Myotis (M*yotis ciliolabrum*)	36.1	8.3
Silver-haired Bat (*Lasionycteris noctivagans*)	33.3	33.3
Big Brown Bat (*Eptesicus fuscus*)	36.1	21.7
Hoary Bat (*Lasiurus cinereus*)	77.8	21.7
Spotted Bat (*Euderma maculatum*)	**8.3**	**0.0**

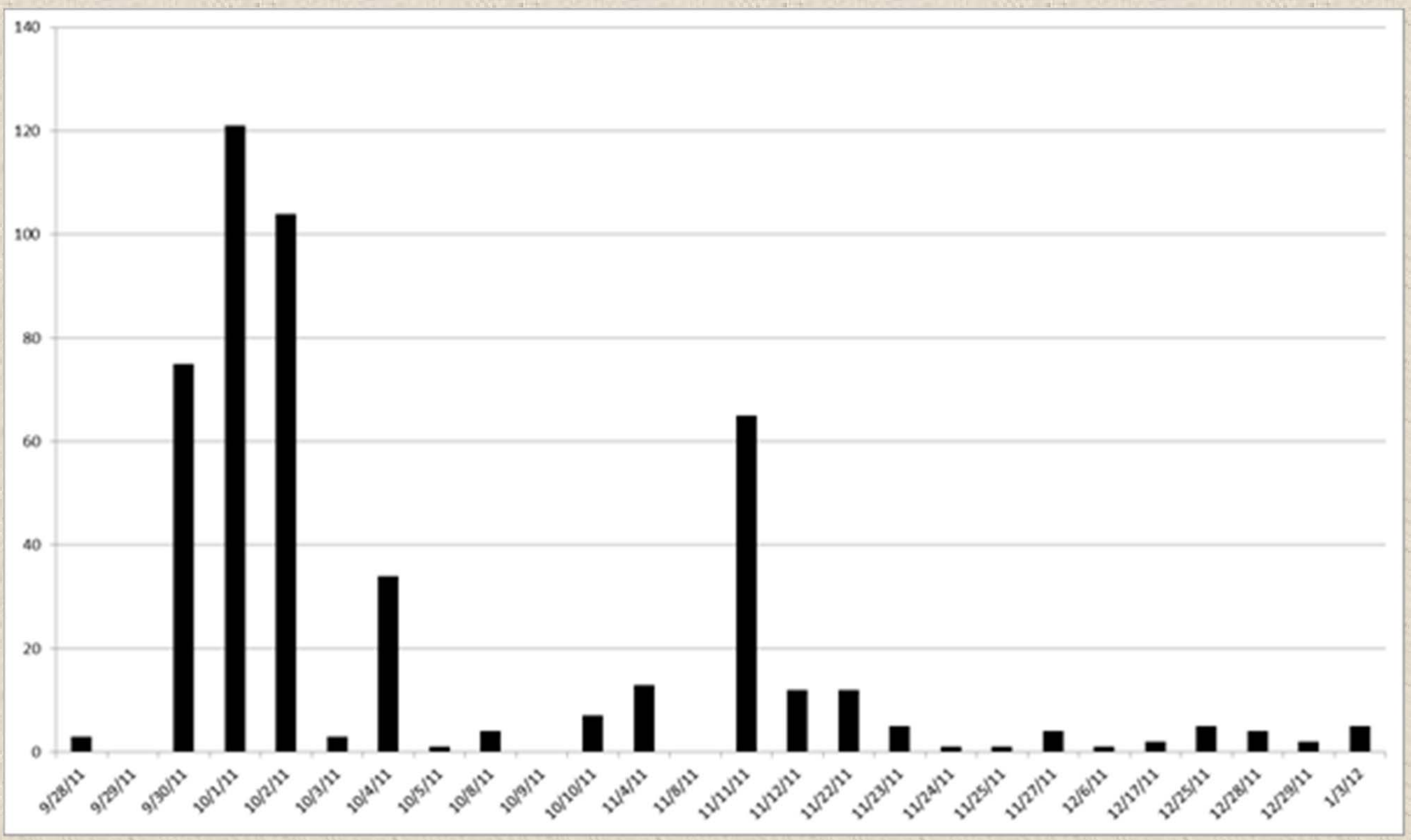
X = 38.2 **X = 18.4**



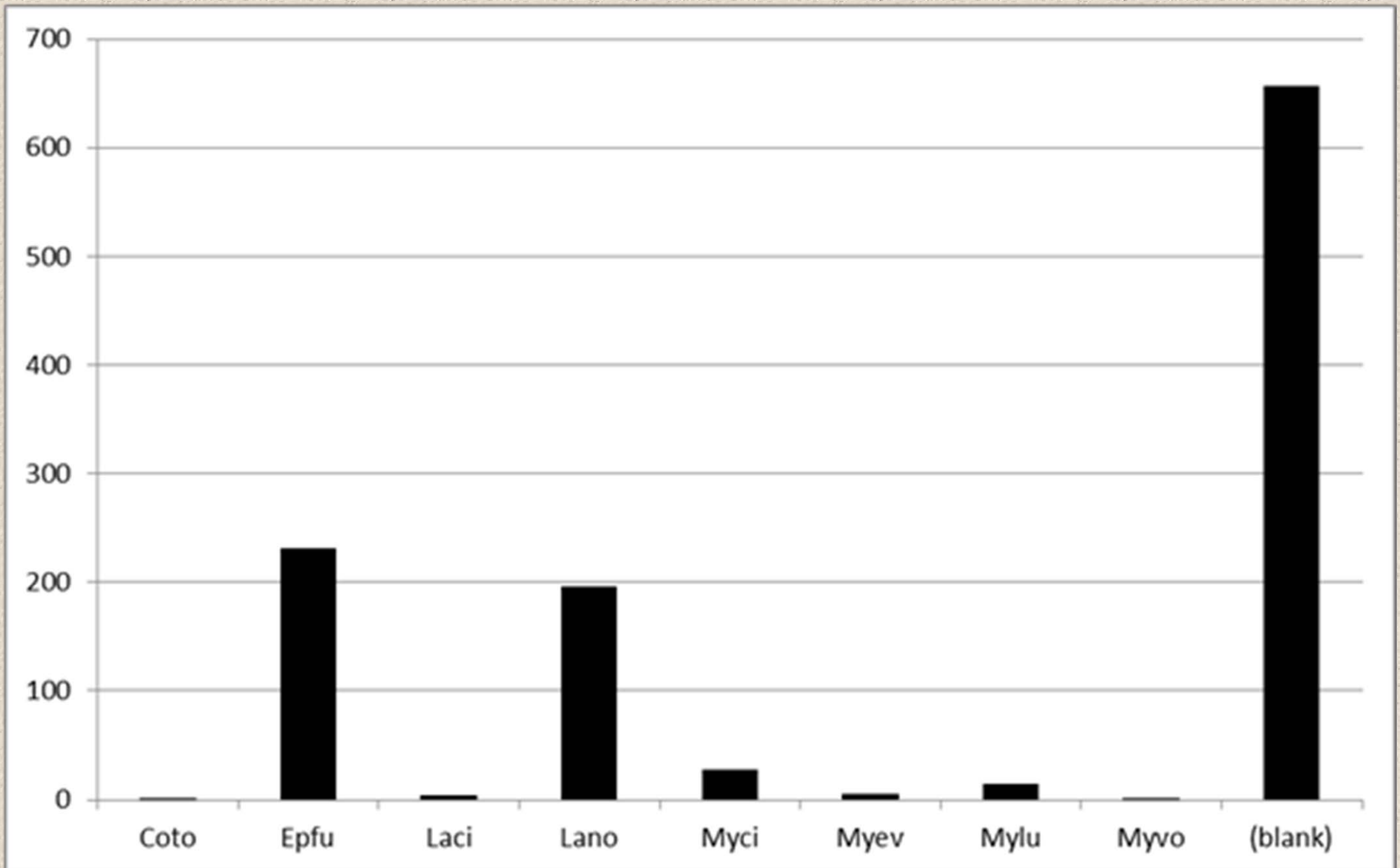
Large Blue Squares = Known hibernacula (+ = with data loggers)
Large Red Circles = SM2 detector installed
Large Purple Circles = SM2 detector installation planned
Large Orange Circles = Potential SM2 sites, funding pending
Small Gray Dots = Caves

Example Output for Landusky SM2 Station

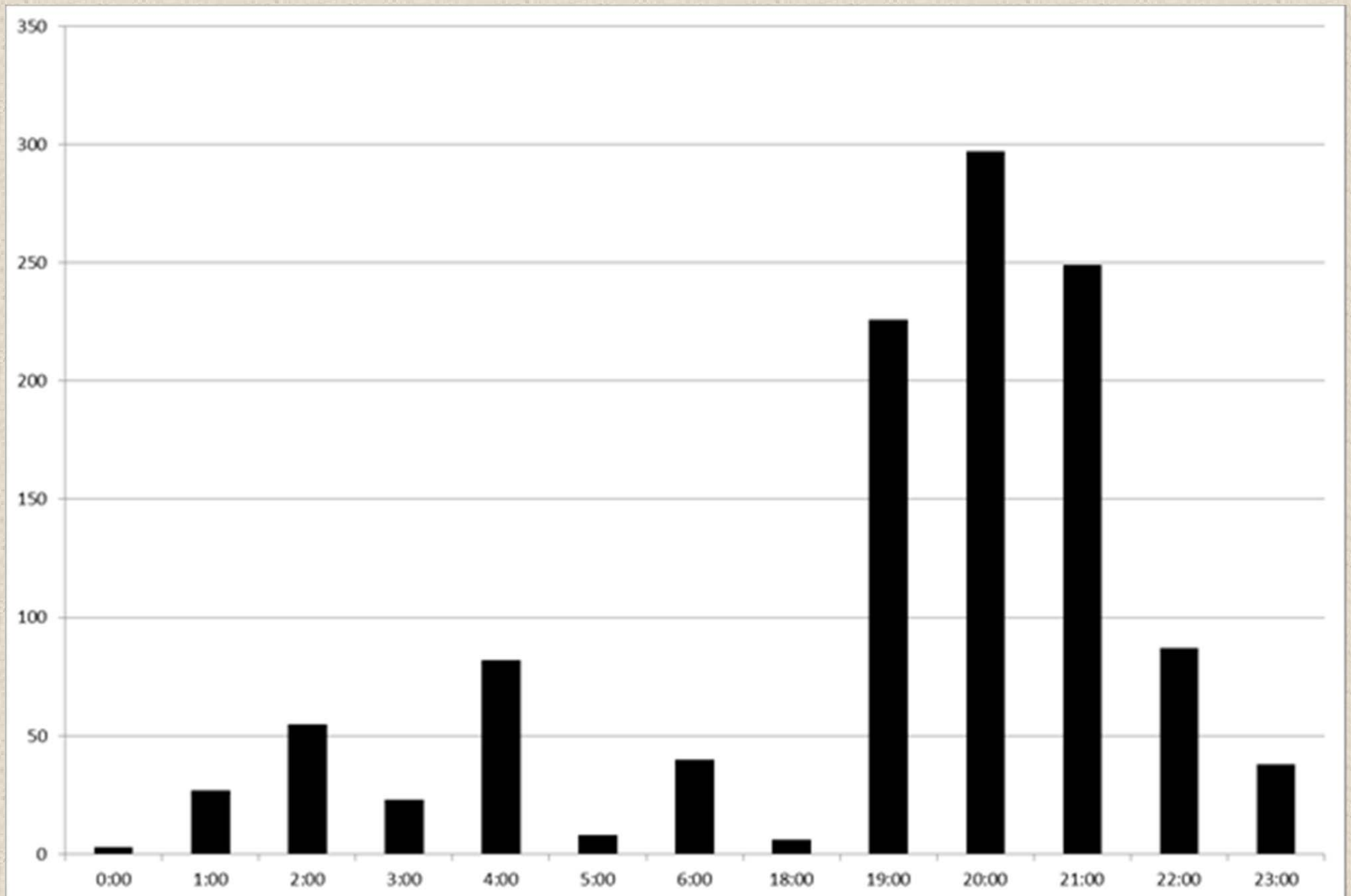
Total Number of Bat Call Sequences Summarized by Date



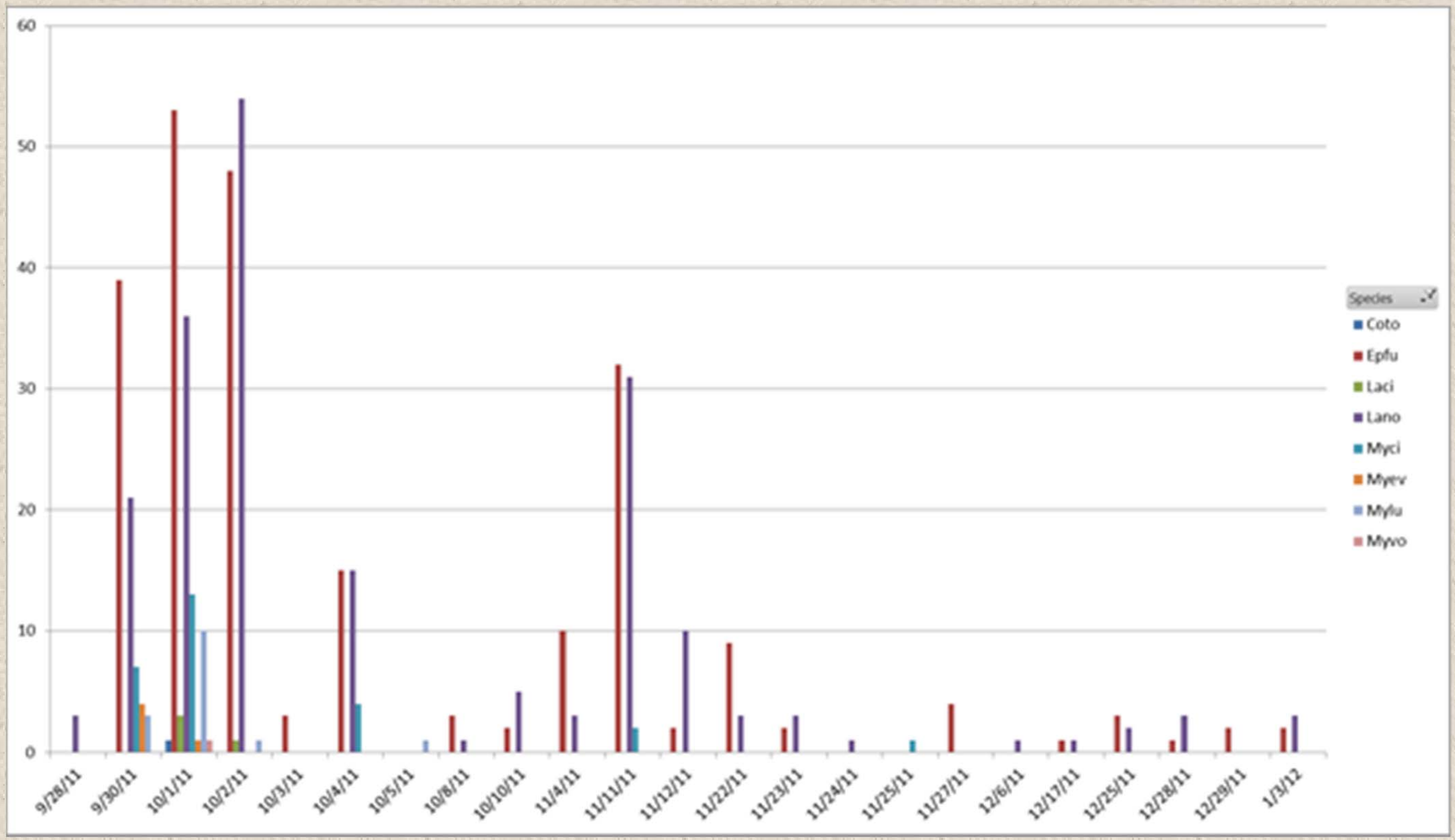
No. Bat Call Sequences Summarized by Tentative Species Identification



Number of Bat Call Sequences Summarized by Hour Across all Months of Deployment



Number of Bat Call Sequences Summarized by Date and Species Across Period of Deployment



Recommendations

Design

- Year round acoustic assessment
- Roost surveys of key mine structures in summer
- Roost surveys of insulated areas in winter

Operation

- Provide escape ramps on open water
- Protect known roosting sites, especially maternity roosts and hibernacula
- Curtail wind power generation at lower wind speeds during migration periods.

Closure

- Provide roosting cracks and crevices through bat houses or structures
- Assess summer and winter bat use prior to sealing adits and install bat gates as needed
- Close openings during periods of known disuse

Acknowledgements

- Montana DEQ (Warren McCullough) for funding bat assessment at Landusky Wind Turbine and inviting this presentation
- Collaborators on statewide acoustic and roost assessments - FWP (Lauri Hanauska-Brown, Kristi DuBois), USFWS (Chris Servheen), USFS (Beth Hahn, Amie Shovlain), BLM (Jo Christensen, Katie Benzel)
- Kristi DuBois, Paul Hendricks, Susan Lenard, and Joe Szewczak for use of photos and images
- Susan Lenard for acoustic analysis