Overview of Montana Bat Conservation Issues and Data Needs

March 3rd, 2012, Lewis and Clark Caverns, Montana

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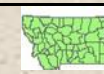
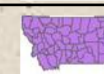
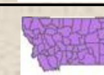
MONTANA
Natural Heritage
Program
http://mtnhp.org

Bats of Montana

- 6 Species of Concern
- 3 Potential Species of Concern

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
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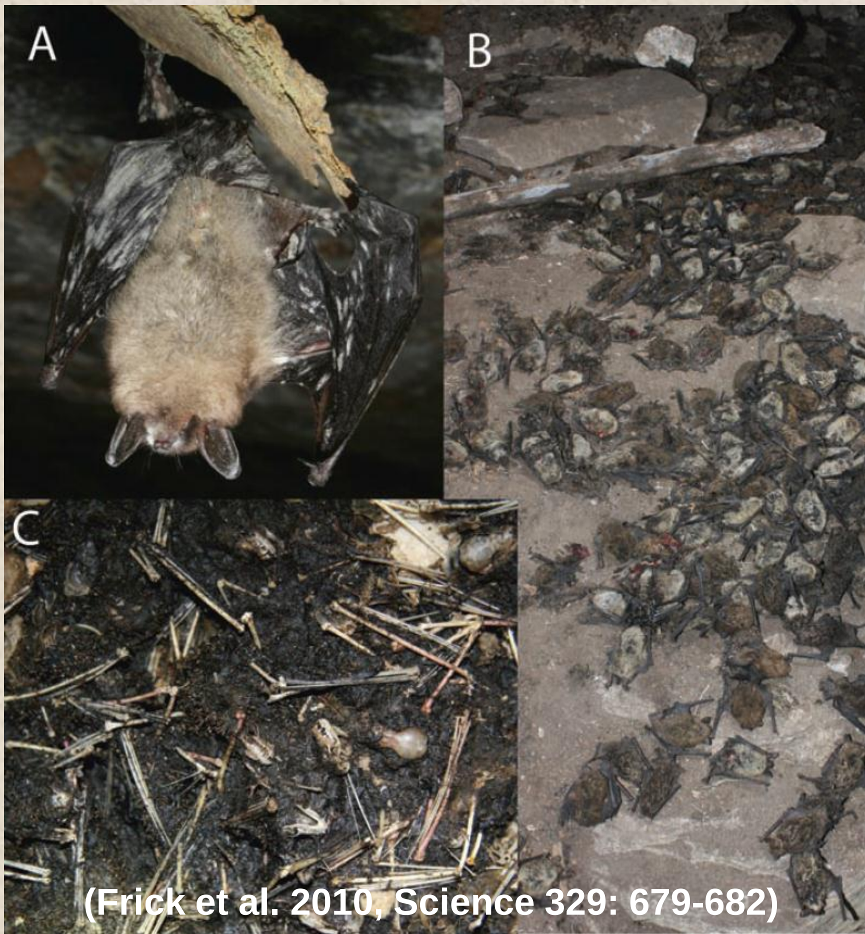
Fringed Myotis	*Myotis thysanodes*	**MYTH**		106
Long-legged Myotis	*Myotis volans*	**MYVO**		294
Yuma Myotis	*Myotis yumanensis*	**MYYU**	**?**	?

White-Nose Syndrome

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

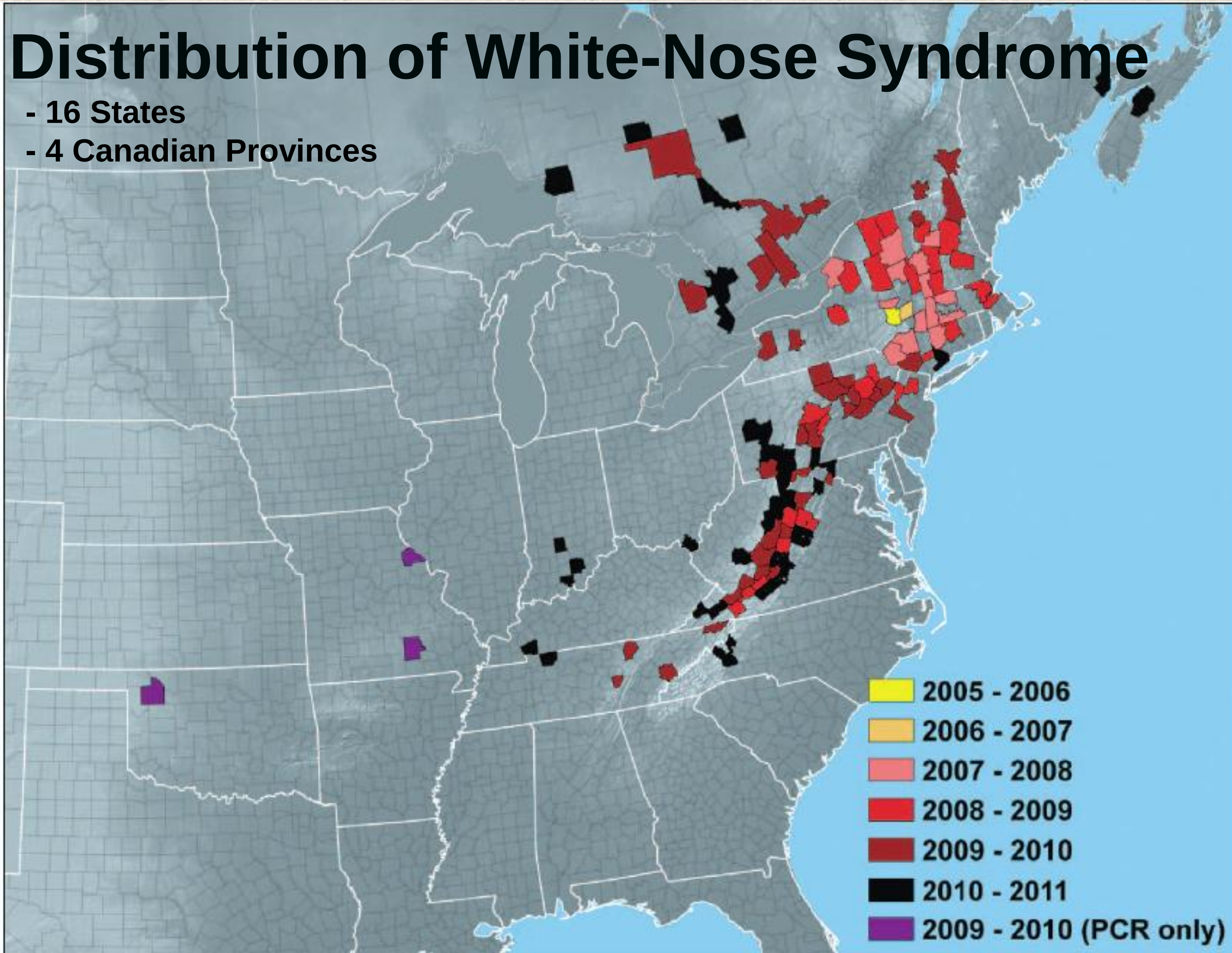
- Has killed 5.7 to 6.7 million bats in N.A. since 2006
  (USFWS January 17, 2012 news release)
- Caused by cold-adapted fungus: *Geomyces destructans*
  (Lorch et al. 2011, Nature 480: 376-378)
- Predicted regional extinction of Little Brown Myotis by 2026
  (Frick et al. 2010, Science 329: 679-682)
- *G. destructans* on bats across Europe,but no mass mortality there
  (Puechmaille et al. 2011, PLoS One 6(4)e19167)



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

Distribution of White-Nose Syndrome

- 16 States
- 4 Canadian Provinces

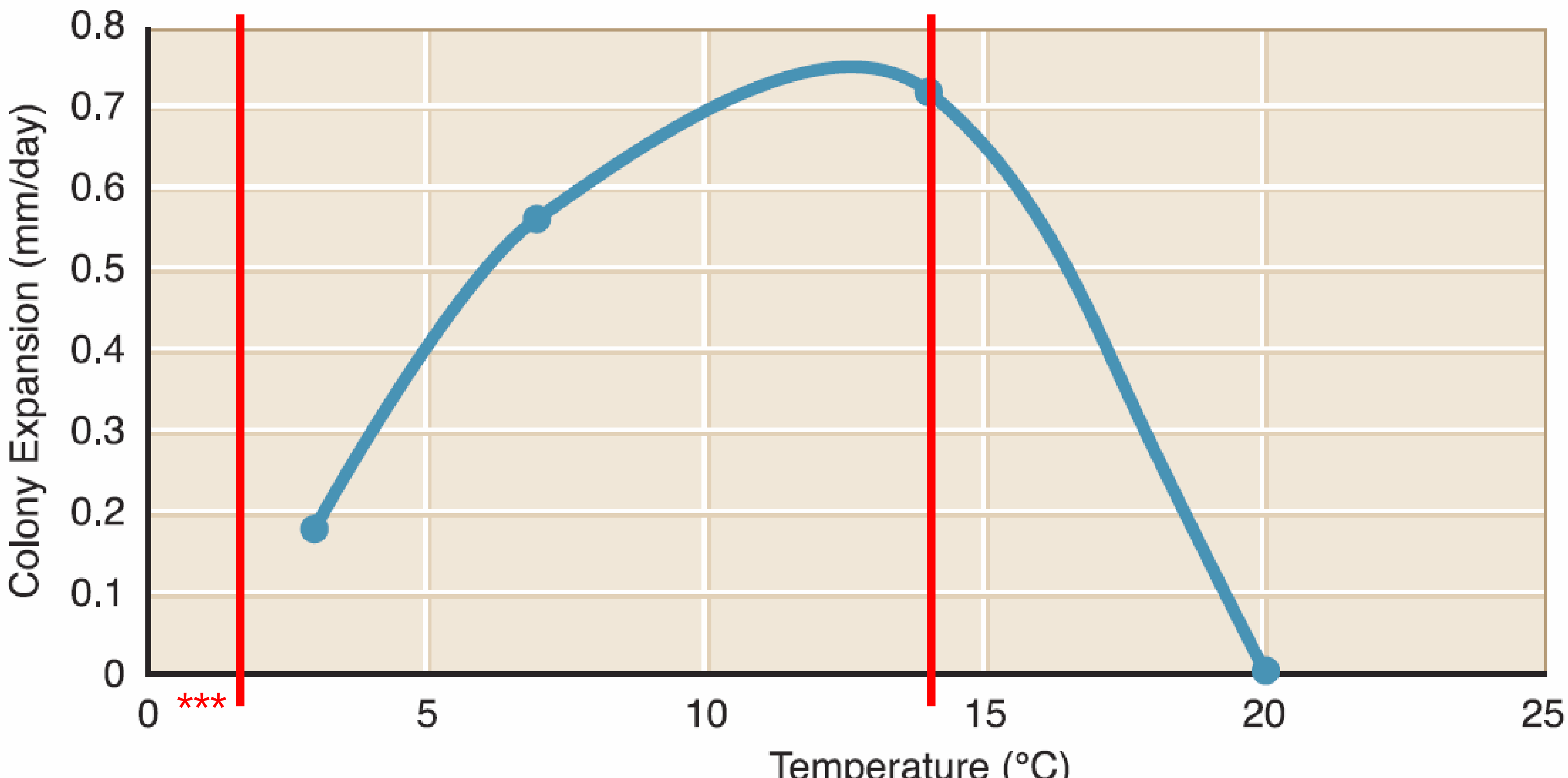


Blehert et al. 2007 Microbe 6(6): 267-273.

Occurrence of white-nose syndrome and/or *Geomyces destructans* in the United States (by county) and Canada (by county or district) from winter 2005–2006 through April 2011.

G. destructans growth and Hibernacula Temps

- Of 45 bat species in U.S., at least 6 of the 25 that hibernate have been documented with WNS



Temperature range of most bat hibernacula in North America is 2-14ºC.

Colony expansion rates of *Geomyces destructans* when grown on cornmeal agar at 3, 7, 14, and 20°C. The trend line estimates colony expansion rates at temperatures ranging from 3–20°C.

Blehert et al. 2007 Microbe 6(6): 267-273.

Hibernation Strategies and WNS Impacts

	Wt	Hibernation Information	Mortality rate:
Mylu	7-10 g	Prefers areas of high RH (> 70%) and temperatures between 5 and 8 C. Nearly always clusters in large groups (5-100s)	91%
Myse	5-9 g	Hibernates solitarily or in small clusters; May hibernate in deep crevices or move between hibernacula in the winter	98%
Pesu	4-8 g	Hibernates solitarily in deeper parts of caves with stable warmer temperatures (9-12 C typical, but range 5 to 16 C) and high RH (> 80%); highest hibernacula site fidelity. First to enter hibernacula and last to leave.	75%
Epfu	11-23 g	Last to enter hibernacula and first to leave, prefers colder drier, more exposed locations with higher air flow within hibernacula than other species; nearly always solitarily.	41%

Wind Energy Development and Bats

- 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

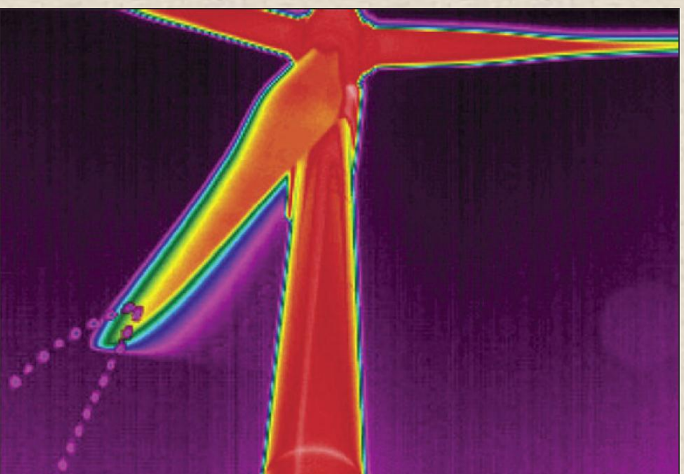
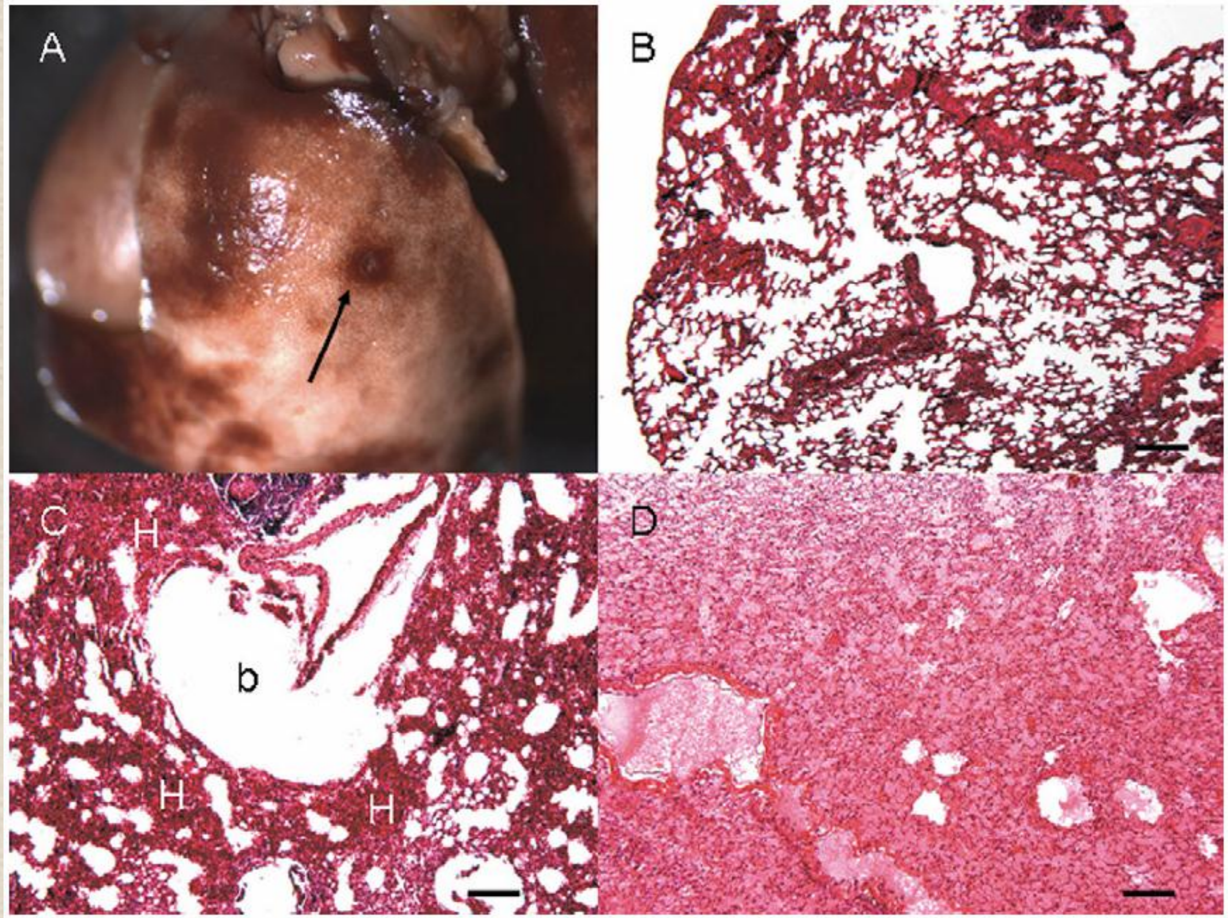


Figure 3. Thermal infrared image of a modern wind turbine rotor, showing the trajectory of a bat that was struck by a moving blade (lower left).

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



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

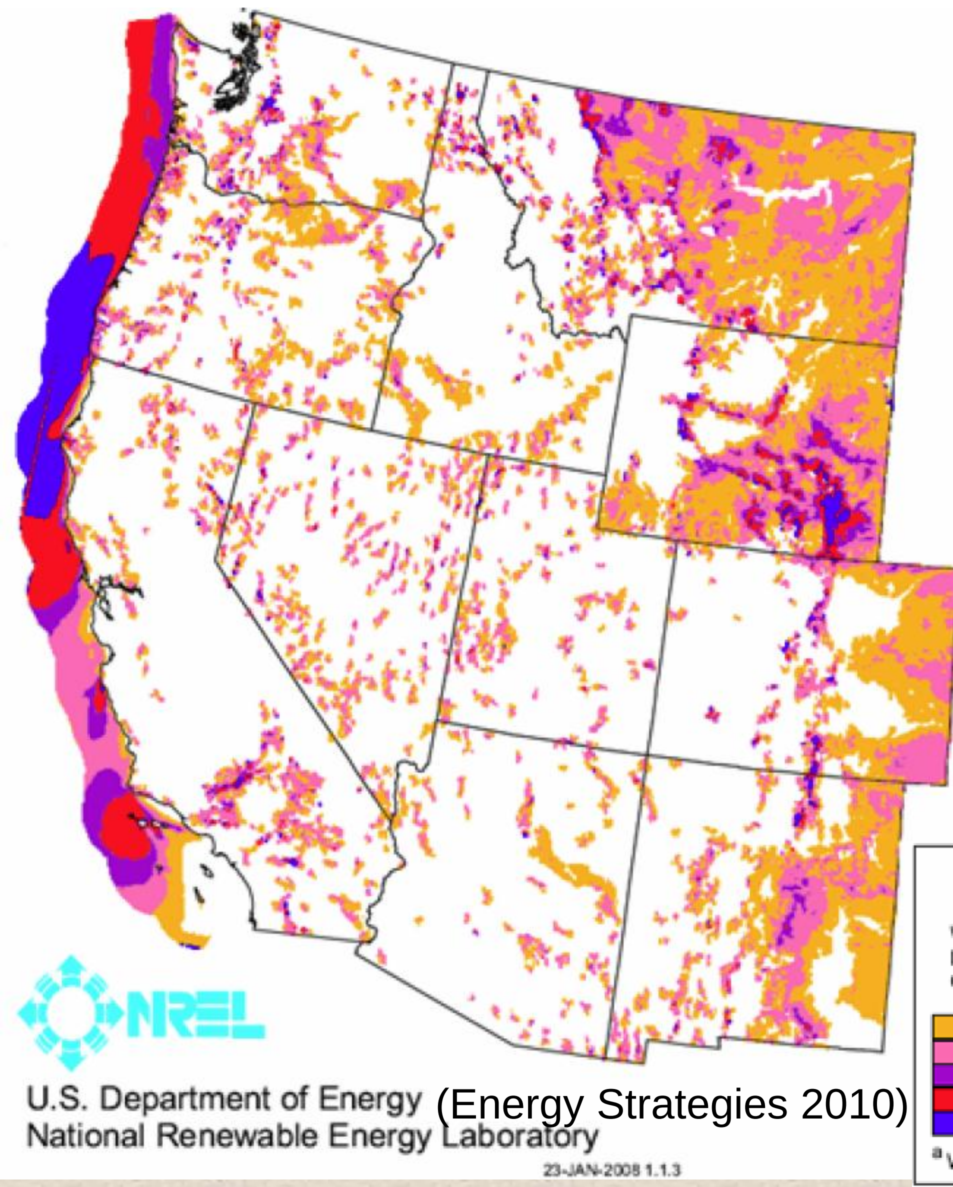
Figure 1. Pulmonary barotrauma in bats killed at wind turbines.

(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.

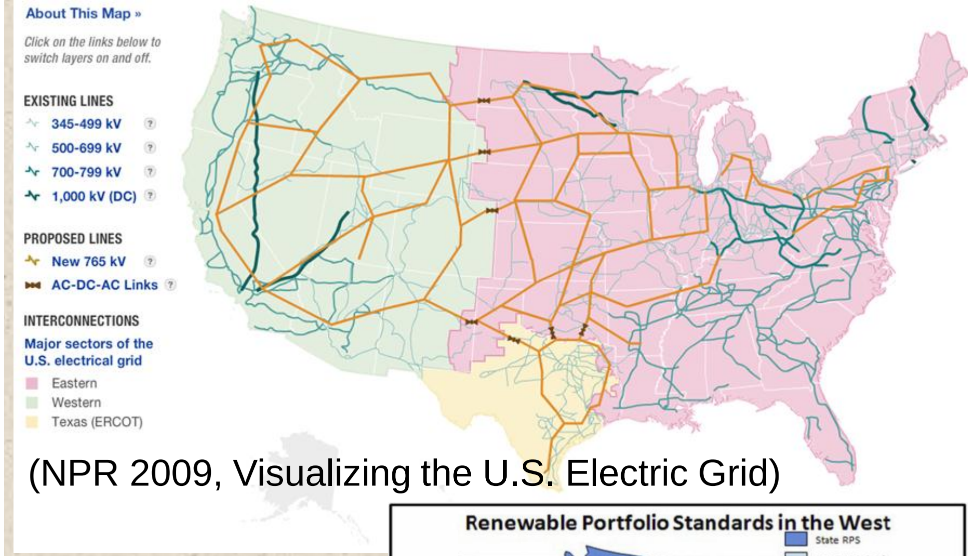
Wind Energy Development 101

Goal of 20% of U.S. energy from wind by 2030 (DOE 2008)

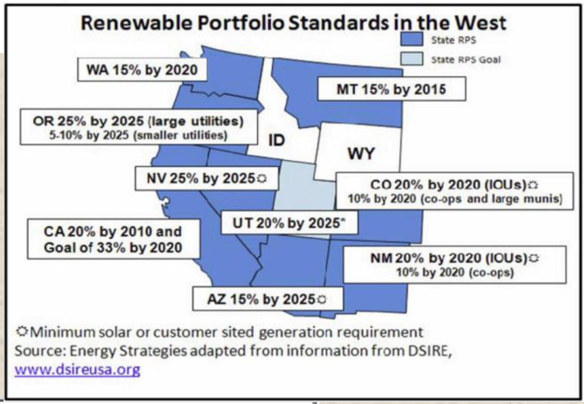
MT is 39% of western onshore potential



(Energy Strategies 2010)



(NPR 2009, Visualizing the U.S. Electric Grid)

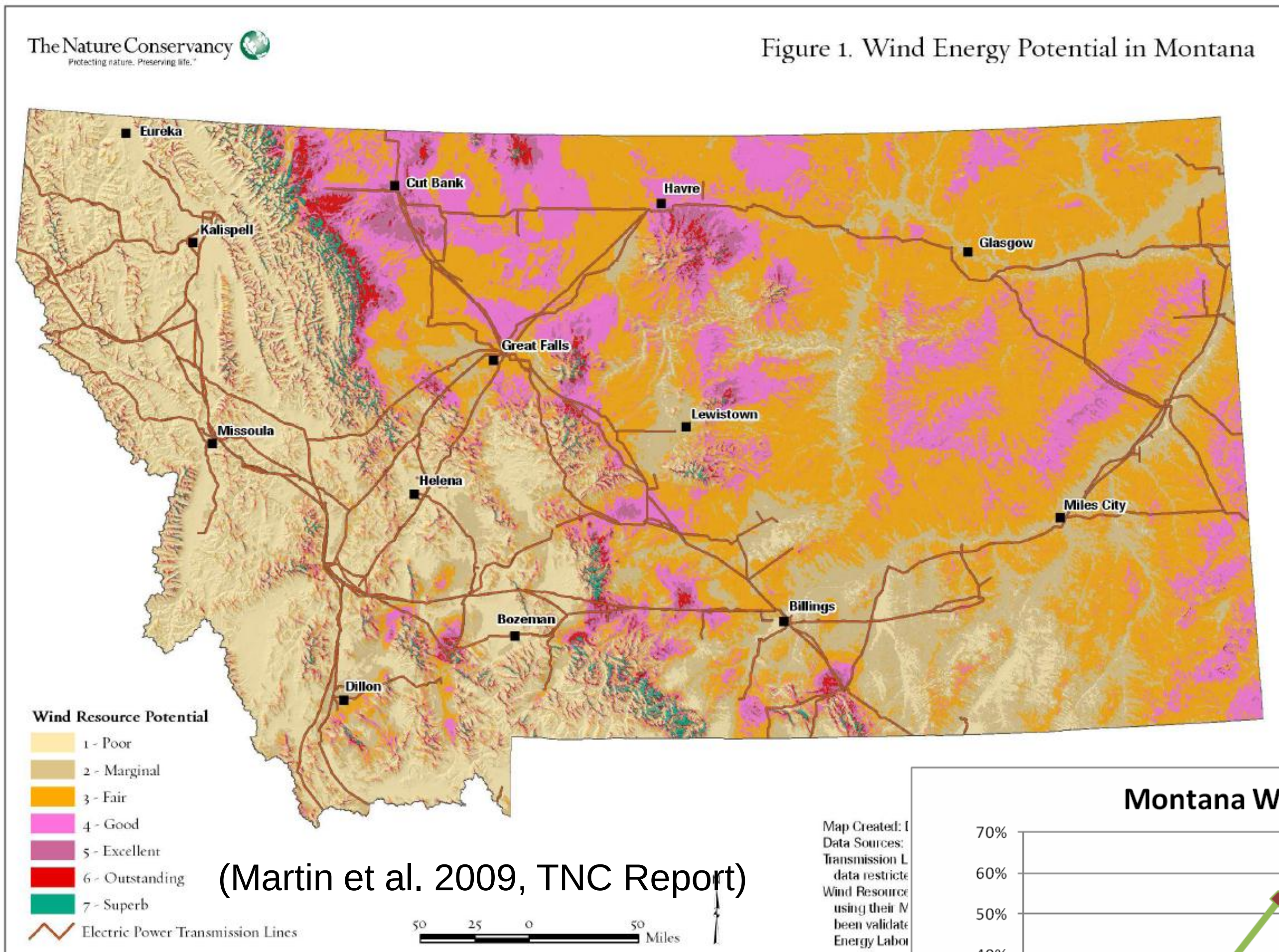


Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m²	Wind Speed[a] at 50 m m/s	Wind Speed[a] at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a] Wind speeds are based on a Weibull k value of 2.0

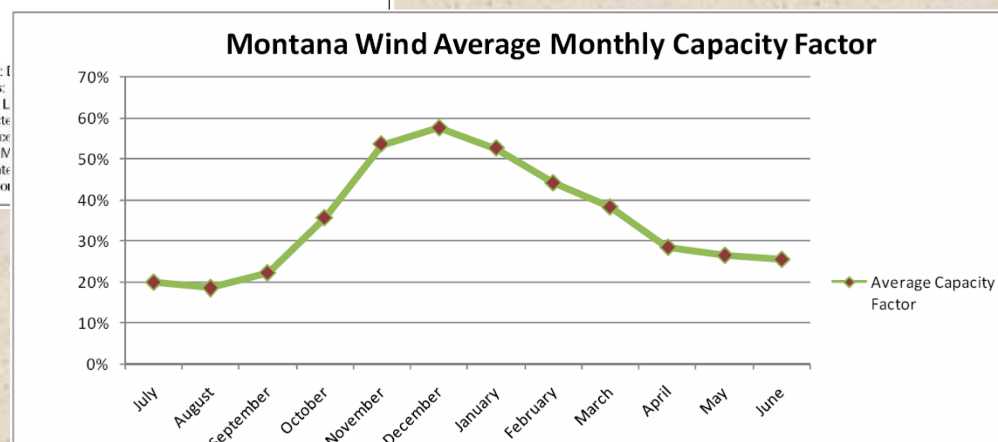
Wind Energy Development and Bats



(Martin et al. 2009, TNC Report)

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

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



(Energy Strategies 2010)

Wind Energy Development Disturbed vs. Undisturbed Lands

20% = 241 GW **7,700 GW available nationally with 3,500 on Disturbed Lands**

State	DOE (GW)	Total (GW)	Disturbed (GW)	% DOE goal on Disturbed Land	Averted Loss (KM^2)	State	DOE (GW)	Total (GW)	Disturbed (GW)	% DOE goal on Disturbed Land	Averted Loss (KM^2)
AZ	2.72	27.37	0.36	13%	534	NM	6.45	297.29	25.68	398%	1193
CA	15.82	108.22	6.18	39%	2719	NV	7.49	36.17	0.22	3%	1431
CO	2.51	290.25	105.2	4197%	420	NY	2.19	48.52	25.64	1179%	381
IA	19.91	490.62	450.56	2263%	0	OK	38.48	259.72	141.81	369%	3058
ID	2.82	55.75	5.33	189%	496	OR	7.92	70.04	8.1	100%	1297
IL	14.68	343.66	304.6	2075%	91	PA	3.1	5.97	0.79	25%	579
IN	6.77	16.46	16.15	238%	0	SD	8.06	854.48	350.53	4349%	1163
KS	7.16	838.21	518.7	7246%	16	TN	1.09	0.37	0.01	1%	78
MD	1.82	1.59	0.28	15%	297	TX	20.46	733.77	320.63	1567%	765
ME	1.11	11.09	0.63	56%	194	UT	2.45	26.61	0.33	14%	451
MI	20.34	15.51	10.76	53%	1092	VA	1.78	5.63	0.57	32%	330
MN	9.94	195.31	173.69	1747%	110	WA	9.87	58.14	10.77	109%	1772
MT	5.26	902.04	245.27	4662%	884	WI	1.54	5.22	3.52	228%	0
NC	1.89	5.35	0.82	44%	339	WV	1.96	9.51	0.8	41%	347
ND	2.26	724.14	457.19	20201%	126	WY	12.77	569.93	63.23	495%	2146
NE	7.88	698.73	291.35	3697%	482	Low wind	N/A	N/A	N/A	N/A	N/A

(Kiesecker et al. 2011, PLoS ONE 6(4): e17566)

Figure 1. Map of continental U.S. with states where DOE targets can (blue) and cannot (red) be met on disturbed lands. We focused on the 31 states that comprise the majority of the DOE vision, excluding states (grey) with less than 1 GW of projected development [1]. Inset table with 31 focal states, their DOE projections (in GW), Total available wind energy (in GW), wind energy available on disturbed lands (in GW), percent of DOE vision that can be met on disturbed land and amount of undisturbed lands that a disturbance focused development scenario would avert (in

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
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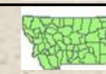
Hoary Bat	*Lasiurus cinereus*	**LACI**		777
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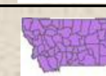
Little Brown Myotis	*Myotis lucifugus*	**MYLU**		1,070
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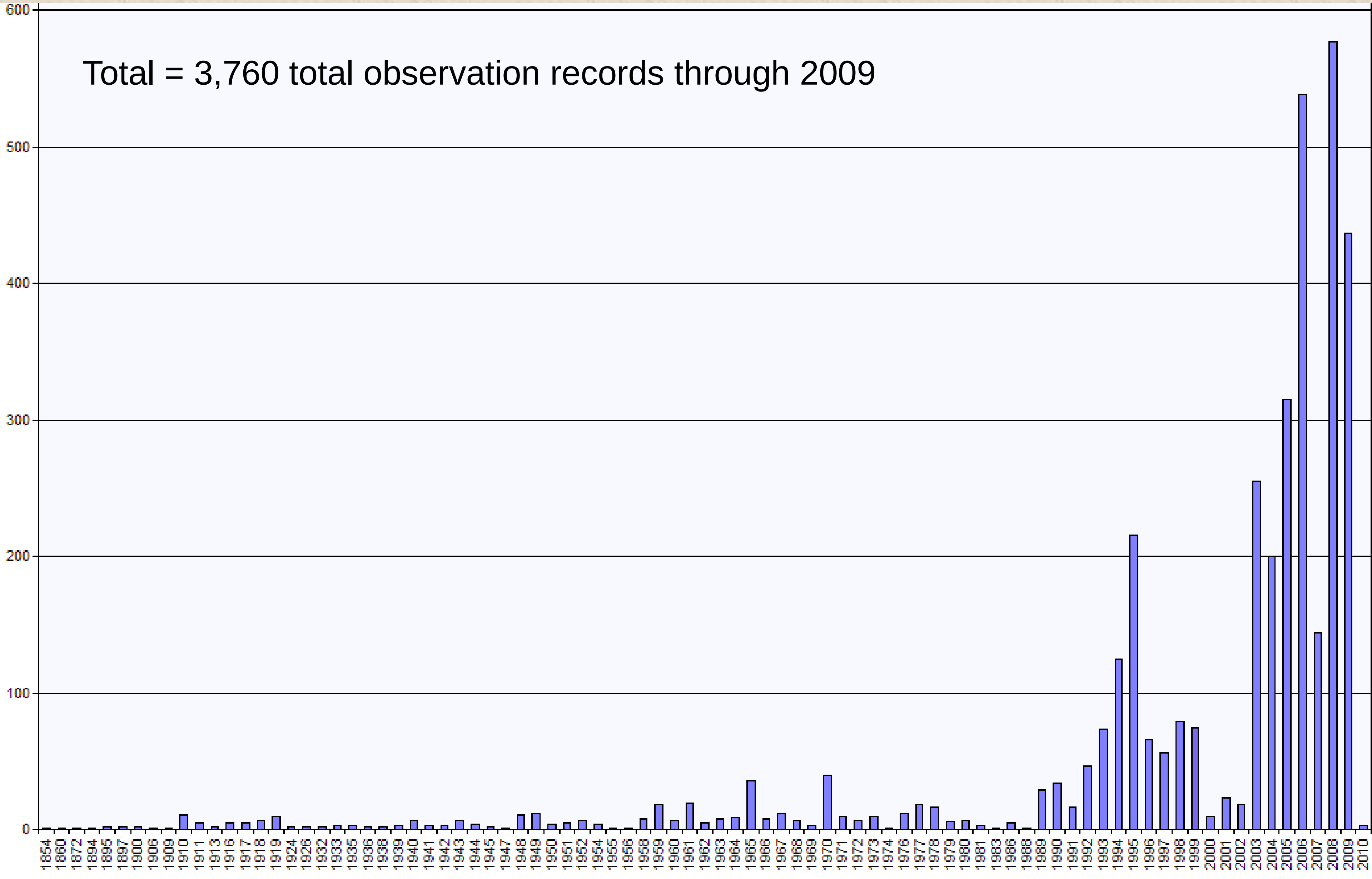
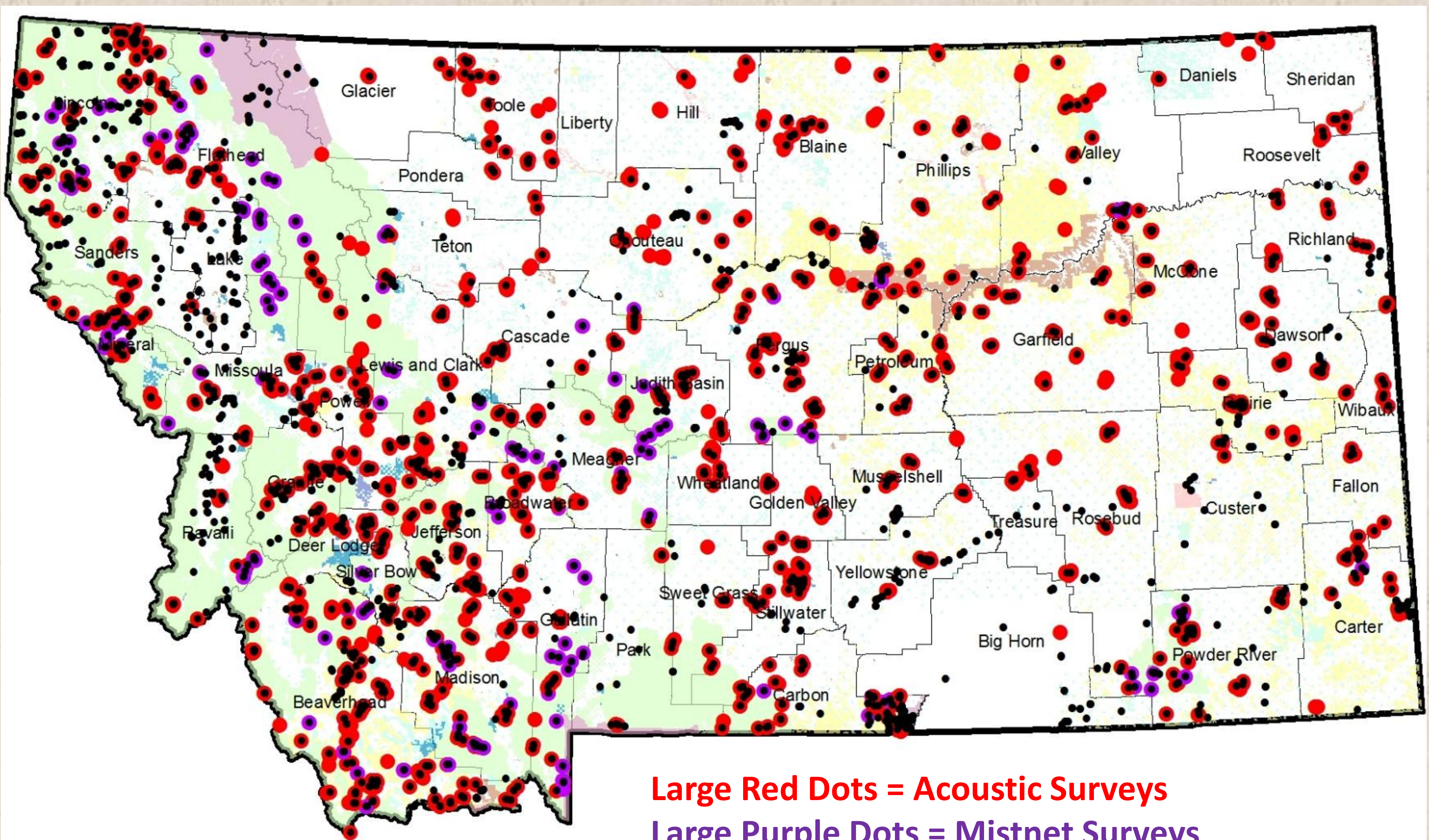
Yuma Myotis	*Myotis yumanensis*	**MYYU**	**?**	?

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

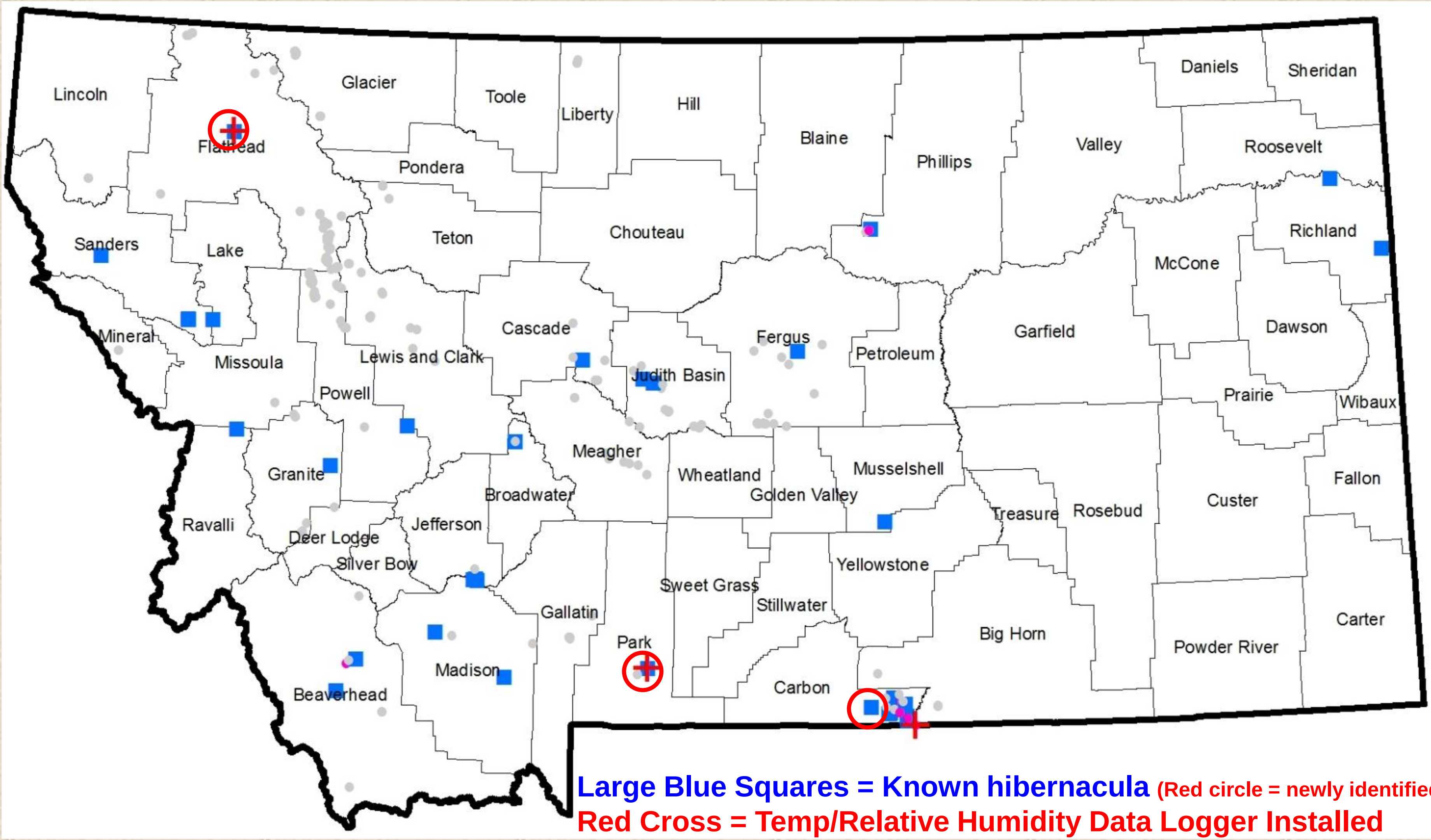
Large Purple Dots = Mistnet Surveys

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

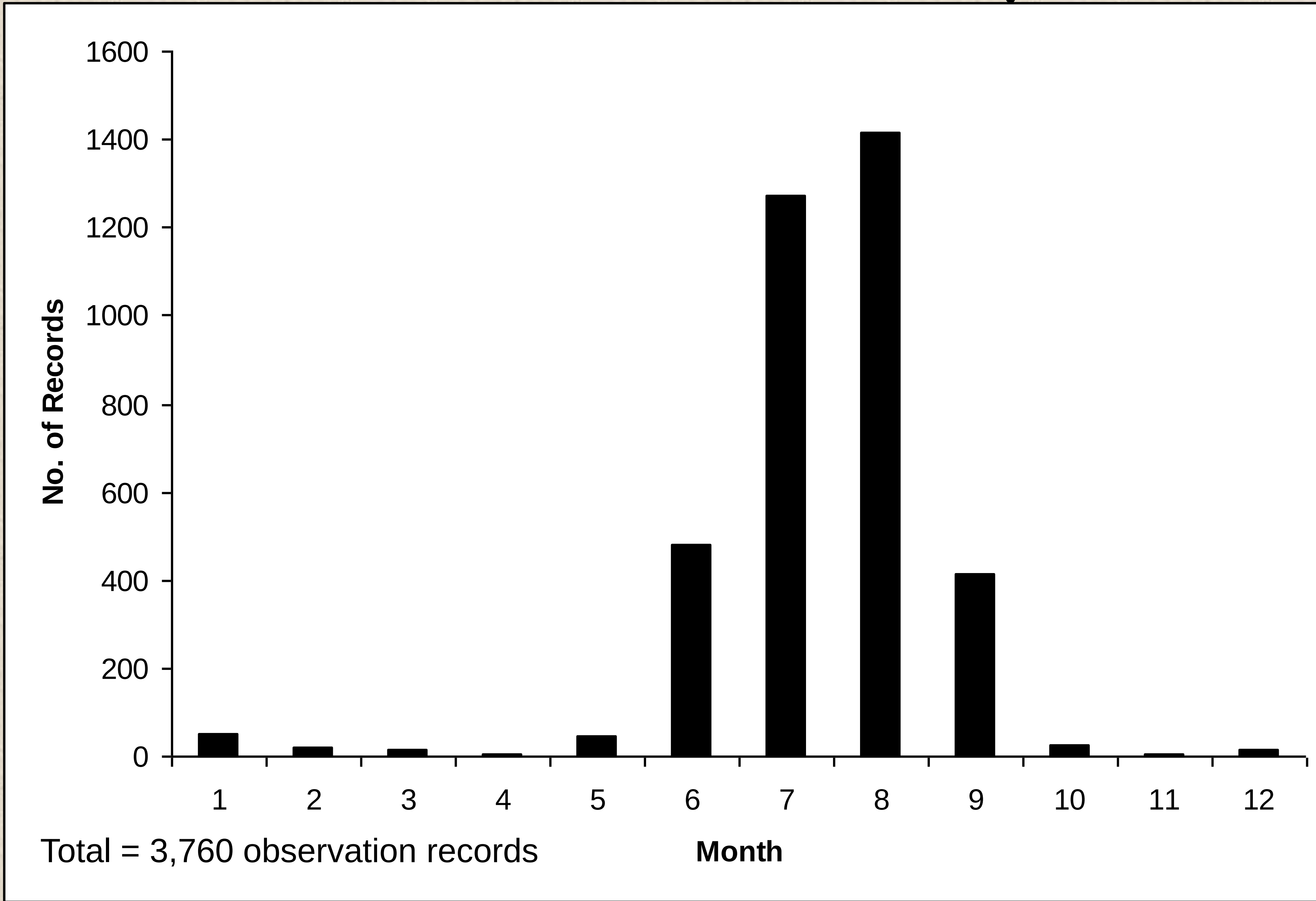
Small Pink Dots = Caves/Mines with bat activity recorded

Spring and Fall Bat Data

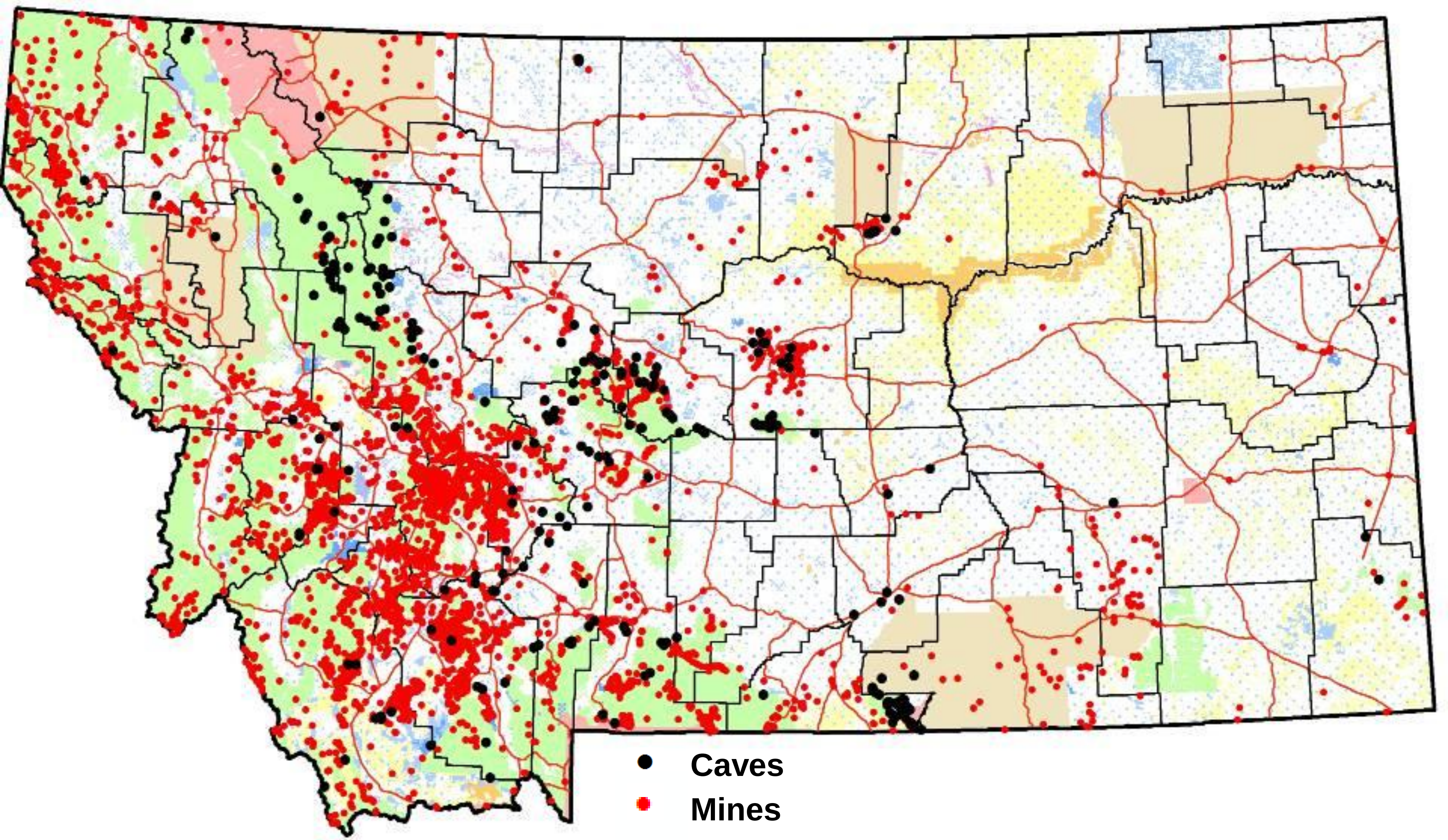
April to mid-May = 11 records

October = 20 records

Montana Bat Observations by Month



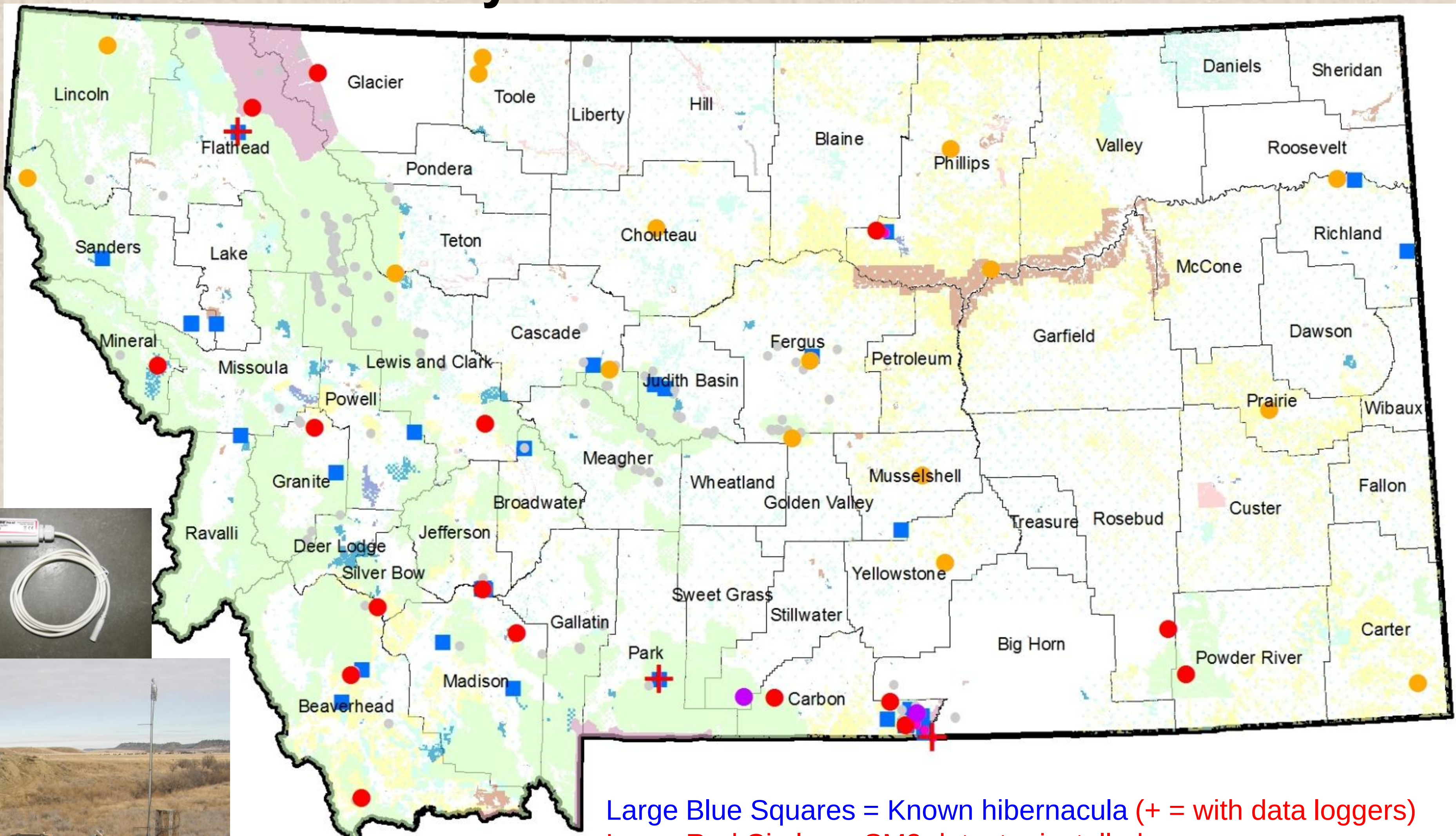
Montana Caves and Abandoned Lode Mines



Data Needs and Management Issues

- **Timing and routes of migration in migratory species for mitigation of impacts from wind turbines:** Hoary Bat, Eastern Red Bat, Silver-haired Bat in particular, but also Spotted Bat, Pallid Bat, and Fringed Myotis
- **Focal studies at wind energy facilities**
- **Overwintering locations with information on temperature and relative humidity of roosting areas**
- **Winter activity levels within hibernacula and outside of hibernacula**
- **Roost locations during “active season”, particularly maternity roosts**
- **Spatial use of landscapes over the course of the year**
- **Data useful for monitoring status – site occupancy rates**
- **Investigation of possible alternative roost stru**

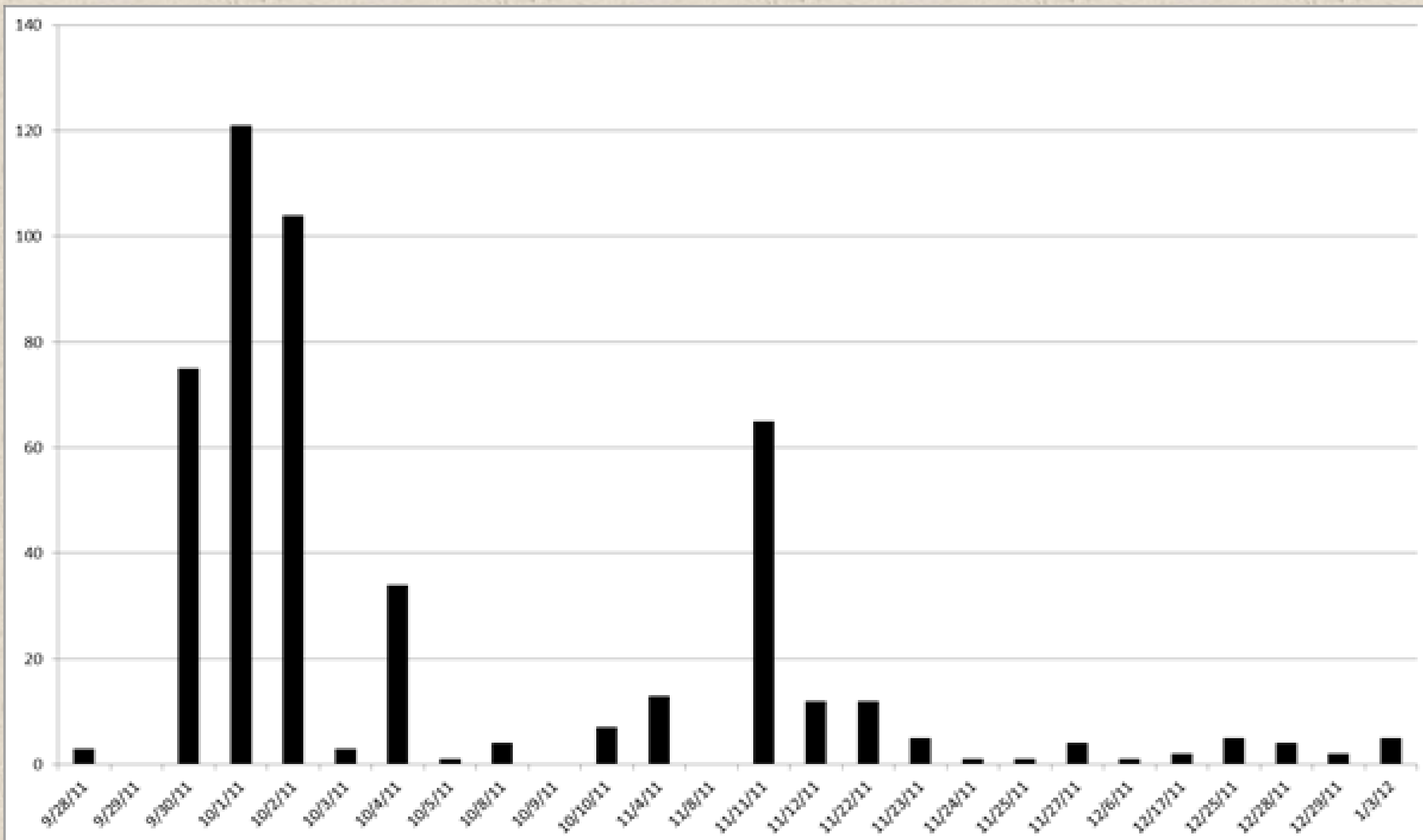
Acoustic and Cave/Mine Baseline Surveys for White-Nose Syndrome and in Montana’s Bats



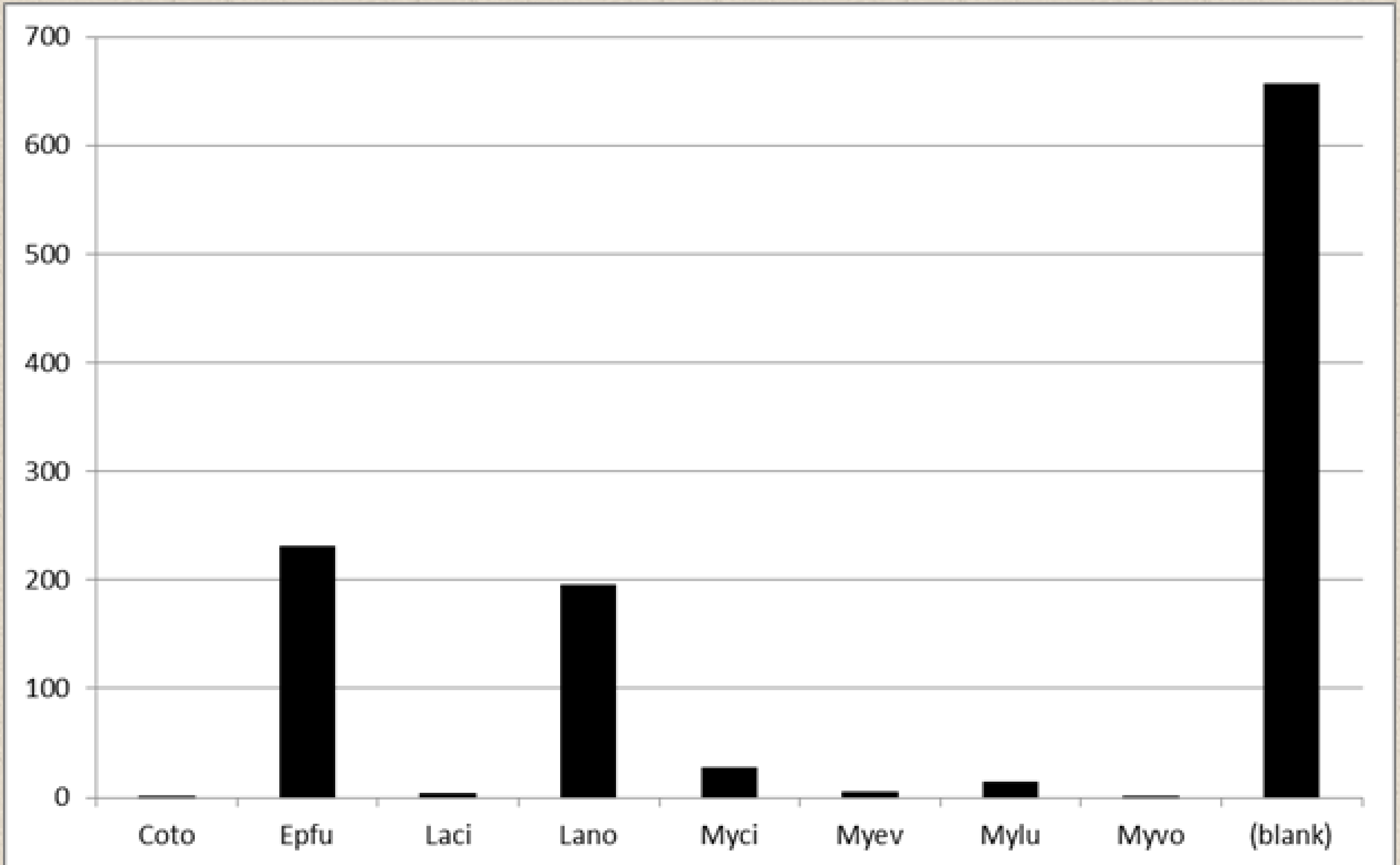
Large Blue Squares = Known hibernacula (+ = with data loggers)
Large Red Circles = SM2 detector installed
Large Purple Circles = SM2 detector installation planned
Large Orange Circles = Potential SM2 sites, funding pending
Small Gray Dots = Caves
Small Pink Dots Caves/Mines with bat activity recorded

Example Output for SM2 Station

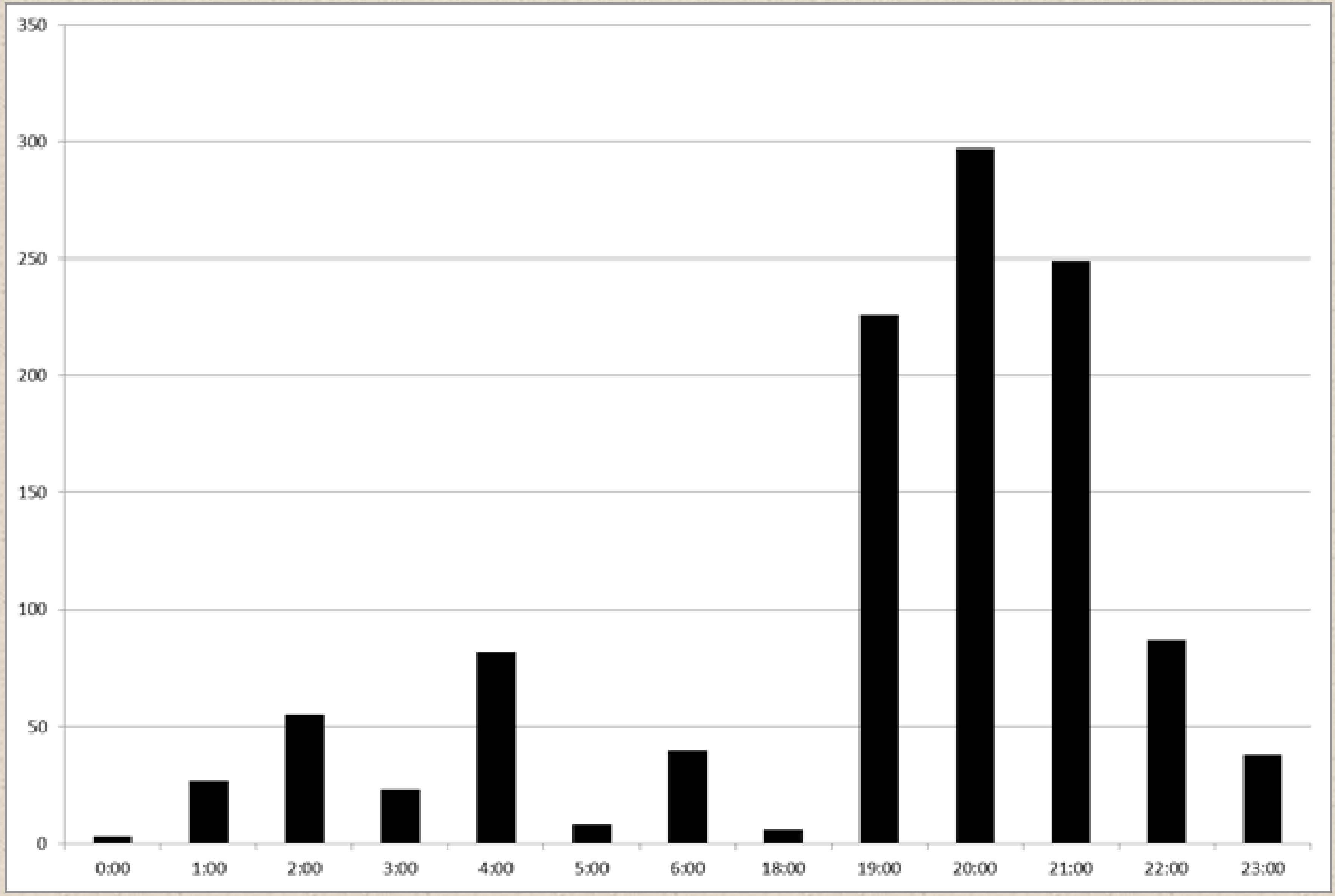
Total Number of Bat Call Sequences Summarized by Date



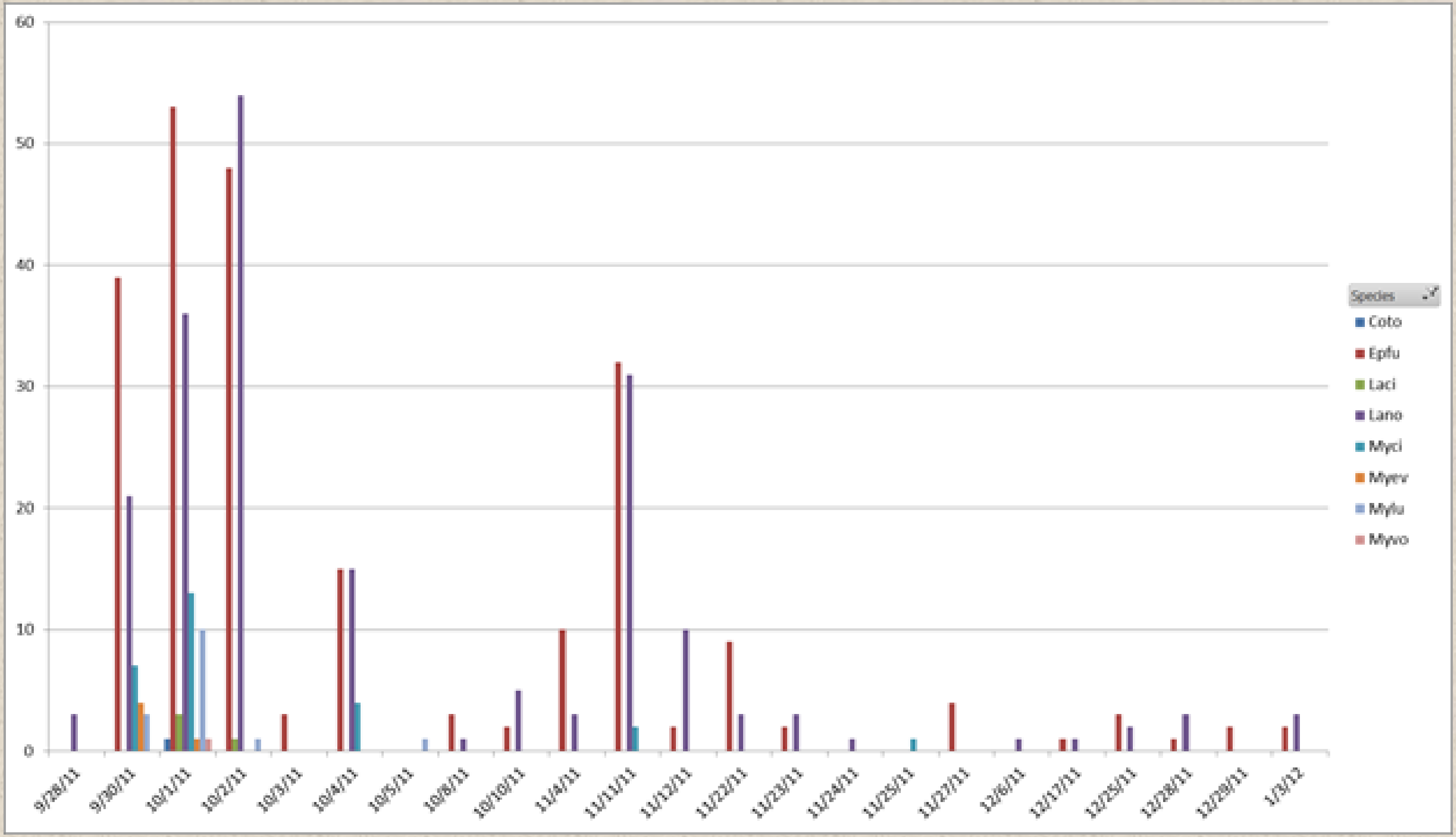
No. Bat Call Sequences Summarized by Tentative Species Identification



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



Overview of Spatial and Temporal Distribution Information for Montana Bats

Rabies in Montana

(Source MT DPHHS)

Bats: 5-10% +

From 1996-1999: 901 tested with 67+ (7.5%)

Skunks: Frequent +

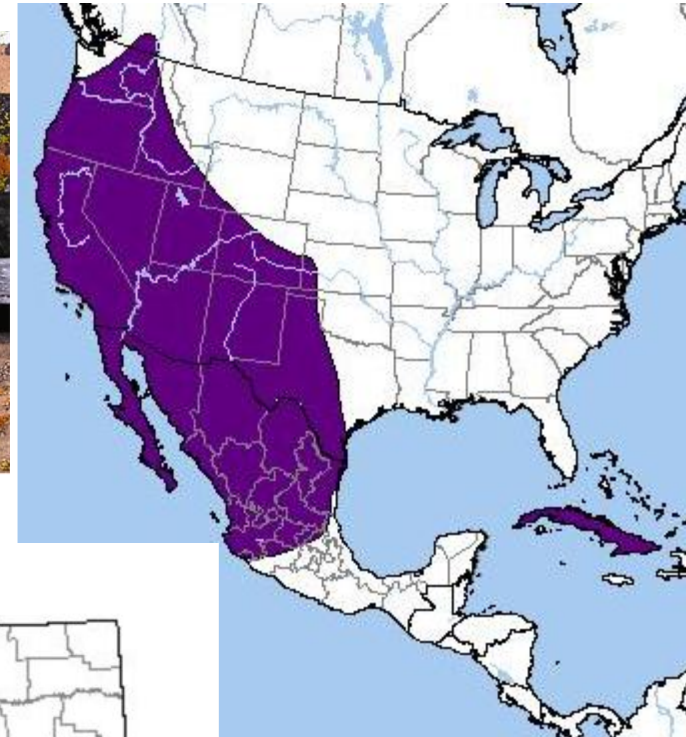
From1996-1999: 304 tested with 122+ (40%)

Raccoons: Rare +

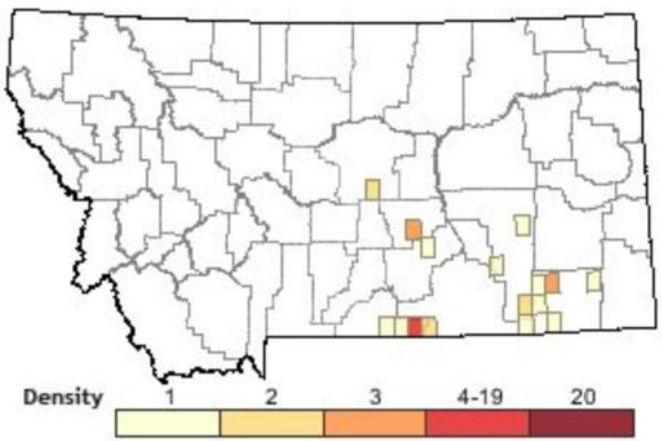
From 1996-1999: 134 tested with 0+

Pallid Bat

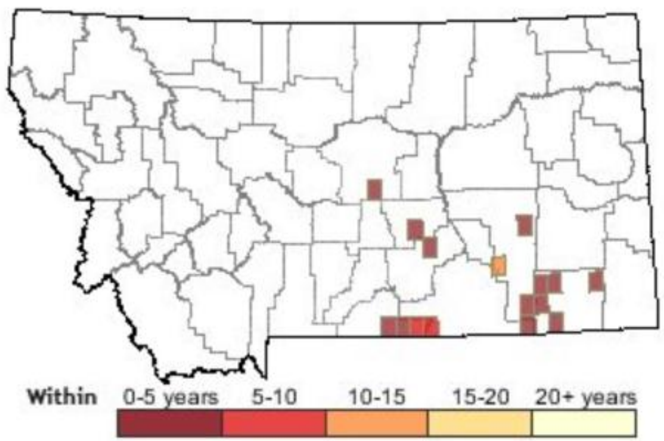
SOC, G5, S2

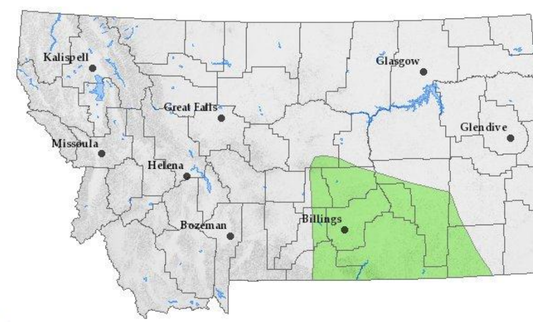


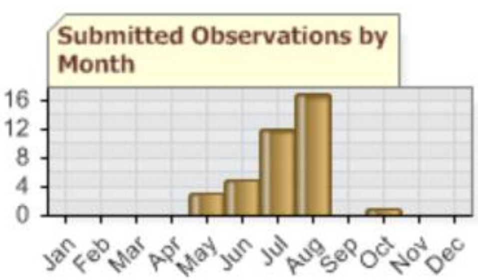
Relative Density

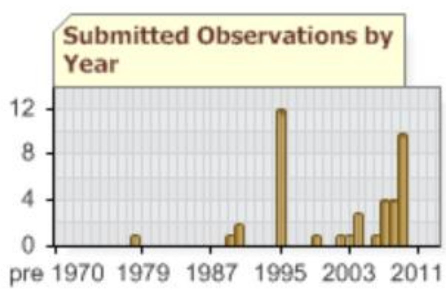


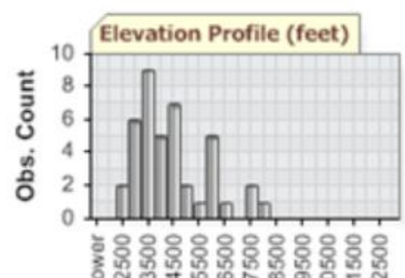
Recency







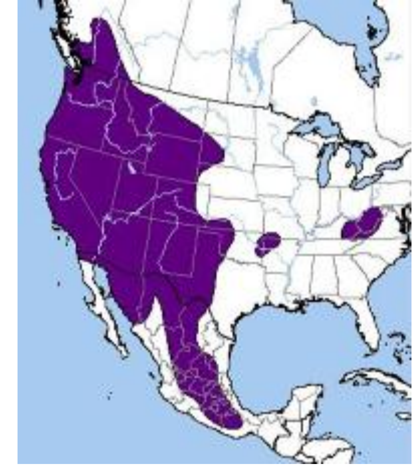




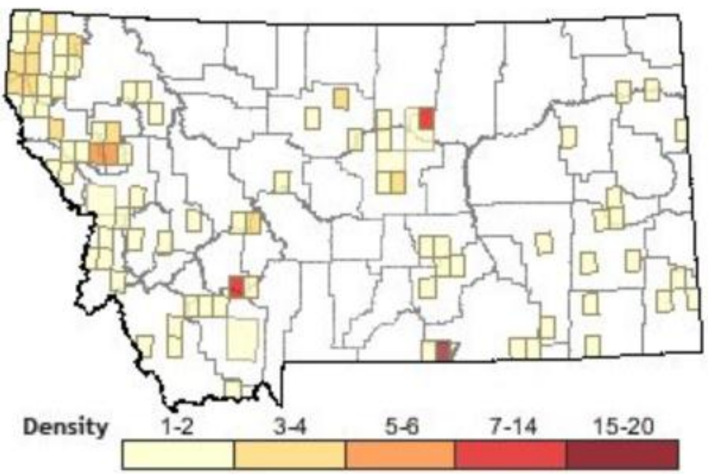
(Records associated with a range of dates are excluded from time charts)

Townsend's Big-eared Bat

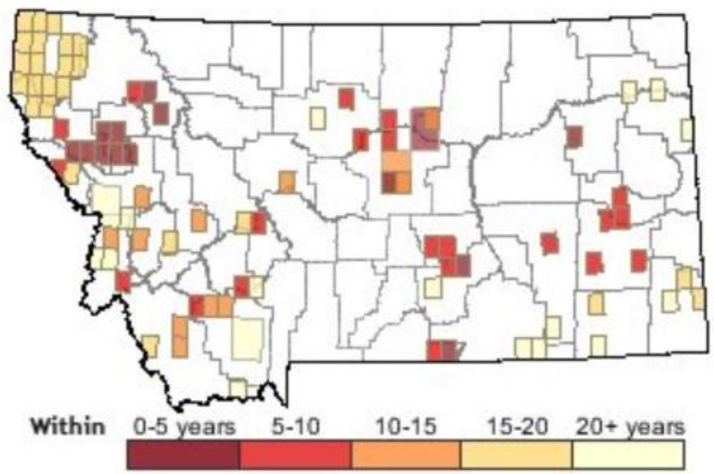
SOC, G4, S2

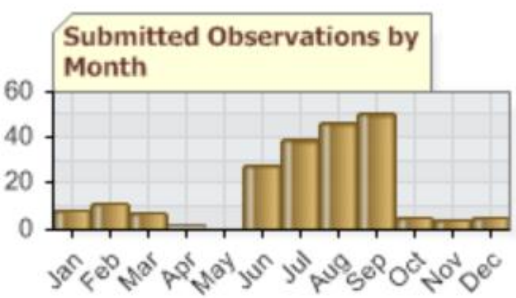


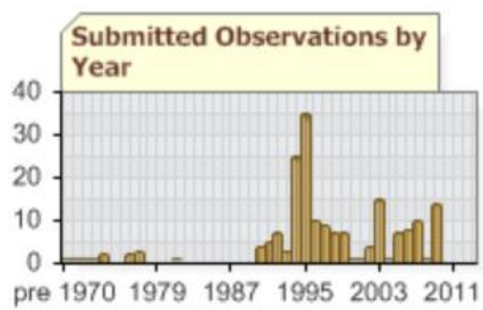
Relative Density

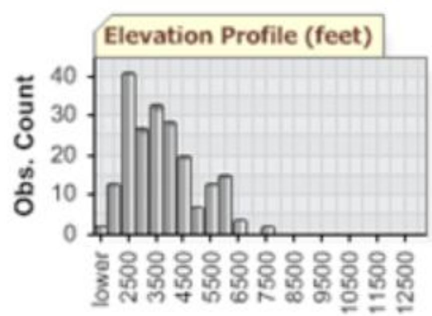


Recency



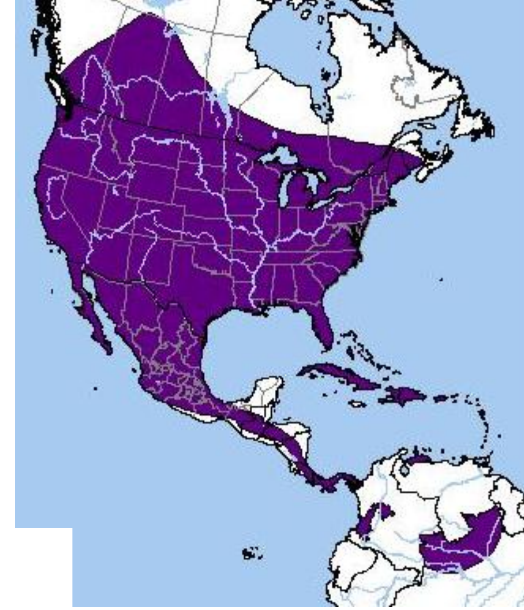




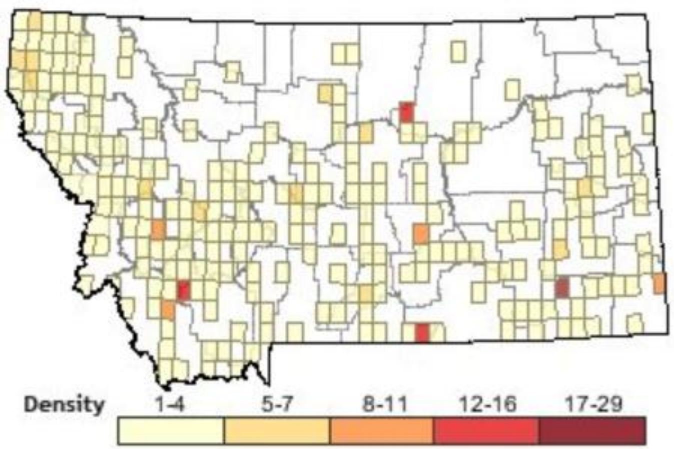


(Records associated with a range of dates are excluded from time charts)

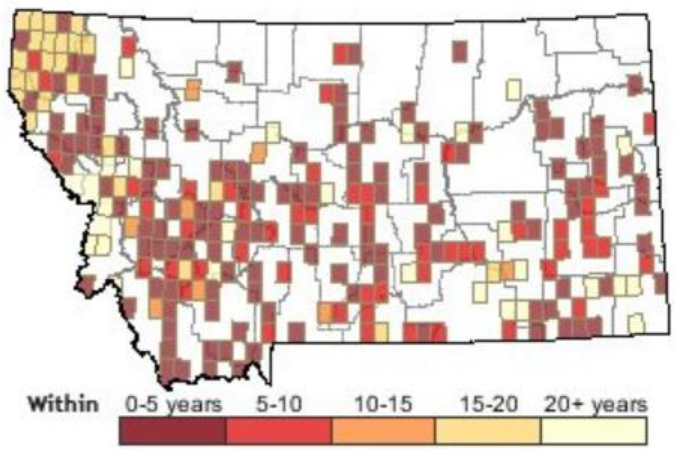
Big Brown Bat
G5, S4

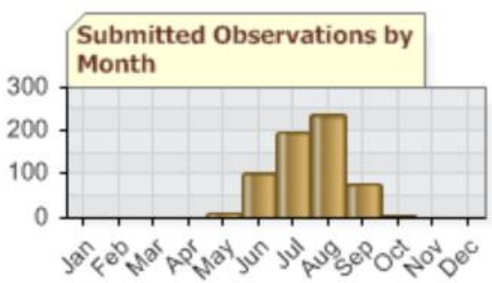


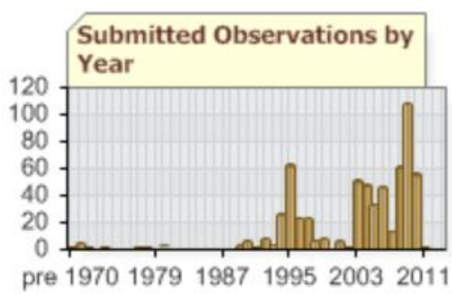
Relative Density

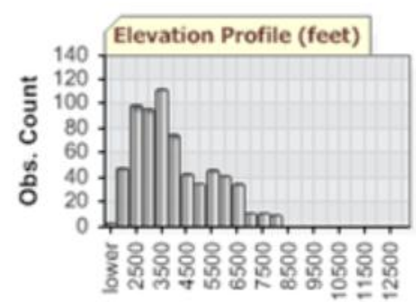


Recency







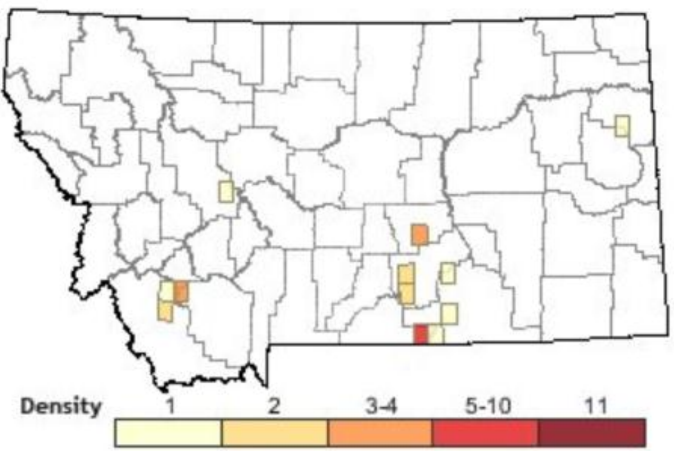


(Records associated with a range of dates are excluded from time charts)

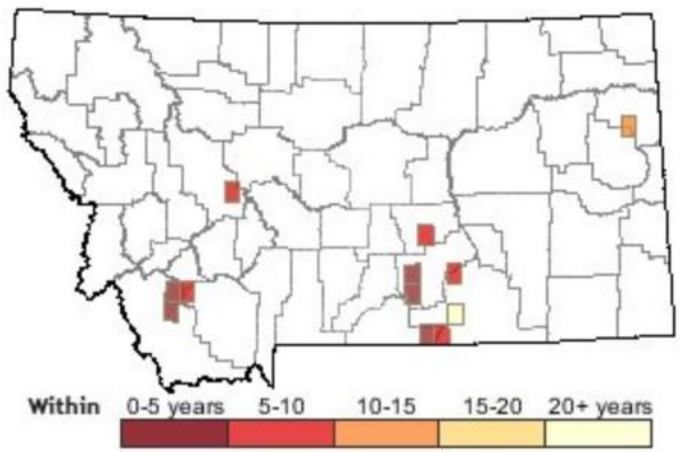
Spotted Bat

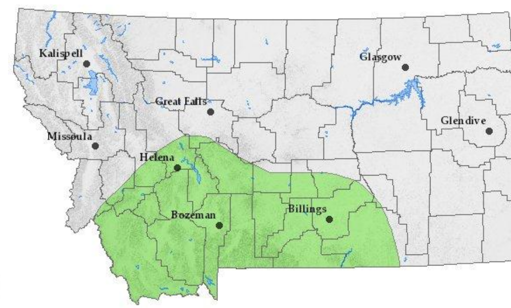
SOC, G4, S2

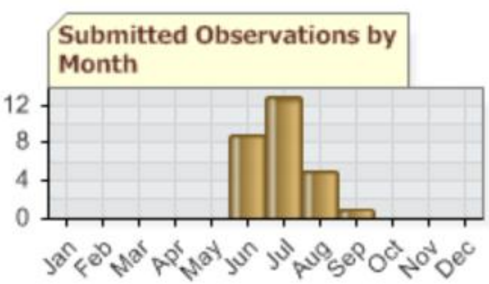
Relative Density

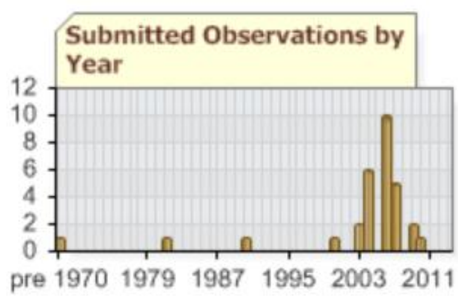


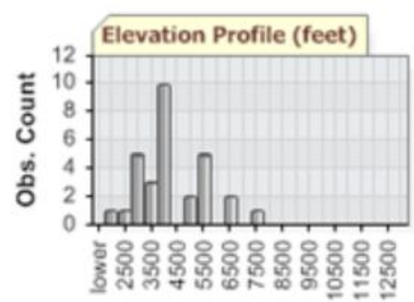
Recency





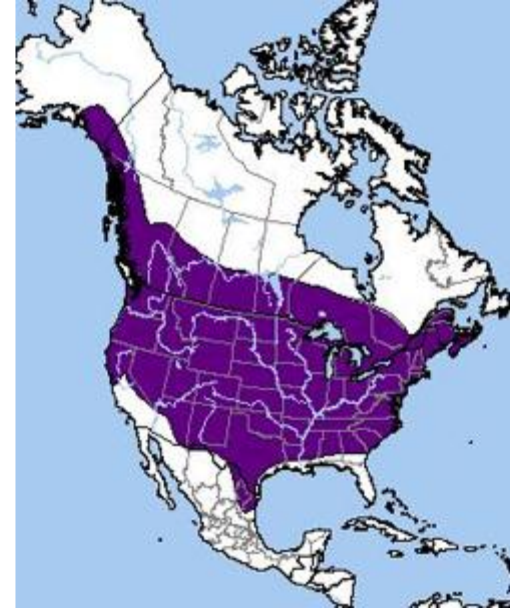




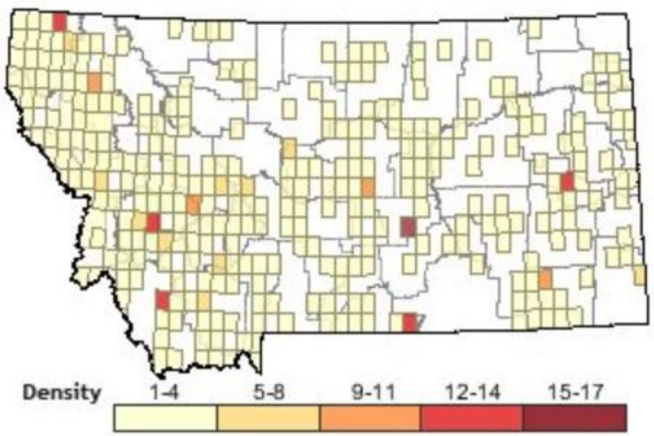


(Records associated with a range of dates are excluded from time charts)

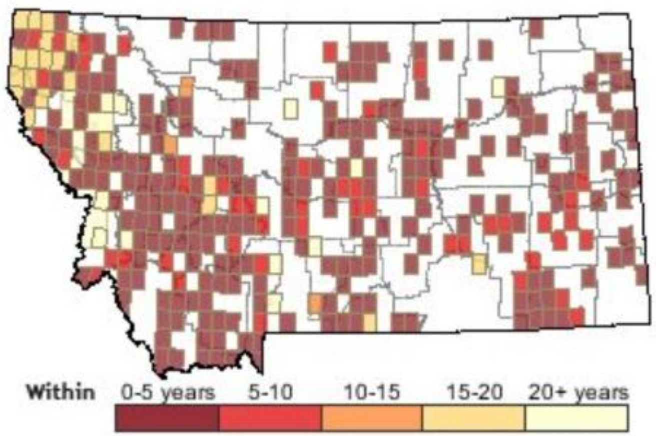
Silver-haired Bat
PSOC, G5, S4

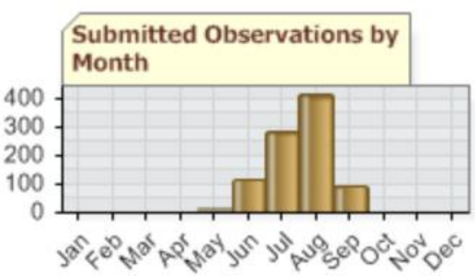


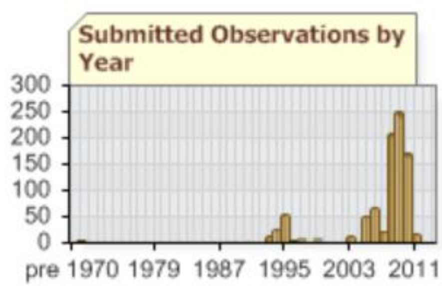
Relative Density

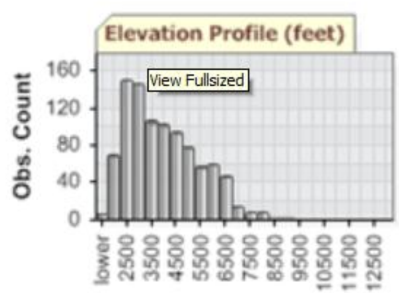


Recency





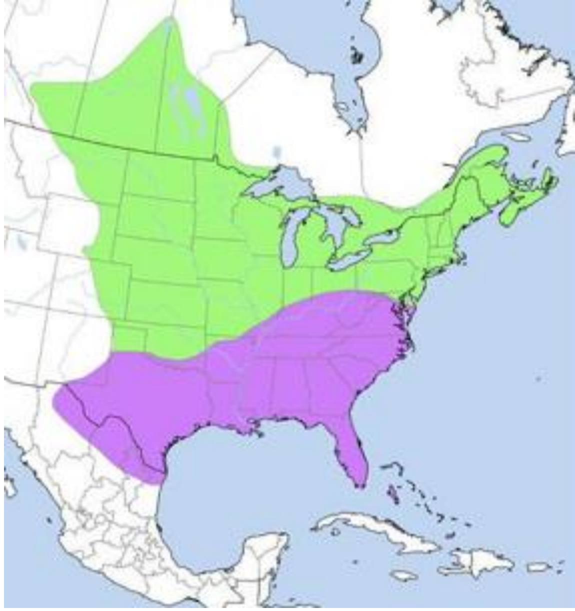




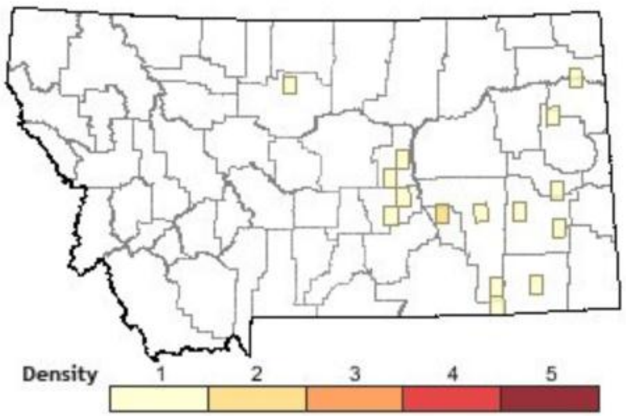
(Records associated with a range of dates are excluded from time charts)

Eastern Red Bat

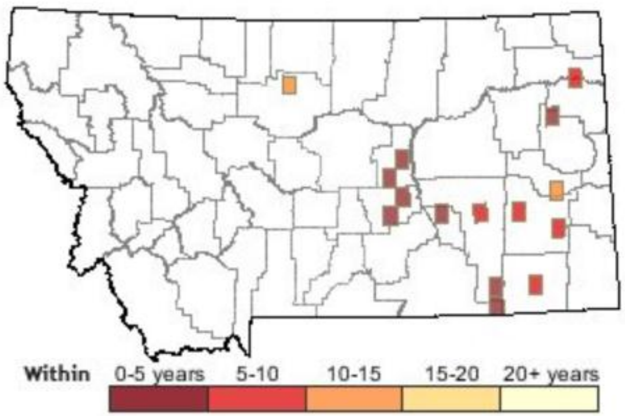
SOC, G5, S2S3

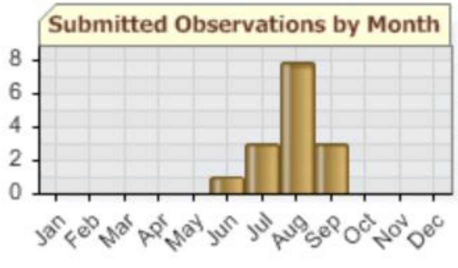


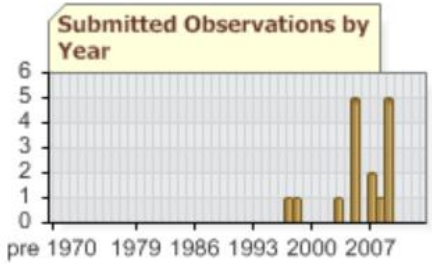
Relative Density

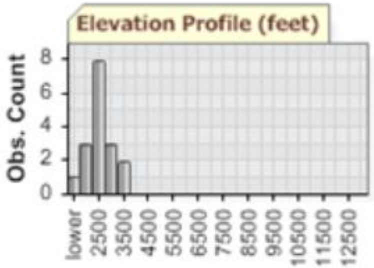


Recency





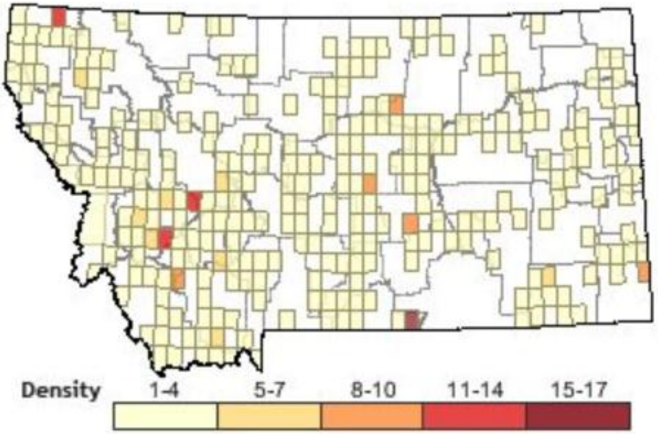




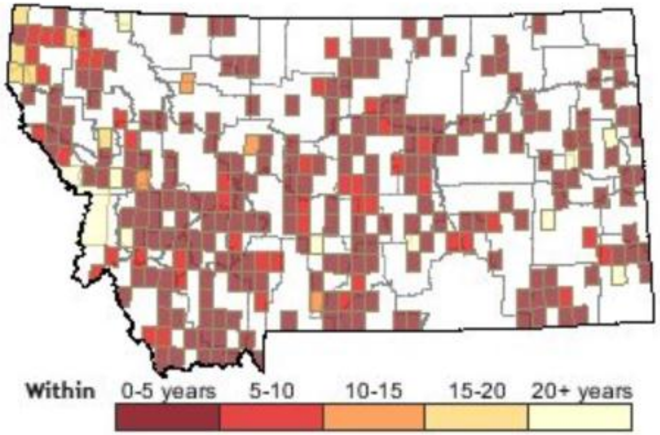
(Records associated with a range of dates are excluded from time charts)

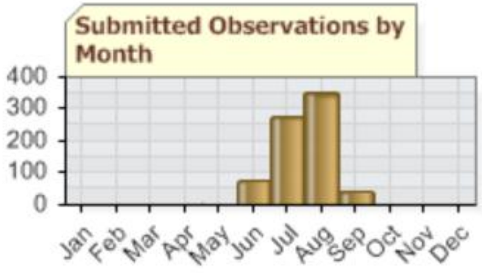
Hoary Bat
SOC, G5, S3

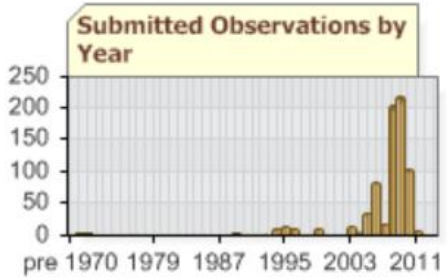
Relative Density

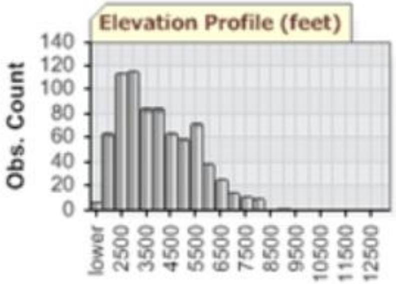


Recency





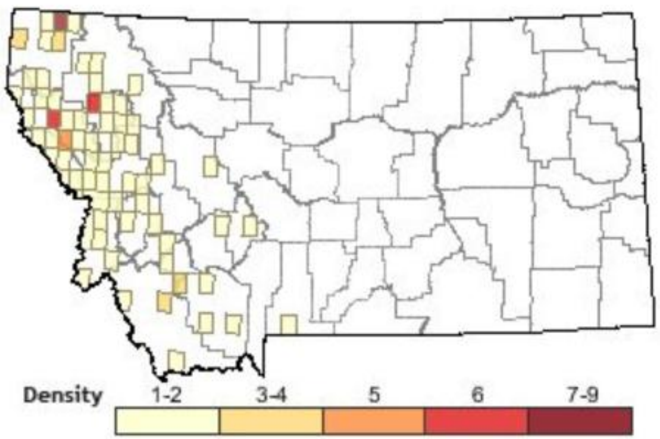




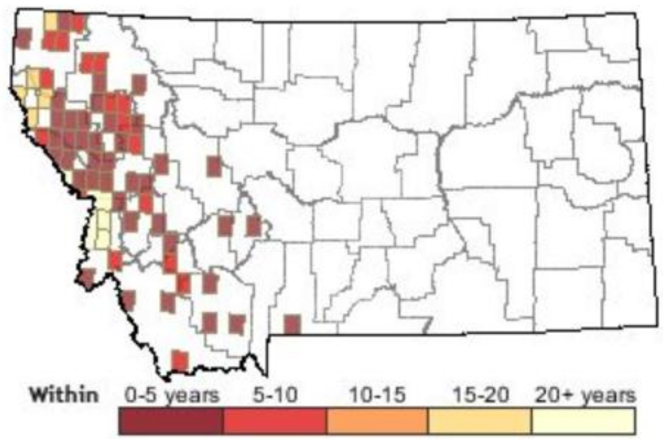
(Records associated with a range of dates are excluded from time charts)

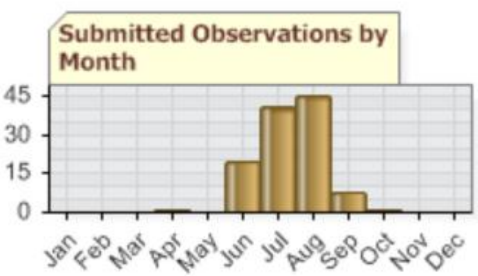
California Myotis
G5, S4

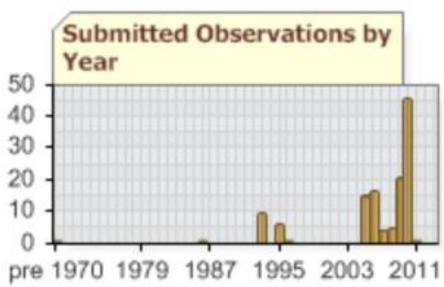
Relative Density

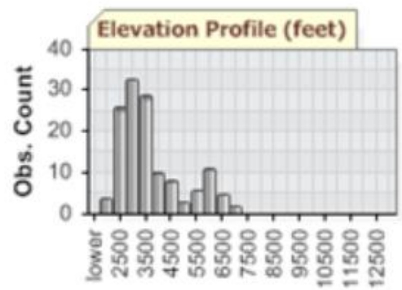


Recency





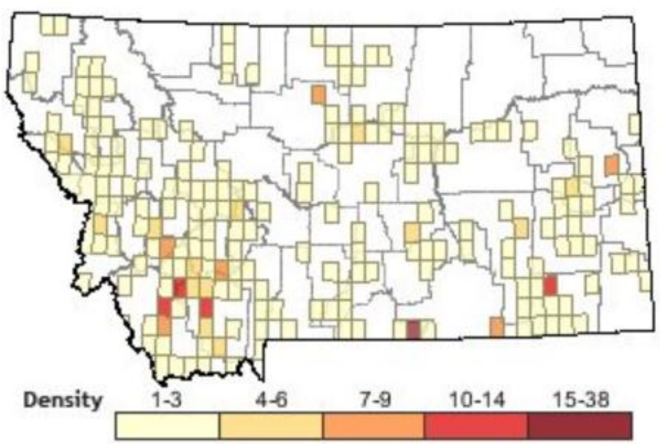




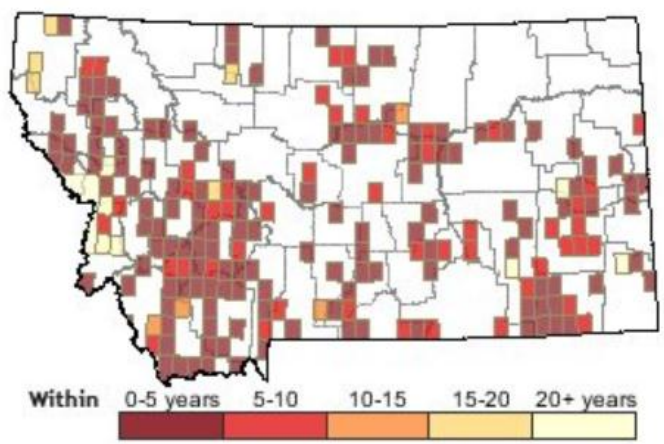
(Records associated with a range of dates are excluded from time charts)

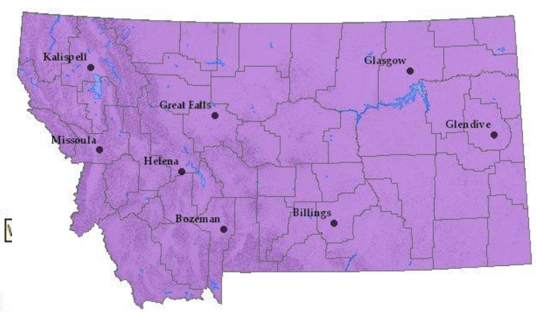
Western Small-footed Myotis G5, S4

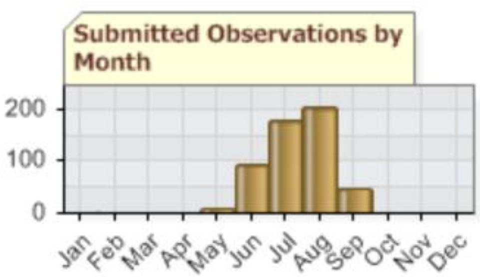
Relative Density

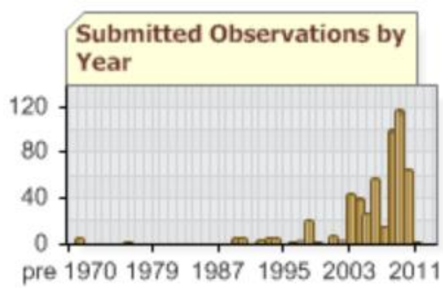


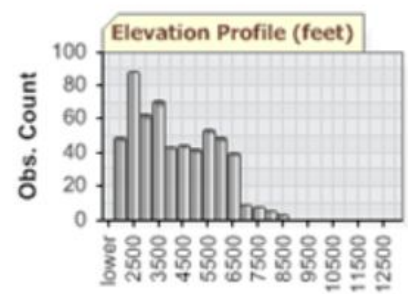
Recency







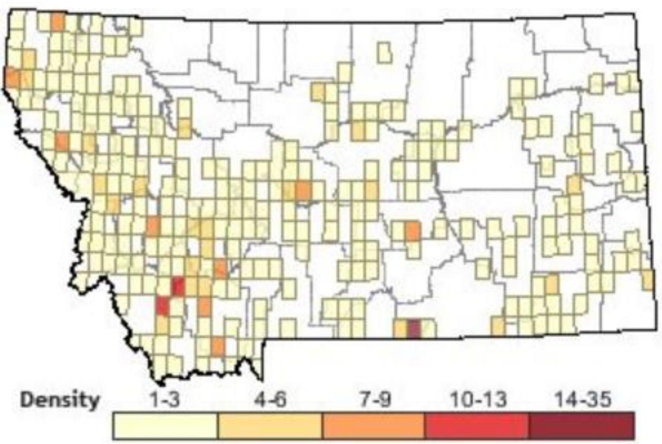




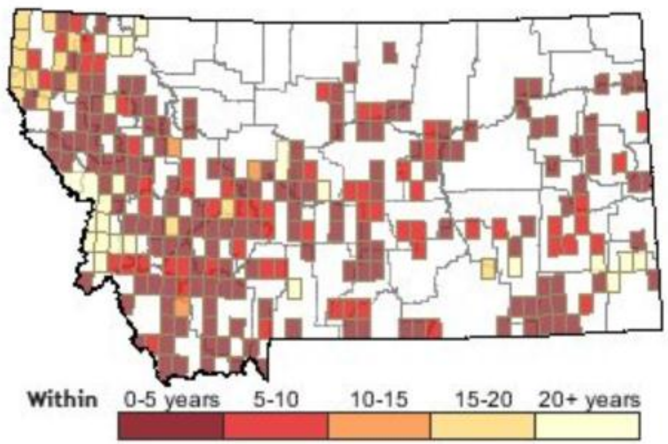
(Records associated with a range of dates are excluded from time charts)

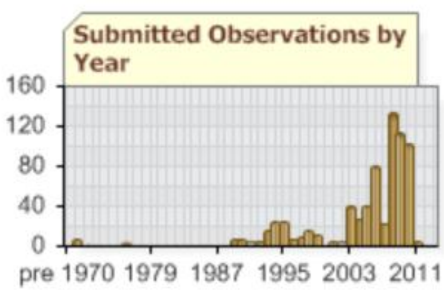
Long-eared Myotis
G5, S4

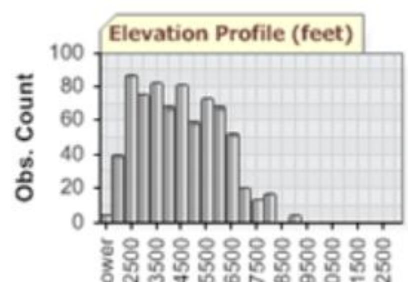
Relative Density



Recency

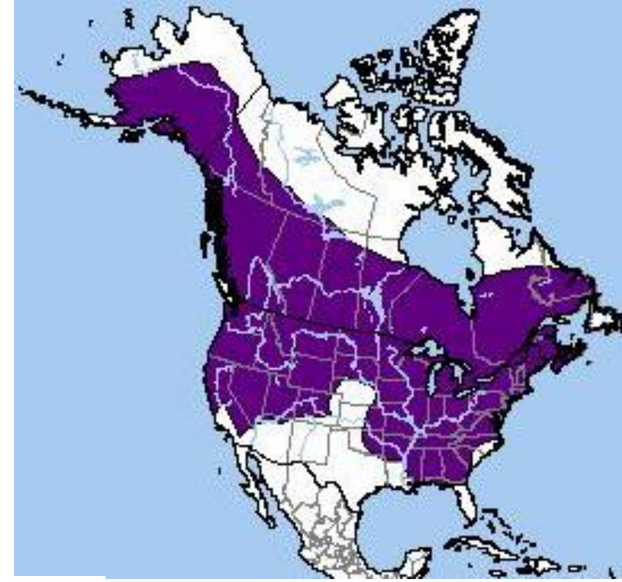




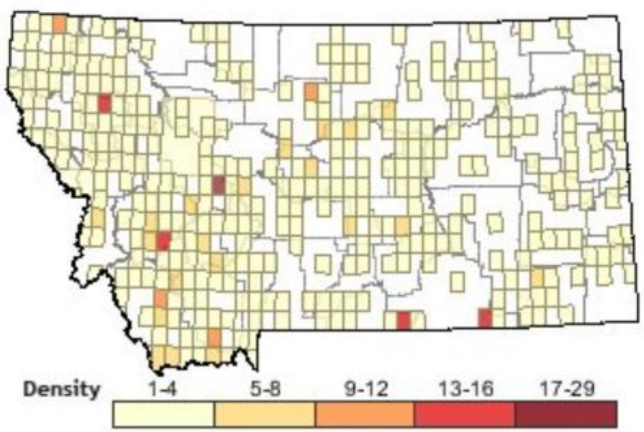


(Records associated with a range of dates are excluded from time charts)

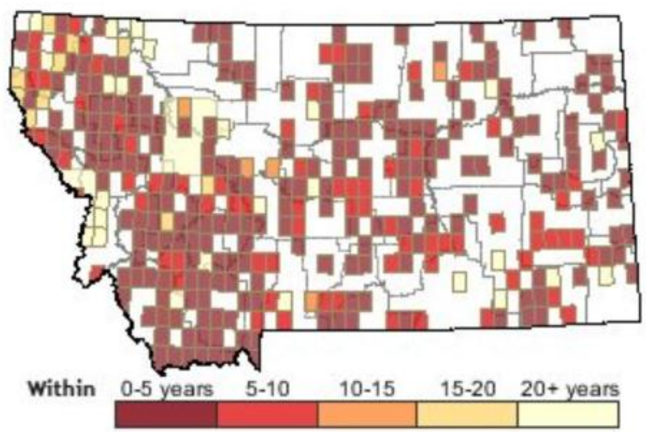
Little Brown Myotis
G5, S4

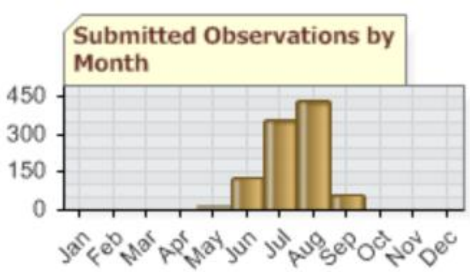


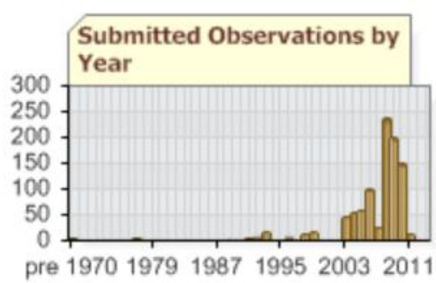
Relative Density

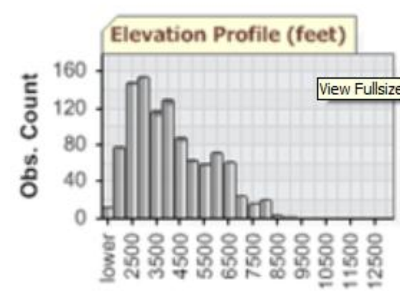


Recency



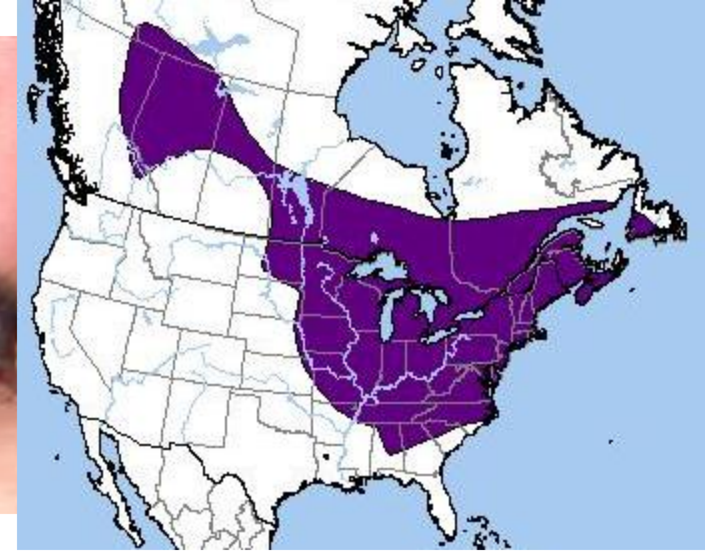




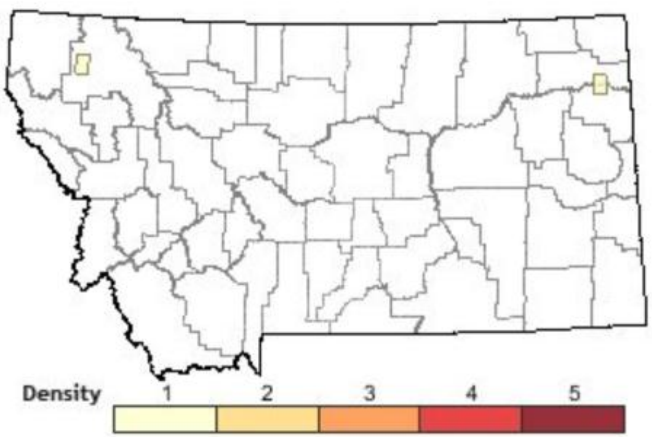


(Records associated with a range of dates are excluded from time charts)

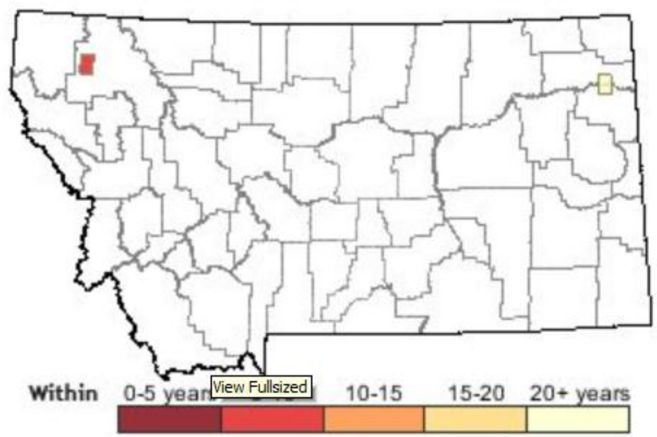
Northern Myotis
PSOC, G4, S24

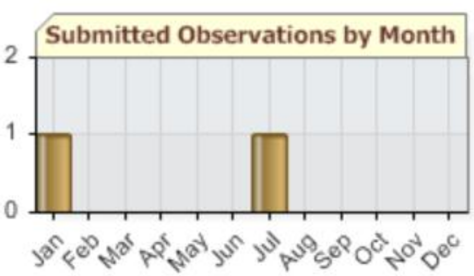


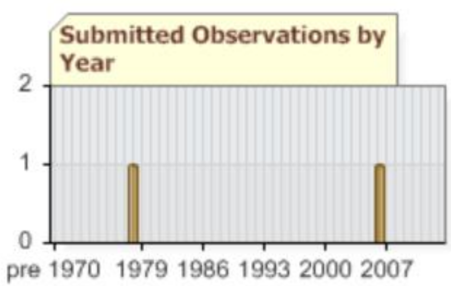
Relative Density

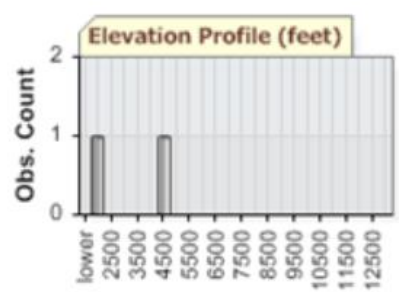


Recency





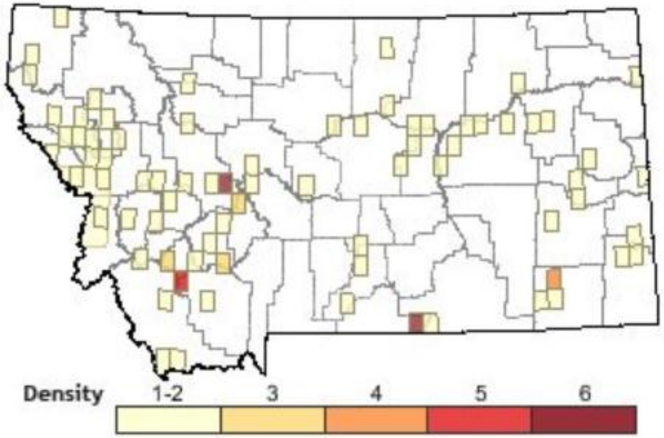




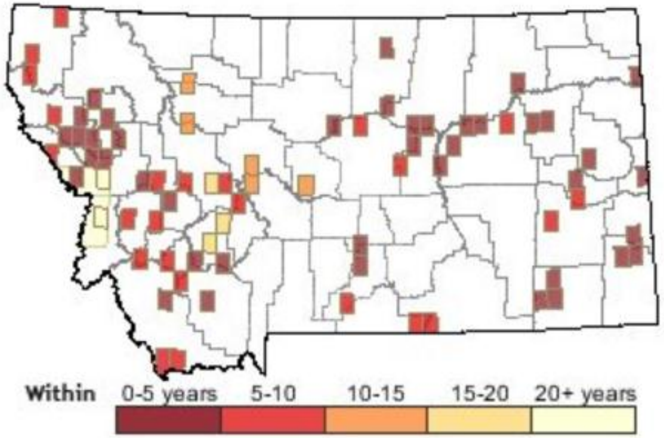
(Records associated with a range of dates are excluded from time charts)

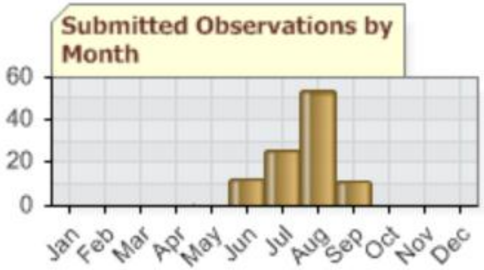
Fringed Myotis
SOC, G45, S3

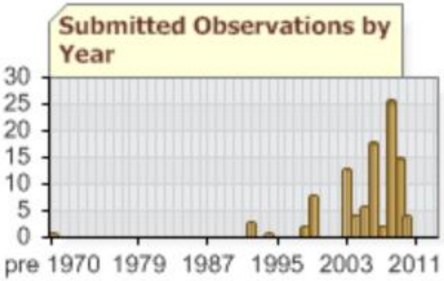
Relative Density

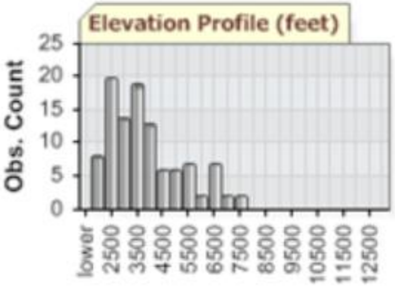


Recency





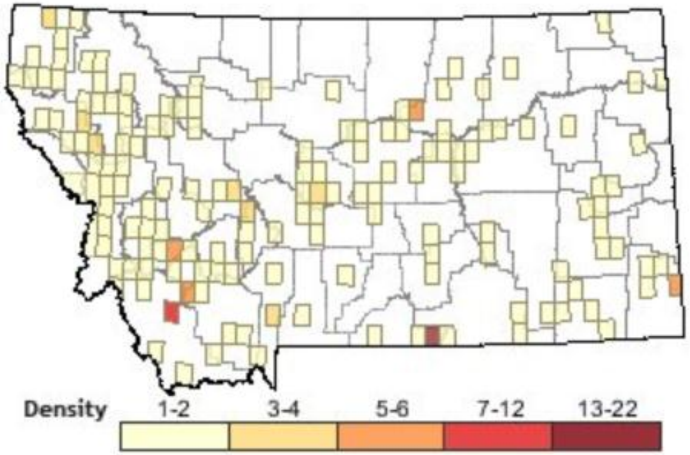




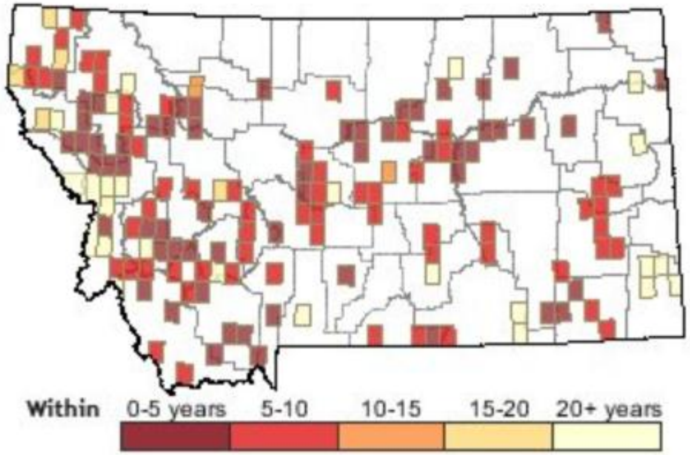
(Records associated with a range of dates are excluded from time charts)

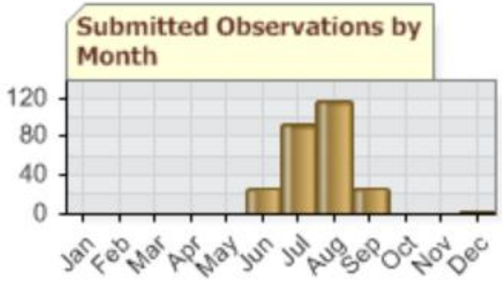
Long-legged Myotis
G5, S4

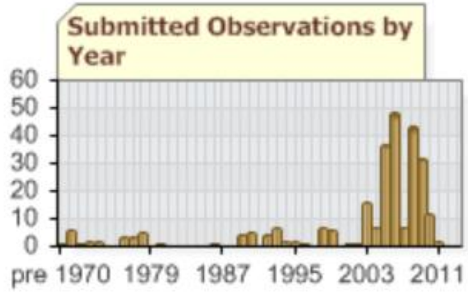
Relative Density

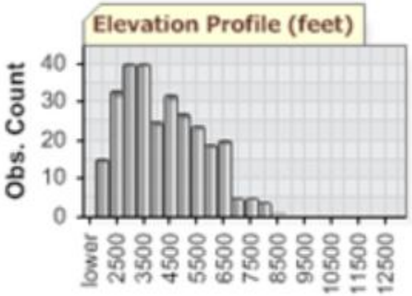


Recency









(Records associated with a range of dates are excluded from time charts)

Yuma Myotis
PSOC, G5, S34