



Montana's Bat Acoustic Surveillance Efforts

North American Bat Joint Working Group Meeting – St. Louis, Missouri
March 5th, 2015

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Plum Creek



MONTANA Natural Heritage Program



Montana Fish, Wildlife & Parks



US Army Corps of Engineers®



Bats of Montana



Pallid Bat
(*Antrozous pallidus*)



Townsend's Big-eared Bat
(*Corynorhinus townsendii*)



Big Brown Bat
(*Eptesicus fuscus*)



Spotted Bat
(*Euderma maculatum*)



Silver-haired Bat
(*Lasionycteris noctivagans*)



Eastern Red Bat
(*Lasiurus borealis*)



Hoary Bat
(*Lasiurus cinereus*)



California Myotis
(*Myotis californicus*)



Western Small-footed Myotis
(*Myotis ciliolabrum*)



Long-eared Myotis
(*Myotis evotis*)



Little Brown Myotis
(*Myotis lucifugus*)



Northern Myotis
(*Myotis septentrionalis*)



Fringed Myotis
(*Myotis thysanodes*)



Long-legged Myotis
(*Myotis volans*)



Yuma Myotis
(*Myotis yumanensis*)

Discover Montana's Wildlife
discover, preserve, protect

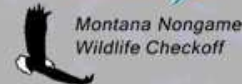


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For more information on all of Montana's native species visit the Montana Field Guide
<http://fieldguide.mt.gov>



Michael Durham/Minden Pictures/Bat Conservation International



Montana Fish,
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Montana

Thanks to the contributing photographers, editors, and sponsors that made this poster possible!

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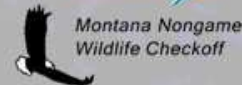
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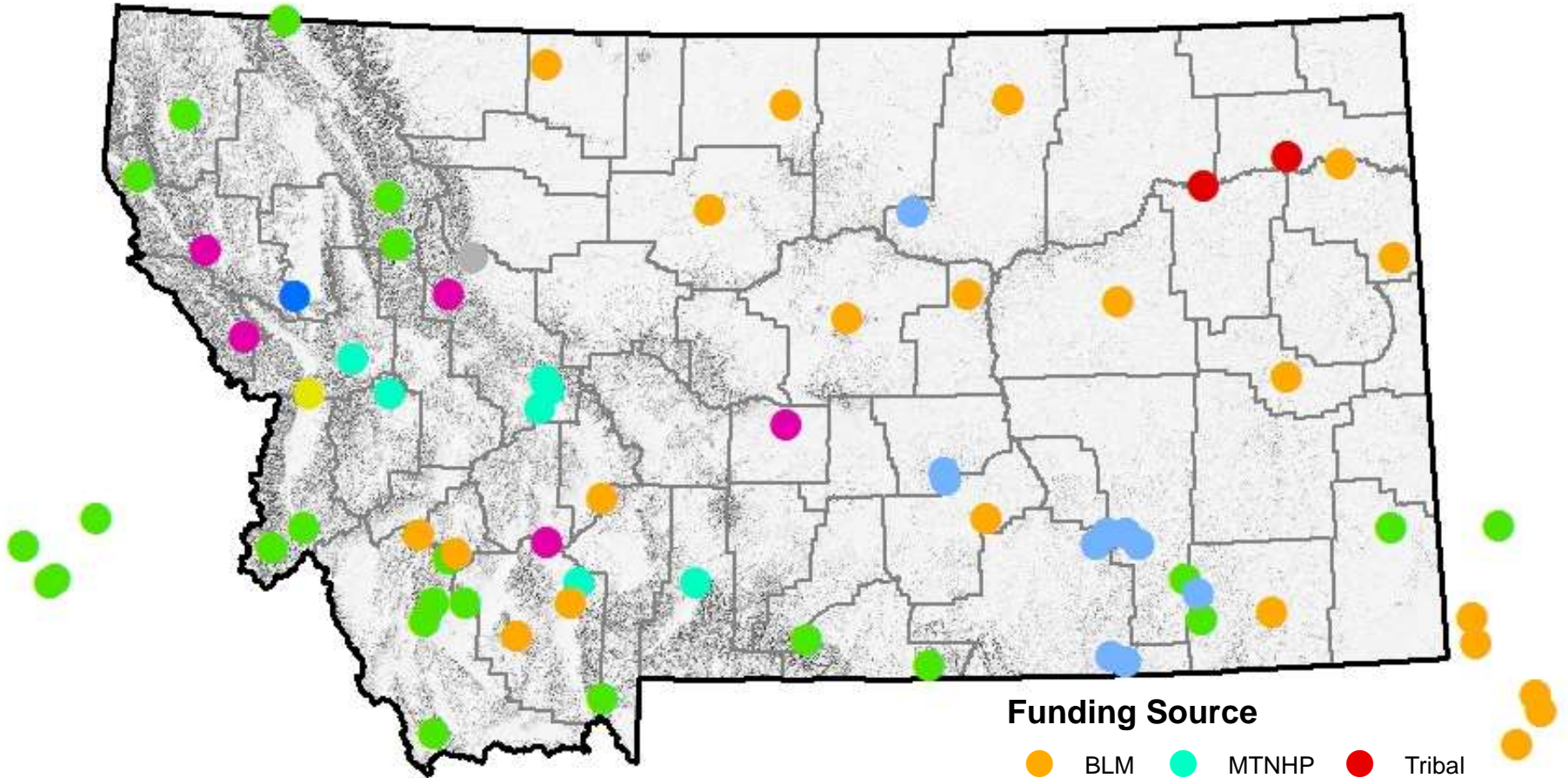
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Acoustic Monitoring Goals

- **Deploy a statewide acoustic monitoring array 2012 – 2015**
- **Document year-round nightly bat activity (bat passes)**
- **Identify annual timing of immergence to, and emergence from, hibernacula by resident species and timing of spring and fall migrations by migratory species**
- **Confirm monthly species presence and minimum active temperatures through hand verification of call sequences**
- **Correlate bat activity level with temperature and, where possible, wind speed and barometric pressure**
- **Identify landscape-level patterns of bat activity**
- **Make information readily available to all stakeholders**

Detector Network



- 69 SM2Bat+ detector/recorders
- SMX-US microphones
- 12 volt deep cycle battery & 30 Watt solar panel
- Deployed year round – sunrise to sunset
- Check every 1 to 3 months

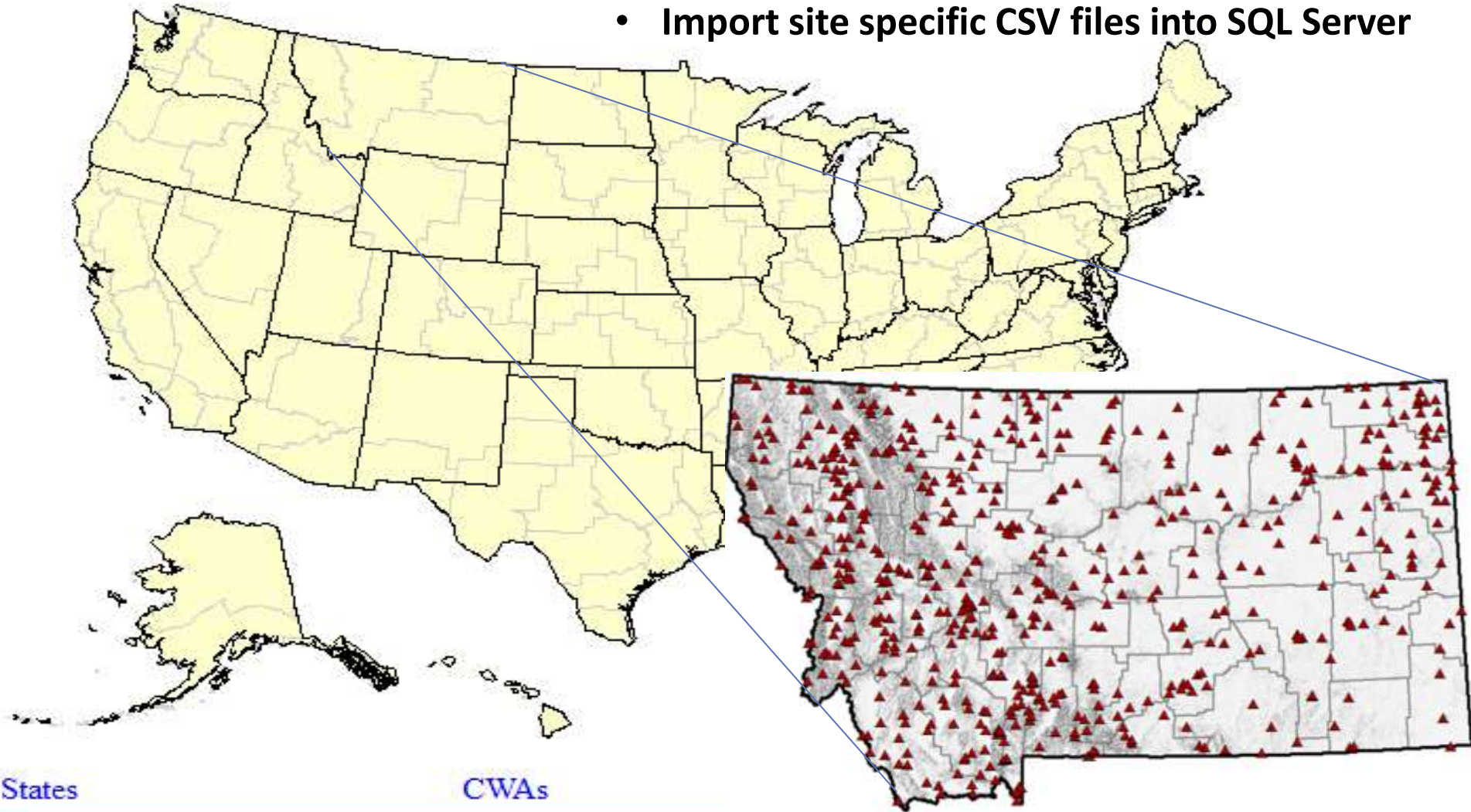
Detector Settings and Processing

- **Sample Rate = 192 kHz**
- **Channels = Mono-R**
- **Compression = WAC0**
- **Gain = 48 dB**
- **High Pass Filter = 8 kHz**
- **Low Pass Filter = Off**
- **Trigger Level = 18SNR**
- **Trigger Window = 2.0s**
- **Trigger Max Length = 0s**
- **Max duration = 86400s**
- **Min signal = 0.002s**
- **Min freq = 16 kHz**
- **Min spacing = 5s**



<http://mesowest.utah.edu/>

- Station ID and start and end date of interest
- Build URL Code that includes MesoWest token
- Import site specific CSV files into SQL Server



States

CWAs

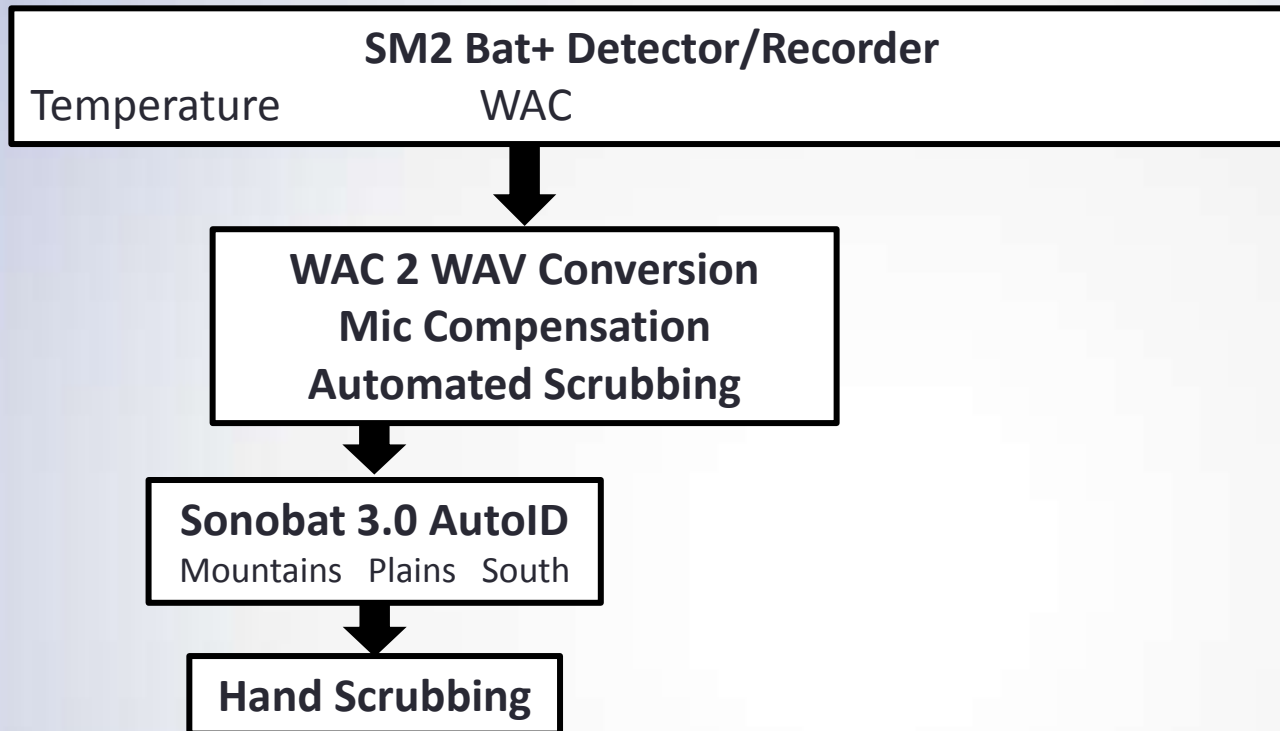
Data Processing Flow Chart

SM2 Bat+ Detector/Recorder

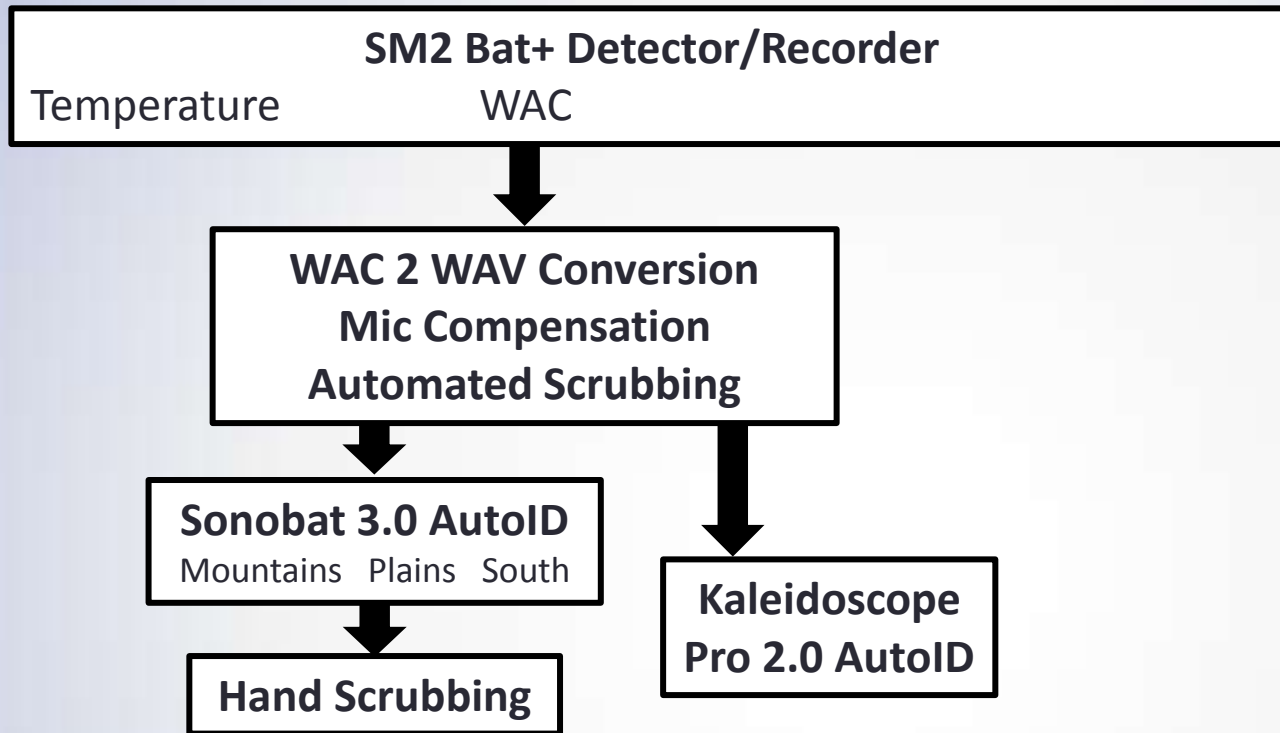
Temperature

WAC

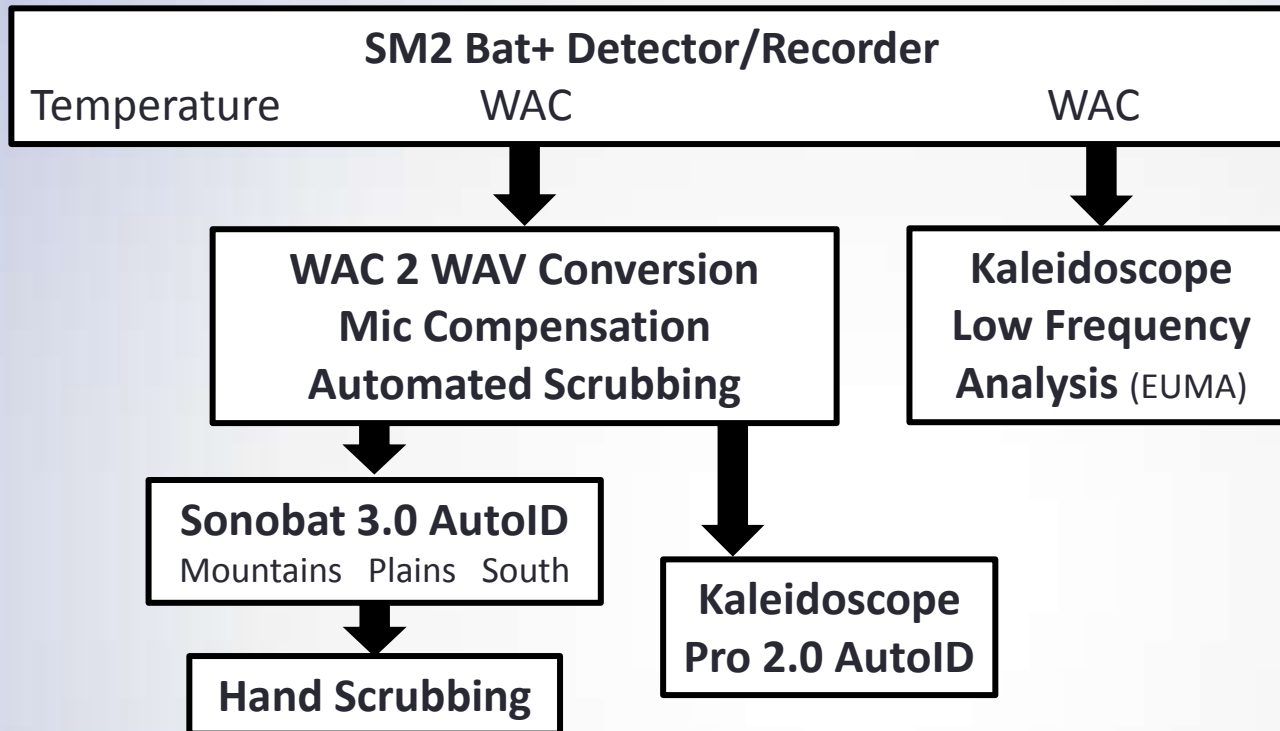
Data Processing Flow Chart



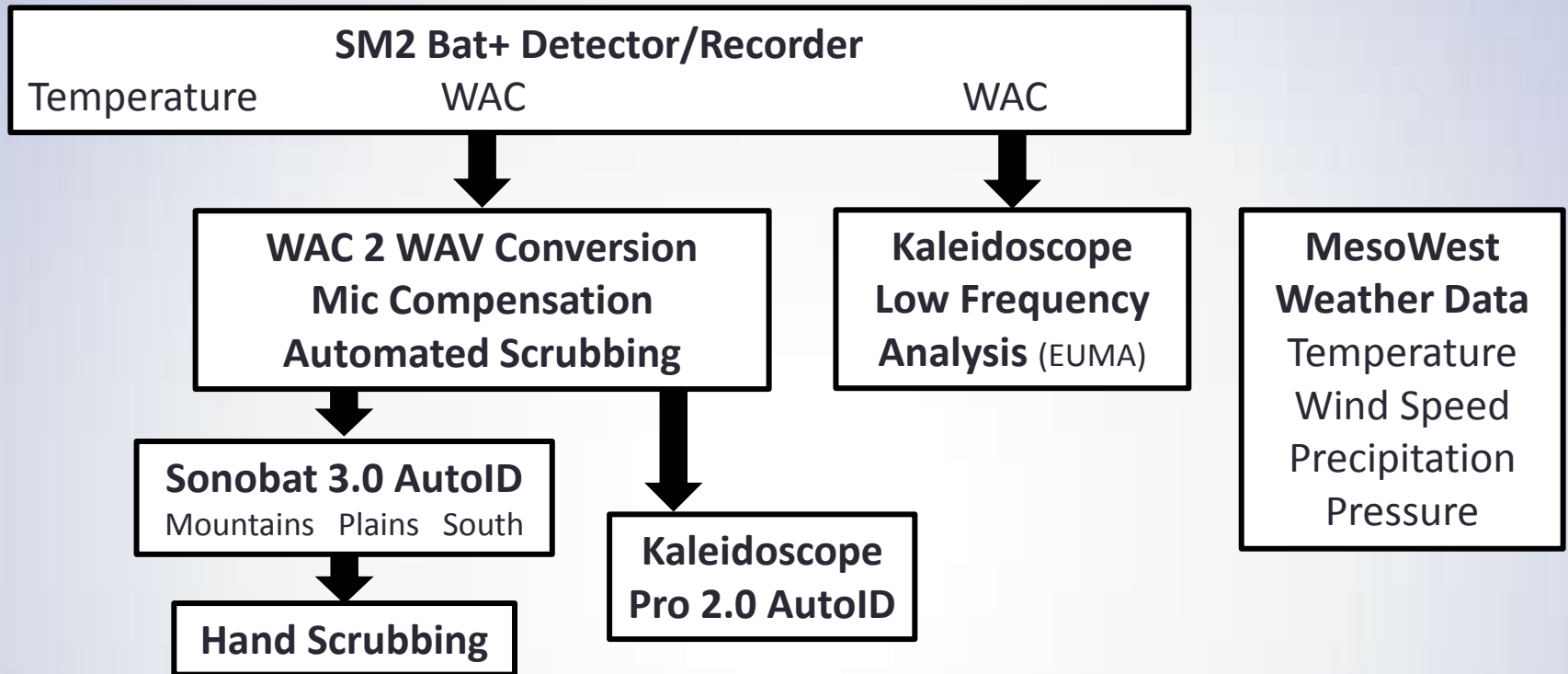
Data Processing Flow Chart



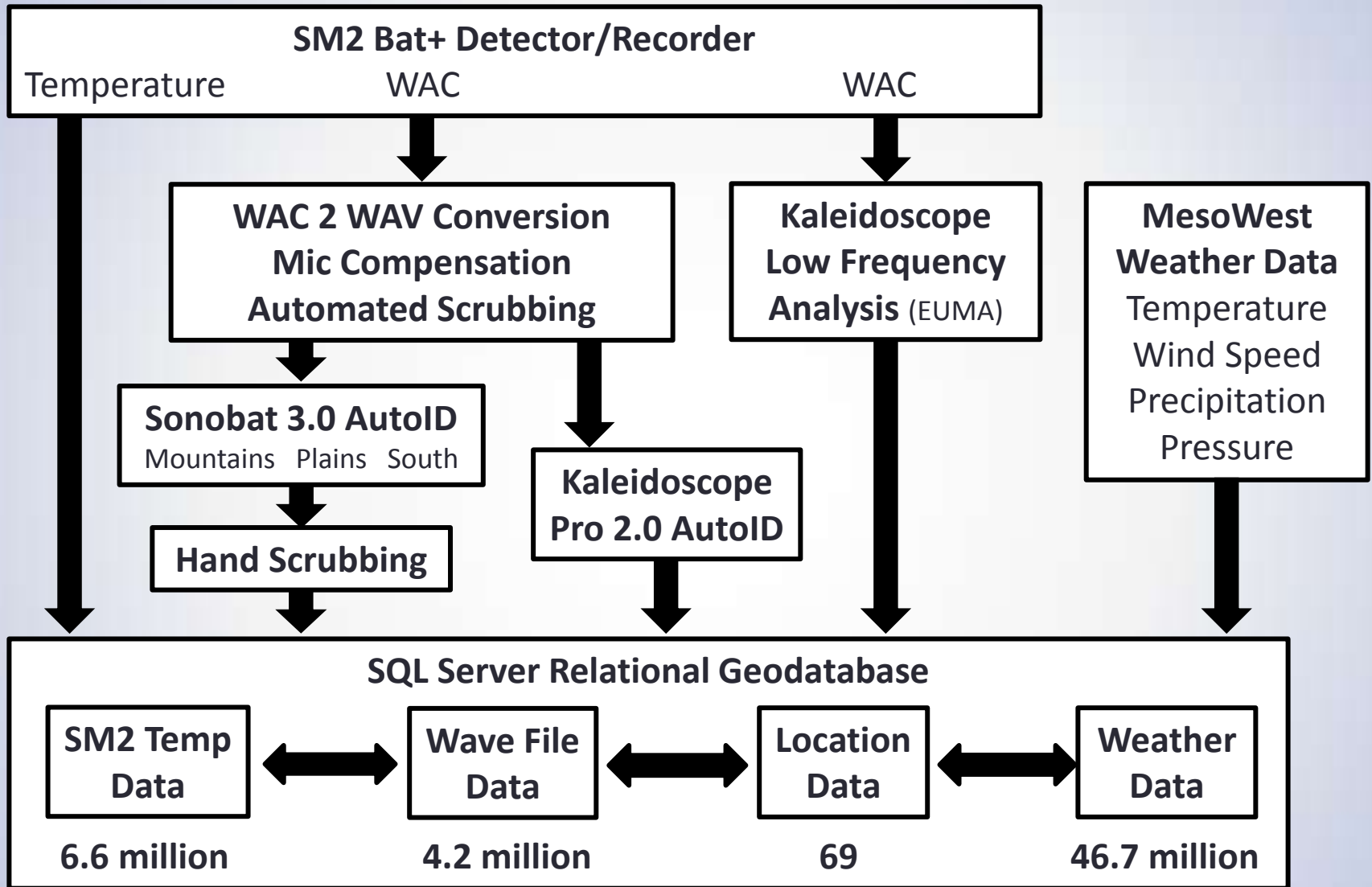
Data Processing Flow Chart



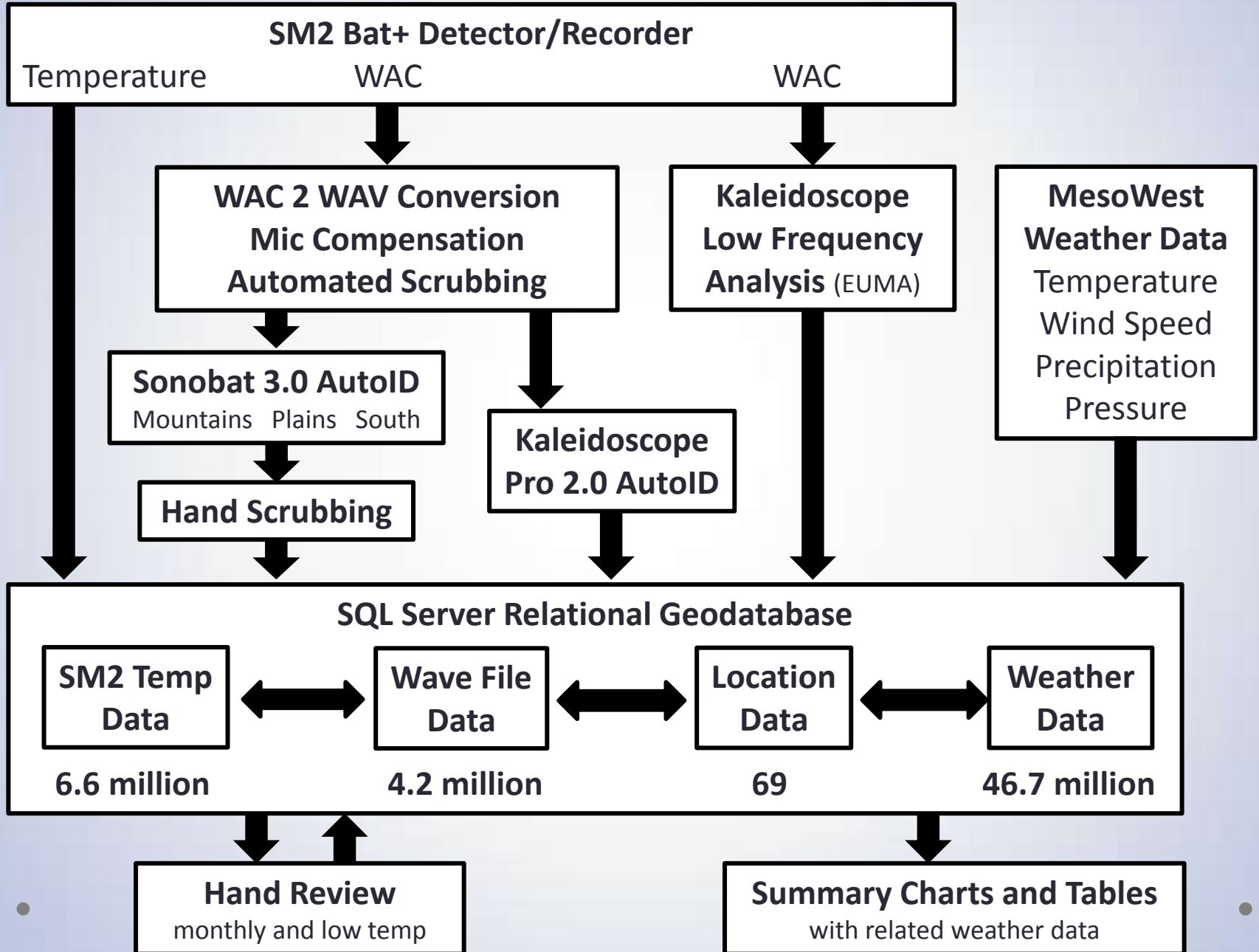
Data Processing Flow Chart



Data Processing Flow Chart



Data Processing Flow Chart



Hand Review Process

- **Montana call key and processing guidelines (Sonobat guidelines, Humboldt State 2011 keys, experience)**
- **Use auto-id and call parameter output to focus review on single phonic group at time and calls most likely to be confirmed**
- **Ensure that sequence has adequate number of search phase calls and is of general high quality (e.g. harmonics present)**
- **Review the call sequence and multiple calls within the sequence**
- **Look for “definitive” call parameters and consider geography and existing mistnet and acoustic data**
- **Ideal to have a small brain trust of reviewers – balance consistency with different view points**

Presenting Information to Partners

- **Excel Spreadsheet with Pivot Tables and Pivot Charts**



- **WHAT WE KNOW**

- overall bat activity across species
- monthly presence of individual species
- lowest detector temp at which individual species are active

- **WHAT WE SPECULATE**

- Activity patterns for species with high auto-id accuracy

- **WHAT WE DON'T KNOW AND DON'T SHARE**

- Activity patterns for species with low auto-id accuracy

Where We Are At

- **35,200 nights sampled across 69 detectors**
- **4.2 million bat passes recorded (12+ TB)**
- **34,162 call sequences examined by hand**
- **5,279 call sequences definitively identified to species**
- **1,421 records of monthly species presence in Montana**
- **6,612,037 temperature logger records**
- **46,764,533 weather station records across 593 stations**

Statewide Bat Activity

Total weekly bat passes



Statewide Acoustic Detections by Month

All Previous Data (blue shading), Probable (black), Definitive (red)

Species	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Pallid Bat				2013 2014	2013 2014	2014	2013 2014	2013 2014	2013 2014			
Townsend's Big-eared Bat ¹				2014	2012	2012	2012 2013 2014	2012 2013 2014		2012		
Big Brown Bat	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2011 2012 2013 2014	2011 2012 2013 2014	2011 2012 2013 2014	2011 2012 2013
Spotted Bat				2012 2014	2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013	
Eastern Red Bat						2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012		
Hoary Bat				2012	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014		
Silver-haired Bat	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2011 2012 2013 2014	2011 2012 2013 2014	2011 2012 2013
California Myotis		2013	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013	2012 2013	2012 2013	2011 2013
W. Small-footed Myotis	2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2011 2012 2013 2014	2011 2012 2013 2014	2011 2012 2013 2014	2011 2012 2013
Long-eared Myotis				2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2011 2012 2013 2014	2011 2012 2013 2014	2012	
Little Brown Myotis	2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2011 2012 2013 2014	2011 2012 2013 2014	2012 2013	2011 2012 2013
Fringed Myotis				2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012		
Long-legged Myotis ²		2014	2013	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013	2013	
Yuma Myotis		2013	2013	2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013 2014	2012 2013	2012	2012	

Migration Dates

Species	Earliest Record	Start Common Presence	End Common Presence	Latest Record
Fringed Myotis	Apr-03	Late Apr	Early Oct	Oct-31
Spotted Bat	Apr-19	Early May	Mid Oct	Nov-12
Pallid Bat	Apr-05	Mid May*	Early Sept*	Oct-01
Hoary Bat	May-01	Late May	Late Sept	Oct-31
Eastern Red Bat	Jun-14	Late June	Mid Sept	Oct-15

*Pallid bat definitive records are currently very limited

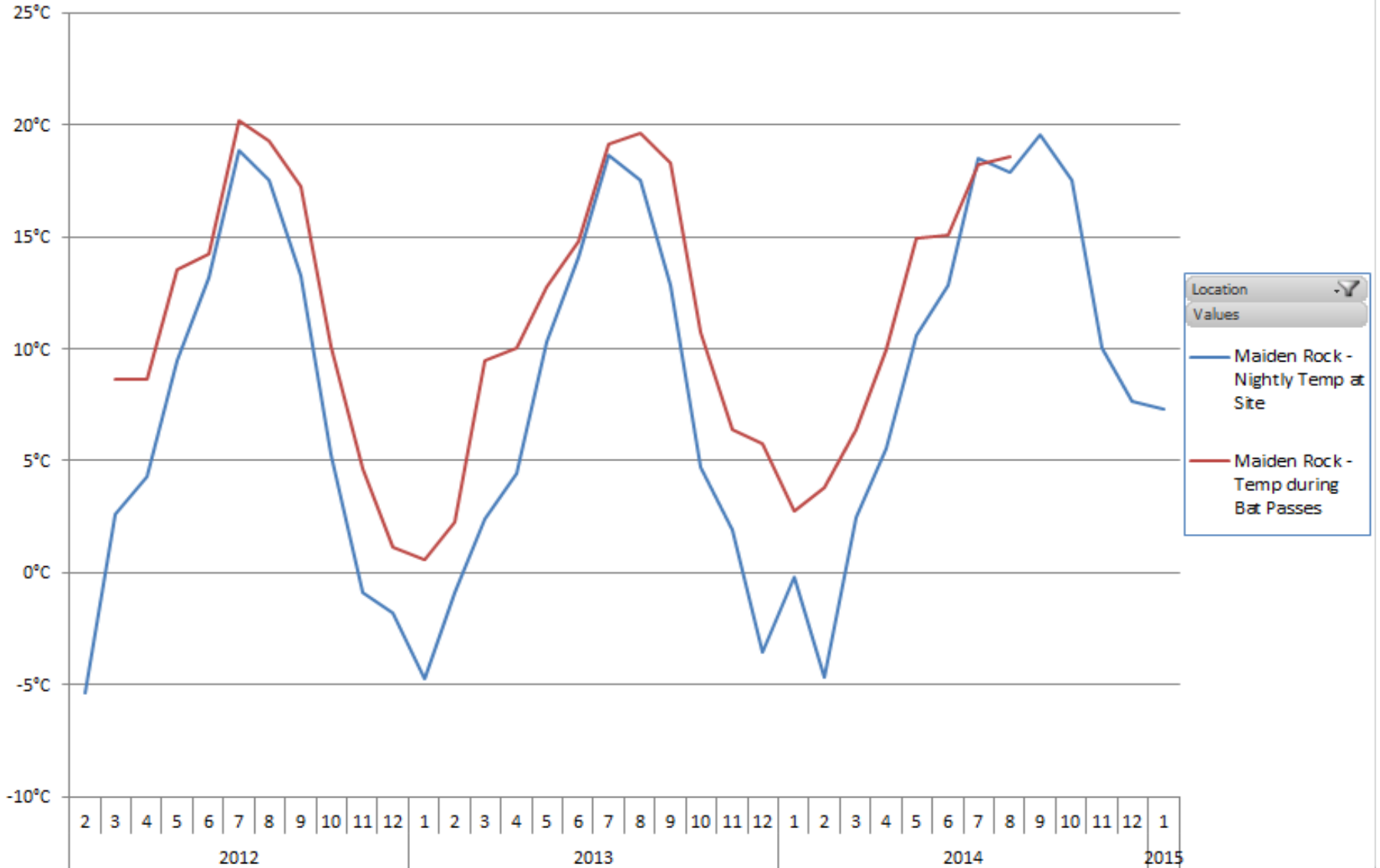
Winter Records

- Regular activity for a few resident species (Nov-Mar)

Species	AutoID	Definitives
Silver-haired Bat	1784	162
Western Small-footed Myotis	1276	60
Big Brown Bat	1158	64
California Myotis	431	9
Little Brown Myotis	170	7
Yuma Myotis	164	2
Townsend's Big-eared Bat	9	
Long-eared Myotis	2	1

Winter Records

Average Nightly Temperatures by Month



Maiden Rock

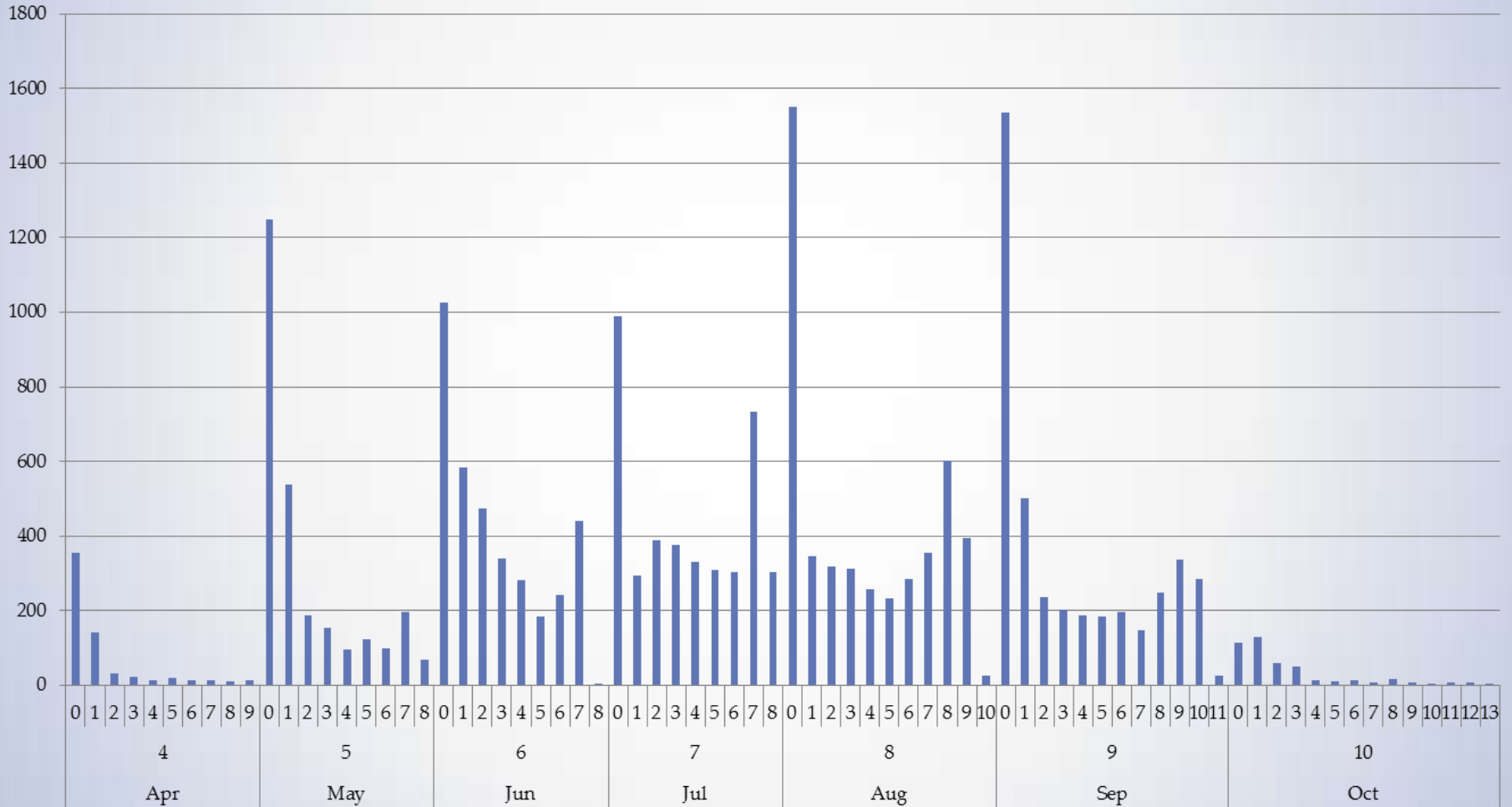
Lowest Detector Temps of Activity

Common Name	Scientific Name	Lowest Temp (°C)
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	-4.9
Big Brown Bat	<i>Eptesicus fuscus</i>	-4.8
Western Small-footed Myotis	<i>Myotis ciliolabrum</i>	-4.8
Long-eared Myotis	<i>Myotis evotis</i>	-2.1
Hoary Bat	<i>Lasiurus cinereus</i>	-0.6
California Myotis	<i>Myotis californicus</i>	-0.5
Little Brown Myotis	<i>Myotis lucifugus</i>	-0.5
Eastern Red Bat	<i>Lasiurus borealis</i>	1.6
Spotted Bat	<i>Euderma maculatum</i>	1.9
Fringed Myotis	<i>Myotis thysanodes</i>	3.1
Pallid Bat	<i>Antrozous pallidus</i>	5.2
Long-legged Myotis	<i>Myotis volans</i>	5.5
Townsend's Big-eared Bat	<i>Corynorhinus townsendii</i>	6
Yuma Myotis	<i>Myotis yumanensis</i>	6.7

* Coldest confirmed bat pass is -8.6 C from an unidentified 40 kHz Myotis

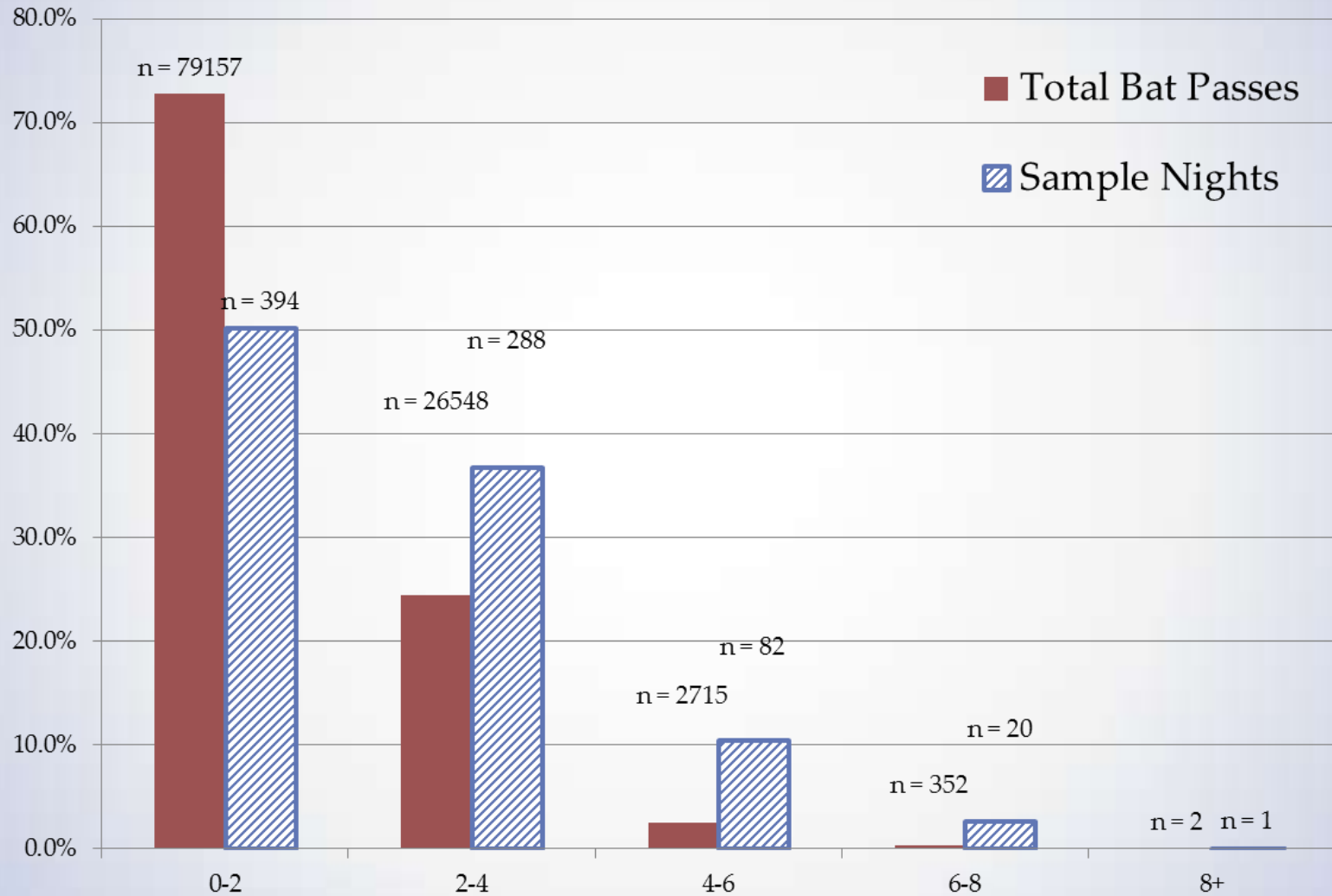
Timing of Activity

Bat Passes by Hour After Sunset



Bear Canyon

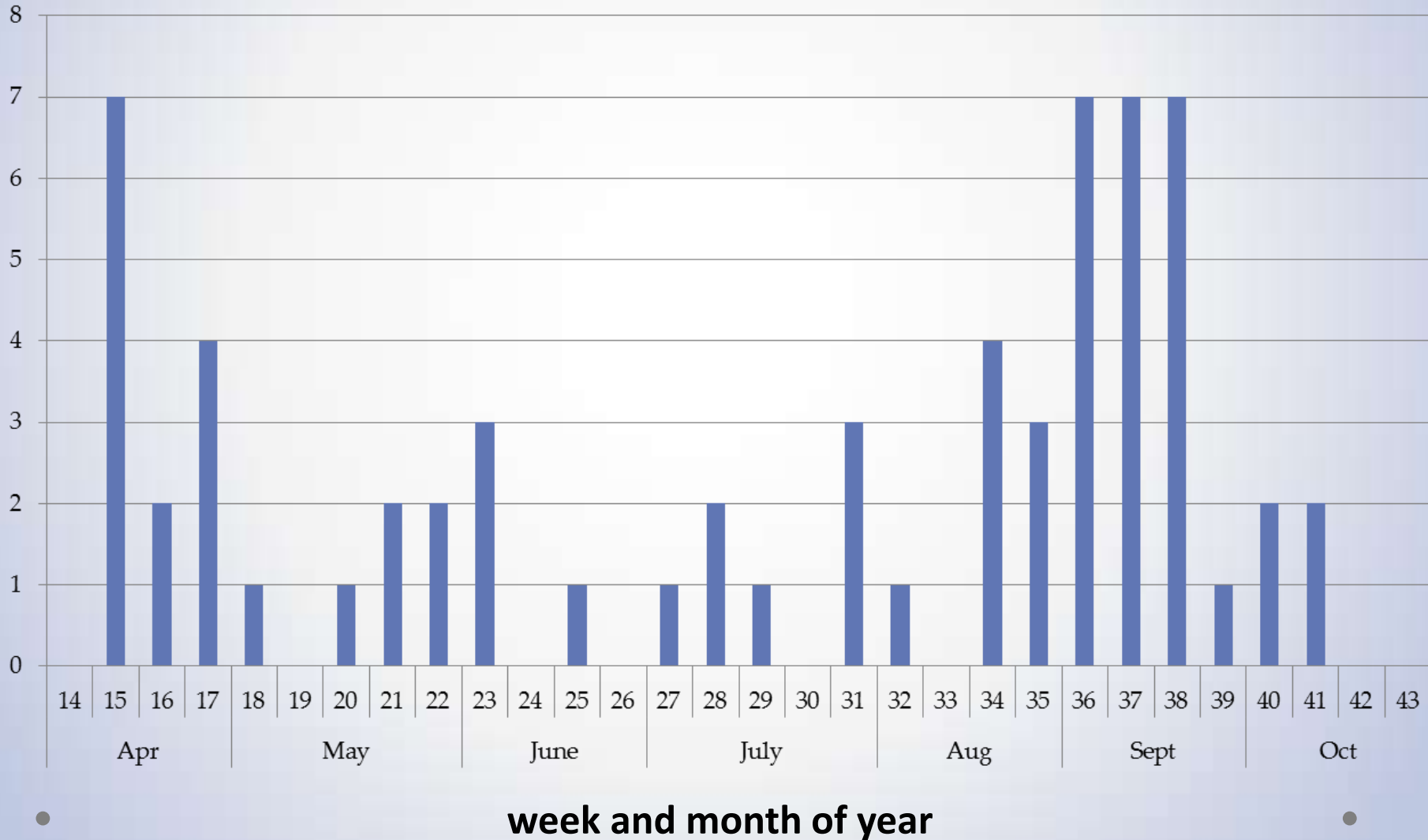
Bat Activity and Wind Speed



Wind speed (m/s), from nearby weather station
Landusky

Spikes in Bat Activity

Number of Spike Nights



Data WE KNOW Available on Natural Heritage Map Viewer

NATURAL HERITAGE MAP VIEWER Scale 1:4,613,428 Maxell, Bryce

mt.gov Field Guide File View Help Sign Out Standard Controls Add Obs Full Extent MT Only Legend

Task Selection

Point Observations

"Tasks" are different sets of Data, Tools, and Map Layers.

Switch Task Reset Map

Tools

- Filter by Species Status (MT)
- Filter by Animals
- Filter by Plants
- Filter by Species Order

Clear

- Aquatic Snails (Neotaeniogloss)
- Arum / Duckweeds / Sweetflag
- Aster/Sunflowers (Asterales)
- Barberry / Buttercup (Ranuncul)
- Bass / Perch / Crappie (Percif)
- Bat Roost
- Bats (Chiroptera)

- Filter by Geography
- Filter by Date
- Filter by Observer
- Filter by Pending

Map Layers

Search for Location

Point Observations for (Order={"Bat Roost", "Chiroptera"})

<http://mtnhp.org/mapviewer/>

Charts and Data

Printable Report Export to Excel

Charts and Graphs

Observations (exact dates only)

By Year (exact years only)

Latitude 39.34167 Longitude -101.21714
49.03504 -117.19939

Observation Details

Species List Plus Obs (may take a while)

Species	Obs Count	Earliest Obs	Recent Obs
Mammals - Big Brown Bat (<i>Eptesicus fuscus</i>)	1014	1894	2014
Mammals - California Myotis (<i>Myotis californicus</i>)	191	1955	2014
Mammals - Eastern Red Bat (<i>Lasiurus borealis</i>)	55	1997	2014
Mammals - Fringed Myotis (<i>Myotis thysanodes</i>)	120	1951	2014

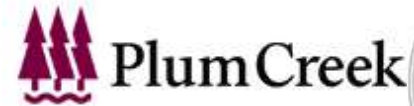
General Recommendations

- 1. Manage information in relational databases to facilitate call review and data summarization**
- 2. Store sound files (compressed and processed) in a long-term reference library to facilitate analysis and future reanalysis**
- 3. Species determinations should be made by a minimal number of personnel, focused on a single phonic group at a time, and guided by a fully developed call determination protocol**
- 4. Use concordant results across software packages and filtering rules to guide and speed hand review of call sequences**
- 5. Detector and call processing standards should be held constant across the life of a project or changed at pre-specified time intervals to facilitate data comparisons within and between monitoring periods; cross calibrate between monitoring periods.**
- 6. Be very explicit with partners about what we know, what we are speculating on, and what we don't know**

Questions?

Bryce Maxell, Montana Natural Heritage Program

bmaxell@mt.gov (406) 444-3655



US Army Corps of Engineers®



Working with Cavers



Whitaker Sink

(also known as Sauer's Pit)
Little Belt Mountains
Judith Basin County, Montana

Profile View Looking North 18° East

Surveyed December 7 and 8, 2002
Fiberglass Tape and SUUNTO Compass

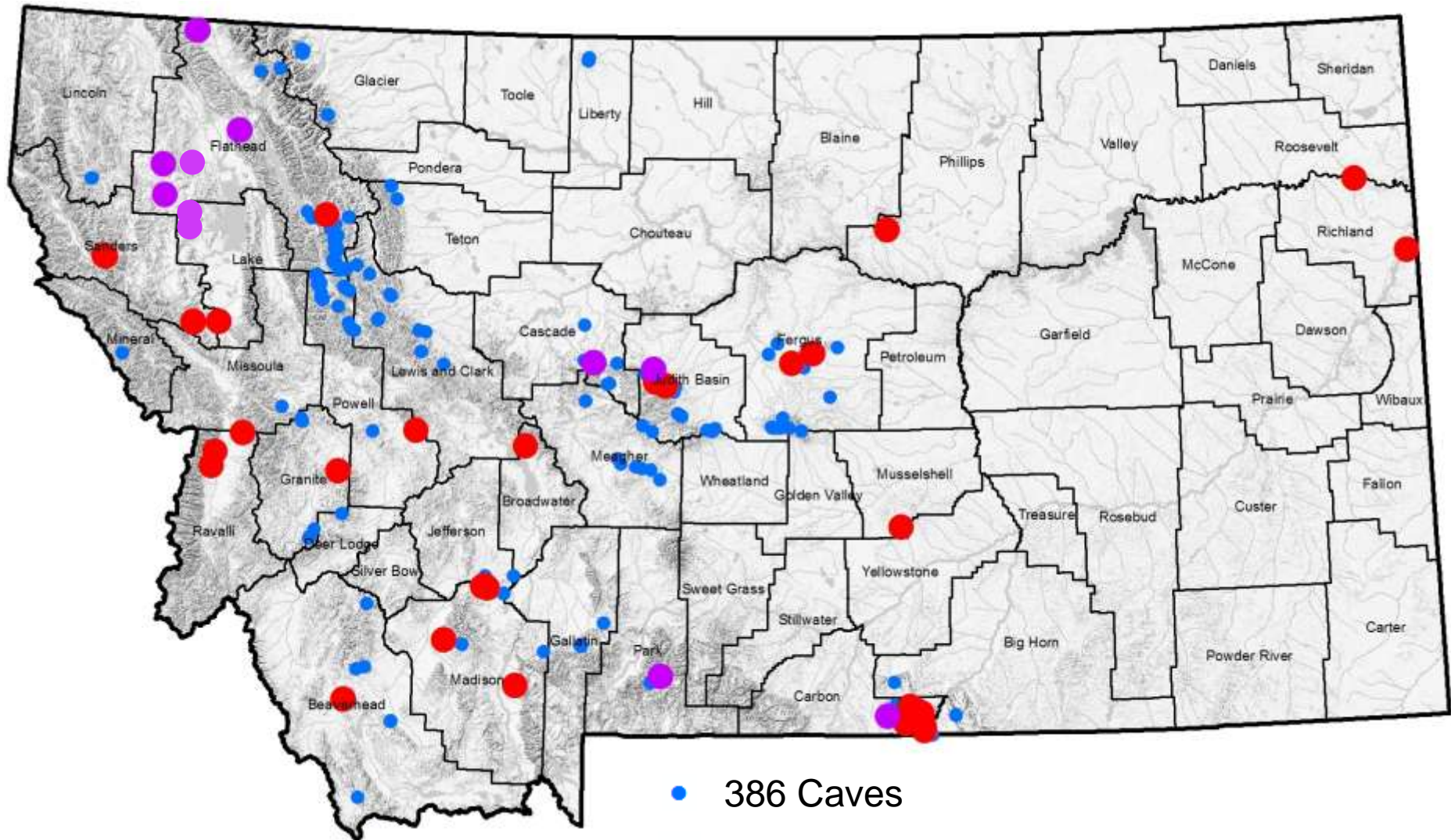
by
Tina Oliphant, Joe Oliphant, Mark Madson,
Russell Everett, James Cummings, Casey Cory,
Rick Brinkman and Hans Bodenhamer



Map and Photo by Hans Bodenhamer



Montana Caves and Known Bat Hibernacula

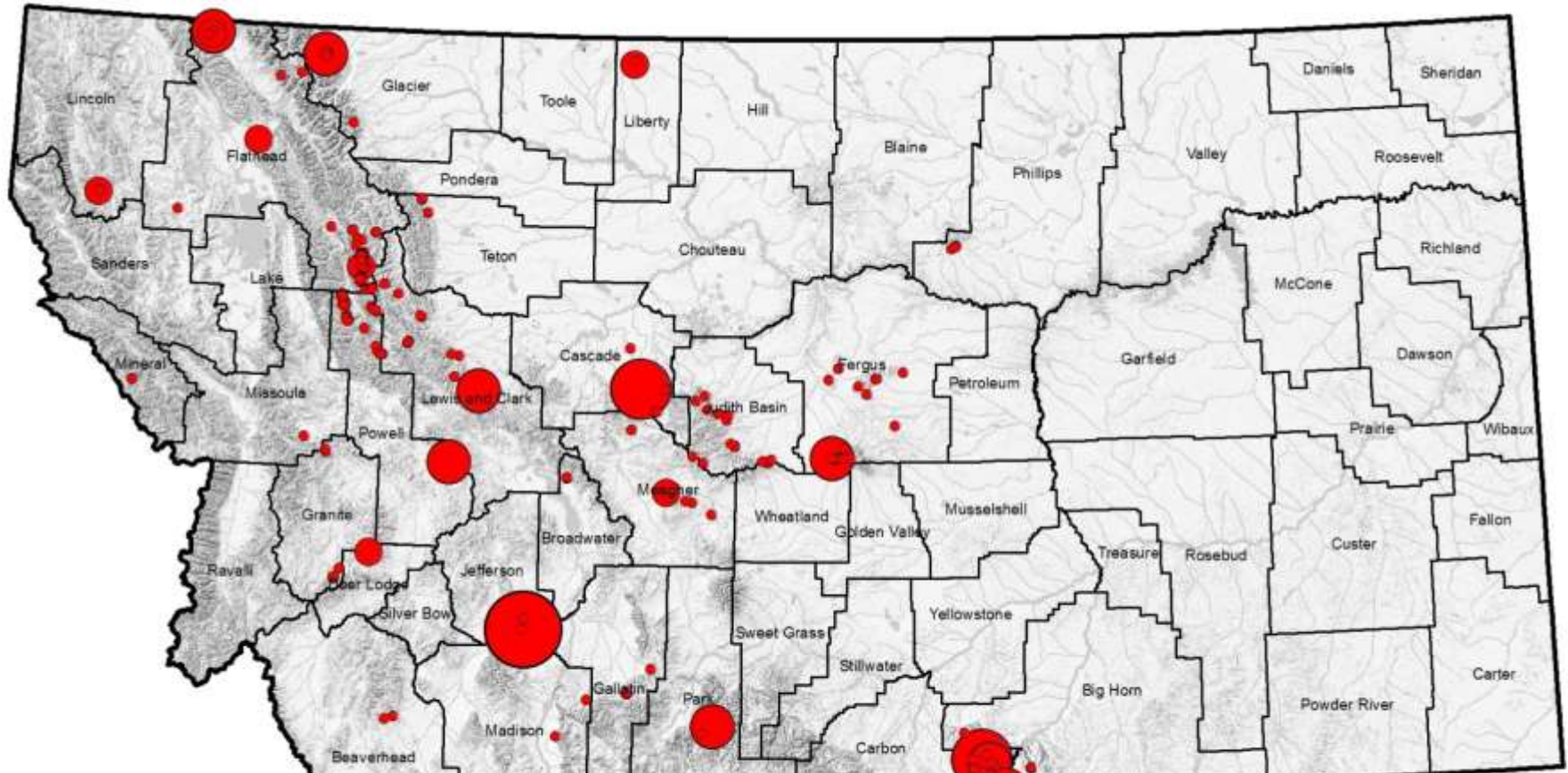


● 386 Caves

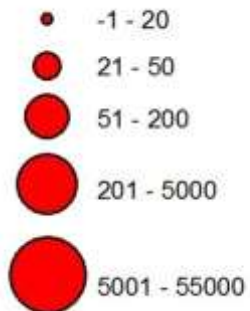
● 41 Hibernacula detected prior to 2010

● 12 new Hibernacula detected since 2010

Annual Estimates of Cave Visitation



Estimated No. Visits



Most Visited Caves (estimated 100+ visits per year)

Lewis and Clark Caverns*
Lick Creek Cave*
Big Ice Cave*
Poia Lake Cave*
Mill Creek Crystal Cave*
Ophir Cave*

Bighorn Caverns*
Snowy Mountain Ice Cave
Yakinikak Creek Cave #1
Yakinikak Creek Cave #2
Blacktail Ranch Cave
 * Bat Use Documented

Numbers of Bats at Montana Hibernacula

Lick Creek Cave

- 140 Myotis species
- 2 Long-legged Myotis
- 1 Long-eared Myotis

Whitaker Sink

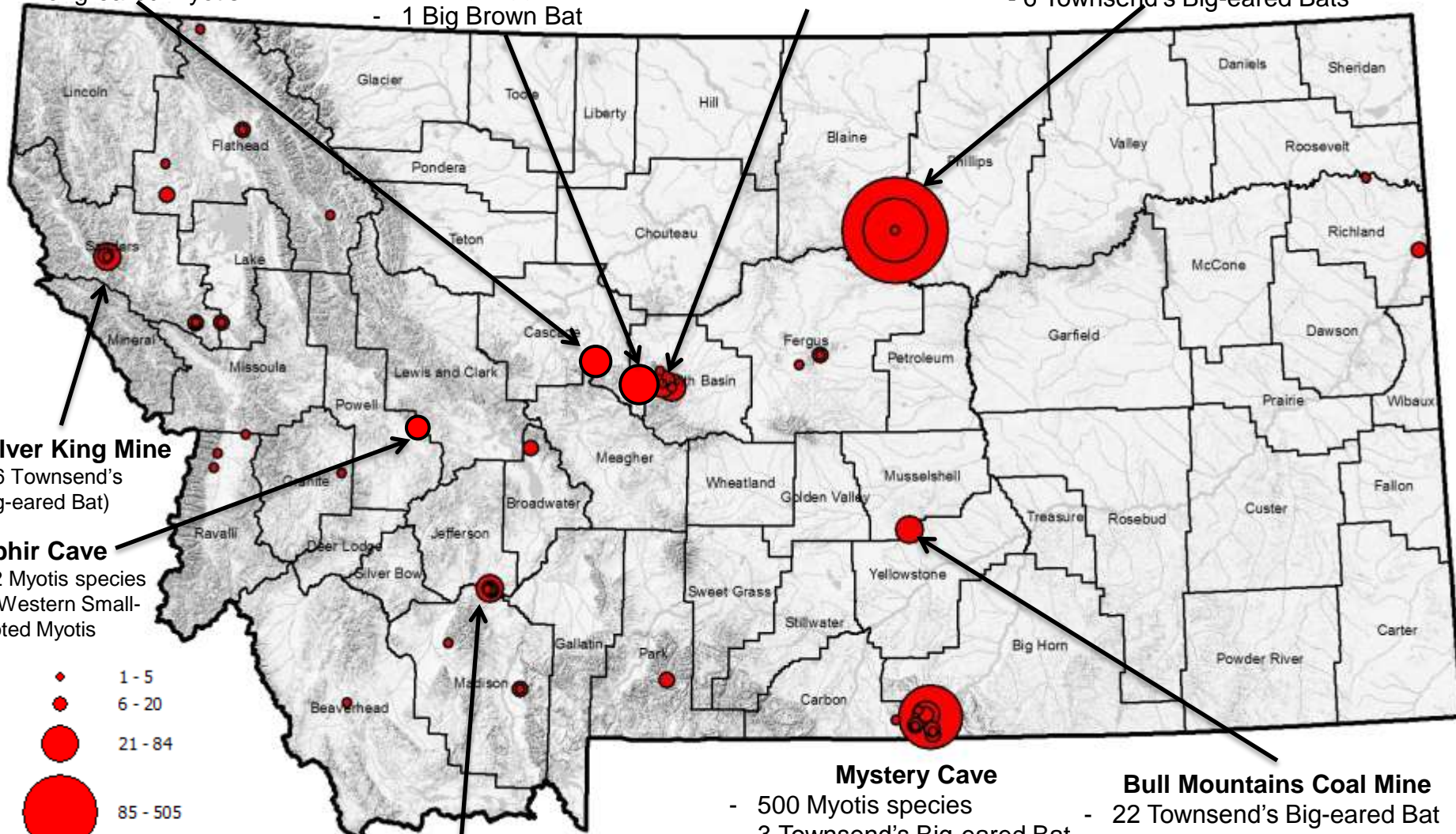
- 214 Myotis species
- 1 Long-legged Myotis
- 1 Big Brown Bat

Old Dry Wolf Station

- 63 Unidentified bats

Azure Cave

- 1751 Myotis species
- 6 Townsend's Big-eared Bats



Silver King Mine

(36 Townsend's Big-eared Bat)

Ophir Cave

-42 Myotis species
-2 Western Small-footed Myotis

Lewis & Clark Caverns

- 14 Townsend's Big-eared Bat
- 3 Western Small-footed Myotis
- 12 Myotis species

Mystery Cave

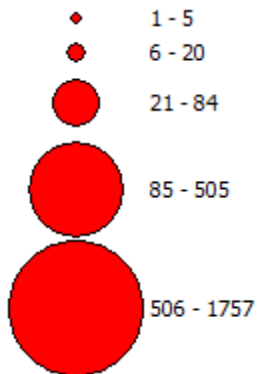
- 500 Myotis species
- 3 Townsend's Big-eared Bat
- 1 Big Brown Bat
- 1 Long-eared Myotis

Bull Mountains Coal Mine

- 22 Townsend's Big-eared Bat
- 14 Western Small-footed Myotis

Little Ice Cave

- 45 Myotis species



Growth of *Pseudogymnoascus destructans*

(Verant et al. 2012, PLoS One 7(9):e46280)

