Deployment protocol for fixed point short-term acoustic detectors (NA Bat)

A supplement to the *Montana Bat and White-Nose Syndrome Plan and Protocols 2012-2016*

Dan Bachen
Senior Zoologist
Montana Natural Heritage Program
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Links to Resources

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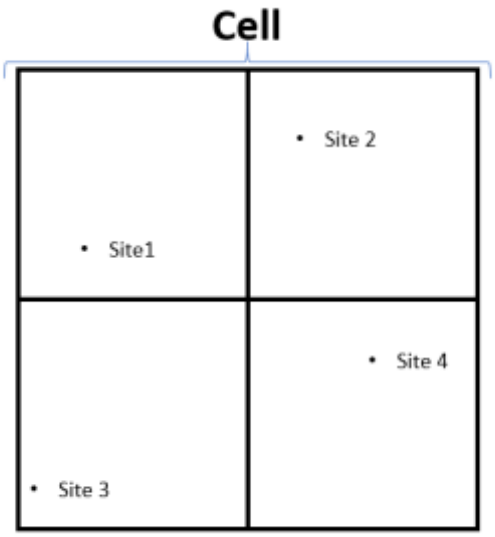
Survey 123 form (mobile and desktop): https://arcg.is/0eeKuq
Site maps (GeoPDF) and resources:
One Drive: https://mtgov-my.sharepoint.com/:f:/g/personal/cwa127_mt_gov/EulJdNmueQZBnjLrES4fdc4BBL3tihDTa6PB7NL0yvoTYw?e=ZoKS7d
Google Drive: https://drive.google.com/drive/folders/1ZB5iHiGko97CqrPt8-3jX9EUq02fi45N?usp=sharing
FTP Site: ftp://nris.mt.gov/public/Bachen/NABatCellMaps

Survey Overview

Four detector/recorder units (hereafter detectors) are placed in one grid cell. Goals are to place detectors at a diversity of features used by bats while avoiding structure that may decrease the quality of the recorded data. Detector recorder units should be dispersed across the cell to the greatest degree possible as allowed by road and trail access. The ultimate goal is to place detectors in such a way that all species present in the cell are recorded.



Terminology

Cell (aka Grid Cell): The unit of survey consisting of a 10 x 10 km square survey area. Cells should have 4 sites, i.e., survey points within. Note cells are sometimes shown quartered to aid in dispersal of sites.

Site: a location within a cell that a detector is deployed at. All cells should have 4 sites established within.

Survey Workflow

1. Scout the site using maps to identify features suitable for survey. The Montana Natural Heritage Program's Map Viewer application can display topographic maps, aerial imagery and land ownership data (http://mtnhp.org/mapviewer/). Grid cell boundaries can be found on the Arc GIS Online project (https://arcg.is/1mHHTT1). Cell boundaries and landscape features can be found in the office and field using the geoPDF files and a PDF viewer or Avenza App.
2. Place 4 detectors at suitable locations within the cell. See following instructions for suitable locations and how to place detectors. Record Cell and site, location (latitude and longitude in decimal degrees), site information, and take a site photograph using the Survey 123 app. When placing each detector make sure:
    a. The site name and number is entered and the location recorded
    b. Detector is on, settings are correct and the unit is functioning
3. Let detectors run for at least 4 nights. For example, deploy Monday and pick up Friday. It is OK to let them run longer if needed (e.g. Monday – Monday) although only the information needed will be analyzed so extending the deployment length is purely logistical.
4. Retrieve detectors
5. Mail in ***labeled*** cards to NHP for analysis (Montana Natural Heritage Program, Care of: Alexis McEwan, 1515 E. Sixth Ave, Helena, MT 59601). Each card should be labeled with the Cell and site number corresponding to the information within the Survey 123 app. The package should include phone number, email, lead surveyor name, and an address to mail the cards back if necessary.

Equipment

Equipment	Number needed per cell*
Detector (e.g. SM4 BAT FS)	4
Microphone with Cable (e.g. SMM-U2)	4
D-cell batteries (4 per detector)	16
SD cards (32 gb or greater, recommend SanDisk SDHC/SDXC)	4
Materials to mount the microphones ~3 meters high (rebar, steel conduit, zip ties)	4
Hammer	1
GPS enabled tablet/ cell phone with Survey 123 project	1

*Note it is possible to survey a cell with fewer units over more recording periods. For example, if you have a single unit you will need to rotate it through 4 sites within the cell over a 4 week period instead of surveying 4 sites within the cell over a week.

Survey Equipment. Two pieces of conduit, a connector, rebar, hammer, detector, and microphone

Non-Detector Equipment

Microphone Support

Support or 'masts' to hold microphones can be made out of a variety of materials. Microphones should be raised to at least 2, preferably 3 meters above ground level.

Mast construction for the older SM2 Bat+ units is covered on page 11 of https://archive.org/details/ZOOWNSPlanAndProtocols20151030/page/n17/mode/2up

Masts for the SM4 detectors and U2 microphones are simple to assemble as the microphone is weatherproof and can attach to a pole with a zip tie. Two sections of ~5 foot steel electrical conduit (1/2 inch diameter) connected with a coupler or 6 inch section of ¾ in conduit crimped or with a screw set in the middle works well.

Conduit: https://www.homedepot.com/p/1-2-in-x-5-ft-EMT-Electrical-Metallic-Tubing-Steel-0550005000/202068069

Coupler to connect conduit: https://www.homedepot.com/p/Halex-1-2-in-Electric-Metallic-Tube-EMT-Set-Screw-Coupling-50-Pack-62805B/202241112

To anchor the microphone support a 12-18 inch section of rebar works well. Use a mini-sledge or hammer to hammer the rebar into the ground and place the mast on the rebar. In rare situations rebar may not provide enough support for the conduit and guy lines may be added. Several 4m lengths of para cord or similar cord/rope can be used with stake anchors.

Figure 2. SM-U2 microphone used for SM4 units secured to the conduit with a zip tie

Figure 1 Home-made coupler made from ¾ inch conduit crimped in the middle used to connect the two pieces of the mast. Pen for scale.

Detector Setup

1. Place rebar in the ground to sufficient depth to support the mast.
2. Attach microphone to the top piece of the mast using a zip tie (SM-U2/SM4) or PVC pipe (other microphones/ SM2 and SM3)
3. Connect mast with coupler and place on rebar
4. Wind microphone cord around the mast or otherwise secure to the mast to reduce noise during windy periods
5. Connect cord to detector
6. Check detector settings and begin survey

Detector Settings

General settings for all detectors

Although we strongly recommend the use of the Wildlife Acoustics SM family of detectors, several manufactures make quality products that can be used for sampling (e.g. Anabat). In this document we provide the specific detector settings for SM4 Bat units in detail (a resource for SM2 Bat+ and SM3 BAT units are referenced below), but we will briefly describe the general settings so that those using other units will collect comparable data.

- Units should be set to record from 30 minutes before sunset to 30 minutes after sunrise (actual sunrise/sunset **not** civil, astronomical, or nautical)
- Detectors must be set and have battery life and SD card space to collect data for at least 4 nights
- All recordings should be full spectrum
- Data should be recorded as .WAC or. W4V files and stored on a SD card. If recordings are stored as uncompressed .WAV files, the SD card should be large enough for 4 nights of recording
- The sample rate should be 384,000
- All calls at or above 8 kHz should be recorded

Settings for Wildlife Acoustics SM2 Bat+ and SM3

The general settings for these detectors are available at:

https://archive.org/details/ZOOWNSPlanAndProtocols20151030/page/n17/mode/2up

Page 16 for the SM2BAT+ and page 19 for the SM3.

However, we are using a few different settings for short-term deployments:

Power: We will use internal power so this switch should be sent to “INT”

Time: We will still use Mountain Standard Time, but to reduce error also Daylight Savings Time. This means that if the detector is set up correctly the time should be the same as what is on your watch or cell phone. **The time zone should be UTC-6**

Labeling: The prefix for files must include the “C” Cell Number and ”S” Site Number (e.g. C86S1 for site 1 in cell 86)

Settings for Wildlife Acoustics SM4BAT FS

Before using these units we HIGHLY recommend reading the manual
http://media.nhbs.com/equipment/SM4-BAT-FS-USER-GUIDE-March18.pdf

Prior to deployment (done in the office)

1. Install new batteries
2. Set **Power Switch** to **INT** (internal). Note this switch functions as the on/off switch for the unit depending on whether it is set up for external or internal power
3. If the menu does not appear use the “Check Status” button to wake the unit up than use the “Stop Schedule” to enter the **Main Menu**

4. Once in the main menu, set the following
    a. **Quick Start**
        i. Select **"Record-30Set->+30Rise.** This sets the detector to run from 30 minutes before sunset to 30 minutes after sunrise
    b. **Settings**
        i. **Audio:** review and change (if necessary) to the following
            1. **Gain** 12db
            2. **16k High Filter** off
            3. **Sample Rate** 384kHz
            4. **Min Duration** 1.5ms
            5. **Max Duration** 50ms
            6. **Min Trig Freq** 7kHz
            7. **Trigger Level** 12 dB
            8. **Trigger Window 2**s
            9. **Max Length** 00m:15s
            10. **Compression** W4V-6
        ii. **Date and Time:** After time zone is set under location use this to check whether the time is correct and adjust if needed
        iii. **Location**
            1. **Prefix:** enter the site name (e.g. C1234S1 for site 1 in cell 1234)
            2. **Latitude:** ***needs to be set in the field after the site is established***. It is necessary to enter a value to check sunrise and sunset and make sure the detector is set correctly. For these purposes the geographic center of Montana will give approximately correct times for setup. Until the detector is deployed enter **46.88N**
            3. **Longitude:** see above. This can be set temporarily to **110.36W**
            4. **Timezone:** Set to **UTC -6:00**
        iv. **Sunrise/Sunset Type:** Solar sunrises/set. This should be approximately correct once the latitude and longitude values are populated. If they are reversed (e.g. sunrise in the evening, set in the morning) check the time zone and make sure its negative.
        v. **Delayed Start:** no
        vi. **LED Indicator**
            1. **Mode:** 5 minutes only. You can leave as always on, but I like to limit this to make the detector less visible.
        vii. **Advanced:** Can ignore for now
    c. **Schedule:** This was set with the quick start option, no need to change.
    d. **Utilities:** Can mostly ignore most of these except for the "Calibrate Mic" and "Format All Cards" functions
        i. **Calibrate Mic:** When selected you should see a – dBV value. If the microphone is unplugged, the value should be -80.59 and not change. Plug the microphone in and snap your fingers or shake keys next to it (create ultrasonic noise) and the value should change if the microphone is functioning.

5. Insert an SD card into Slot A. Use the "**Format all Cards**" in the **Utilities menu** to format the card.
6. Back out to the Main Menu screen
7. Turn the detector off by moving the power switch to EXT (external)

In the field

1. Turn the detector on (power switch to INT) and navigate to the main menu (see previous instructions)
2. **Set the location (latitude and longitude in decimal degrees**) of the detector
3. **Double check that "Prefix"** is set to the site and cell and matches the Survey 123 app
4. Connect the microphone and cable, set up mast
5. Use the Calibrate Mic utility to check microphone function
6. Back out to the Main Menu screen
7. Press the Scheduled Start and confirm that there no errors and that the unit will record at sunset that evening
8. Shut case and return after 4 nights

Site Selection and Detector Placement

Goals are to place detector/recorder units at a diversity of features used by bats while avoiding landscape structure that may decrease the quality of the recorded data. As most cells have been surveyed, placement at past survey points is ideal. If the features or landscape has changed such that sites may no longer attract bats, or the cell has not been surveyed please use the following guidance for establishing sites.

Spatial considerations

To the greatest degree possible, detectors should be placed so that the entire cell has coverage. Ideally each ¼ of the cell would have a detector placed within it. If portions of the cell are inaccessible or are unsuitable for survey, the detectors should be placed within the suitable area maximizing separation within suitable habitat types. Detectors should also be placed to best represent habitat within the cell. For example, if a cell includes valley bottom and higher elevation meadows, an effort should be made to place detectors in each.

Features to target for surveys

- **Waterbodies**: Used by all species to drink and by some species to forage. Areas of calm water/ pools on streams and rivers. Ponds and lakes of all sizes. In dry areas this includes stock tanks, seeps, and other marginal water sources. As always, high clutter environments (defined below) should be avoided. Water sources with clear flyways are used by the greatest diversity of species
- **Openings in the forest/forest edges**: Used for foraging and travel by many species.
- **Rock outcrops/canyons/badlands**: Provide roosts for many species
- **Caves/mines/buildings/bridges**: Day and night roosts. Be cautious about placing the microphone too close to a roost as multiple animals in the same air space can impact call quality and make species identification difficult. Also be cautions of placing detectors next to reflective surfaces such as walls or abutments as reflected calls are difficult to identify.

Things to avoid

- **Clutter**: Clutter can be defined as any structure that impedes the flight of bats including trees and tall shrubs, structures like buildings, and rock features. Anything that adds complexity to an animal's air space that they will have to keep tabs on and actively avoid flying into. When approaching these objects, bats will change the shape of their calls to acquire more information. This changes call shape and decreases quality which makes species identification more difficult. Detectors should be placed 20-30 m away from clutter if possible with microphones oriented toward open areas. Sometimes clutter is unavoidable, but placements should seek to minimize it whenever possible.
- **Reflective surfaces**: Rock walls, surfaces of structures, and water. Give ample space between the microphone and theses surfaces as reflection of calls makes analysis difficult

Roost entrances/exits: Avoid placing the microphone directly at the entrance to a roost. Animals sharing airspace will alter their calls to reduce confusion. This can create atypical call sequences and make analysis difficult. Instead place the detector at a minimum of 15-20 meters away from the entrance to allow animals to spread out.

Site Examples

Detector is deployed on the bank above water level. By placing the microphone above the water, reflection of sound off the water is reduced as is the temperature difference between air and water which can distort calls.

This microphone is placed to record animals foraging and drinking over the river and to record any animals roosting in the embankment behind. Note that the microphone is placed on a berm above the river to reduce reflection and thermal interference. The microphone is also set away from the embankment so any roosting bats have a chance to spread out after emerging which reduces the instance of atypical and social calls. The microphone is also oriented away from the face of the embankment to reduce reflection off of this feature.

Again this detector is placed above a water source to reduce call distortion while recording foraging and drinking bats. The microphone is also placed as far away from the trees (clutter) as possible to reduce atypical calls.

This microphone was placed in a field adjacent to a shallow pond. As we were not able to place the detector above the waterbody we moved the detector back so that the water was at the edge of the sphere of detection to avoid call distortion. The detector is also placed a similar distance from the edge of the forest. Species foraging along the edge will still be recorded but animals traveling through the forest will not be.

Talus and rock outcrops provide roosts for a diversity of species. This microphone is placed away from clutter on a talus slope. Although the microphone is potentially placed on or in close proximity to roosting animals, day roosts in talus seem to be dispersed and a high density of emerging bats in close proximity to the microphone is unlikely.

This detector is placed in a wash surrounded by small rock outcrops. The detector is placed away from the juniper (clutter) and far enough away from the rocks that reflection off these surfaces is not a problem. However the rocks are close enough to the sphere of detection so that bats communing from day and night roosts will be recorded by the detector.

This detector is placed next to a mine adit (approximately 2.5 m in diameter). This mine is used as a day roost, night roost, and to drink as there is a small pond that is the only water source in the area. The detector is placed 15 m away from the entrance to reduce the density of animals and increase call quality.

The detecor may be hard to see in this photo, but is placed near the treeline on the right hand side. It was paced to assess bats foraging over this field and along the forest edge within a stand of aspens. The best placement option would have been in the middle of the field, but as a well traveled road passes close by we chose to place at the margin to reduce chances of theft.

This microphone is set in a wet meadow bordering a riparian area. It is placed in the center of the opening to reduce the impacts of clutter.

Examples of what not to do

The microphone is attached to a fence post abround 1 meter off the ground. Not only is there clutter at microphone level, the temperature difference between the ground and air at sunset can interfere with call quality and make analysis difficult. Masts that raise the microphone at least 2 meters above the ground, preferably 3 meters, should be used to prevent this.

Maps

Georeferenced PDFs used in combination with a GPS enabled smartphone or tablet, provide a good resource for those conducting surveys by displaying the person's location in reference to the cell boundary and survey features.

Cell maps are stored on an external ftp site. We have created three map types:

1. Cell boundary over air photos
2. Cell boundary over a cadastral base map with water features
3. Cell boundary over a 100k topo map

Each type of map is stored in its own folder and the maps are labeled by cell number. To access these folders past the following address into a web browser or click on the link below.

FTP: ftp://nris.mt.gov/public/Bachen/NABatCellMaps

Google Drive: https://drive.google.com/drive/folders/1ZB5iHiGko97CqrPt8-3jX9EUq02fi45N?usp=sharing

OneDrive (state of MT employees): https://mtgov-my.sharepoint.com/:f:/g/personal/cwa127_mt_gov/EulJdNmueQZBnjLrES4fdc4BBL3tihDTa6PB7NL0yvoTYw?e=ZoKS7d

To use these on a mobile device you will need to do two things:

1. Load the pdf maps onto the device either through connecting to the FTP site, which may require a separate app, cloud storage (Dropbox or Google Drive), or emailing to yourself
2. Download a georeferenced pdf viewer app (Avenza) to view the maps with your location

Getting the maps onto a mobile device

First option: directly from the FTP site.

1. Try to navigate to the ftp site on your phone or tablet by putting the ftp address into a web browser. If this works, navigate to the file and download.
2. If this returns an error, go to the app store, search "ftp", and download an ftp manager or access app. I used "FTPManager" which works well. Establish a new connection to the ftp site ("new" or "+"), enter ftp://nris.mt.gov/public/Bachen/NABatCellMaps in the Host Name or IP box.

Second option: Use cloud storage that can be accessed on the device

1. Navigate to the files you need on the FTP site using a personal computer. Save these files to Google Drive or DropBox that is accessible on your mobile device.
2. Access the files on your mobile device and save to the device

Third option: Email to the device

1. Navigate to the files you need on the FTP site using a personal computer. Download the files and attach to an email, address this email an account that is available on the mobile device.
2. On the mobile device, access the email and download to maps to the device

Viewing the maps on a device

1. Download “Avenza” from the App Store or Google Play. It will prompt you at various points to upgrade to a version that requires a subscription. The free version should work for our purposes.
2. Open Avenza. Find the “+” within the top bar. Use this to add a map. Select the “From Storage Locations” option.
3. On the top bar there should be an option of on my device (e.g. “On My iPhone”). Click this.
4. Navigate to the location of the map and select it. Note that if you are using the free version, you are only allowed to display 3 maps at a time so managing these in the app may be necessary.
5. You should now be able to view the map.

Data Collection with Survey 123

We will collect site data using a Survey 123 application that can be loaded onto a cell phone or tablet. This is best done with a GPS enabled device that has a camera. If you do not have access to a device that can be used for this purpose, you can also use a desktop computer to enter these information, however you will need a GPS, camera, and field notebook instead.

To set this up:

1. In the App Store or Google Play search “Survey 123” and download
2. Click the app and follow the prompts to make sure it has loaded/ is set up. Note that you do not need an ArcGIS online account to use
3. Once this app is installed, click this link to load the survey: https://arcg.is/0rr1fO

The survey is also accessible on a personal computer at the following link: https://arcg.is/LnXTL

Survey Fields:

Surveyor: Name of the primary contact for the survey (Last, First) or the ArcGIS username of this individual.

Additional Surveyors: any additional people who are conducting this survey

Date (Start): Date the detector is deployed

Date (End): Date the detector is retrieved. This will need to be edited after retrieveing the unit

Location of Survey Site: If using a GPS enabled device this will populate with the latitude and longitude of the survey location as well as the precision of this value. Please pay attention to the precision. If the survey has just been loaded GPS coverage is poor, the precision may be low. In this case wait until it improves, or if it is not improving, click the map and center the pin on your location using the map.

Cell Number: This is the Cell (GRTS) number which is numeric and up to 4 digits long and corresponds to the other maps. The ArcGIS online project can be used to find this.

Site Number: Each detector placed within a cell is assigned a unique number between 1 and 4 by the surveyor.

Site Type: Select the value that best describes the site.

Site Description: A brief description of the site where the detector was placed. For example:

> "Detector placed between talus slope and reservoir. Area dominated by sagebrush."

Distance to Clutter: How close the detector is placed to trees, tall brush, buildings, cliffs, and other features that may obstrutct the flight of bats. If the detector is in the open and no clutter is visable do not fill a value.

Distance to Water: How close the detector is to a stream, river, pond, lake, or other source of water used for foraging or drinking. Keep in mind that bats often use small watersources like puddles in ruts in the road and small pools associated with springs.

Detector Type: Model of detector used

Detector Serial Number: A unique number to identify the detector deployed at the site. This helps us identify units that are malfunctioning

Microphone Type: Model of the microphone used for the survey

Microphone Serial Number: Serial number of the microphone

Site Photos: Please take at least one photo of the detector deployment. The photo(s) should show any significant landscape features that may attract bats or otherwise impact acoustics at the site. Note that there is a known bug that may cause the app to crash if you try to add photos previously taken and stored on your phone. If this occurs you can restart the app and continue the survey. You can then email the photos (labeld by cell and site) to dbachen@mt.gov.