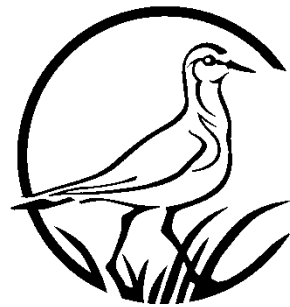# Overview of Deploying Microphones & SM2Bat/SM2Bat+ Detector/Recorders and Subsequent Data Analyses

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MONTANA
Natural Heritage
Program
http://mtnhp.org

# Deploying Microphones to Record High Quality Call Sequences

Considerations for Selecting Passive Acoustic Monitoring Locations

1. Does location fill gap in statewide acoustic monitoring scheme?
2. Does location provide information to inform local management decisions?
3. Is roost habitat available in the nearby landscape, preferably year-round?
4. Is surface water available in the nearby landscape, preferably year-round?
5. Is there adequate solar exposure for powering the detector/recorder?
6. Is the site free of vegetation or other biotic and abiotic sources of ultrasonic noises (e.g. running water, electric lines, shrubs)?
7. Is the detector at risk of damage from vandalism, cows, or other hazards?

DON'T DO THIS!
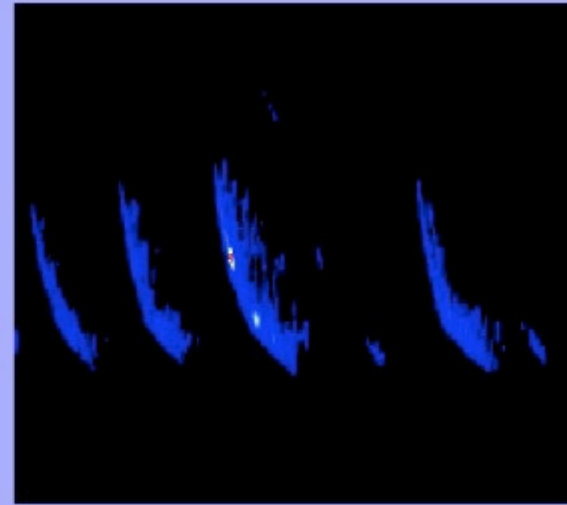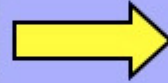
DO THIS!
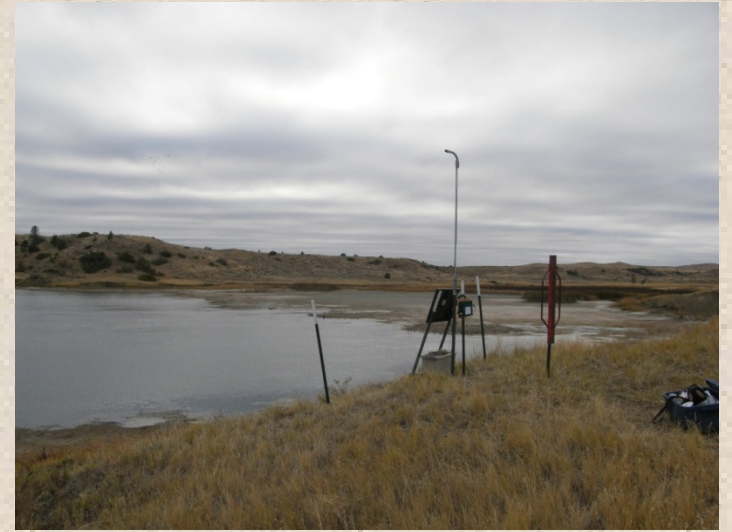
SM2Bat and SM2Bat+
Detector/Recorder Settings Overview

Wake/Exit Button: used to power unit up or down between recording sessions to check settings and card memory status. With latest firmware can hold wake/exit down to start recording during a scheduled recording session when power was added after scheduled start time.

Back, Up, Select, and Down buttons: used for programming internal settings. Can press Up and Down buttons at same time outside of a programmed recording session to force a ~45 minute recording session and can press the Back button to stop this recording. During a forced recording session you can listen with headphones and see the level of sound on the display by pressing the Select button

External power connection

Headphone jack

Internal Power from D-cell batteries. AA batteries on right are for internal clock.

External Sensor Connector (SM2 only)

Reset (SM2 only): Used to abort a recording session

Left and right microphone jumpers (SM2) or switches (SM2+) that control the bias (on), high pass filter frequency setting (1,000 Hz), and gain (48 dB). For the SM2 + switches 1 & 7 are on and all others are off. For the SM2 the upper two jumpers are all the way to the right and the lower two jumpers are staggered so that both are at 24 with the lowest all the way to the right.

Power Source Jumper (SM2) or Switch (SM2+) for external or internal power.
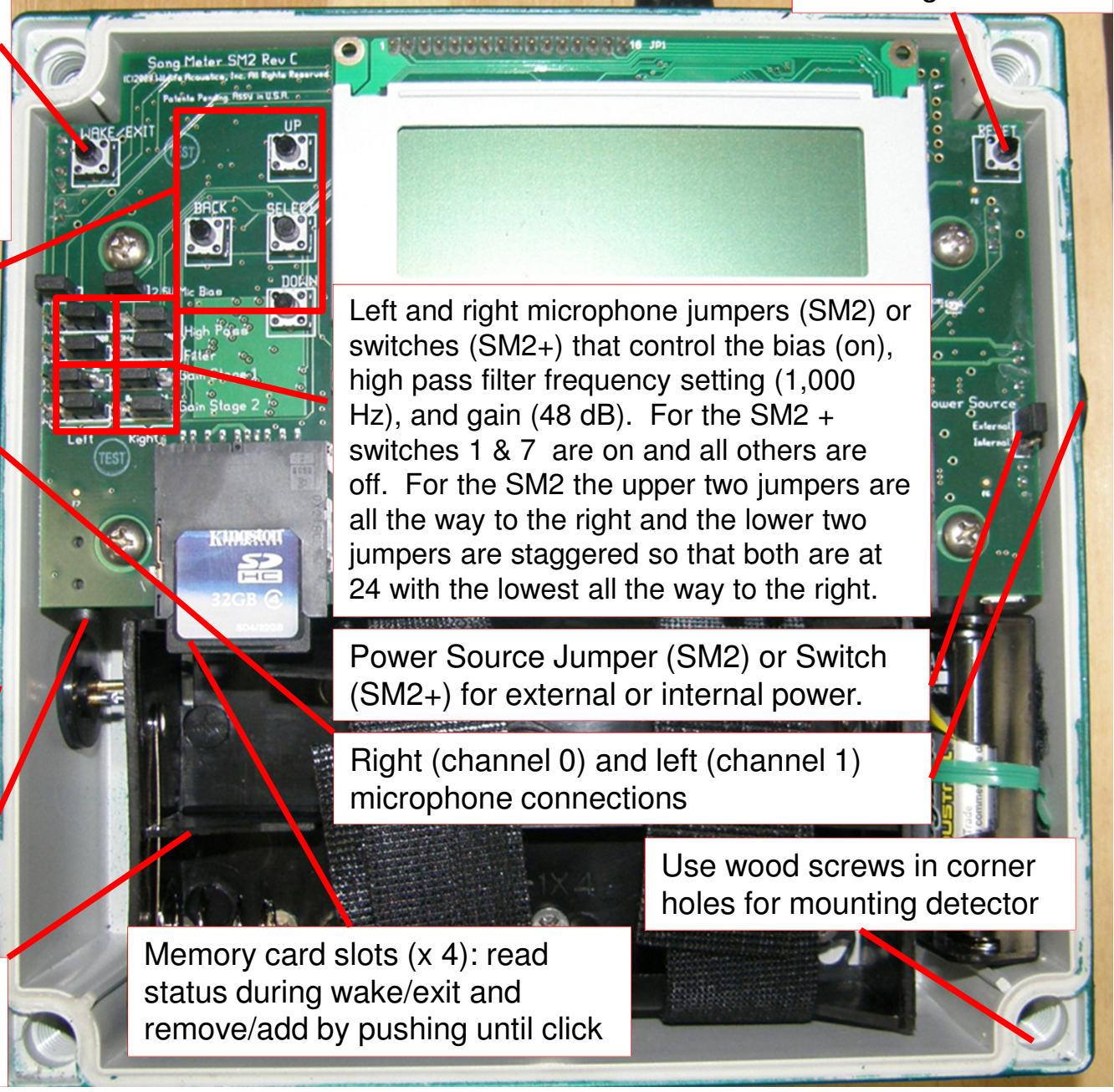
Right (channel 0) and left (channel 1) microphone connections

Use wood screws in corner holes for mounting detector

Memory card slots (x 4): read status during wake/exit and remove/add by pushing until click

Schedule Settings

1. Push Select to get to main menu and push it again to select Schedule
2. Push Up or Down to select advanced and push select
3. Program the following six lines of code by pushing select and then using the Up or Down buttons to select the relevant line of code
   01 At SSET-00:00:00 (use this to start recording a specified time before/after sunset)
   02 DO
   03 Record 00:30:00 (you will need to push Select and Up to program the 30)
   04 GOTO LINE 03 0X (e.g., you could record for a total of for 2 hours by specifying 3X)
   05 UNTSRIS+00:00:00 (use this to start recording a specified time before/after sunrise)
   06 GOTO LINE 01 0X (e.g., you could record for a total of for 7 nights by specifying 6X)
4. Push Back to get back to the main menu

Utility Settings

1. Push Select to get to main menu and push Down and Select to get to Utilities
2. Select "Go to sleep" to ensure that the SM2 is turned off, won't use much power and will wake in the middle of a recording session if Wake/Exit is pushed
3. Select "Load a config from A:" to load a new recording configuration you have programmed in Song Meter Configuration Utility or that you have saved after programming an SM2.
4. Select "Save A:SONGMETR.SET" to save the current recording settings into a configuration file.
5. Select "Erase all cards" to do that. However, probably better to just erase data while hooked to your computer after the data has been backed up. Cards might need to be periodically reformatted using SDFormatter V3.1 or later software
6. Select "Set factory default" to return to default recording settings.

Upgrading Firmware

1. Load the new firmware onto an SD card from the Wildlife Acoustics website http://www.wildlifeacoustics.com/wa-php/downloads.php
2. Insert the SD card into Slot A of the detector.
3. Hold the Up button down as you hit and release the Reset button (SM2) or turn the power switch off and back on (SM2+) until you see the boot message
4. Your SM2 file will show up and use the Up/Down and Select to select it
5. Press Reset (SM2) or turn the power switch off and back on (SM2+) to reboot and the screen will tell you it is "Upgrading" and "Complete"

Time and Date Settings

1. Press Select and then Down and Select to select the Settings menu
2. Press Select to select the Time and Date menu
3. Use Select, Up/Down, and Back to set the correct standard time. DO NOT USE DAYLIGHT SAVINGS TIME (set off of a GPS if you can)

Location Settings

1. Press Select and then Down and Select to select the Settings menu
2. Press Down and Select to select the Location menu
3. Select "Prefix" and use the Up/Down and Select to enter letters in a prefix that will be included on all resulting sound files (exclude spaces using camel hump format)
4. Use back to get to Location menu then Down to Select and enter North Latitude and West Longitude coordinates rounded to the nearest 2 decimal places.
5. Use back to get to Location menu then Down to Select and enter the Timezone. Montana is -7:00 hours from GMT.

Sensors Settings (not typically used)

1. Press Select and then Down and Select to select the Settings menu
2. Press Down and Select to select the Sensors menu
3. Use Select, Up/Down, and Back buttons to select sensor settings for an external temperature, anemometer, barometer, or other sensor callibrated by hand.

Audio Settings

1. Press Select and then Down and Select to select the Settings menu

2. Press Down and Select to select the Audio menu and use the Up/Down, Select, and Back buttons to enter the following Audio Settings
   Sample Rate = 192,000
   Channels = Mono-R, Mono-L, or Stereo depending on microphones deployed
   Compression = WAC0
   Gain Left and Right = leave at 0.0 dB. These are only set with jumpers/switches
   Advanced Settings
       Dig HPF Left and Right = Off if not in use and fs/24 if in use (192/24 = 8 kHz as minimum frequency in order to filter out sounds below Spotted Bats)
       Dig LPF Left and Right = Off since we don't want to remove highest frequencies
       Trg Lvl Left and Right = Off if not in use and 18SNR if in use (SNR = signal to noise ratio)
       Trg Win Left and Right = 2.0s so that call sequence won't be recorded within 2 seconds of one another
       Trg Max Length = 0s
       Div Ratio = 16
       Nap Trg Lv1 = off

Other Important SM2 Notes

1. If power is not provided to the detector/recorder until after the beginning of a scheduled recording session or if you are making changes in the settings menu during the beginning of a scheduled recording session, the detector will not record that night and will instead start recording the next evening. If this happens, you can hold the Wake/Exit down to force recording to initiate. The display will read "Backing up…" and then "Recording…."
2. If you are moving the detector around during a recording session, unplug the microphone(s) or have the unit "Go to Sleep" in the Utilities Menu to avoid recording noise artifacts
3. You can force the SM2 to record outside of a scheduled recording session by pressing the Up and Down buttons at same time outside of a programmed recording session. This will force an ~45 minute recording session and you can press the Back button to stop this recording. During a forced recording session you can listen with headphones and see the level of sound on the display by pressing the Select button.
4. If you are recording a bat of known identity for a reference call, record the time of the recording in your field notebook so that you can match it up with the time stamped recording

Checklist for Checking SM2Bat and SM2Bat+ Detectors 1

Tools Needed
- Phillips Screw Driver for opening detector
- Multimeter for checking voltage
- Rag for cleaning solar panel

Checklist
1. Check microphone cover to make sure it is intact (i.e. no bird damage). The cover will turn orange, but still provides protection to the microphone if intact. If damaged, the cover needs to be replaced in order to ensure the microphone is protected from weather damage.
2. Check that the microphone cable is connected at the detector.
3. Clean solar panel to make sure it is free of dust, bird feces, etc.
4. Check power cable connections on detector, voltage regulators, and battery to make sure everything is connected.
5. Check voltage of battery with the multimeter. Hopefully it is in the range of 12-13 volts. If it is below 11 volts there is a problem.
6. Check that "charging" (red) and "power out" (green) lights on charge controller are on; sometimes hard to see in direct sunlight so cup your hands over them. If the voltage is 12-13 volts then this isn't a big deal, but if voltage is below that, the power and charging lights provide important information to diagnose problems with battery charging issues.

Checklist for Checking SM2Bat and SM2Bat+ Detectors 2

7. Take the cover off the detector recorder with the Phillips Screw Driver and:
   a. If the screen doesn't power up when you take the cover off, push the Wake/Exit button in the upper left.
   b. Record the % full reading for each card.
   c. Remove cards that are full or that haven't been downloaded within the last 2 months and mail them to: Bryce Maxell, Montana Natural Heritage Program, P.O. Box 201800, 1515 East Sixth Ave., Helena, MT 59620-1800
8. Shift empty cards on the right to the left (i.e. towards slot A) and add empty cards in at the right so that 4 cards are in the detector from May through September and at least 2-3 cards are in the detector from October through April.
9. Make sure cards are reading in their new slots. If they aren't, push the Wake/Exit button to put the unit to sleep and then wake it up again.
10. If interested or if there have been recent problems with the detector check that the detector recorder settings match those in the slides above.
11. Put the detector to sleep by pushing the Wake/Exit button and take note of the time when the detector says it is going to sleep until. The time should correspond with the standard time for sunset; i.e. one hour before sunset while we are on daylight savings time and at sunset once we are back on standard time during the winter.
12. If for any reason the screen freezes during your visit, turn off the power using the external/internal power switch/jumper in the middle of the right side of the unit.
13. If there are problems during your visit and you have cell phone coverage you can call Bryce Maxell for help at: (406)-444-3655 (office) or (406) 461-1279 (cell).

Work Flow for Processing Acoustic Files from SM2Bat and SM2Bat+ Detector/Recorders

Overview of Processing Acoustic Files

SM2Bat and SM2Bat+ (single night or longterm deployment)
1. Remove card and use card reader to copy .wac files to computer. Archive original .wac files for potential reanalysis in the future.
2. Convert .wac files to .wav files using Wildlife Acoustics WAC to WAV Conversion Utility
3. Compensate for SM2 microphone using Sonobat Batch Compensator Utility
4. Eliminate nonbat noise files using Sonobat Batch Scrubber
5. Batch attribute files using Sonobat Batch Attributer
6. Batch analyze files using Sonobat Batch Analysis Utility
7. Hand check files identified to species against call key
8. Manage call analyses in Access database for long-term deployments involving thousands of sound files.
9. Summarize call data using pivot tables.

WAC to WAV File Conversion and elimination of noise files

SM2 Batch Compensator
Compensates for slight frequency shift (higher) by SM2 SMX-US Microphone
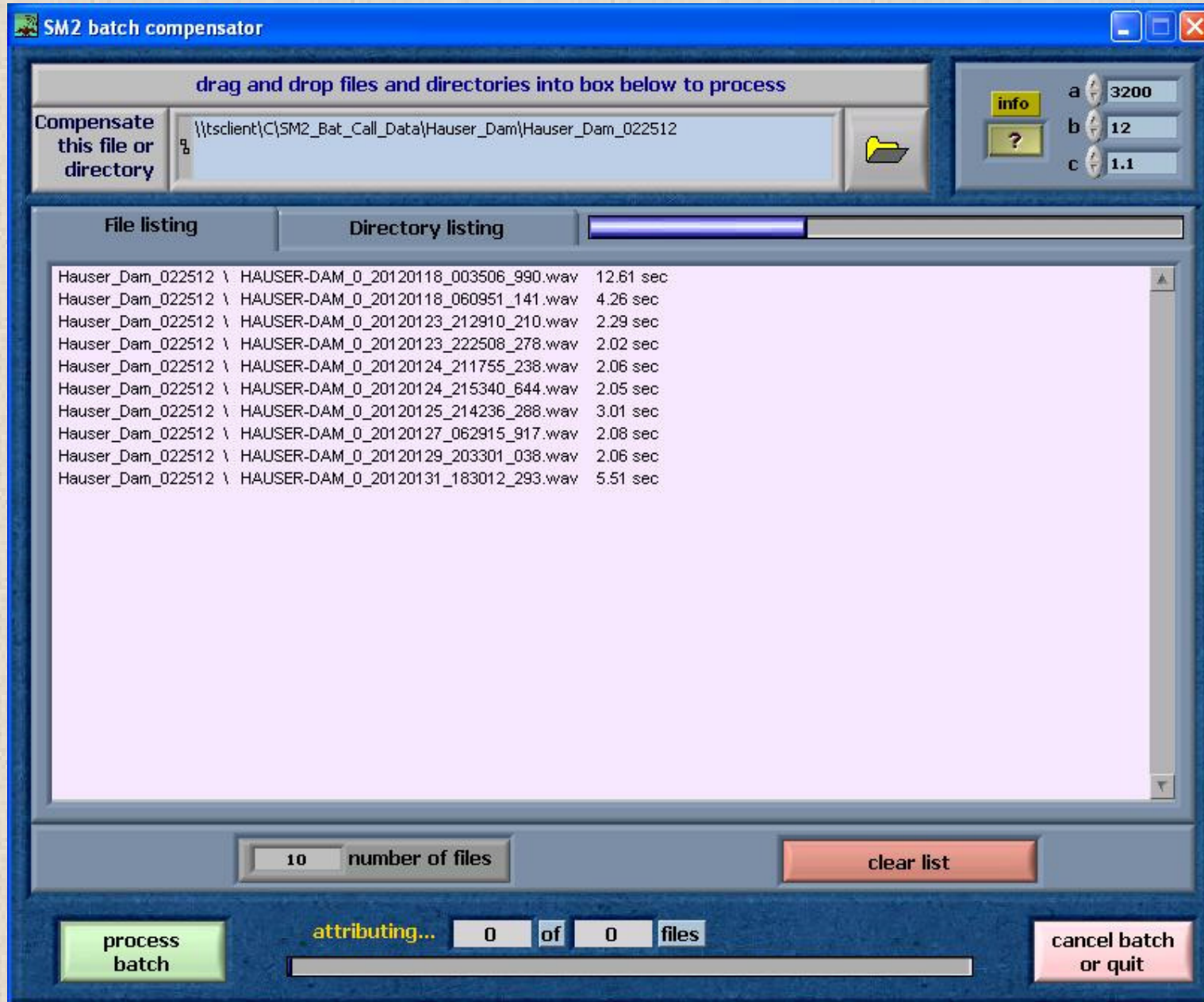
SM2 Batch Scrubber
Scrubs noise files


SonoBat Batch Scrubber 3.vi

This utility will scan through the specified directory to recognize files lacking bat calls, for example files triggered by noise and move them into a directory named "Scrubbed Files" in the same directory as the searched files. The search logic seeks signals with a smooth trend in frequency. *Caveat:* the search logic rejects call segments less than 2 msec, weak signals, and also voice note files. Files must also be in .wav format to scan.

browse to or drop the directory to scrub:

\\tsclient\C\SM2_Bat_Call_Data\Hauser_Dam\Hauser_Dam_022512

browse

right/left channel to search for stereo files: R

default scrub- looks for calls at all frequencies equally

?

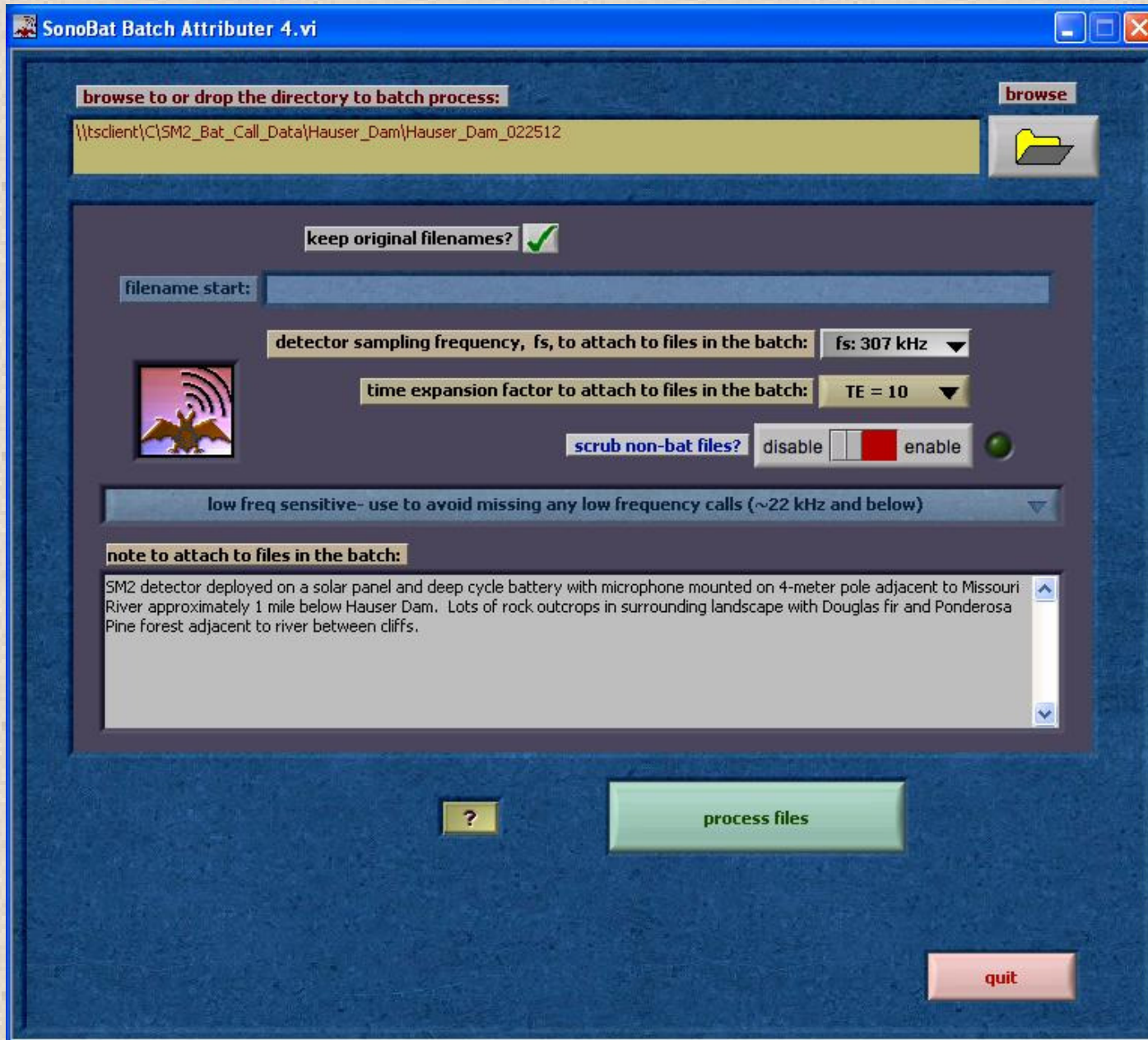**scrub files <rtn>**

file   HAUSER-DAM_0_20120118_060951_141.wav

scrubbing...   **2** of **10** files   **0** files scrubbed

quit

SM2 Batch Attributor
Batch Attribute Files

Automated Analysis with Sonobat 3.0 or Later

Note: Use Mountains version for mountainous areas of western Montana. Use South version for eastern Montana Great Plains habitats south of the Missouri River. Use Plains version for eastern Montana Great Plains habitats north of the Missouri River.

Hand Check of Automated Analyses with Sonobat 3.0

1. Use "Mountains" version for mountainous areas of western Montana. Use "South" version for eastern Montana Great Plains habitats south of the Missouri River. Use "Plains" version for eastern Montana Great Plains habitats north of the Missouri River.
2. Use Szewczak and Weller (2006) dichotomous acoustic key with only call characteristics listed as definitive used to definitively assign a call sequence to a particular species identification.
3. Check calls identified to species by Sonobat 3.0 or later batch analyses within each month until each species has either been definitively identified as present during that month or until all calls have been reviewed by hand.
4. Check all call sequences associated with temperatures below 4 degrees Celsius to verify that they are bats and, if possible, what their species identity is.
5. Check other calls of interest as needed (e.g. to identify migration date range within a month or examine calls with particular frequencies, durations, or other characteristics etc.).