# EMCLA Autonomous Recording Unit (ARU) DeploymentProtocol

# Including testing, activation, deactivation, field deployment and data management

# **Overview of ARUs:**

Autonomous recording units (ARU's) are used to remotely survey a variety of species such as birds, amphibians, and bats. On this project, the brand of ARU that we are using is the Song Meter made by Wildlife Acoustics. The units are designed to record autonomously for long periods of time to conduct bird surveys. While most of our Song Meters are the SM2+ model, there are 3 other models that you may have to deploy. The basic operation of all models is the same but there are a few programming differences to be aware of. This protocol will walk you through all aspects of using Song Meters from programing to field deployment and data storage.

The field part of this protocol focusses on the forest and wetland ARU deployments for the EMCLA. It does not cover project specific sampling design or site selections. Always check these details with your project supervisor so the deployment locations are correct for the project you are working on. Some adjustments in mounting design may be required. For example, wetland areas do not have trees and you may have to use a stake or other method to secure the ARU in place.

The first step is to familiarise yourself with both the Song Meter bird recording units and the software used to program them. Read the User manual for the Song Meter and practice using the Song Meter Configuration utility. Also talk to someone who has experience programming these units. The Wildlife Acoustics website is also a useful source of information.



Figure 1. External ports on SM2+ units.



Figure 2. Diagram of the inside of SM2+

# **SECTION 1: Activation and Deactivation**

This section covers what you need to know about starting an ARU up to run in the field and how to stop it when you pick it up.

# Activating the ARU

- 1. Attach microphones to each side
- 2. Use Philips screwdriver to open lid. (Use a large size screwdriver so that you do not strip the screws.)
- 3. Press the "Wake/Exit" button to start the unit or turn on the power switch.
- 4. Wait for the unit to initialize
- 5. Press "Select" button to go to setting options.
- 6. Scroll down to Location
- 7. Select "File Prefix"
- 8. Change the file prefix to the site and station name using the correct format (Project specific)
- 9. Press select twice at the end of the file name to save the changes

- 10. Use the "Back" button to navigate back to the start-up screen
- Press "Up" and "Down" button simultaneously to do a test recording (see Section 4) Press "Select" button during the recording to look at gain levels for left and right microphones. Numerical and visual gain indicators should be identical.
- 12. Press "Back" button to stop test recording
- 13. Press the "Wake/Exit" Button to put the unit in standby. It should show a message saying: "Going to sleep until <date and time> before it shuts off. Date and time should correspond to the start time programmed into the SET file. This will vary depending on the recording schedule that a specific species or project requires.

2011-Sep-16 13:34:12 Going to sleep until 2011-Sep-16 05:30:00

# Deactivating the ARU (at pickup):

- 1. Open the lid
- 2. Press the "Wake" button
- 3. Use "Select" button to leave start-up screen
- 4. Scroll down to "Utilities". Select.
- 5. Select "Go to Sleep". The unit will turn off completely and stop recording
- 6. Then turn the power switch to the off position
- 7. If the ARU is mid-recording when you arrive, you can either wait for the recording to finish or press the "Back" button to stop the recording and then follow the steps above.

# **SECTION 2: Field Deployment**

This section will walk you through how to mount the ARU to a tree and a few other bits of information for successful deployment. Always make sure that you are following project specific instructions to find the correct ARU location.

The following equipment is needed to complete the job (in addition to regular field equipment):

- ARU kit: ARU with mounting brackets, lock, cable, key, 2 microphones in hard-sided case, three 16 GB SD cards, mounting screws
- SD card with SET files.
- Spare microphones and SD cards
- Electric drill (or screw driver if you want to use muscle power)
- Grey electrical wire (for GPS enabled units)
- Philips screw-driver (or universal screwdriver with Philips bit)
- Data sheets
- Flagging tape
- Felt marker and pencil

# **ARU Placement**

- 1. Chose trees that are not wider than the ARU (7 inches diameter). A wider tree will interfere with sound reaching the microphones.
- 2. Locate units far enough away from the road so that they are not easily detected by humans (15 to 20m is sufficient, especially once the trees and shrubs leaf out)
- 3. Put ARU on NORTH side of the tree to protect unit from direct sun and ensure more accurate temperature readings. The microphones need to be pointing east and west.
- 4. Put ARU 1.5 m high on a tree. Screw in both top and bottom brackets
- For GPS enabled units, mount GPS receiver higher than ARU (as far as you are able to reach). Use grey electrical wire to secure the cable to the tree. It is important to use a soft material to secure the excess cable so it does not get creased or damaged.
- 6. Open the cover
- 7. Follow the steps described in "Activating the ARU". Change the file name BEFORE you do the test recording
- 8. Press the wake/exit button to put the ARU into sleep mode.
- 9. Close the cover screws
- 10. Finally, lock the unit to the tree. Run the cable over the lid and around the tree as required to take up slack. If possible tighten the cable enough to lock the lid in place. Make sure that the cable does not touch the microphones.
- 11. Fill out all fields on the Deployment Datasheet
- 12. BEFORE YOU LEAVE MAKE SURE THAT YOU ATTACHED THE MICROPHONES, NOTHING IS TOUCHING THE MICROPHONES, AND THE UNIT IS READY TO RECORD AT THE CORRECT TIME.

## ARU PICK-UP

- 1. Make sure that you have the correct keys for the locks with you before you hike out to the ARU
- 2. Unlock the ARU
- 3. Open the cover
- 4. Follow the instructions for "Deactivating an ARU"
- 5. Close the cover
- 6. Fill out all fields on the ARU Pick-up datasheet
- 7. Pack the unit and microphones securely in the carrying case

# **Data Sheets**

Fill out <u>all fields</u> on the datasheets every time that you deploy or pick-up the ARU. Do not rely on your memory to fill information in later. If for some reason you end up at a pick-up or deployment without your datasheets, use your field notebook to record the correct information and fill out the correct datasheets once you get to your truck or camp location. Never think that you are too busy or pressed for time to fill out datasheets. The datasheets are part of the job and need to be completely correctly.

# **Deployment Datasheet (EMCLA Owls 2013)**

<u>Cluster:</u> Put this at the top of each data sheet Site: Site number or other official site descriptor Station: Name of station that you are deploying the ARU (Project dependent) Date: Date ARU is deployed Time: The time of day the ARU is deployed **Easting and Northing:** Write down the coordinates: if you are at the exact location designated by the GPS, use these co-ordinates and do not take a new point. If you have moved more than 15 m, take a new point.

Observer: Name/initials of observer

**ARU ID**: Use the unit number or the serial number. The serial number sticker is on the bottom of the Song Meter

**File Prefix**: Use the file prefix designated for your project. Frequently this will be the same as the GPS point name. **BE SURE THAT YOU CHANGE THE FILE PREFIX EVERYTIME THAT YOU DEPLOY THE ARU AT A NEW LOCATION. CHANGE THE FILE PREFIX BEFORE YOU DO THE TEST RECORDING.** 

**Battery Status**: New or Used and # of days used. Notes on when the batteries were checked and/ or replaced. For example, you could note that the batteries where used only 5 days prior—in which case they will last another 15 to 20 days.

SD Card Number: Fill in the SD card numbers for all slots (e.g. SC 001 or EMCLA 157).

**Test Recording Done**: Yes / No Confirm that you were able to do a test recording when you put out the ARU

**Location Moved:** Yes/No. An ARU is considered moved if it is deployed more than 15 m from the designated location. In the case of the moved location, you need to take a new point and label with the same name as the original location but add NEW to the end. The Easting and Northing need to reflect the new location.

**Photo: Yes / No**. Indicate whether you took photos of the station. Do this at deployment. If photos are not taken at deployment, make sure that they person picking up knows to do this.

**Left Mic. #:** the number of the left microphone. Use diagram on the bottom of the ARU to define left and right.

**Right Mic. #:** the number of the left microphone. Use diagram on the bottom of the ARU to define left and right.

**Comments**: Any comments related to the ARU location, e.g. distance from planned point, how to find them etc.

# Pick-up Data Sheet (EMCLA Owls 2013)

<u>**Cluster:**</u> Put this at the top of each data sheet

Site: Site number or other official site descriptor

Station: Name of station that you are picking the ARU up from (Project dependent)

Date: Date ARU is picked up

Time: The time of day the ARU is picked up

Observer: Name/initials of observer

**ARU ID**: Use the unit number or the serial number. The serial number sticker is on the bottom of the Song Meter

File Prefix Correct: Yes / No. Check that the file prefix on the files is correct.

**SD Card Number**: Fill in the SD card numbers for used slots (e.g. SC 001 or EMCLA 157).

**Left Mic. #:** the number of the left microphone. Use diagram on the bottom of the ARU to define left and right.

**Right Mic. #:** the number of the left microphone. Use diagram on the bottom of the ARU to define left and right.

**Photo:** Yes / No. Indicate whether you took photos of the station.

**# of Text Files:** This is the number of text file that contain temperature information. There should be one text file for each SD card (indicated by A, B, C or D at the end of the file). The text file should have the same file prefix as the other files.

**# of WAC files**: This is the number of sound recordings on all SD cards from a particular deployment. **File Volume**: This is total volume of files in gigabytes (GB).

**GPS File**: If you are using a GPS enabled unit, there should be one GPS file for each deployment. **Comments:** Anything. For example, are the microphones working, or damaged etc. If there is a file name mistake, PLEASE MAKE SURE TO MAKE A NOTE AND KEEP TRACK OF IT.



Figure 3. ARU placement on tree. Microphones still are wider than the trunk, thus avoiding sound shadow from the tree. Tree should not be any wider than this one. 4 to 7 inches in diameter is ideal.



Figure 4. ARU with GPS placement on tree. Note how the excess cable is secured to the tree.

# Section 3: DATA MANAGEMENT

Taking care of the data is one of the most important parts of your job. Do not let data management pile up. If you are running behind in saving data from SD cards, take some time out of the field and copy the data. Keeping track of existing data is as important as collecting more.

**Before you delete any data from a SD card, it MUST BE BACKED UP IN TWO PLACES.** You will be given two hard drives (and a computer with large storage capacity, one for each crew of two). Save SD cards to one of the hard drives. Once data is downloaded onto one hard drive, copy the data to the second hard drive. For example, back up Drive 3 to Drive 4 and back up Drive 4 to Drive 3. Put all data from one cluster on the same hard drive.

Data will be uploaded to the server and to back-up drives every time you come back to Edmonton or someone will bring you empty drives. Keep the data safe. If you leave the truck, take one copy of the data with you. The small hard drives are easy to carry. Or leave one drive in the hotel room while you go out for the day. Some researchers have lost all their data when a truck is stolen.

Store all the data from one site in a folders labeled according to Cluster, Site, Station and Deployment Date (e.g. Cluster 01>Site 02>NE 2013Mar19).

Always check and double check file names so that we know where each set of recording came from. If the files from one station have been mislabelled make the data manager aware of the problem so that they can correct it before the files go into final storage. If you correct the file name (only do this after proper instruction from data manager), make a note of the incorrect file name in the comments of the Deployment form in the database (to be explained in more detail).

Uploading data to an online site: Eventually, we will have an online site for you to upload data to. You will be given clear instructions on how to use this once it is ready.

# **SECTION 4: Testing and Programming**

# a. Testing a Song Meter

Song Meters should be tested before every deployment. The following steps allow you to test quickly if a Song Meter is recording correctly:

- Put batteries in the unit and turn the power on
- The LCD screen should show that the unit is waking up and display the date, time, software version and the status of the SD cards
- Put a card in slot A
- Connect microphones to each port on the outside
- Do a test recording: manually initiate recording by pressing the up and down buttons at the same time.
- Once the unit is recording, press the select button to toggle to the screen showing the gain levels. The gain bars and numbers should be similar. Talking directly into the left or right microphone should cause them to peak on that side.
- Stop the test recording by pressing the back button.
- If there is difference in the left and right gain levels, switch microphones and try again. If the relative difference between the sides remains the same, the unit itself is faulty. If the sides are reversed, one of the microphones is faulty and should be replaced.

Any substantial differences between channels indicate an issue with the microphone connection or the wiring or switches. See section on Troubleshooting for how to address some of these. <u>Any microphones</u> <u>or units that are not recording cleanly should not be deployed in the field until the issue is corrected.</u> See Appendix 1 for examples of good and bad recordings.

<u>Other things to look at:</u> Check that all external ports are tight and sealed so that water cannot get into the Song Meter case. The microphone ports are particularly important because a loose part will lead to a loose microphone connection and excess static in the recording. Check that the wiring to the batteries is intact and that all button and switches are working. On newer models, check that the white switches on the switch board are in the correct configuration. The left and right switch rows need to be identical. See Appendix 1 for default settings. On older SM2 units, check that all small black connectors are in place.

#### b. Loading ARU recording schedule

Unless you are programming the unit yourself, you will be given a pre-made configuration file (SET file) to upload from the SD card in slot A. <u>Always check that you are using the correct SET file and/or</u> <u>settings for the particular project that you are deploying the ARU for</u>. You will always have to enter the file prefix (see "Setting the File prefix" below) every time that you move the ARU to a new location. <u>Make sure that you always have the correct file prefix because this is what uniquely identifies the recording from that location.</u> An error in file naming can result in lost or incorrect data.

- 1. Put the SD card with the .SET files in Slot A (will not load from another slot)
- 2. Wake up unit (see instructions above)
- 3. Navigate to "Utilities" page
- 4. Select "Load Songmeter Set from A"
- 5. Select correct SET file from SD card in slot A
- 6. Press Select button again. The Song Meter set file will now load. This file will configure everything except for the time, date, and file prefix.

To program the Song Meter directly, follow the instructions in the Song Meter User Manual. You will get a manual with your new Song Meter or you can download this from the Wildlife Acoustics website. For both the Configuration Utility and manual programming, use the following default settings, unless you are instructed otherwise. See Appendix 1 for default settings.

#### Time and Date

Select "Time and date" from the settings menu. The display will look like this:

Time and date: <u>2</u>011-Sep-16 03:00:39 -Solar Sunrise/Set Rise 05:52 Set 17:58

The current time and date are shown on the second line, and today's calculated sunrise/sunset times are shown on the bottom line. The sunrise/sunset times are dependent on the latitude and longitude. GPS-enabled units will automatically find their location and figure out sunrise and sunset according to that. All other units will need latitude and longitude entered so that they know what part of the world they are in.

#### Time and Date

The time and date <u>are not updated</u> from the .SET file created on the computer. They need to <u>be set manually</u> for each Song Meter. Select the time and date on the setting menu and use the buttons to change to the current time and date. Check the time and date every time you deploy the Song Meter. The date may be reset to if the timer batteries run out or for other reasons.

#### **Location Settings**

The location settings allow you to change the file prefix, geographic location, and time zone.

#### **Setting the File Prefix**

The Song Meter automatically labels each recording with the date and time that it started according to the following format: *YYYYMMDD\_hhmmss*. In addition, it allows for a 12 character file prefix that is set by the user. This prefix becomes part of the file name for every recording made during a particular recording session. This prefix needs to be programmed at each deployment to a new location. The prefix may contain capital letters, numbers, and hyphens. Press the select button to advance to each position in the prefix, and then use the up and down arrows to select from among the possible characters. Press select one more time to mark the end of the prefix. Use the project specified file prefix.

#### Latitude, Longitude and Time zone

The latitude and longitude need to be set for the study area for all SM2+ and SM2+BAT Song Meters. Use the latitude and longitude of the actual point, of the site or of the study area. For the EMCLA owl surveys we are using a center point for the entire study area. Having the correct latitude and longitude is most important if you create a recording schedule that tracks either sunrise or sunset.

The final value to set for the location is the time zone. You can specify the local time zone (as used to set the clock) in hours relative to UTC (Universal Time Coordinated). Note that Song Meter does not automatically adjust for daylight savings time. This is mostly because daylight savings time is determined by government action and not by nature, so we cannot predict the start or end of daylight savings time as this in fact changes from time to time in different countries by their respective governments. For Mountain Standard Daylight Saving Time use -07.00 for the time zone setting.

#### Battery life and file volume

The best way to estimate the number of days that a Song Meter will run on a given schedule before the batteries run out is to use the Song Meter Configuration Utility to visualize the deployment schedule. Estimates of battery life are displayed in the Song Meter Configuration Utility. These estimates are fairly reliable except for BAT enabled units and GPS enabled units, which require more power. Song meter running in cold weather may also use more power. The configuration utility also allows you to calculate the amount of data storage (as SD cards) required to for a certain sampling schedule. If you want to have the recorder run as long as the batteries do, always have more memory space than battery life. Memory space required will vary depending on file compression rate.

#### **SECTION 5: Important ARU Care Instructions**

Always handle the ARU units with care. They contain sensitive electronic components that will not withstand crushing or heavy impacts. Do not use excess force to remove the cover, tighten the cover screws or take the mics on and off. Do all these operations gently. Use the correct size screwdriver on the cover screws so that the head do not get stripped.

<u>ARU transport</u>: Dropping the units or having them bounce around during transport can cause damage to the connections inside and destroy the outside as well. Always transport the ARUs in the padded bag provided (or in a similar padded, secure wrapping). Be especially careful with the GPS-enabled units and make sure that they cables do not get bent or damaged.

<u>Transporting in Totes:</u> Put the foam pads in the bottom of the totes. Put enough packing material around the ARU bags that these cannot bounce around in the totes. Strap the totes firmly to the quad so that the totes cannot fall off during rough trails.

The microphones are also sensitive to impact and pressure. Always transport them in hard side cases that are waterproof and cannot be crushed. If microphones are wet when you pick up a recorder, make sure to dry them out before storing them.

**Rain, Snow and other wet stuff:** Extra care is required to handle ARUs in wet weather. When the Song Meters are closed, they are water tight and can withstand most weather conditions in the field. However, **do not get water inside on the electronic components or into the external microphone sockets**. Water will short out the electrical circuits and may cause permanent damage to the units. Take extra care on activation and deactivation on rainy days. Having wet hands, gloves and clothing will make it difficult to keep the inside of the ARU dry. The following steps may be used to minimize the amount of time an ARU is open if you need to deploy in heavy snow or rain.

# Rainy day activation:

- Set up ARUs in your truck or room. Load SD cards, check batteries, test microphones and press Wake/Exit button to prepare the recorder to start at the correct time.
- CLEARLY LABEL each recorder with the Site and Station that it is programed for.
- Take the recorder out, mount it to the tree and securely attach the microphones.

# Rainy Day Take Down:

- Take the recorder off the tree
- Open it and turn it off only at the truck or in your camp.
- Note the time when you take down the recorder so that blank tracks can be deleted. Mark this clearly on the datasheet.

# Troubleshooting

If the ARU will not start or record or is not recording equally on both channels, there are a number of things to check before taking it out of service.

<u>Screen freezes</u>: Just as with any other piece of electronic equipment, the unit will occasionally freeze and not respond to any of the buttons. If this happens, use the power switch to turn the unit off. Let it sit for minute and then turn it back on. This will mostly get it started again. Reload the SET file and check all settings after a forced shutdown like this.

<u>Song Meter won't turn on:</u> This mostly happens due to an interruption of the power supply. Check that the power switch is moved to "internal power" (or the jumper is in the correct location for older models). Also check that the batteries are touching all the contacts. Sometimes a battery will not be positioned correctly and interrupt the circuit.

<u>Timer batteries</u>: The timer batteries will also affect how the Song Meter works. If you cannot set the time or the unit won't turn on, check the timer batteries. You may need to take the main battery holder out to do this. If the timer batteries are taken out and/or replaced, you will have to reset the time and the time zone information.

<u>Uneven gain</u>: Check that both microphones are firmly connected. Check that the switch board is in the correct set up (or the jumpers are securely connected on the older units). Switch microphones to check

if one of the mics is the problem. If none of these remedies works, there may be an internal wiring issues and the unit should be taken out of service and check over more thoroughly.

<u>Excess static</u>: excess static in one of the channels may be cause by wiring issues or microphone connections. If a test recording shows excess static, try different microphones and make sure that the mics are properly connected to the external ports. If none of these remedies work, take the unit out of service and have it checked over more thoroughly.

# **SECTION 6: Photos**

To do a brief assessment of vegetation and keep a record of what every point looks like, we are taking photos at every ARU deployment location. Take 5 photos at each location: 4 in each cardinal direction (North, East, South, West) and 1 of the canopy. Don't take a photo with a bush immediately in front of it. Get as clear a field of view as possible. Take the canopy photo by holding the camera at waste height an aiming the lense at the sky.

Label the photos the same as the GPS locations and add the direction: OW13-01-01CT-N. Take the photos at deployment if at all possible. Otherwise make sure to tell the pick-up crew which locations still need photos taken. Also take extra photos of the center point to so that we have a visual reference of what the oil and gas structure is. The only exception is if you are forbidden to take photos on active lease site.

# **APPENDIX 1: Setting and Schedules**

## Default Song Meter Settings for Bird recording in stereo:

Switch board settings (Left and right are the same):

- Row 1: On
- Row 2: On
- Row 3: Off
- Row 4: One
- Row 5: Off
- Row 6: Off
- Row 7: On
- Row 8: Off
- Row 9: Off

Audio Settings

- Sample rate: 16000
- Channels: stereo
- Compression: WAC0 (for lossless 60% compression of files) or OFF for full size WAV format
- Gain left +0.0dB
- Gain right +0.0dB

Advanced Settings:

- Dig HPF Left: Off
- Dig HPF Right: Off
- Dig LPF Left: Off
- Dig LPF Right: Off
- Trg Lvl Left: Off
- Trg Lvl Right: Off
- Trg Win Left: 2.0s
- Trg Win Right: 2.0s
- Div Ratio: 16

Audio and Advanced settings are both updated from the SET file. These settings are the same for the GPS enabled units and for BAT enabled units if they are used for recording birds. If you are using a BAT enabled unit to record birds, make sure that any default BAT settings are turned off before you start.

#### Sample Song Meter Recording Schedule:

10 minutes on the hour, 24 hours per day stating at 8 PM (20:00 hours) for maximum duration of battery life:

01 AT TIME 20:00:00 02 RECORD 00:10:00 03 PAUSE 00:50:00 04 GOTO LINE 02 23X 05 GOTO LINE 01 00X The "00X" in line 05 means "Forever", which will keep the Song Meter running until the memory is full or the batteries die.

You can adjust the start time simply by changing the time in line 01. If you want to record shorter block of time, reduce the number of repeats in line 04. For example, if you wanted to record for 6 hours on the hour starting at 4 AM the schedule would look like this:

01 AT TIME 04:00:00 02 RECORD 00:10:00 03 PAUSE 00:50:00 04 GOTO LINE 02 06X 05 GOTO LINE 01 00X

If you don't want to end up with excess data and only want to record for a set number of days, simply change the value in line 05 to the number of days you want to record for or reduce the number of recordings per day. Very complex schedules are possible. Use the manual and the Song Meter Configuration Utility to learn how to do this.

# **APPENDIX 2: Examples of corrupt recordings**

Use sound software to look at the sound files for quality. If you are recording in WAC compression format, you will have to use the Kaleidoscope software from Wildlife Acoustics to convert the files from WAC to WAV format. Once you have WAV format, you can use sound software to view the file. Even a simple wave form display (Figure 1) will give you information on how the left and right channels compare. A spectrogram view such as is available in Adobe Audition will give you information on the amount of static between channels. You can also check this by listening to the recordings and comparing the left and right channels.



Figure 1. Wave form view of a wav showing faulty recording on the left channel.



Figure 2. Spectrogram view of recording showing left channel problems: low gain on recorded sound and excess static.



Figure 3. Blank recording showing <u>normal static levels that are equal</u> between channels.