Autonomous Recording Unit Objectives and Methods
NOAA Firebird Project
Last edited: 03/01/2023 by Heather Levy

Description
We are using autonomous recording units (ARUs) to (1) determine optimal configuration for managers/researchers deploying ARUs for Black Rails and (2) to detect Black Rails across the Gulf Coast States. We have four main objectives:

1. **Distance Trials**: Comparing detection rates among different models of ARU units based on habitat type, wind speed, and whether the unit was outfitted with extra wind mufflers
    a. Fieldwork finishing by 3/5/2023
2. **Paired surveys**: Comparing detections rates between ARUs and humans
    a. Fieldwork in 2022 and 2023
3. **Long-term Deployment**: Deployment of ARUs in occupied areas during the length of the breeding season to determine seasonal/diel vocal activity and potentially compare these among the states
    a. Fieldwork in 2022 and 2023
    b. Florida and Mississippi have diel-level data from 2022
4. **Scouting**: Assess the presence of Black Rails in potential habitat using local knowledge and the recently produced USGS high marsh layer by deploying 'scouting' units (decided with each state's discretion)
    a. Fieldwork in 2022 and 2023

This document is intended to provide methods to objectives 2-4. The protocol for objective 1 can be found here: SOP - ARU Distance Objective .docx

Equipment
1. Labeled ARU
2. Silica gel packets to keep the interior of units dry (optional)
3. For long-term deployments (objectives 3 and 4): T-post with foam insulators and heavy duty zip ties OR wire to secure the units
4. For short-term deployments (objectives 1 and 2): Adjustable tripod with wood configured to the mounting block so the ARUs can sit on top OR a garden stake with zip ties or wire to attach the unit
5. Batteries (number and kind will depend on unit)
6. Datasheet and pencil
7. Clipboard

Datasheet

ARUs deployed for Objectives 3 and 4 will each have their own log to keep track of activities. Please keep logs in your clipboard whenever you go in the field.

[02-24-2023 Draft Datasheet.docx](#)

General
- **Maintenance**: Label each unit in your inventory uniquely using mailbox stickers or tags. There is no formal naming convention since many of the units were already named prior to the start of this project.
- **Batteries**: Each unit will take different batteries. SM3s and SM4s both take 4 D-cell batteries. Cornell Swift and Swift one units take 3 D-cell batteries. If you are using rechargeable batteries, make sure you are using fully charged batteries. If you are using non-rechargeable batteries, please ensure you are replacing batteries with fresh ones. Because rechargeable batteries lose power over time, non-rechargeable batteries are recommended.
- **Required programs**: [Sox-o-matic](#), [Raven Lite](#) or [Raven Pro](#), a [Box](#) account
    - Note: If using RavenLite, you will need to manage a separate spreadsheet to keep track of manual reviews

Configuring ARUs
Configurations for each model of ARU will vary based on make and model. Some will require that you download a software app and others will require that you download an app onto your smartphone. Please see below for product links that include configuration download links and user manuals. 64 GB SD cards or higher are recommended for objectives 3 and 4.

[Wildlife Acoustics Song Meter 2](#)
[Wildlife Acoustics Song Meter 3](#)
[Wildlife Acoustics Song Meter 4](#)

Objective 2: This objective does not require a pre-set schedule. By default, the SM3 and SM4 are in "daily schedule mode". This means it repeats its program every 24 hours. On the Main Menu page, click on 'Quick Start' and 'Record Always'. When you press the button 'Schedule Start', on the screen it should say 'Preparing to record continuous'. Make sure the green light under the 'Check Status' button is blinking green.

Objectives 3 and 4: For these objectives, we will be setting schedules so that ARUs record for 24 hour time periods every other day. You will need to download the SM4 Configurator Software. To do this, you will need to [create an account on the Wildlife Acoustics website](#). Once you have created an account, navigate to 'Resources' and select 'Downloads' on the dropdown menu. Select the SM4 icon and download the 'SM4 Family Configurator Software'. Please note that the SM3 Configurator is nearly identical, and automatically displays the advanced schedule mode on the right.

<u>SM4 Configurator</u>

Schedules are saved to SD cards, so you don't need to plug the unit into your computer. After you have selected a clean card to use, open the SM4 Configurator Program. You will see four

sections. On the left is the Deployment Scenario and the Setting. On the right is the Schedule. Below is a timeline that displays estimates of when units will be recording, when flashcards will be full, and when batteries will be empty. (Please note these are just estimates and battery life is likely to decrease in extreme heat).

'Deployment Scenario'

Select SM4, and add your selected SD cards to Slot A and Slot B. It is recommended that you use higher capacity SD cards (64 GB and higher). Make sure Mic 0 and Mic 1 are set to internal. If you are using alkaline batteries (recommended), keep the Battery (Wh) at 72. The chart below will give you an estimate on when the unit will record until.

'Settings' (Left column)

Leave 'Prefix' blank.

Check the box next to 'Timezone'. If you are deploying during Daylight Savings Hour, please make sure to account for that. For example, Eastern Standard Time is UTC -5:00, and Eastern Daylight Time is -4:00. The unit will not automatically switch when Daylight Savings Time ends on March 12, 2023. If you deploy your unit beforehand, you will need to manually adjust the time on the ARU in the field.

Check the box next to 'Position'. If you know the coordinates of where you will deploy the ARU, add them here. If you won't know the exact location until you are in the field, you can add rough coordinates using site-level information. This will just help to estimate sunrise and sunset time. Make sure the dropdown below is set to 'sunrise/sunset'. When you are in the field and decide on the exact location, on the Main Menu click down to 'Settings' and then to 'Location'. Manually enter the coordinates here. **After ARUs have been retrieved and data has been downloaded, please be sure to reset the location to avoid confusion if the ARU is deployed in another location.**

If you will be deploying your unit before you want it to start recording, you can click the checkbox next to 'Delay Start' and add in the date you would like it to start recording. Make sure the dropdown box below is set to 'LED always'.

Leave 'Battery Cutoff' and 'Sensitivity' unchecked.

On the lowest dropdown menu, click on 'Schedule mode advanced'.

'Settings' (right column)

Leave 'Channel' on 'stereo' in the dropdown menu.

Leave both 'Gain left' and 'Gain right' at 16.00 dB.

Leave both 'Preamp left' and 'Preamp right' at 26 dB.

Leave both the left and right 'High-pass filter' off.

Make sure the 'Sample Rate' is set to 24000 Hz in the dropdown menu.

Keep the 'Max Length' to 01:00 (this will create 1 hour time segments for audio files)
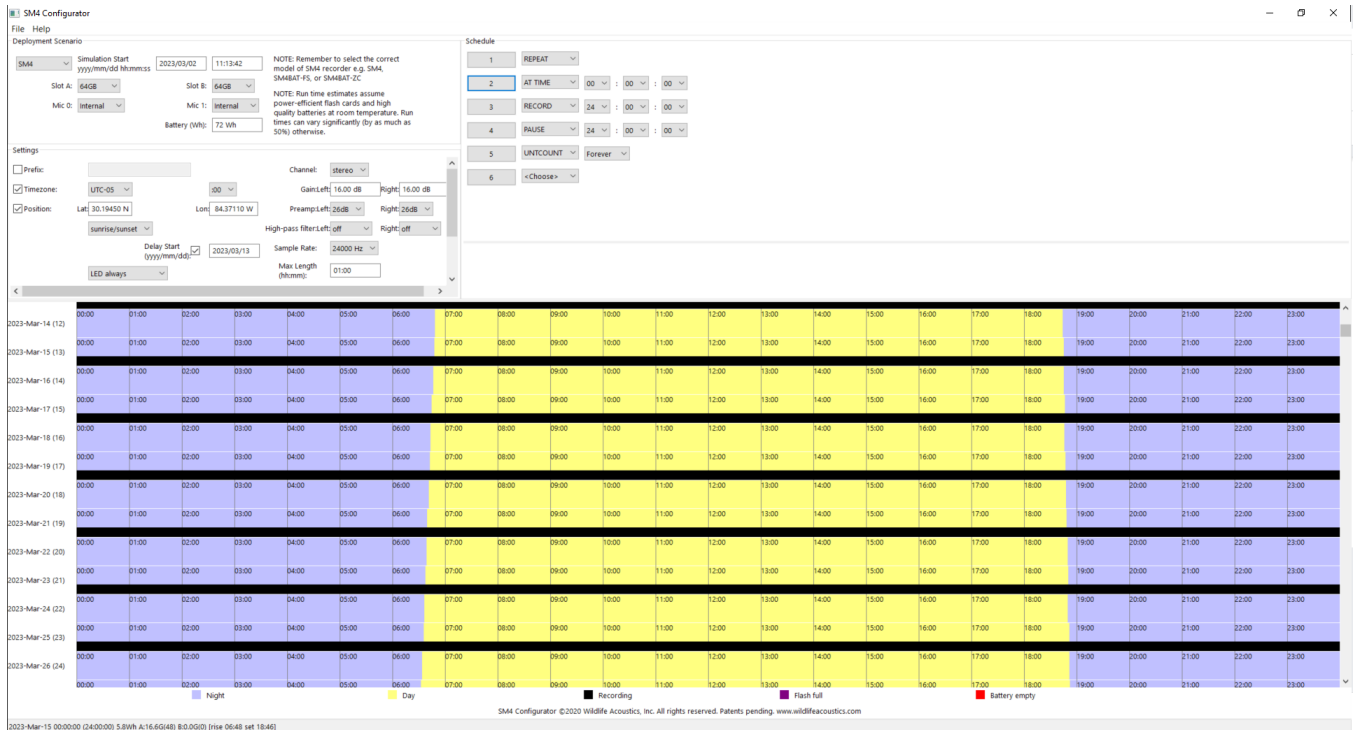
Keep 'Compression' as 'none'.

'Schedule'

Create a schedule that mimics the following image:

The timetable below should give you an estimate of when the ARU will be recording. You should see the black line (indicating recording) on every other 24 hour period.

When you are finished creating your schedule, save it both to your computer (to easily copy and paste over to other SD cards) and to the inserted SD card.

When you turn on the SM4, on 'Main Menu', click down to 'Schedule', 'Import Schedule', and select the name of the saved recording schedule from the SD card.

Data Storage, Management, and Converting

Data from retrieved ARUs should be downloaded as soon as possible to avoid confusion. Transfer data from the SD cards into an external harddrive. Organize folders based on state, year, and objective. From there, we will be creating a separate folder for raw files (.WAV) and converted files (.FLAC). Data from SM3s and SM4s will automatically organize itself sequentially with the prefix as the ARU serial number and the suffix as the date and time.

Objective 2: For the paired surveys, create a subfolder for each date so it can easily be matched up with the datasheets. Once each individual file from each survey point has been added, please add the name of the survey point to the beginning of the file name and keep the remainder of the name that contains the ARU prefix, date, and time. All surveys taken on any given day will all go in the same folder.
FL_ARU_Data\2023\.Wav\Paired_Objective\07-01-2023\FL_SMNW_U111_001_CALL_001-S4A17652_20220620_081207

Objective 3: For the long-term objective, create a subfolder for each location (e.g., FL_SMNW_U111_001), with a subfolder under it for each unit (e.g., 3A).

FL_ARU_Data\2023\.WAV\Long_Deployment_Objective\FL_SMNW_U111_001\3A

Objective 4: For the scouting objective, create a subfolder for each location (e.g., FL_SMNW_U111-001), with a subfolder under it for each unit.

FL_ARU_Data\2023\.WAV\Scouting\FL_BBWM_HIMO_002\3A

To upload files to the Box account where they will be processed by Cornell, they first need to be compressed using a program called [Sox-o-matic](). Once you have downloaded the program, choose whatever format you wish to convert from to FLAC. This will typically be from .WAV files. Under Options, select number of threads = 4 and FLAC compression = 2 and leave everything else empty. Under Renaming select File names contain YYYMMDD_HHMMSS and the User Defined Format using the following naming convention (Be sure to save your settings):

SS - State Abbreviation (AL, FL, LA, MS, TX)
HHHH - Site
MUMU - Management Unit
- Number of BLRA sampling location
ARU - unit ID

EXAMPLE:

SS_HHHH_MUMU_###_ARU
FL_SMNW_U111_001_UH9

FL = Florida
SMNW = St. Marks National Wildlife Refuge
U111 = Management unit 111
001 = Number of sampling unit within the management unit
UH9 = ARU H9

We will be saving copies of both the raw and converted files. Create a separate subfolder for the converted files (.FLAC).

FL_ARU_Data\2023\.FLAC\....

Once all data is converted, it can be uploaded to the box folder. We are working under the directory Firebird ARU data. At the end of the season, I will create a 2023 folder that will be organized by state. If you do not have access to the shared Box account, please contact Blake Lamb at bdl227@msstate.edu.

Objective 1: Comparing Makes/Models of ARUs

This objective has its own separate and the fieldwork for this will wrap up by March 5, 2023. Please contact Blake Lamb at bdl227@msstate.edu if you have any questions regarding this objective.

Objective 2: ARU/Observer Comparison

Experimental Design

Our goal is to have at 20-25 sites per state. In conjunction with call-broadcast surveys, each of these sites will be visited 6 times. First, select routes that are occupied by Black Rails to maximize the sample size for this objective. The remaining number of points can have unknown occupancy. We will be using SM3s and SM4s exclusively for this objective, however SM4s are lighter weight-wise and easier to take into the field to access. Each team should have at least one unit per crew, plus an additional backup unit.

Deployment

Make sure the ARU is set to 'default' mode (i.e., it is not configured to record during a particular day or time). Please see the 'Configuring ARUs' section for more information. When you arrive at the call-broadcast location, quickly and quietly set up the ARU on its mounting garden stake at a height of 1.2 m. The microphones should be set up so that the front of the unit is facing the targeted habitat. Fill out the metadata on the call-broadcast datasheet and include the ARU unit being used and which points are paired. Turn the ARU on, and press 'schedule start', make sure it is actively recording by checking the green blinking light (this is on the front of the unit for both the SM3s and SM4s). Before you start the call-broadcast sequence, clearly enunciate the point count number, observer, and start time (to help sort audio files later); start the call-broadcast sequence; and, when finished, audibly announce 'finished' and end time. Press 'schedule stop', then turn off the ARU and dismount it from the pole.

Objective 3: Long-term Deployment

Experimental Design

Our goal is to deploy ARUs at 5 total occupied sites in the state to assess regional variation of vocalization timing and behaviors across the geographic range of the Firebird project. For this objective, we will only be using SM4s and SM3s and will focus on sites occupied in 2021 and 2022. We will use 3 SM4 or 3 SM3 units for each occupied site, deployed 100 m apart in a triangular manner that best encompasses the potential habitat surrounding the locations occupied. Units will record during every other 24-hour period during the call-broadcast surveys (March 15 - July 31).
   AM: 1 hour before sunrise to 3 hours after sunrise
    PM: 90 minutes before sunset to 1 hour after sunset

Deployment

Please see the 'Configuring ARUs' section to create and select the proper schedule. Determine the deployment location based on occupancy in 2021 and 2022. Make sure the points selected are in accessible marshes and the ARUs can be securely positioned in habitat. ARUs should be fashioned around the point center so that each ARU is 100 m away from one another. Fresh batteries are recommended, as rechargeable batteries tend to lose power over time. Place units out on March 15th at the latest and keep them out until at least July 31st (they can be deployed later or earlier, depending on the interest of the team deploying them). Drive a t-post into the ground at least 6 inches into the ground so that the ARUs are standing at a height of 1.2 m. Fashion a foam insulator or some other protective fabric between the ARU and the t-post to avoid scratching the unit. Heavy duty zip-ties work well to attach the units to the post securely. About twice weekly (this may change depending on how battery life is holding up in the heat), visit each unit to replace batteries and SD cards. Make sure all batteries are fully charged or are brand new before putting them in the unit.

For each ARU, keep a log to track when playback is occurring so these data are not mistakenly analyzed and pegged as birds calling. Please keep note in the log if you do hear a bird calling during the playback. This can be done at the end of the day by comparing call-broadcast sheets to the ARU logs. These log books should be digitized into an excel spreadsheet.

Occupied BLRA habitat

100 m · 100 m · 100 m
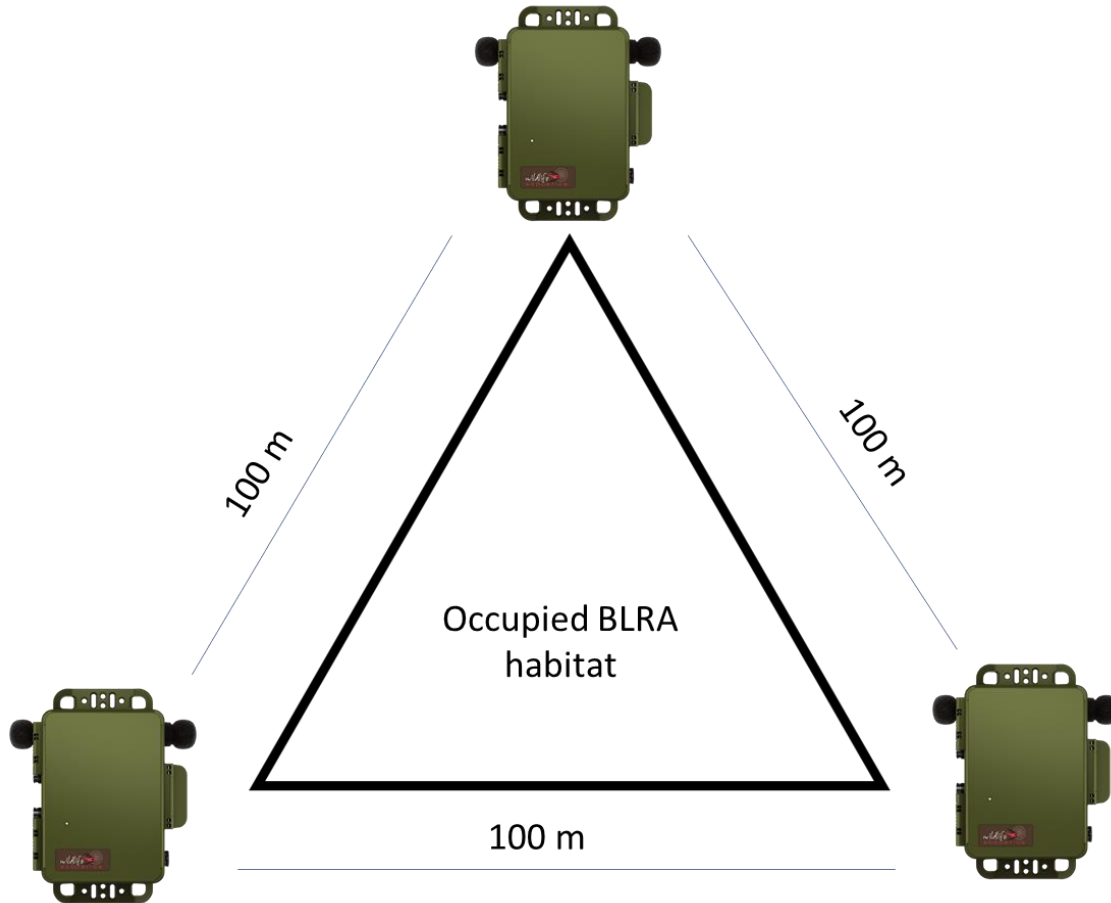
Objective 4: Scouting

To maximize monitoring of presence/absence of BLRAs of high marsh habitat across the geographic range of the Firebird project, we will deploy the remaining inventory of ARU units at at sites that contain high marsh, but are logistically difficult or require too much time to access for traditional call-broadcast surveys (i.e., that are not monitored otherwise). High marsh can be assessed using both local knowledge and the USGS high marsh map layer. This is completely up to the states discretion, including the number of units deployed at each site and how many total locations receive ARUs. It is recommended that 1 ARU is deployed for every 100 m of potential habitat. The configuration of units will vary depending on the shape of the patch. See instructions above for deployment and record keeping.

Units should be configured to record for 24/7 every other day. It is recommended to keep units out for at least 4 weeks at a time during peak breeding season to determine whether an area is occupied. This will require a battery change sometime in the middle of deployment.