

Southeast Coast Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure 1.4.01

Programming and Maintenance of Automated Recording Devices for Vocal Anuran and Landbird Monitoring— Version 2.0

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Summary

This standard operating procedure (SOP) describes the process of programming recording schedules into automated recording devices (ARDs) used by the Southeast Coast Network (SECN) to monitor vocal anurans and landbirds. The ARD models covered by this SOP include: Song Meter 4 (“SM4”) and Song Meter Mini (“SM-Mini”), developed by Wildlife Acoustics, Inc. ARD maintenance tasks are also addressed herein.

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #
03/15/2013	B. Smrekar	Added equipment list and warning label, changes to shipping and maintenance and office prep procedures.	Not included in the first version of the SOP.	1.1
07/08/2016	B. Smrekar	Added section on testing microphones and input portals; updated recording schedule and service conditions, log.	Not included in the current version of the SOP.	1.2
05/25/2023	M. Parrish	Complete revision.	New hardware (SM-Mini and SM4 recorders) and new software now in use.	2.0

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Required Equipment

- Wildlife Acoustics, Inc. Song Meter audio recorder (SOP applies to the following models: Song Meter 4 (SM4) or Song Meter Mini (SM-Mini).
 - SM4 GPS accessory puck.
- Song Meter Configurator Software:
 - SM4: PC with Song Meter SM4 Configurator application installed; and/or
 - SM-Mini: iPad with Song Meter Configurator app installed.
- SDHC card:
 - 32 GB or larger, Class 4 or higher.
- SD card reader peripheral or integrated laptop SD card reader.
- Batteries:
 - SM4: Four rechargeable D-cell batteries plus one CR 2032 clock battery.
 - SM-Mini: Four AA-cell lithium batteries.
- Simple Green wipes (or similar gentle cleaner).

Intake Maintenance Following Field Deployment

Perform maintenance on all ARDs upon retrieving them from the field. Some maintenance can be performed in-house and is described below. More intensive technical maintenance on damaged or malfunctioning units must be outsourced to technical personnel at Wildlife Acoustics, Inc.

Local (In-house) Maintenance

- Inspect the ARD for damage to the case, seals, microphones, and battery tray, since these are typically damaged during deployment. Water ingress is a particular problem (often indicated by the presence of rust inside a unit) and water-affected units must be sent to Wildlife Acoustics, Inc., for repair.
- After checking for functionality, remove batteries. Single use batteries (including clock batteries) may be recycled. Rechargeable batteries must be tested and recharged. Refer to *SECN SOP 1.4.24 Inventory, Maintenance, and Testing of ARD Batteries—Version 1.2* (Parrish 2023) for necessary battery maintenance tasks. Clock batteries (SM4 only) must be replaced prior to the next deployment event.
- Clean the ARD using a gentle cleaner. Do not spray cleaner directly onto/into the units or damage may occur; apply cleaner to a paper towel instead. Simple Green wipes and an old toothbrush are generally all that is needed to clean up ARDs. Replace gaskets, microphones, microphone foam covers, or other components if they are found to be damaged. Pay extra attention to ensuring gasket seals are clean and intact.
- Ensure ARDs still have NPS arrowhead stickers and other identifying markings, such as the unit number. A permanent marker can be used to label the units as needed. Reapply camouflage material if necessary.
- If there are signs the waterproof seal of the ARD was compromised (water damage or insect colonies present inside unit), it should be shipped to Wildlife Acoustics, Inc., for refurbishment.
- Perform a microphone check using the SECN's microphone calibrator (EXTECH model 407766). The procedure involves generating a test tone at each microphone and comparing the unit's dB level readout to equipment specs for the microphone. Refer to each model's user manual for pass/fail specs and specific testing procedures. If a microphone fails the test, ship the unit to Wildlife Acoustics, Inc., for repair prior to redeploying it in the field.

About a month prior to commencement of field activities, check the [Wildlife Acoustics website](#) for new firmware updates and apply them to the units if necessary. Follow instructions from Wildlife Acoustics, Inc., for firmware updating procedure.

Professional (Outsourced) Maintenance

Consult Wildlife Acoustics, Inc. technical support as necessary to discuss device problems, identify troubleshooting procedures, ensure devices needing service are shipped to the proper address or

technician, and that they are aware of service needs. The types of issues for which professional maintenance is required include the following (this list does not cover all situations):

- Improper functioning (e.g., inability to maintain recording schedule, atypical power drain).
- Leaking seals (case gaskets can be replaced in-house).
- Microphone malfunction that cannot be repaired by replacement of microphone.
- Broken, cracked, or corroded battery trays or SD card slots.
- Holes in case (e.g., squirrel damage).

Before outsourced maintenance occurs, obtain a cost estimate of service prior to shipping, and ensure the program manager is aware of and approves the expected service costs.

Shipping

Contact Wildlife Acoustics, Inc., to obtain a service order number (RA) and follow their packing instructions. Record the serial number of each device shipped to Wildlife Acoustics, Inc., for service and document the specific problems with the device. Include a copy of this documentation, including SECN contact information and the specific SECN point of contact with the shipment. Wrap each device in need of service individually to protect it during the shipping process. Group as many devices as possible into as few boxes as possible to keep shipping costs down. Ship the devices to the address provided by the technician and follow any other instructions they provide. Ship to Wildlife Acoustics, Inc., or the authorized servicer identified by them, by any standard means (e.g., FedEx, UPS, USPS). Ensure the shipping option includes a tracking number and delivery confirmation. Upon return of the devices to the Southeast Coast Network, perform a microphone test (see above) prior to deployment.

Camouflage and Moisture Control

The SM4 and SM-Mini ARDs are molded using green plastic and are unobtrusive in the field. Take care to mount the units out of the view of the visiting public (e.g., mount the ARD behind a tree if a trail is nearby, or behind natural concealment). If desired, camouflage tape or cloth can be adhered to the unit, provided it does not interfere with the microphones, but this is not generally needed. Purchase paracord with a camouflage pattern that blends into tree bark (e.g., do not purchase blaze orange paracord that would attract unwanted attention from humans).

The ARDs are water resistant under most circumstances, but if a lid gasket is damaged or if the unit is strapped too tightly to a tree (thus warping the case), moisture can become an issue. Check gaskets before deployment and replace if needed. Do not mount the ARD too tightly to a tree. Animal damage (e.g., mammals chewing on cases and microphones, or insects finding their way inside) can allow moisture inside, but there is little to be done about this besides inspecting units before deployment and ensuring only intact units are used. Limited protection may be possible by placing wire mesh cages around microphone windscreens.

Formatting SD Cards

Both SM4 and SM-Mini models are equipped with SDHC (Secure Digital High Capacity) cards (referred to herein as “SD cards”). The SD cards must have a minimum capacity of 32 GB storage space and be class 4 or higher. Cards are formatted in the device type they will be used in, using the onboard formatting utility. See user manual for instructions specific to each model. **Ensure all cards are set to “unlocked” mode prior to deployment.**

Programming Devices

Due to the strong influence of environmental variables in anuran calling behavior, and the differences in typical peak calling times of SECN anuran species, the applied programming times for sampling events are relatively widespread to capture vocalizations from as many species as possible. The Song Meter Configurator software used to program ARDs includes a power and storage estimation capability that can inform the user if the specified batteries and SD card(s) will provide sufficient capacity to complete field sampling.

Recording Schedule Programs

The ARDs are programmed to record landbird vocalizations for 12 minutes (08:00 to 08:12) every other morning for a minimum of 80 days. Additionally, ARDs record vocal anuran vocalizations for 60 seconds every 20 minutes (18:00 to 07:00) during every fourth night during that period. Once deployed and activated in the field, the units run their recording schedule autonomously until the schedule terminates. The devices are retrieved from the field and SD cards are downloaded in the lab for analysis.

Note: Prior to 2021, overnight recordings lasted 30 seconds every 10 minutes instead of 60 seconds every 20 minutes. In 2021, changes to the scheduling options with the SM-Mini eliminated the ability to schedule recordings less than 1 minute in length, therefore nocturnal recordings were doubled in length from 30 seconds to 60 seconds and reduced in frequency from every 10 minutes to every 20 minutes. Overall recording duration was not changed.

Program SM4 units with the scheduling code shown in Table 1. Program SM-Mini units as shown in Table 2.

Table 1. SM4 programming code to execute a 94-day deployment under the Landbird and Vocal Anuran Community Monitoring Protocols for Southeast Coast Network Parks.

Program	Setting	Comments
01 AT DATE	2021 MAR 15	Initial recording begins on March 15, 2021.
02 REPEAT	–	Begin master 4-day loop (Instruction lines 02 to 15)
03 AT TIME	08 00 00	Power up at 08:00:00
04 RECORD	00 12 00	Record audio for 12 minutes (08:00 to 08:12; Landbird recording)
05 AT TIME	18 00 00	Device powers down until 18:00, then powers up.
06 REPEAT	–	Begin overnight loop (Instruction lines 06 to 09)
07 RECORD	00 01 00	Record one minute of audio (18:00 to 18:01)
08 PAUSE	00 19 00	Power down and pause for 19 minutes
09 UNTTIME	07 00 00	Close overnight loop. Repeat overnight loop 19: 07:00.
10 PAUSE	24 00 00	Power down and pause for 24 hours. (until 07:00)
11 AT TIME	08 00 00	Power up at 08:00:00
12 RECORD	00 12 00	Record audio for 12 minutes (08:00 to 08:12; Landbird recording)
13 PAUSE	23 48 00	Power down and pause for 23 hours, 48 minutes (until 08:00 the next day)
14 PAUSE	23 00 00	Power down and pause for 23 hours (until 07:00 the next day)
15 UNTDATE	2021 JUN 17	Close the master loop and repeat the loop through June 17, 2021.

Table 2. SM-Mini programming code to execute a 93-day deployment under the Landbird and Vocal Anuran Community Monitoring Protocols for Southeast Coast Network Parks. This program takes advantage of the ability of the SM-Mini to concurrently run three Custom Schedules by specified date ranges.

Program	Setting	Comments
ACOUSTICS SETTINGS Sample Rate	32000 Hz	Recordings will range from 0 to 16 kHz
ACOUSTICS SETTINGS Max Length	13 minutes	No recording will be longer than 13 minutes.
ACOUSTICS SETTINGS Channel	Stereo	(Requires optional second accessory microphone is installed.)
ACOUSTICS SETTINGS L Channel Gain	18 dB	Default.
ACOUSTICS SETTINGS R Channel Gain	18 dB	Default.
LOCATION & TIME ZONE	User specified	Location is set in the field when syncing to cell phone GPS. Time Zone is UTM minus 04:00 for Eastern DST
DELAY START	MARCH 15, 2021	First day of recording is March 15, 2021.
SCHEDULE	CUSTOM SCHEDULE	Custom scheduling will be in effect
START DATE	MONTH 03 DAY 15	Schedule one begins March 15. –
START	TIME + 08 00	Begin recording 08:00
DUTY CYCLE	CYCLE DUTY ON 00 12 DUTY OFF 00 48	ARD will repeat the following duty cycle: Recorder will activate for 12 minutes, then shut off for 48 minutes –
END	TIME + 09 00	Duty cycle will end at 09:00
DAY DUTY CYCLE	CYCLE DUTY ON 01 DUTY OFF 01	Recording schedule will cycle according to the day. Recorder runs schedule one day, then skips one day. –
END DATE	MONTH 06 DAY 15	Schedule one ends June 15. –
START DATE	MONTH 03 DAY 15	Schedule two begins March 15. –

Program	Setting	Comments
START	TIME + 18 00	Begin recording 18:00
DUTY CYCLE	CYCLE	ARD will repeat the following duty cycle:
	DUTY ON 00 01	Recorder will activate for 1 minute, then shut off for 19 minutes.
	DUTY OFF 00 19	–
END	TIME + 23 59	Duty cycle will end at 23:59
DAY DUTY CYCLE	CYCLE	Recording schedule will cycle according to day.
	DUTY ON 01	Recorder runs schedule one day, then skip three days.
	DUTY OFF 03	–
END DATE	MONTH 06	Schedule two ends June 15.
	DAY 15	–
START DATE	MONTH 03	Schedule three begins Mar. 16 (extends from schedule 2).
	DAY 16	–
START	TIME + 00 00	Begin recording 00:00
DUTY CYCLE	CYCLE	ARD will repeat the following duty cycle:
	DUTY ON 00 01	Recorder will activate for 1 minute, then shut off for 19 minutes.
	DUTY OFF 00 19	–
	END TIME + 07 00	Duty cycle will end at 07:00
DAY DUTY CYCLE	CYCLE	Recording schedule will cycle according to day.
	DUTY ON 01	Recorder runs schedule one day, then skips three days.
	DUTY OFF 03	–
END DATE	MONTH 06	Schedule three ends June 16.
	DAY 16	–

Note on Sampling Location Coordinates

Coordinates of each sampling location are permanent. Coordinates are maintained on the SECN GIS server as an Esri shapefile (L:\GIS\projects\Wildlife\SL_coords\SL_COORDS_2023.shp). As a reminder, western hemisphere longitude is stored as a negative value (e.g., -80.12345°) when encoded as decimal degrees. To enter the coordinates properly in the Configurator, use positive values for latitude and longitude along with N and W designators (e.g., 33.98765 N, 83.34567 W).

Programming the SM4

The procedure outlined below is a basic approach to programming the SM4 using the code above. For greater clarity or troubleshooting, please refer to the current user manual (Wildlife Acoustics, Inc. 2021a) SM4 units need to have their firmware updated according to the user manual instructions before each field season.

1. Insert an SD card into the unit and turn the power on (switch to **INT** power).
2. Scroll down to **Utilities** and press Enter to select. Scroll down to **Format All Cards** and press Enter to select. Select **Yes** to confirm the format operation and press Enter. The card will be formatted. Press the left arrow twice to return to the **Main Menu**.
3. Plug in the SM4 GPS accessory and place the unit in view of the sky until the on-screen “GPS * * *” message changes over to “GPS FIX.” Unplug the GPS accessory puck.
4. Switch the power off to the unit (switch to **EXT** power). Remove the SD card and insert it into the PC card reader peripheral.
5. Open the SM4 Configurator program. Input the SM4 generic program (see above) into the Configurator. Also open a Microsoft Excel window alongside, containing sample location numbers and their coordinates that will be referenced for the park.

CAUTION: Be aware the SM4 Configurator software interface allows settings to be changed if the user scrolls the mouse wheel. This can easily result in settings being inadvertently changed without being obvious to the user.

6. Set the **Simulation Settings** options to appropriate values that will be used to assess the battery life and SD card storage capacity over the duration of the specified program. Determine if the batteries and data cards are sufficient for the intended deployment period.
7. Click to select the checkboxes next to **Prefix**, **Time Zone**, **Position**, and **Delay Start**.
8. Select the following settings if they are not included in the SM4 generic program already:
 - a. **Delay Start:** (Date on which sampling should begin).
 - b. **Channel:** Stereo.
 - c. **Gain L/R:** 16.00 dB (both).
 - d. **Preamplifier L/R:** 26 dB (both).
 - e. **Hi Pass Filters L/R** (both off).
 - f. **Sample Rate:** 32,000 Hz.
 - g. **Max Length:** 00:13 (13 minutes).

- h. **Compression:** None.
9. In the **Prefix** box, enter the following: park 4-letter code followed by a hyphen, three-digit sample location ID followed by a hyphen, and the three-digit ARD unit number (e.g., CAHA-001-401).
 10. Specify the **Time zone** during which sampling will take place.
 - a. Fall to Spring (Eastern Standard Time): Specify UTC -05:00
 - b. Spring to Fall (Daylight Savings Time): Specify UTC -04:00
 - c. Time zone switch-over occurs on different days each year. The ARD will not update time zone automatically.
 11. Specify the **Latitude** and **Longitude Position**. Remember that decimal degree longitude in the southeastern US is a **negative** value; however, to enter the coordinates properly in the Configurator, use **positive** values for latitude and longitude along with N and W designators (e.g., 33.98765 N, 83.34567 W and **not** 33.98765 N, -83.34567 W.)
 12. Review the calendar for start and end dates, and ensure that the sampling regime is correct and that the battery and card life will meet the needs of the sampling schedule
 13. Save the program to a formatted SD card as a .SM4S file and insert the card into the ARD. Switch on the power to the ARD.
 14. Scroll down to **Schedule** and press Enter to select. Scroll down to **Import Schedule** and press Enter to select.
 15. Select the .SM4S file and press Enter to load it into memory. Then check **Edit Schedule** to ensure the correct schedule has been loaded.
 16. Turn off the ARD unit and label the front with a piece of painter's tape with the sampling location written on it in permanent marker. The ARD is ready for deployment. Each ARD will be pre-programmed with the coordinates and prefix codes appropriate for a single sampling location. The label will ensure that field deployment is not confusing.

Programming the SM-Mini

The procedure outlined below is a basic approach to programming the SM-Mini using the code above. For greater clarity or troubleshooting, please refer to the current user manual (Wildlife Acoustics, Inc. 2021b).

Note: Instructions to the user to “short press” a button indicates a momentary button press. A “long press” indicates the user should hold the button down for 3–4 seconds.

SM-Mini units need to have their firmware updated according to the user guide instructions before each field season.

1. Open Wildlife Acoustics Configurator App on an iPad.
2. Remove the SM-Mini case and switch the power switch to “ON.” Wait a few seconds, then long-press the Pair button on the device. When the Bluetooth indicator LED begins blinking green, release the button.
3. The recorder should appear on the *Detected Recorders* screen on the iPad. Tap the “Pair” icon. The unit will update the time and location based on the iPad’s settings.
4. Tap “Yes” to update time and location settings. Note: if programming for a DST deployment during EST, the unit will pop up an alert if you specify a different UTC time zone than the iPad is currently set to.
 - a. Fall to Spring (Eastern Standard Time): Specify UTC -05:00;
 - b. Spring to Fall (Daylight Savings Time): Specify UTC -04:00;
 - c. Time zone switch-over occurs on different days each year.
5. Tap the recorder name and enter the recorder settings screen.
6. Click “Configure” and select the option to format the memory card.
7. Exit the configure screen and change the unit name. Each unit is named according to the park, sample location, and ARD unit number (e.g., “CALO-001-550” for Cape Lookout National Seashore sample location 1, ARD 550).
8. Import the configuration program from the Configuration Library and ensure it updates the unit.

Note: There appears to be an occasional program bug where the software indicates it was “updated” but it does not actually import the program into the ARD. In this case, unpairing and re-pairing the ARD from the iPad usually fixes it. This is an apparent bug in the Wildlife Acoustics, Inc., software.

9. Exit to the App's home screen and click on the "Status" icon, then check the following settings:
 - a. Recorder Name (should be the renamed designator from step 7)
 - b. Battery Level (should be 95%–100%)
 - c. Schedule Name (should be "Custom Schedule")
 - d. Right Microphone (should be "Attached")
 - e. Battery Type (Should be AA)
 - f. Firmware Version (should be most current version number)
10. Exit the Status screen and unpair the unit. Add a piece of blue painter's tape to the front of the unit with the park and sample location number written on it to facilitate field deployment.
11. Switch the power off on the ARD prior to packing it. Remember to power up the unit once it is time to deploy it.

Literature Cited

- Parrish, M. C. 2023. Inventory, maintenance, and testing of ARD batteries—Version 1.1. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP—1.4.24. Southeast Coast Network, Athens, Georgia. Available at: <https://nps.gov/DataStore/Reference/Profile/2299552> (last accessed June 2023).
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