Terrestrial ABMI Autonomous Recording Unit (ARU) and Remote Camera Trap Protocols

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CONTENTS

- *At baseline survey sites*: Four remote cameras are placed in a square approximately 600 m apart centered on an ABMI site (i.e. near the corners of the original bird point count stations; Figure 1) to record mid- and large-sized mammals (Figure 2).
- In the green zone, cameras and ARUs are placed within 50 m of each station in a habitat similar to that of the grid corner (Figure 2).
- *At revisit survey sites* (where data have been collected in previous years): Two cameras are placed on the NE and SW corners of a square centered on an ABMI site.
- If possible, ARUs are placed at the exact same locations as the cameras to record bird vocalizations
- If required, the camera and ARU at a station may be **up to 10 m** apart.
- Units are deployed between mid-fall and Mar 31 and retrieved in July. Some units may be deployed earlier.
- Cameras and ARUs are preprogramed before deployment with the settings in Appendices 1 and 2, respectively.
- Scent is placed at NE and SW corners at deployment (baseline survey) (Figure 2) or at the NE corner (revisit survey) (Figure 3).
- If a scented location falls within 200 m of a residence, it is moved clockwise until a suitable station is found.
- A painted stake is placed 5 m in front of the camera at the NW and SE corners (baseline survey) or at the SW corner (revisit survey) to aid with photo interpretation and analysis.

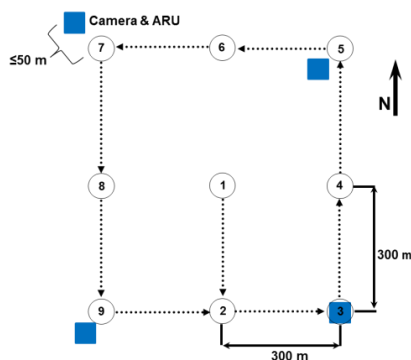**Figure 1**. Placement of camera traps and ARUs relative to ABMI bird point count stations.
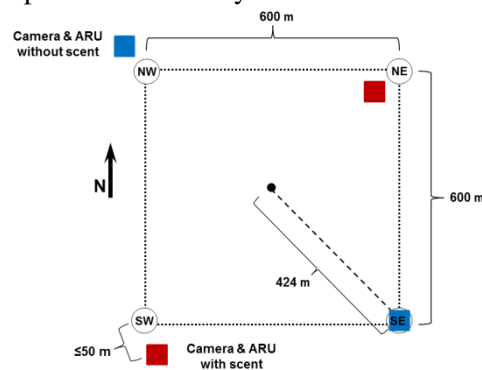

Figure 2. *Baseline Survey*: Cameras and ARUs are placed near the corner of a 600 x 600 m square centered on an ABMI site. The NE and SW corners are scented.
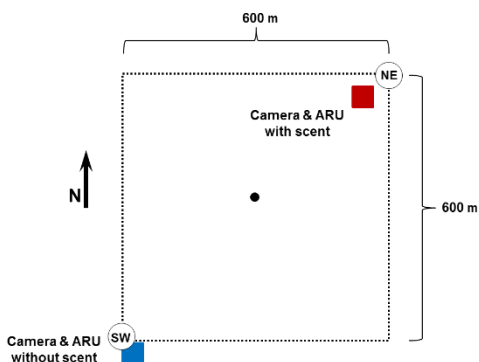

Figure 3. *Revisit Survey*: Cameras and ARUs are placed near NE and SW corners of a 600 x 600 m square centered on an ABMI site. The NE corner is scented.

SITES IN CROP FIELDS, PASTURES, & OPEN WATER: SELECTION CRITERIA

In forested sites, cameras/ARUs are moved a maximum of 50 m to a new location that is in a habitat similar to the grid corner (e.g. if the grid corner is under the canopy the new location must be under the canopy, or if the grid corner is on a cutline the new location must be on a cutline). Crop fields present a unique challenge since these areas area often ploughed, seeded, and sometimes cleared during our field season. As a result, we aim to move the original camera/ARU point location to the closest edge (e.g. fence row, road edge, field break, etc.) with the goal that units will not be disturbed while deployed and moving the station will not bias the data. Since stations that fall in pasture are not likely to be disturbed as much as those that fall in crop fields, our goal is to not move stations in pasture from their original location unless absolutely necessary. Regardless of where units are moved to, when deployed, they should face the original habitat type (ex. a crop field), and not the new habitat type (ex. a shrubby fence line).

Existing camera/ARU point stations are moved in the lab, pre deployment, using the general criteria below and verified when units are deployed:

- If possible, stations should be moved to a location with habitat that is as similar as possible to the original location
- Stations should not be moved more than 500 m from their original location
- There should be a minimum distance of 500 m between stations
- Avoid moving stations to treed locations, if possible
- A station should not be moved to the edge of body of water (wetland, creek, etc.) or a clump of trees unless it originally falls on one

Open Water
- If a station is within open water but ≤ 500 m from vegetation or the lake shore, then relocate the station to the nearest vegetation/shore.
- If a station is in open water and > 500 m from vegetation or the lake shore, then it is not surveyed using cameras and ARUs.

PRAIRIE AND CROP FIELDS

- If possible, the new location should be in a similar habitat to the original location
- The following locations are listed in order of priority:
  1. An interface between two cultivated fields with little or no uncultivated ground at the interface (if in a crop field)
  2. Fence line adjacent to the cultivated area with as narrow a non-cultivated strip as possible
  3. Road adjacent to the cultivated area. In order of preference:
     a. Vegetated trail
     b. Narrow gravel road
     c. Narrow paved road
     d. Large paved road (e.g. highway)
- Avoid moving points to trees and large shrubs if possible

PASTURE

- If possible, the new location should be in a similar habitat to the original location
    - Even if there is a treed location nearby, a station is moved from its original location only if the landowner rejects its original placement
- If moving a station, the following are listed in order of priority:
    1. Pasture edge or a similar cleared area
    2. Fence line adjacent to the pasture
    3. Road adjacent to the pasture. In order of preference:
        - e. Vegetated trail
        - f. Narrow gravel road
        - g. Narrow paved road
        - h. Large paved road (e.g. highway)
- Avoid moving points to trees and large shrubs if possible

Maps with several options are created in the lab (Appendix 3) and show the primary choices and alternates for each point.

DEPLOYMENT: STANDARD FIELD EQUIPMENT

You will need to bring the following equipment to every site, regardless of what set-up is required. Setup specific equipment lists can be found later in this document.

- Personal equipment (weather, safety, etc.)
- Reconyx PC900 or HP2X camera unit (with 12 lithium AA batteries and one 8 GB SDHC memory card)
    - Unit will be programmed ahead of time using SD card and Reconyx software to the settings described in Appendix 1
    - Manual
- ARU SM3 or SM4 (with 4 D batteries, and either two 16 GB or two 32 GB SDHC memory cards, depending on the unit)
    - Unit will be programmed ahead of time to the settings described in Appendix 2
    - Manual
- Protective laptop cases
- Desiccant packets (tubes provided by Reconyx)
- Spare SD cards
- Spare batteries
- Extra programming cards for ARU units
- Conduit (1.3 m), painted with alternating swatches of high contrast paint
- Cordless drill with proper bits (see specific sections below)
- Screw drivers- Phillips head, square socket (Robertson) head, flathead
- GPS (NAD83, decimal degrees)
- Datasheet, clipboard, pencil
- Compass

- Measuring tape
- Photo sheet and dry erase marker
- Digital camera
- Mallet
- Folding saw
- Scent (O'Gorman's Scent)
- PVC scent tubes & lure stakes
- Tablet
- Access package

RETRIEVAL: STANDARD FIELD EQUIPMENT

You will need to bring the following equipment to every site:

- Personal equipment (weather, safety, etc.)
- Cordless drill with proper bits (see specific sections below)
- Screw drivers- Phillips head, square socket (Robertson) head, flathead
- Protective laptop cases
- Tablet
- GPS (NAD83, decimal degrees)
- Datasheet, clipboard, pencil
- Compass
- Folding saw
- Photo sheet and dry erase marker
- Digital camera
- Access package

REMOTE CAMERA TRAPS

Remote camera traps are used to passively monitor wildlife in the field. We use Reconyx PC900 and HP2X cameras to collect data at our sites (Figure 4). The cameras are very user friendly and intuitive, but we still recommend reading over and bringing a user manual into the field in case issues arise.

Figure 4. Remote camera traps (Left: PC900 Model, Right: HP2X Model both from Reconyx).

ACTIVATING THE CAMERA

- Ensure the SD card is properly labeled. Record the card number in the tablet
- Attach a desiccant pack inside the camera closest to the batteries
- Turn the camera on
- Ensure the date and time are properly set on the camera (refer to the camera manual for any necessary adjustments)
    - The cameras have been programmed for daylight savings time. After November 3rd and before march 10th the units should be an hour ahead.

- **In The HyperFire 2 ONLY: Ensure the location is set to Latitude 54.40 N and Longitude 115.00 W**
    - **"Change Setup" →"Location" →"Other" →"Set Lat/Long"**
    - **Validate Sunrise according to the date you set up the camera (it will auto adjust)**
        - **www.timeanddate.com**
- Changed the user label to reflect where the unit will be deployed
    - PC900: In the menu select "Change Setup" → "Advanced" → "User Label" → "Add" and enter "ABMI-[SITE#]-[STATION]".
    - HP2X: In the menu select "Change Setup" → "User Label" → "Add"
    - For example, the user label for a camera deployed at site 905 in the NE corner would be: ABMI-0905-NE. Don't forget that the site number should be four digits. *
- Select "WalkTest" mode from the camera's main menu, close unit, and slide it into the C-bracket. Use either the eyebolt or the end of the Python lock through the lock channel to temporarily keep the camera in place.
    - The "WalkTest" mode allows you to determine the active motion detection zones of the camera (Figure 5)
- Ensure that the bottom of the top detection band of the camera is about 80 cm from the ground (Figure 5).

- Additionally, test the detection zone by walking through the target area (at different distances, heights, and directions) and ensuring the red WalkTest light on the front of the camera flashes where detections are expected.
- Depending on the size and shape of the attachment tree/post, it may be necessary to use sticks or pieces of wood to help fine tune camera position and aim.
- The camera will automatically self-arm and begin taking pictures after a two-minute period during which it does not detect any motion

* We recommend programming the prefix for each unit ahead of time (i.e. before deployment). This saves a lot of time in the field, and the LCD screens work better at warmer temperatures.

Figure 5. Remote camera detection bands, relative to the location of the painted conduit.

DEACTIVATING THE CAMERA

- Open the camera cover
- Press the "Ok" button to disarm the camera
  - The display will show the number of pictures on the SD card, how full the card is (%) and remaining battery (%)
  - Record this information in the tablet
  - You can also scroll to "Check Status" to see the information above
- In the menu select PC900: "Change Setup" → "Advanced" → "User Label" → "View" or HP2X: "Change Setup" → "User Label" → "View" Copy down the user label (prefix) that has been programmed into the camera.
- Slide the power switch to the "Off" position
- Record the SD card numbers in the tablet and slide the card back into the camera

AUTONOMOUS RECORDING UNITS

Autonomous recording units (ARUs) are used to remotely survey a variety of species such as birds, amphibians, and bats. Wildlife Acoustics Song Meters are designed to record autonomously for long periods of time. Our Song Meters are the SM3 model and SM4 models (Figure 6). The basic operation of all models is the same, but there are a few programming differences to be aware of. Please familiarise yourself with both the Song Meter recording units and the software used to program them. Read the User manual for the Song Meter. The Wildlife Acoustics website is also a useful source of information.
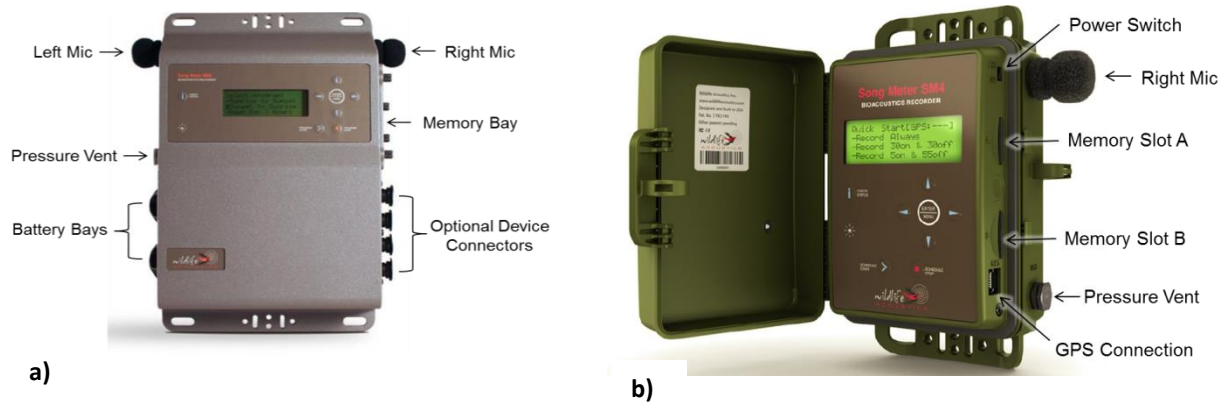

Figure 6. Key ports and features of Autonomous Recording Units (ARUs): **a)** the SM3 model; and **b)** the SM4 model. Both units are produced by Wildlife Acoustics.

SM3 MODEL ACTIVATION & DEACTIVATION

ACTIVATING THE ARU

- Turn the unit on, by moving the power switch DOWN
- Wait for the unit to initialize. If the unit does not turn on after a few seconds, press and hold the "Check Status" button for 2 seconds.
- Push the "Check Status" button once to verify the date and time. Adjust if necessary.
    - The ARUs have been programmed for daylight savings time. After November 3rd and before March 10th, the units should be an hour ahead.
- In the "Song Meter Main Menu" scroll to "Settings" and press "Enter/Menu"
- Scroll to "Location" and press "Enter/Menu"
- Select "Prefix"
- Change the file prefix to the site and station name using the directional arrow buttons. Use the format: "ABMI-[SITE#]-[STATION]". For example, the user label for an ARU deployed at site 905 in the NE corner would be: ABMI-0905-NE. Don't forget that the site number should be four digits. *
- Press the "Start Program" button. The unit will begin a 1-minute test recording and will then power down until it is scheduled to record again.

- During the test recording leave a voice stamp with the following information: Site #, Station, Date, Time, ARU Unit #, Crew Members

* We recommend programming the prefix for each unit ahead of time (i.e. before deployment). This saves a lot of time in the field, and the LCD screens work better at warmer temperatures.

DEACTIVATING THE ARU

- Press the "Stop Program" button
- Wait for the unit to initialize.
- In the "Song Meter Main Menu" scroll to "Settings" and press "Enter/Menu"
- Scroll to "Location" and press "Enter/Menu"
- Select "Prefix"
- Copy down the prefix that has been programmed into the ARU.
- Open the Memory Bay and turn the power switch to the OFF (up) position
- Record SD card numbers in the tablet
- If the ARU is mid-recording when you arrive, you can either wait for the recording to finish or press the "Program Stop" button to stop the recording and then follow the steps above

SM4 MODEL ACTIVATION & DEACTIVATION

ACTIVATING THE ARU

- Turn the unit on, by moving the power switch DOWN. You will be using the internal battery (INT).
- Wait for the unit to initialize.
- Push the "Check Status" button once to verify the date and time. Adjust if necessary.
    - The ARUs have been programmed for daylight savings time. After November 3rd and before March 10th, the units should be an hour ahead.

- In the "Main Menu" scroll to "Settings" and press "Enter/Menu"
- Scroll to "Location" and press "Enter/Menu"
- Select "Prefix"
- Change the file prefix to the site and station name using the directional arrow buttons. Use the format: "ABMI-[SITE#]-[STATION]". For example, the user label for an ARU deployed at site 905 in the NE corner would be: ABMI-0905-NE. Don't forget that the site number should be four digits. *
- To make a test recording, hold the up and down arrow keys at the same time.
- During the test recording leave a voice stamp with the following information: Site #, Station, Date, Time, ARU Unit #, Crew Members
- Press "Schedule Stop" to stop the test recording once you have finished recording your voice stamp
- Press the "Schedule Start" button to commence the programmed schedule. The following message will be displayed before the unit goes to sleep: "Going to sleep until <date and time>"
    - Date and time should correspond to the start time programmed into the .SM4S file. This may vary depending on the recording schedule.

* We recommend programming the prefix for each unit ahead of time (i.e. before deployment). This saves a lot of time in the field, and the LCD screens work better at warmer temperatures.

DEACTIVATING THE ARU

- Press and hold the "Stop Program" button for several seconds.
- Wait for the unit to initialize.
- In the "Main Menu" scroll to "Settings" and press "Enter/Menu"
- Scroll to "Location" and press "Enter/Menu"
- Select "Prefix"
- Copy down the prefix that has been programmed into the ARU.
- Turn the unit off by sliding the power switch up (EXT)
- Record SD card number in the tablet
- If the ARU is mid-recording when you arrive, you can either wait for the recording to finish or press the "Schedule Stop" button to stop the recording and then follow the steps above.

DEPLOYMENT IN TREED AREAS

FIELD EQUIPMENT

- [Standard Field Equipment](#)
- C-bracket (1 per camera)
- Deck screws (4 per camera, 2 per ARU)
- ¼" flat washers (4 per camera)
- Square socket (Robertson) head drill bit
- Knife/saw (if needed to trim branches/vegetation; gloves are required when using knives or saws)
- $\frac{3}{8}$ x 8" eyebolt with nut or Python cable lock and key

CAMERA DEPLOYMENT INSTRUCTIONS

- Identify suitable attachment point for camera in vicinity of target area (e.g. tree, fence post, etc.)
- Camera position should be determined following these guidelines:
  - Targeting a detection zone ~5 m from camera
  - A view, at least 5 m wide and 10 m long, that is not obstructed by shrubs and trees
  - Set at a height of 1 m (ground to bottom of the camera lens) (Figure 8) and angled to hit a point 80 cm above the ground, 5 m away from the camera lens (Figure 5)
    - The goal is to maximize detections of mid- and large-sized mammals in target area (no farther than ~10 m from camera, and not small animals right under camera)
  - Ideally facing North, or alternatively South, to avoid visibility problems with direct sunlight from East and West.
    - **Note**: In forests and shrubby areas, where direct sunlight is less of an issue due to canopy cover, achieving a 5m wide by 10 m view takes priority over what direction the camera faces.
- Determine the snow depth. Dig down through the snow, if necessary, and mount the camera so it will be 1 m above the ground surface.
- Holding the camera against the tree, determine the attachment location that will best capture the target area, and attach the C-bracket to the tree. Ensure that all 4 screws are tight to make it more difficult for bears to re-direct the camera.
- Drive a 1.3 m painted conduit stake 0.3 m into the ground (at NW and SE points of baseline survey sites only), 5 m in front of the camera in the target area
  - Ensure that after the snow melts no more than 1.0 m of conduit will be visible (Figures 5 & 8)
- For locations that are scented, (NE and SW points of baseline survey sites) hammer a red lure stake through a PVC scent tube. Smear 1 tablespoon of scent into the PVC tube
- If necessary, clear vegetation interfering with visibility of target area (e.g. branches, small shrubs). Try to anticipate vegetation growth as much as possible (i.e. remove saplings/branches that might grow/leaf/blow in front of camera).

- Follow the steps in *Activating the Camera*
- Loop the python cable lock through the hole in the camera unit and pull tight to secure the camera to the tree (using the "cinch" setting on the lock when tightening. Move to "lock" and remove key once tightened)
  - In areas where cameras are not locked, use an eyebolt and nut to hold the camera in place
- Fill out the photo sheet with the ABMI site number, Station, Camera #, and Date, and take a series of test photos
  - Wait for the camera to arm and take a test photo holding the photo sheet. Start at the painted conduit stake and walk slowly towards the camera, tilting the laminated sheet slightly downward to avoid sun glare on the shiny surface.
- Fill in all data fields in the tablet and any problems encountered in setting the camera
- Use the waypoint average feature on the GPS to create a waypoint
- Before leaving the camera check that the clear plastic areas are clean and not covered in fingerprints or dirt. Clean these areas with a lens wipe if needed.

Before leaving site make sure:

- Camera is securely attached and armed
- Key is removed from cable lock (if applicable)
- GPS location is accurately recorded, and all data fields are completed
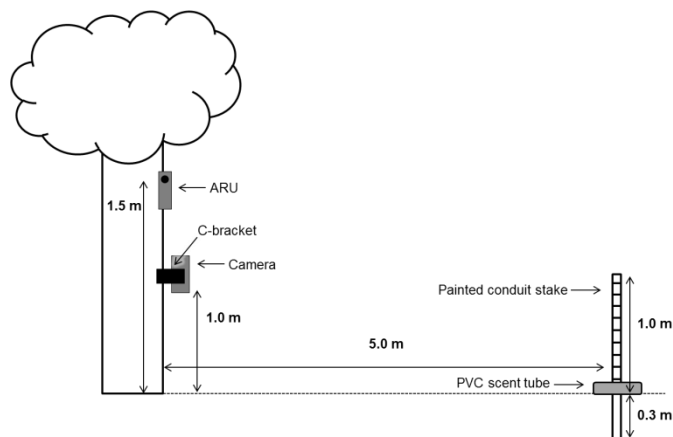

Figure 8. Camera and ARU set in a treed location. Ideally, both units should face north.

ARU DEPLOYMENT INSTRUCTIONS

- Choose trees that are not wider than the ARU (tree diameter depends on the model of ARU). A wider tree will interfere with sound reaching the microphones (Figure 9). Ensure that both microphones can be seen from behind the tree.
- Remove any branches that may interfere with the ARU microphones
- Put ARU on NORTH (+/-5° of 0°) side of the tree to protect unit from direct sun and ensure more accurate temperature readings. The microphones should be pointing east and west.
- Mount ARU at a height of 1.5 m (ground to microphone) (Figures 7 & 8). Screw in both top and bottom brackets.
- Follow the steps described in *Activating the ARU*
- Lock the unit to the tree (if applicable)
- If using an SM4 unit, zip tie the front cover shut to prevent accidental openings, cut the end of the zip tie with wire cutters
- Make sure that the lock cable is not touching the microphones
- Use the waypoint average feature on the GPS to create a waypoint
    - Only one point is needed if ARU and Camera are in the same location
- Fill out all data fields in the tablet

Before leaving site make sure:

- ARU is securely attached and ready to record at the correct time
- You have done a test recording
- Nothing is touching the microphones
- Key is removed from cable lock (if applicable)
- GPS location is accurately recorded, and all tablet fields are filled in

Figure 9. ARU placement on a tree. Microphones still are wider than the trunk, thus ensuring that sound is not blocked by the tree.

DEPLOYMENT WITHOUT USING SCREWS

In areas where units cannot be mounted to trees using screws (e.g. protected areas such as provincial parks) it is necessary to mount units using less invasive means.

FIELD EQUIPMENT FOR ROPE ATTACHMENT METHOD

- [Standard Retrieval Field Equipment](#) (minus drill and screwdrivers)
- Rope

CAMERA ATTACHMENT

- Identify a suitable location for deploying the camera
- Attach camera to tree by threading the rope through the camera lock channel and tie the camera to the tree
- Wrap the rope around the tree several times to ensure that the camera is securely attached
- Once camera is deployed, thread a cable tie through each padlock loop in the camera, and zip closed to prevent accidental opening

ARU ATTACHMENT

- Identify a suitable location for deploying the ARU
- Secure ARU to tree at desired height by threading rope through the mounting brackets
- Wrap the rope around the tree several ties to ensure that the ARU is securely attached

FIELD EQUIPMENT FOR ZIP TIE ATTACHMENT METHOD

- [Standard Deployment Field Equipment](#) (minus drill and screwdrivers)
- 24" UV Resistant Heavy-Duty Cable Ties

CAMERA ATTACHMENT

- Identify a suitable location for deploying the camera
- Attach a C-bracket to the tree using two heavy duty zip-ties wrapped around both the trunk and bracket ensuring the ties cross each other (form an X) to minimize movement
- If the tree diameter is too large, two zip-ties can be attached together to lengthen them
- Adjust the camera aim prior to fully tightening the zip-ties

ARU ATTACHMENT

- Identify a suitable location for deploying the ARU
- Secure ARU to tree at desired height by threading two zip-ties through both the top and bottom mounting brackets and the around the tree

- Adjust the unit prior to tightening zip-ties

RETRIEVAL IN TREED AREAS

FIELD EQUIPMENT

- [Standard Retrieval Field Equipment](#)
- Cordless drill with square socket (Robertson) bit
- Screw driver- square socket (Robertson) head
- Wire cutters
- Python lock key (at some sites)

CAMERA RETRIEVAL INSTRUCTIONS

- Once you locate the camera, fill out the photo sheet with the ABMI site number, Station, Camera # and Date and take a series of test photos.
- Start at the painted conduit stake and walk slowly towards the camera, tilting the laminated sheet slightly downward to avoid sun glare on the shiny surface.
- Open the camera cover. This might require cutting zip ties, removing an eyebolt and sliding the camera out of the C-bracket, or removing the python lock
- Follow the instructions for *Deactivating the Camera*
- Place camera in a secure location
  - Wrap the camera is bubble wrap or put in a laptop case during transport
- Double bag scent tubes in two Ziploc bags; place in plastic grocery bag
- Tape painted conduit markers together for easier transport

ARU RETRIEVAL INSTRUCTIONS

- If you are accessing a site where units are locked, make sure to bring python lock keys
- Follow the instructions for *Deactivating the ARU*
- Remove the ARU from the tree or post and place it in a laptop case for secure transport

If the ARU is mid-recording when you arrive, you can either wait for the recording to finish or press the "Program Stop" button

DEPLOYMENT IN PASTURE AND CROP FIELDS

Deploying cameras and ARUs in pasture and crop fields is similar in that in both cases units are attached to a post secured in the ground. The main difference between the two locations is that in a pasture, an agronomy cage is installed in order to prevent cattle from interfering with the units. Since cattle are not a major concern in crop fields, an agronomy cage is not used.

ADDITIONAL FIELD EQUIPMENT

- [Standard Field Equipment](#)
- Steel post (7'/2.1 m; Dimensions: 1¼" x 1 ¼" x 0.100) with pre-drilled holes
- $^7/_{16}$" wrench
- $^5/_{16}$" socket wrench
- Custom A-bracket
- ¼ x 2½" carriage bolt (1)
- ¼ inch nut (2)
- ¼ inch flat washer (2)
- Hose clamps ($1^1/_{16}$ – 2") (2)
- Post pounder
- Cable ties (7½" length)
- Python cable lock and key
- Agronomy cage (Four 6'1"/1.9 m x 3'6"/1.1 m panels) ***PASTURE SITES ONLY**

CAMERA & ARU DEPLOYMENT INSTRUCTIONS

- Ensure that the given location is suitable for deployment
- Dig a small clearing
  - Crop Field: ~ 0.1 m^2 – Just large enough for the post
  - Pasture: ~ 2.0 m^2 – The agronomy cage will need to fit into the clearing
- Pound the 7'/2.1 m steel post into the ground using the post pounder
  - Ensure that ~ 0.5 m of the post is below the surface
- Camera position should be determined following these guidelines:
  - Targeting a detection zone ~5 m from camera
  - A view, at least 5 m wide and 10 m long, that is not obstructed by shrubs and trees
  - Set at height of 1 m (ground to bottom of the camera lens) (Figure 8) and angled to hit a point 80 cm above the ground, 5 m away from the camera lens (Figure 5)
    - The goal is to maximize detections of mid- and large-sized mammals in target area (no farther than ~10 m from camera, and not small animals right under camera)
  - Ideally facing North, or alternatively South, to avoid visibility problems with direct sunlight from East and West.
    - **Note**: Ensure that the camera faces the habitat type of its original location (i.e. face the camera into a crop field rather than along the fence line it was moved

to). **Facing units north/south is secondary to facing the units into the correct habitat type.**

- Determine the snow depth. Dig down through the snow if necessary and mount the camera so it will 1 m above the ground surface.
- Thread the bolt through one of the pre-drilled holes in the post and screw into the threaded inset on the back of the camera
  - Add washer and nut. Tighten with wrench.
- To adjust the tilt of the camera: Add a custom A-bracket between the camera and post (Figure 10)
  - Slide the bracket up and down to adjust the tilt of the camera
  - Tighten nut with a wrench
- Mount the ARU onto the steel post at a height of 1.5 m (ground to microphones) using two hose clamps
- Drive a painted 1.3 m conduit stake 0.3 m into the ground (NW and SE points of baseline survey sites), 5 m in front of the camera in the target area
  - Ensure that after the snow melts no more than 1.0 m of conduit will be visible
  - If there is not enough room to place a stake 5 m in front of the camera, get as close to 5 m as possible, but omit the conduit stake if it is closer than 3 m.
  - If the station is lured but the stake cannot be placed, scent should still be applied in front of the camera by digging a small hole and placing lure within it
- For locations that are scented (NE and SW points of baseline survey sites) hammer a red lure stake through a PVC scent tube. Smear 1 tablespoon of scent into the PVC tube
- Follow the remaining instructions in *Deployment in Treed Areas: Camera Deployment Instructions*
- To activate the units, follow the instructions in *Activating the Camera* and *Activating the ARU*
- Loop the python cable lock through the holes in the camera unit and the ARU. Use the "cinch" setting on the lock when tightening. Move to "lock" and remove key once tightened.
- Thread a cable tie through each padlock loop in the camera and SM4 ARU, and zip closed to prevent accidental opening
- Use the waypoint average feature on the GPS to create a waypoint
- In pasture only: surround the post with an agronomy cage and fasten panels with zip ties (Figure 11)

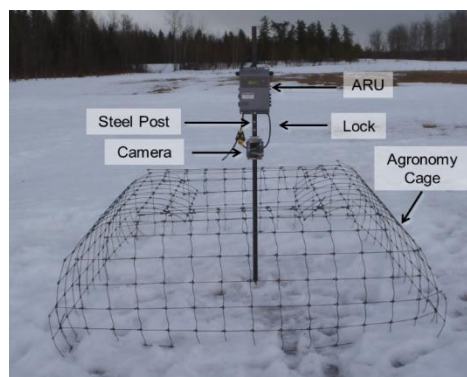**Figure 10**. Custom A-bracket attached between the post and camera to adjust the tilt of the unit.

Figure 11. Camera and ARU deployed in a pasture. In a crop field, the set-up is not be surrounded by an agronomy cage.

RETRIEVAL IN PASTURE AND CROP FIELDS

ADDITIONAL FIELD EQUIPMENT

- Standard Retrieval Field Equipment
- Flat head screwdriver or socket wrench (for ARUs)
- $^7/_{16}$" wrench
- Python lock key

SPECIFIC RETRIEVAL INSTRUCTIONS

- In pasture only: Cut zip ties and remove cage panels (Figure 11). Flatten for easier transport.
- Follow the instructions for *Deactivating the ARU* and *Deactivating the Camera*
- Unscrew hose clamps holding the ARU in place and remove the unit from the post. Place it in a laptop case for secure transport.
- Remove camera from post
  - Loosen the nut farthest away from the camera first
  - Unscrew bolt from the threaded inset on the back of the camera
  - Remove custom bracket (Figure 10) if necessary
- Remove the 7'/2.1 m steel post
- Pull the conduit out of the ground

DEPLOYMENT IN WET, TREELESS LOCATIONS

Units deployed at wet sites (i.e. bogs and fens) where there are no suitable trees for unit attachment will need to be mounted to conduit and stabilised with a tripod (Figure 12).

ADDITIONAL FIELD EQUIPMENT

- Standard Field Equipment
- Tripod
- Rebar (2 m)
- Conduit (2 m)
- Post pounder
- Mounting blocks
- Hose clamps (¾ – 1¼")
- $^5/_{16}$" socket wrench
- $^7/_{16}$" socket wrench with extension
- Cable ties (7½" length)
- Python cable lock and key

CAMERA & ARU DEPLOYMENT INSTRUCTIONS

- Identify a suitable location for deploying the camera & ARU
- Dig a clearing large enough so that when finished, the tripod legs will be standing on the ground (about
  1 m^2)
- Pound the 2 m rebar into the ground using the post pounder (Figure 12)
  - o Ensure that at least 1.0 m of the rebar is below the surface since this will act as an anchor when the ground thaws
- Slide the 2 m conduit over the rebar, then slide the tripod and mounting block over the conduit
- Pound the conduit into the ground so at least 0.5 m is below the surface
- Open the tripod legs, and ensure that all of them are resting on the frozen ground
- Camera position should be determined following these guidelines:
  - o Targeting a detection zone ~5 m from camera
  - o A view, at least 5 m wide and 10 m long, that is not obstructed by shrubs and trees
  - o Set at height of 1 m (ground to bottom of the camera lens) (Figure 8) and angled to hit a point 80 cm above the ground, 5 m away from the camera lens (Figure 5)
    - ▪ The goal is to maximize detections of mid- and large-sized mammals in target area (no farther than ~10 m from camera, and not small animals right under camera)
  - o Ideally facing North, or alternatively South, to avoid visibility problems with direct sunlight from East and West.
- Attached the mounting block to the threaded inset on the back of the camera
- Mount the ARU onto the conduit at a height of 1.5 m (ground to microphones) using two hose clamps

- Drive a 1.3 m painted conduit stake 0.3 m into the ground (at NW and SE points of baseline survey sites), 5 m in front of the camera in the target area
  - Ensure that after the snow melts no more than 1.0 m of conduit will be visible
- For locations that are scented (NE and SW points of baseline survey sites) hammer a red lure stake through a PVC scent tube. Smear 1 tablespoon of scent into the PVC tube
- Follow the remaining instructions in *Deployment in Treed Areas: Camera Deployment Instructions*
- To activate the units, follow the instructions in *Activating the Camera* and *Activating the ARU*
- Thread a cable tie through each padlock loop in the camera and SM4 ARU, and zip closed to prevent accidental opening
- Use the waypoint average feature on the GPS to create a waypoint
- Loop the python cable lock through the holes in the camera unit and the ARU. Use the "cinch" setting on the lock when tightening. Move to "lock" and remove key once tightened.
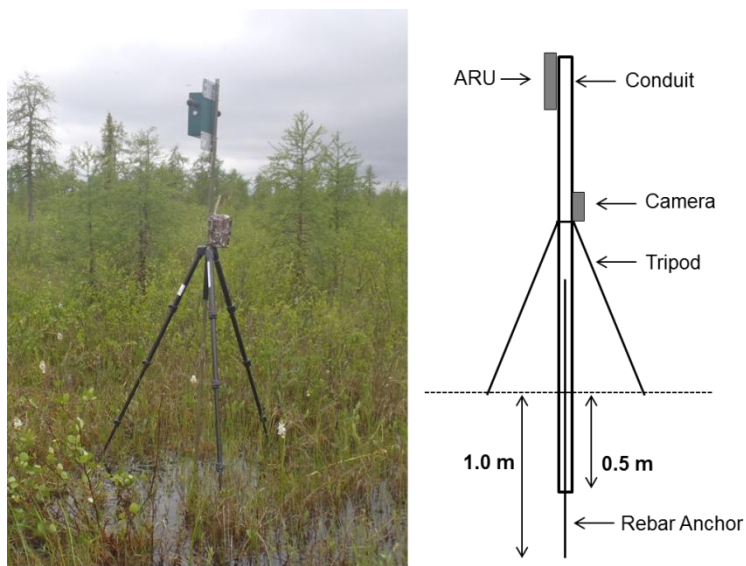

Figure 12. Camera and ARU set up in a wet area using a tripod

RETRIEVAL IN WET, TREELESS LOCATIONS

ADDITIONAL FIELD EQUIPMENT

- Standard Field Equipment
- Flat head screwdriver (for hose clamps)
- $7/16$" socket wrench with extension
- Wire cutters
- Python lock key (at some sites)

SPECIFIC RETRIEVAL INSTRUCTIONS

- Unlock the camera and ARU from the tripod (if applicable)
- Follow the instructions for *Deactivating the ARU* and *Deactivating the Camera*
- Unscrew hose clamps holding the ARU in place and remove the unit from conduit. Place it in a laptop case for secure transport.
- Unscrew and slide the camera mounting block over the conduit
- Remove the mounting block from the threaded inset on the back of the camera using a socket wrench with extension
- Pull the tripod, conduit, and rebar out of the ground (Figure 12)

ARU AND REMOTE CAMERA DATA COLLECTION

Fill out <u>ALL</u> data fields every time you deploy or pick-up a camera/ARU. Do not rely on your memory to fill in information later. If for some reason you end up at a deployment or pick-up without your tablet or back-up datasheets, use your field notebook to record the correct information and transcribe the data into the tablet once you get to your truck or camp location.

GPS COORDINATES

You will be provided with Garmin GPSMAP 78 units to use in the field. You will have to mark the location of every camera and ARU deployed. Please use waypoint averaging when collecting coordinates to ensure that locations are as accurate as possible.

To Collect a Waypoint

- "Main Menu" → "Waypoint Avg." → "Create Waypoint"
- Lay the GPS unit on the ground or hang on a tree branch as close as possible to where the camera/ARU is deployed
- When the Sample Confidence reaches 100%, hit "Save"
- The waypoint will be automatically named. Rename the waypoint using the convention in the following paragraph or note the temporary name so that you can re-name it to something more informative.

To Re-name a Waypoint

- "Main Menu" → "Waypoint Mgr."
  - o Select waypoint that you would like to re-name
- Re-name each waypoint using the following convention: [Site #]-[Station]-[CAM/ARU/BOTH]. Ex. 992-NE-BOTH

SNOW DEPTH

Before you trample the snow around the camera/ARU, remember to measure snow depth. Using a carpenter's tape determine the snow depth at a point 0.5 m directly in front of the unit.

PHOTOS

To do a brief assessment of vegetation and keep a record of what every point looks like, we take photos at every camera/ARU deployment location.

Deployment
- Take one landscape photo of the camera and ARU set-up (or two photos if the units are attached to separate trees) using a digital camera
- Ensure the ground is visible at the bottom of the photo with the camera and ARU in the centre of the image
- Label the photos with the site number, station, date, and SET (to indicate that you took a photo of the set-up): **ABMI_YEAR_[Site#]_[Station]_[ARU/CAM/BOTH]_SET**. No need to put leading zeros in from of the site number. For example, a photo of the camera and ARU at the NE station at site 333 would be "ABMI_2017_333_NE_BOTH_SET"

Retrieval
- Take seven photographs using a digital camera
    - *Transect Photos* – From the camera/ARU location, take landscape photographs at eye level in each of the four sub-ordinal directions (NE, NW, SW, SE).
    - *Representative Site Photo* – From anywhere near the camera/ARU; take a single photograph that best represents the physical and vegetation characteristics of the site (SITE).
    - *Canopy Photo* – Standing at the camera/ARU, take a photograph of the canopy from waist height with the camera pointing directly up (CANOPY).
    - *Set-Up Photo* – Take one landscape photo of the camera and ARU set-up (or two photos if the units are attached to separate trees) using a digital camera. Ensure the ground is visible at the bottom the photo with the camera and ARU in the centre of the image
- Check the quality of the photos and re-take if blurry.
- You will have to take a total of 12 photos if cameras and ARUs are attached to separate trees.
- Label the photos with the site number, station, date, and, and direction (NE/NW/SW/SE/SITE/CANOPY): **ABMI_YEAR_[Site#]_[Station]_[ARU/CAM/BOTH]_[DIRECTION]**. For example, a transect photo facing NE at the NE station at site 333 where there is only a camera would be "ABMI_2017_333_NE_CAM_NE"

CONDITION

To help with camera/ARU inventory and repair before the subsequent field season, record the physical and mechanical condition of each unit during retrieval. Circle the applicable physical and mechanical condition on the datasheet or select the appropriate condition from a drop-down in the tablet and note any details in the comments section.

Physical
- Excellent: Unit appears to be in good working order and will unlikely need repair.
- Good: Unit may need some minor repair, but damage is unlikely to affect unit function. Examples include: bite marks that do not penetrate unit casing, broken infrared mask on camera, peeling paint.
- Fair: Unit may need some minor repair. Damage may affect unit function, or the quality of the data collected. Examples include missing wind cover on ARU microphones or muddy/caterpillar encrusted camera lens.
- Poor: Unit will likely need major repair. Examples include: broken ARU microphones, shattered camera lens, bite marks that penetrate unit casing, water damage.

Mechanical
- OK: Unit operation as expected.
- CHECK: There was a mechanical error or malfunction when unit was retrieved. Examples include: Unit did not turn on, error messages appeared; basically, anything out of the ordinary.

ECOSITE DATA

Determine the ecosite type in a **50 metre radius** for:
- All four Camera/ARU locations
- Site centre

- If the camera and ARU are not located on the same tree, stand between the two units and determine ecosite type from there
- Determine the historical and primary current ecosite type within the area sampled and record the proportion of area (in 10% increments) occupied by that type. If more than two ecosites are present, include details and percentages in the comments section.
- Secondary ecosite types must occupy 20% of the area; otherwise they are considered part of the primary ecosite.

For more information on how to collect ecosite data, please refer to *Terrestrial Field Protocols*

IMPORTANT CARE INSTRUCTIONS

Always handle the ARUs and camera units with care. They contain sensitive electronic components that will not withstand crushing or heavy impacts.

Transport: Dropping the units or having them bounce around during transport can cause damage to the connections inside and destroy the outside as well. Sharp or abrasive materials can also damage the lens cover on cameras and blur the images. In the field, always transport the ARUs and cameras in a padded bag.

The microphones are sensitive to impact and pressure. Also, if microphones are wet when you pick up a recorder, make sure to dry them out before storing the unit.

Rain, Snow and other wet stuff: Extra care is required to handle ARUs and cameras in wet weather and in wet locations (ex. bogs and fens). When these units are closed, they are water tight and can withstand most weather conditions in the field. However, **do not get water onto the electronic components inside**. Water will short out the electrical circuits and may cause permanent damage to the units. Take extra care when activating or deactivating cameras and SM4 units in wet conditions. The following steps may be used to minimize the amount of time a camera or ARU is open if you need to deploy in heavy snow or rain.

Rainy day activation:
- Set up cameras and ARUs in your truck or room: Load SD cards (if necessary), check batteries, pre-program site and station prefixes.
- Record unit number, SD card number, and other information in the tablet ahead of time so that minimum time is spent with the unit open in wet conditions.
- CLEARLY LABEL each recorder with the site and station that it is programed for.
- In the field, minimize the time units are exposed to the elements.

Note: If possible, please do not start ARU recordings until you are at the correct station. Test recordings are used to verify date and time of deployment. If you do have to start the recording schedule early or if you must, do a test recording ahead of time, please mark this clearly on your data sheet!

TROUBLESHOOTING

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

Screen freezes: 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. Check the SET/PGM/SM4S file (and reload if necessary); and check all settings after a forced shutdown like this.

Song Meter won't turn on: This mostly happens due to an interruption of the power supply. Check that the power switch is moved to "Internal" power source on (down) on the SM3 and SM4 models. Also, check that the batteries are placed correctly in the battery bay.

Timer batteries: The timer batteries will also affect how the Song Meter works. If you cannot set the time or the unit won't turn on, the timer batteries may need to be replaced. We can replace timer batteries in SM4 units, but only Wildlife Acoustics can replace timer batteries in SM3 units.

SD CARD MANAGEMENT

The photos and recordings on SD cards are very valuable and great care must be taken to ensure that stations and sites are not mixed up when units are collected in the field. Managing SD cards during retrieval is a very important task.

- Once back at camp, remove SD cards from cameras and ARUs
- Place each camera SD card into a yellow coin (2.25 x 3.5) envelope
- Place each ARU SD card into a blue coin envelope
  - o Please do not seal the coin envelopes!
- Fill out labels on SD card coin envelopes as you go
- Place coin envelopes from one site (8 envelopes in total - 4 camera, 4 ARU) into a larger envelope (~4.5"x6.75"), and label it with the site number (Figure 13)
- Place sites from the same block into a large envelope
- Submit envelopes to your supervisor at the end of shift. They will transport them to the University of Alberta for processing
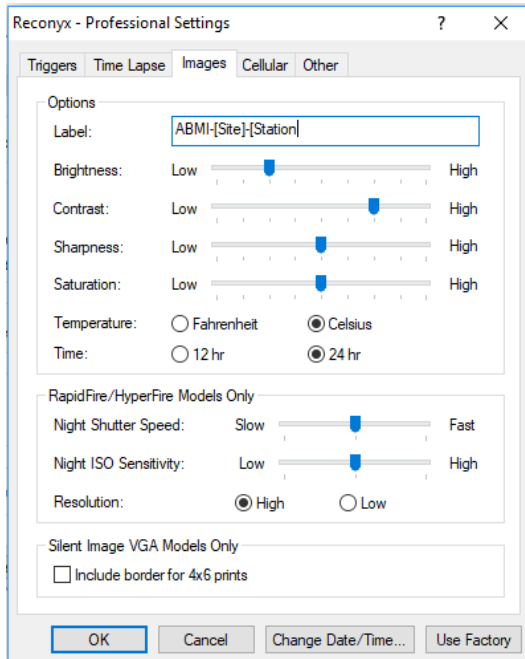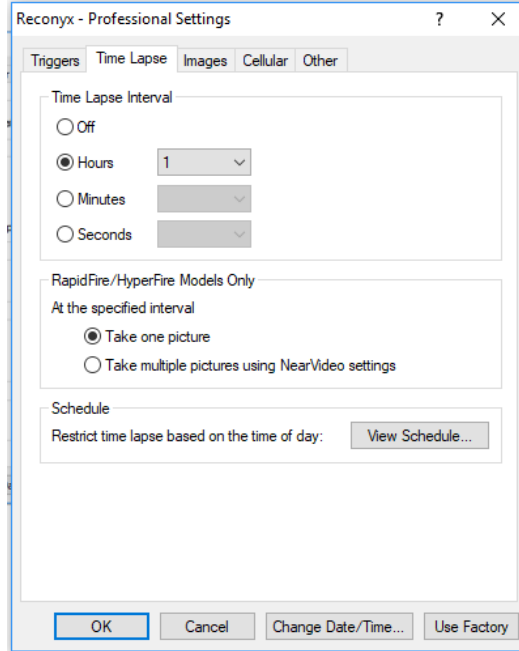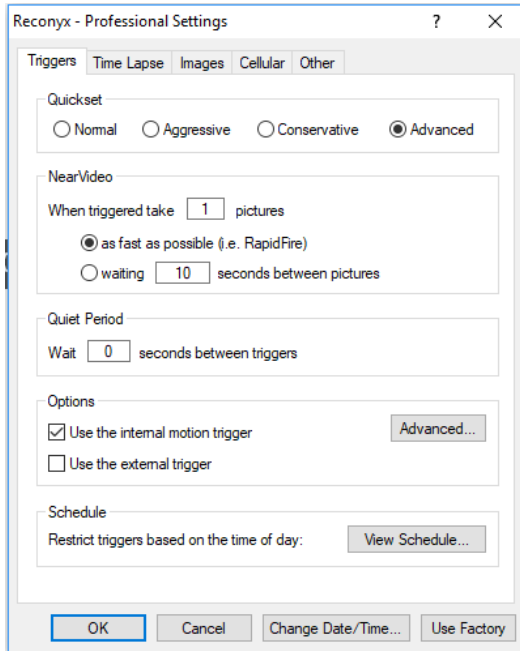
Remote crews: Leave SD cards in the units. Send units and associated data files back to base and the logistics coordinator will manage SD cards.

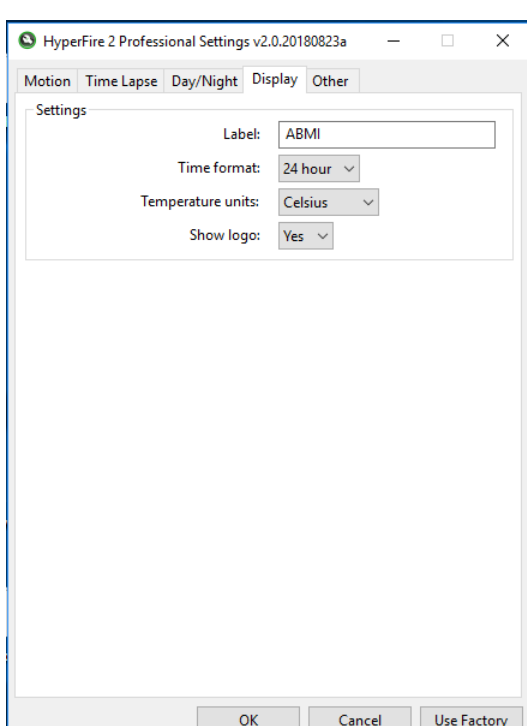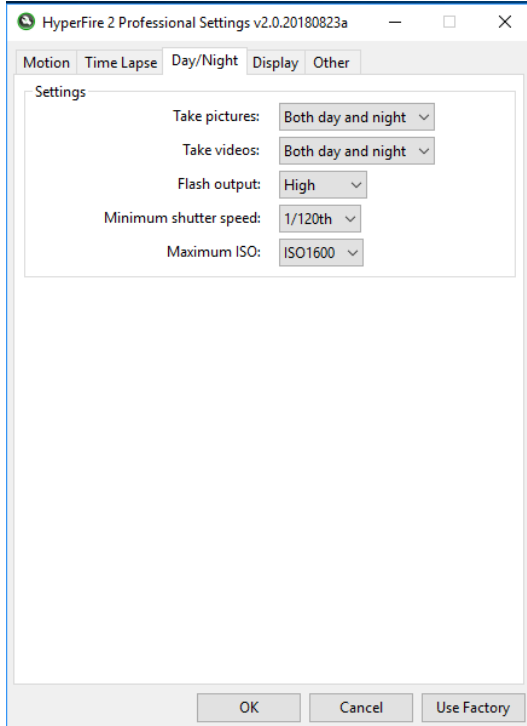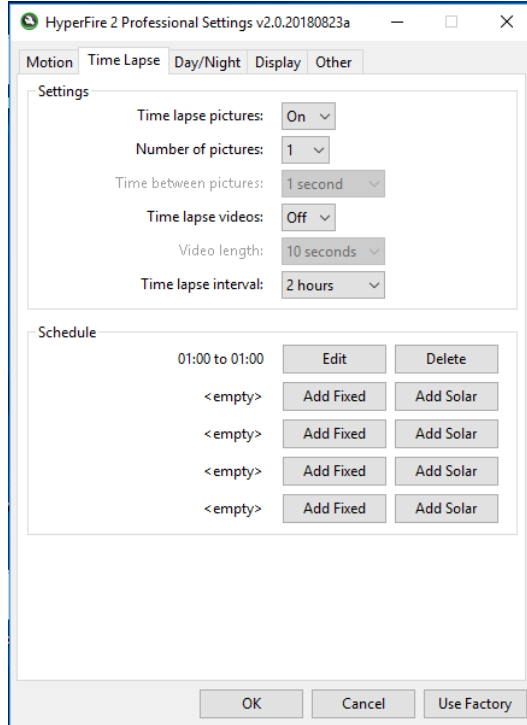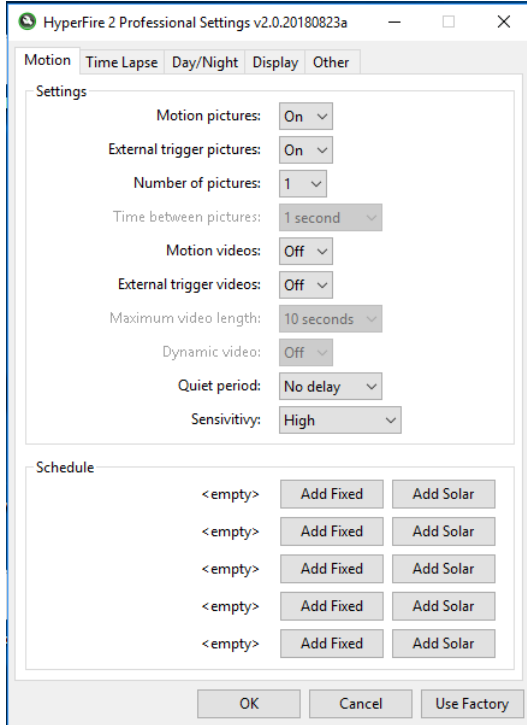**Figure 13**. SD card management following unit retrieval from the field.

APPENDIX 1: REMOTE CAMERA TRAP SETTINGS

Reconyx PC900

APPENDIX 1: CONTINUED

Reconyx HyperFire 2

APPENDIX 2: ARU SETTINGS AND SCHEDULE

Information that is the same for SM3, and SM4

2019 Recording Schedule:
- 10 min at 00:00:00
- 3 min at 02:00:00
- 10 min at 30 min after sunrise
- 3 min at 2 hrs. after sunrise
- 3 min at 12:00:00
- 3 min at 15:00:00
- 3 min at 1 hr. before sunset
- 3 min at 1 hr. after sunset

Location (specified in SET/PGM/SM4S file):
- Latitude: 54.40 N
- Longitude: 115.00 W

Solar Mode: Sunrise/Sunset (specified in SET/PGM/SM4S file)

Timezone: UTC -06 (this is 6 from Prime Meridian = Mountain Standard Daylight Savings Time, specified in SET/PGM/SM4S file)

Memory:
- Slot A = 16 GB
- Slot B = 16 GB

OR

- Slot A = 32 GB
- Slot B = 32GB

Batteries: 4 D-Cell batteries (Internal, Alkaline)

Note: SM3 programs are scheduled to do a 1 minute Test recording when they are put into stand by. When you press "Start Program" on the SM3, it will record 1 min and then say: Going to Sleep Until 01 March 2019 (or whenever the next scheduled recording time is).

Settings specific to SM3

SM3 does not use left and right to identify channels. The left channel is designated CH 0 and the right channel is CH 1.

All information for audio setting, file type, gain and schedule are specified in the SM3 program file. There are no longer any manual switches for any of these. Similar to the SM2, this info is entered line by line into the program using the SM3 configuration utility.

Program:
- 1 HPF CH 0: Off Ch 1: OFF
- 2 GAIN CH 0: 19.5 dB CH 1: 19.5 dB
- 3 FS WAC Format CH 0+1 48000 Hz

- 4 ZC Off DIV 8
- 5 TRGLVL CH 0: Off CH1: Off
- 6 RECORD 00:01:00
- 7 AT DATE 2019 Mar 01
- 8 REPEAT
- 9 AT TIME 00:00:00
- 10 RECORD 00:10:00
- 11 PAUSE 01:50:00
- 12 RECORD 00:03:00
- 13 AT SRIS +00:30:00
- 14 RECORD 00:10:00
- 15 PAUSE 01:20:00
- 16 RECORD 00:03:00
- 17 AT TIME 12:00:00
- 18 RECORD 00:03:00
- 19 AT TIME 15:00:00
- 20 RECORD 00:03:00
- 21 AT SSET -01:00:00
- 22 RECORD 00:03:00
- 23 PAUSE 01:57:00
- 24 RECORD 00:03:00
- 25 UNTCOUNT Forever

Settings specific to SM4

Settings and schedule are programed using SM4 Configurator software.

Settings:

Gain: Left: 12.5 dB, Right: 12.5 dB
Sample rate: 44100 Hz
Max Length (hh:mm): 1:00
LED delay off
Delay start (dd/mm/yyyy): 01/03/2019

Schedule:

- START time 00:00
- DUTY always
- END time 00:10
- START time 02:00
- DUTY always
- END time 02:03
- START rise + 00:30
- DUTY always
- END rise + 00:40
- START rise + 02:00
- DUTY always
- END rise + 02:03
- START time 12:00

- DUTY always
- END time 12:03
- START time 15:00
- DUTY always
- END time 15:03
- START set – 01:00
- DUTY always
- END set – 00:57
- START set + 01:00
- DUTY always
- END set + 01:03

APPENDIX 3: MAPS FOR SITES IN CROP FIELDS & PASTURE

Sites in crop fields require special attention since camera traps and ARUs will need to be deployed in locations that will not be disturbed during the field season. This requires careful planning well before deployment and extensive work to obtain permission from landowners.

A map is created ahead of time following the criteria outlined in *Sites in Crop Fields: Selection Criteria*. The primary camera and ARU locations are labelled SITE CORNER-1 (e.g. NE-1) and are represented by a yellow star symbol. The alternate camera and ARU locations are numbered in order of preference (ex. NE-2 is preferred over NE-3) and are represented by a yellow dot.