



PTAC Grant #20-ERPC-02 Final Report

June 20, 2022

Environmental Sensor Monitoring – Improving the Processing Efficiency of Acoustic Big Data to Support Alberta’s Land Managers

In the past five years, wildlife monitoring has changed fundamentally in Alberta. Environmental sensor networks that include autonomous recording units (ARUs), remote cameras, vegetation sensors, soil water sensors, and GPS-enabled movement tracked devices are rapidly replacing conventional human survey techniques. Such sensors allow for continuous or near continuous data collection over extended periods of times resulting in the accumulation of “big data”, a key benefit of their use.

ARUs are used to monitor vocalizing species in Alberta such as bats, songbirds, amphibians, owls, waterfowl, ungulates, and canids. By our estimates, Alberta has the largest set of audio recording data in the world. For example, the Bioacoustic Unit and the ABMI have collected 0.5 petabytes of acoustic data using ARUs since 2012. In addition, the province has been conducting bat acoustic surveys since 2014. Only a small percentage of these audio recordings have been processed by conventional techniques (i.e., manual transcription) for all species while automated recognition has been used to search through all of the data for some species of concern. To make the most effective use of these data, an integrated approach to collecting, storing, visualizing, processing, and creating information is needed. WildTrax is our solution to this challenge.

The overall goal is to improve the efficiency and scope of environmental data delivered to industrial environmental managers. The rate limiting step in the use of environmental data is processing time. The development and incorporation of effective species recognizers into WildTrax will significantly improve this rate limiting step. Furthermore, by bundling bat and habitat data into the platform, managers will save time in gathering the data they need, and benefit from additional data aggregation opportunities.

Creation of a more efficient transcription process within the acoustic platform via the development of automated species classification

Complete library of species vocalizations (100 clips per species)

Status: Complete

For this project, an additional 20 species were identified for which to extract vocalizations. The historical library will be made available through Google drive, while Species Verification will be used to populate the new updated library with verified sounds clips. With respect to Species Verification in WildTrax, species and their corresponding clips, will be structured into a library which will be more accessible for users. Clips will be accessible within an organization, and publicly for those who wish to release their data. The next step here is to create the UI/UX to support efficient data access by users.

Single species recognizer development and testing

Status: Complete

On www.wildtrax.ca, 24 recognizers currently exist for download by the public. In addition to these 24 recognizers, BirdNet (<https://birdnet.cornell.edu/>) scores have been added to facilitate users during the verification process (Figure 1). BirdNet is an open-source tool developed by the Cornell Lab of Ornithology and the Chair of Media Informatics at Chemnitz University of Technology to detect and classify avian sounds using machine learning. BirdNet probability scores are also downloadable as part of the data package received upon downloading data from www.wildtrax.ca.

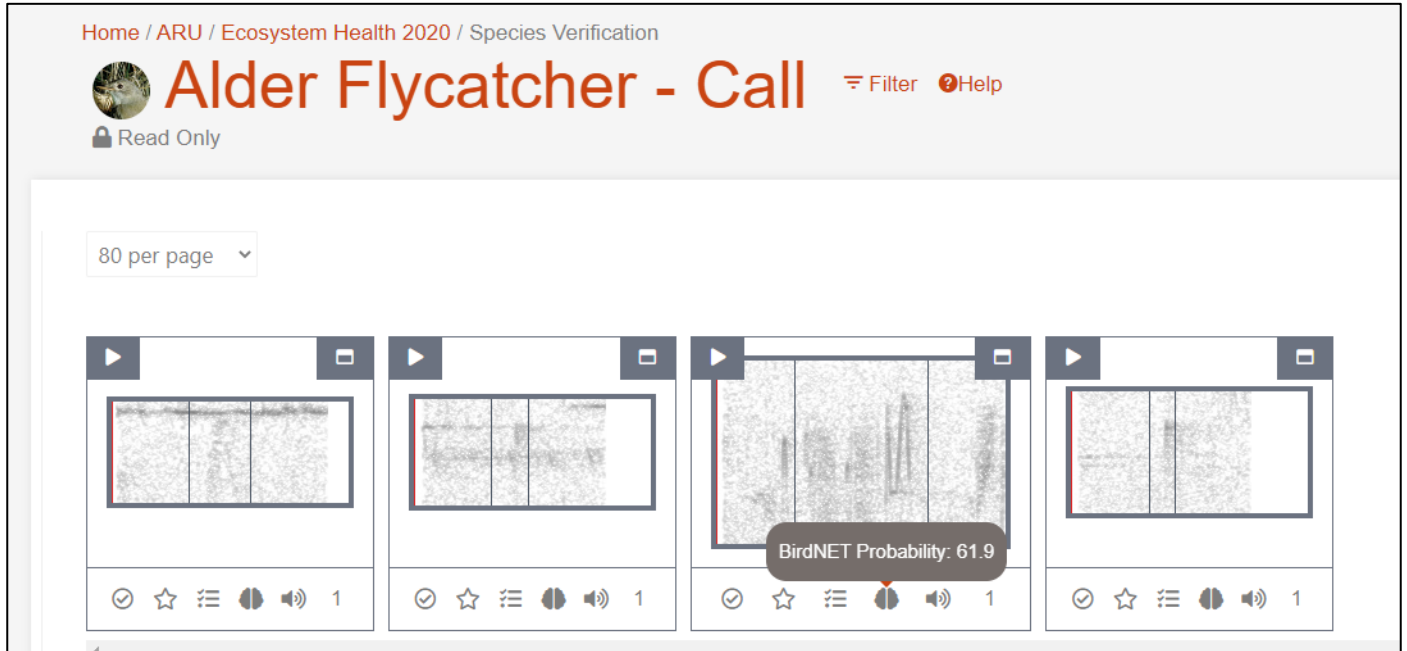


Figure 1. Species verification and BirdNet Probability scores for applied tags.

Incorporation of location, date, time, species checks into WildTrax

Status: In Progress, Near Complete

To facilitate tag data quality control, species verification within the ARU sensor interface was developed (Figure 2). This interface allows users to see all tags from their project grouped by species-vocalization type. Thus, when verifying, users only need to focus on one species-vocalization type at a time which improves data accuracy.

SPECIES CODE	VOCALIZATION	VERIFIED	TOTAL	PENDING	VALIDATOR
ALFL	Call	0	4	0	-- Not assigned --
ALFL	Song	0	110	0	-- Not assigned --
AMBI	Call	0	1	0	-- Not assigned --
AMCO	Call	0	16	0	-- Not assigned --

Figure 2. Species verification interface.

The species verification interface functions like the remote camera species verification interface. Some key differences however include the display of spectrogram clips which were made during the processing stage (Figure 3). In addition, verifiers can open a clip and dynamically modify it to further facilitate the correct identification of the tag (Figure 4). Further to that, users can filter by date and time to facilitate date/time checks. Further refinement to this interface such as clip subsampling will be implemented in the future.

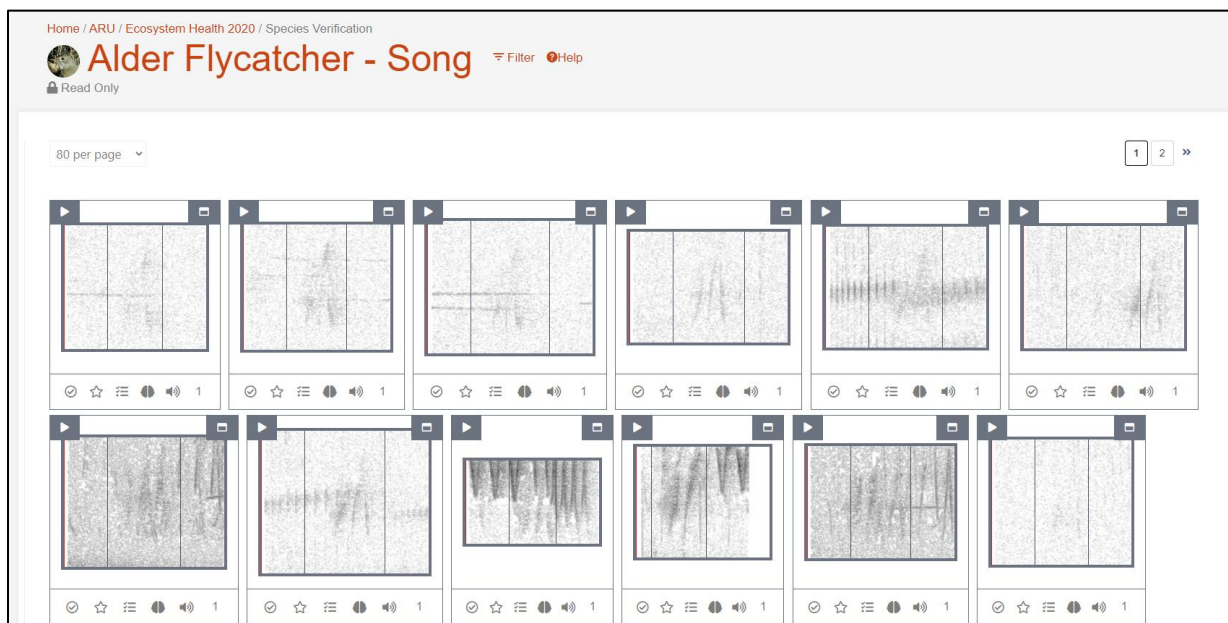


Figure 3. Species verification interface for Alder Flycatcher – Song.

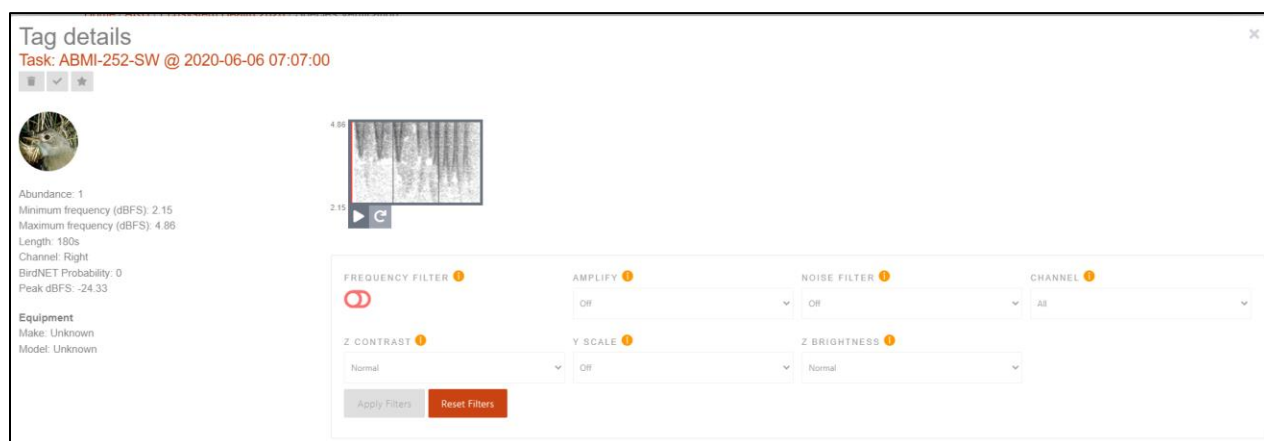


Figure 4. Detailed tag view within Species Verification. Note the dynamic controls that can be applied to confirm the tag.

Species verification facilitates other applications as well. It will continuously contribute towards and facilitate the growth of the species vocalization library. Publishing these verified tags by Project Administrators will populate that Organization's internal library as well as the public library if the owner chooses to publish their data publicly. To further facilitate the organization of these tags, the system allows verifiers to rate their tags (Figure 5). Ratings are based on [eBird media classification](#) to allow for data consistency and interoperability. The rating of tags supports the species vocalization library, but also the development of single species recognizers in the future.

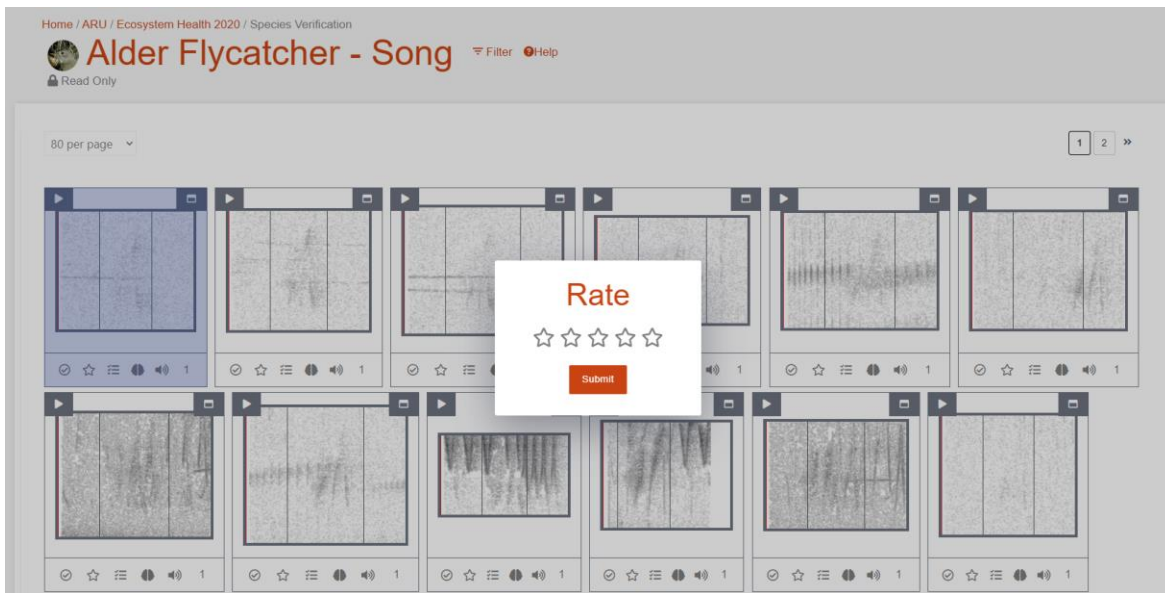


Figure 5. Species verification tag rating system. The 5-star rating system aligns with [eBird](#).

The addition of a location checks is pending. Incorporation of this element depends primarily on the finalization and incorporation of spatial models and data into the WildTrax database to support this automated check.

Integrate Alberta eBat into WildTrax

Understand user workflow

Status: Complete

A specifications document was developed for bat data incorporation into WildTrax. The WildTrax team continues to work with the provincial bat WG to ensure development and features align with their needs. This includes identify appropriate terminology used by the community.

Create project, task, user assignment for bats in WildTrax

Status: In Progress

After thorough consideration of the specifications document that was created, it was decided to integrate Bats (i.e., ultrasonic sensor) into the existing ARU sensor. The primary reason for this decision was the similarity in technology used to monitor birds, bats and small mammals (i.e., Autonomous recording units).

To support users from both communities within the ARU sensor we have developed the ability for Project Administrators to define their project species list (Figure 6). This functionality allows users to select either bat or bird species groups, or a combination of both depending on the scientific question being asked. In addition, the ability to select from pre-set lists will be added. For example, users can select from a list of species for Alberta, or Canada and the species associated with these lists will be added to the Project Species list. Again, this functionality provides Project Administrators the ability to select from commonly used groups of species to allow for more efficient species selection.

The visualization of the uploaded Bat data will be similar to the ARU processing interface. A spectrogram will be displayed at the top of the page, with a logged sounds table below. Users will be able to upload their historical tags into the system similar to how it is done for ARUs. This will prevent users from having to redo and processing, but also to support bat data that is preprocessed with bat recognizers.

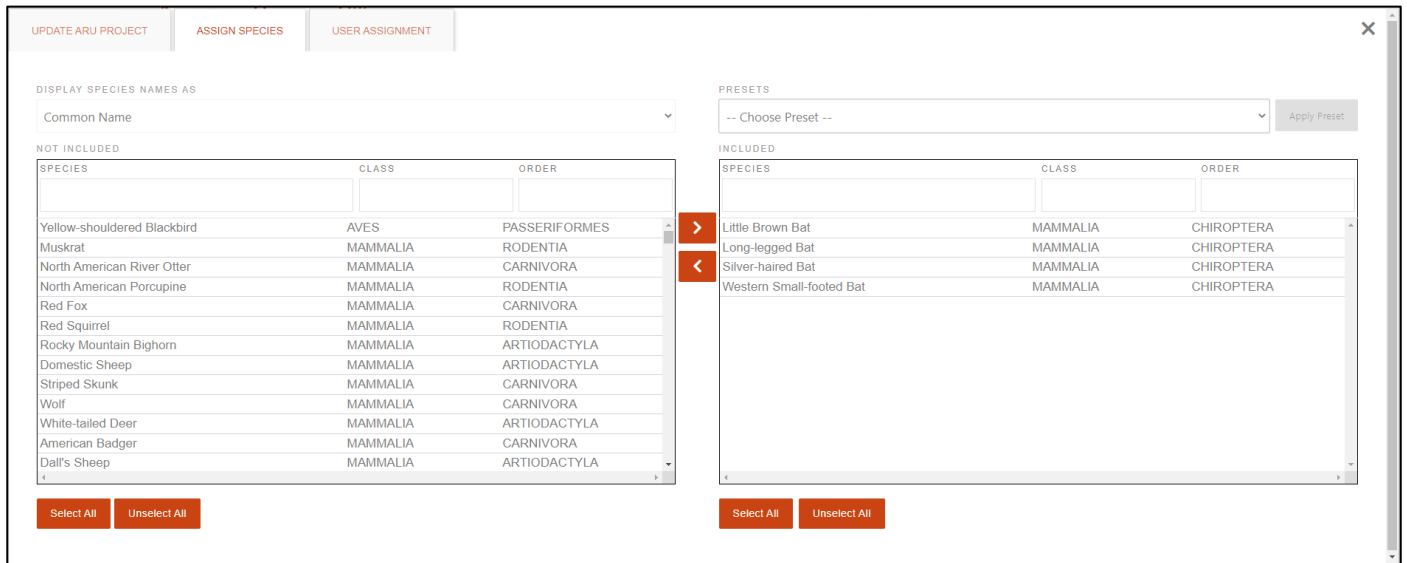


Figure 6. Define a species list for your project. Users have the capability to define their species of interest for each project. List can be refined to bat species of interest for example.

Integration of eBat data

Status: In Progress

The frontend development to integrate Bat data into WildTrax is still in progress. Given the integration with the ARU sensors, the upload function is being redesigned to support the ultrasonic range. To facilitate the upload process, users will be guided through a step-by-step process (Figure 7). Once complete, the user will have uploaded their recordings and tasks to their project successfully.

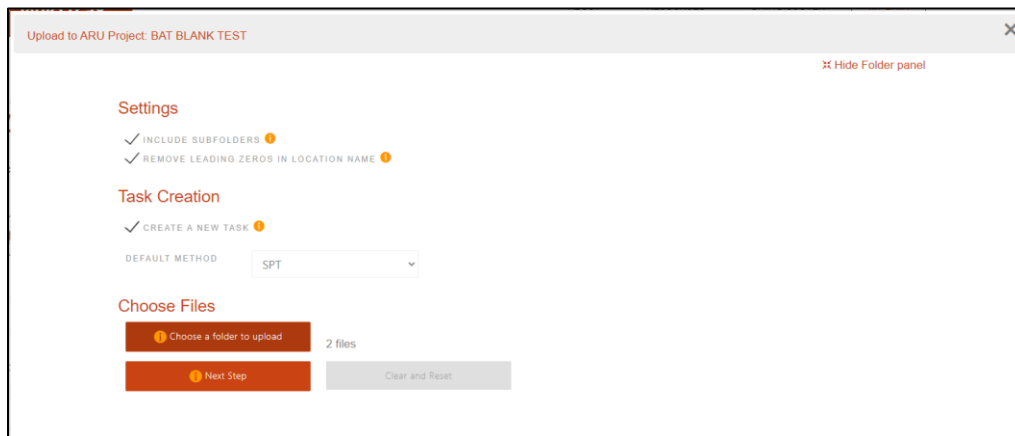


Figure 7. ARU Project Upload interface.

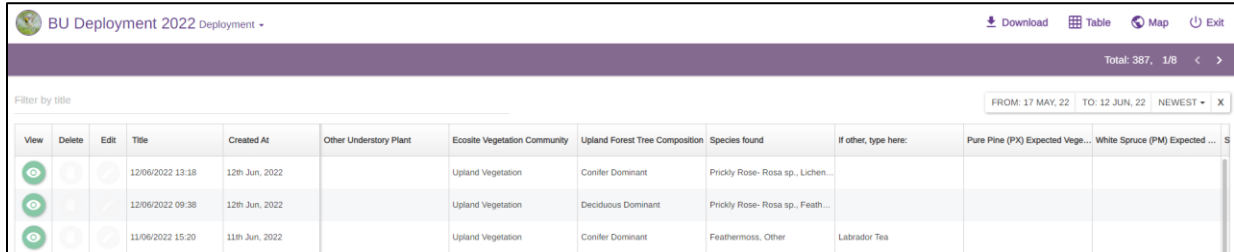
In preparation for the completion of the frontend, which will support the upload of bat data, collected bat data has been prepared. Further, data upload examples have been provided from the Bat WG to ensure the seamless upload of historical data into WildTrax.

Ability to collect site photos and habitat information at environmental sensor locations using the software infrastructure from the ABMI mobile application NatureLynx

Create platform to gather habitat information and take site photos where sensors are deployed

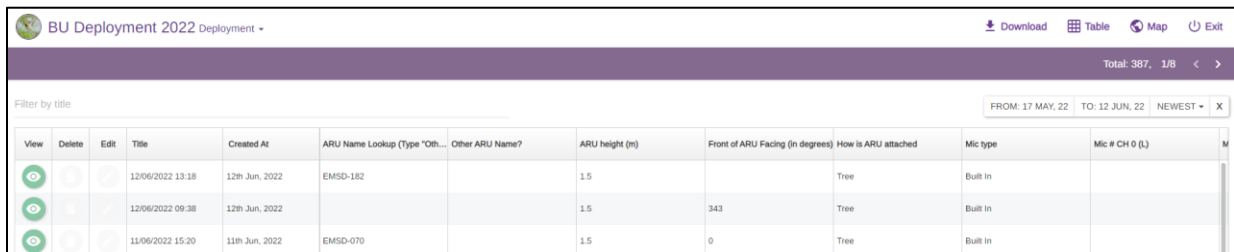
Status: Complete

Data collection forms have been created in Epicollect5 (Figure 8) to support habitat data collection (Figure 9) and site photos (Figure 10) while the new android tablet application is in development. In addition, WildTrax Users can upload their site photos to locations within WildTrax (Figure 11). Habitat fields will be added into WildTrax to support some of the data collected in the Epicollect5 forms.



The screenshot shows a mobile application interface for 'BU Deployment 2022'. It features a table with columns for 'View', 'Delete', 'Edit', 'Title', 'Created At', 'Other Understory Plant', 'Ecosite Vegetation Community', 'Upland Forest Tree Composition', 'Species found', 'If other, type here:', 'Pure Pine (PX) Expected Vege...', and 'White Spruce (PM) Expected ...'. The table contains three rows of data with timestamps from 12/06/2022 13:18 to 11/06/2022 15:20. The interface also includes a 'Filter by title' section, a date range selector (FROM: 17 MAY, 22 TO: 12 JUN, 22), and a 'NEWEST' dropdown menu.

Figure 8. Epicollect5 data collection in a mobile application for the deployment of ARUs in the field. View is from the desktop application.



The screenshot shows a mobile application interface for 'BU Deployment 2022' displaying habitat data. The table has columns for 'View', 'Delete', 'Edit', 'Title', 'Created At', 'ARU Name Lookup (Type "Oth...', 'Other ARU Name?', 'ARU height (m)', 'Front of ARU Facing (in degrees)', 'How is ARU attached', 'Mic type', and 'Mic # CH 0 (L)'. The table contains three rows of data with timestamps from 12/06/2022 13:18 to 11/06/2022 15:20. The interface also includes a 'Filter by title' section, a date range selector (FROM: 17 MAY, 22 TO: 12 JUN, 22), and a 'NEWEST' dropdown menu.

Figure 9. Epicollect5 habitat data collection within the mobile application. View is from the desktop application.

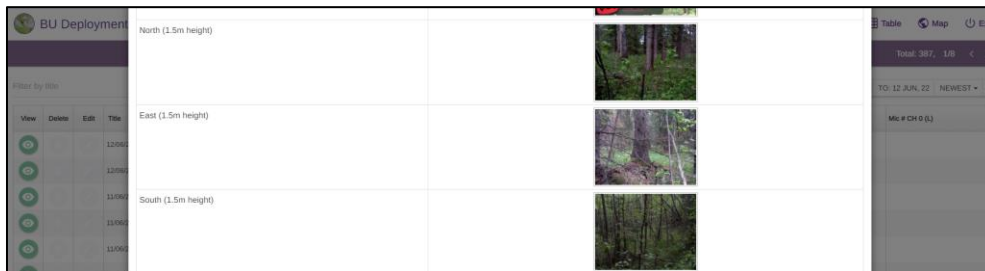


Figure 10. Epicollect5 image data collection within the mobile application. View is from the desktop application.

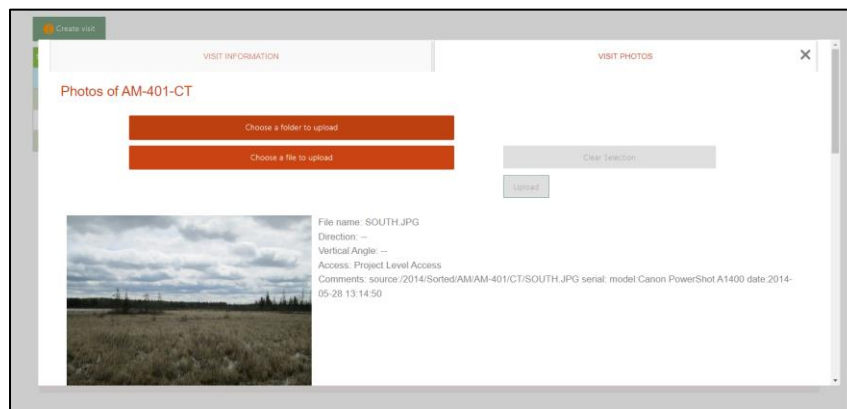


Figure 11. Visit photos in WildTrax.