



Crater Lake National Park Biological Sound Station Protocol

Version 1.0



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Introduction

Beginning in 2012, the wildlife team at Crater Lake National Park began experimenting with using biological sound stations to help document Northern Spotted Owls (*Strix occidentalis caurina*). It is believed that biological sound stations have the potential to be an invaluable tool in helping the wildlife team implement our Northern Spotted Owl (NSO) monitoring project. Recordings from these stations can help provide information on site occupancy and pair status of many wildlife species including spotted and barred owls. While sound stations will not eliminate the need for traditional surveys, they may reduce the time, effort, and costs of surveys in addition to enabling more areas to be surveyed.

This document provides a description on how to setup and implement the biological sound stations. Efforts should be made to use the same quality equipment from year-to-year therefore this protocol focuses on the equipment that is currently in use by the wildlife team. The main purpose of this protocol is to describe how to select locations for the sound stations, describe how to setup the sound stations, explains how to review the data, manage the sound files, and enter results into the database. This will ensure consistency and comparability from year-to-year.

Methods

Throughout this section we describe the step-by-step process that is used to obtain sound data for the purposes of helping document NSO and Barred owls. While this protocol focuses on these two species, many of the steps below could be followed for any project using these sound stations.

The general process for implementing this protocol includes: 1) selecting a site, 2) setting up the station, 3) retrieving the station, 4) file management, 5) sound file review, and 6) data entry. Details for each of these steps are described below.

It should be noted that in some instances, field crews will survey a NSO site while the sound station is deployed at the same site. If spotted owl surveys are conducted in the area while the sound station is running, record the date the survey was done and the time of each call point on the sound data sheet when you return to the field.

Modelling Sound

Selection of general areas to sample should be based on specific data collection goals that are developed each year by the Terrestrial Ecologist prior to the start of the field season. As of 2013, the park used the program System for the Prediction of Acoustic Detectability (SPreAD) in a geographic information system (GIS) environment (SPreAD-GIS) to model the distribution of sound at each known NSO sites to determine the best locations to place audio recording devices. The process we used to determine where to put sound stations at the known NSO sites is described below and should be repeated in the future for new owl sites or for surveying new areas that contain owl habitat.

For known NSO sites, we used ArcGIS to plot all NSO and barred owl locations. We then used a Kernel Density Estimator (KDE) and a 95% isopleth to develop polygons that were representative of NSO and barred owl locations at each known site (Table 1).

Table 1. Size of polygon created using kernel density estimator and 95% isopleths for known spotted owl activity centers along with the number of spotted owl and barred owl locations used in the model.

Site	Area (km ²)	# NSO Points	# Barred Owl Points
Annie Creek	10.49	9	20
Bear Bluff	0.53	5	2
Boundary Springs	0.05	12	0
Bybee Creek	4.65	10	10
Castle Creek	11.69	12	17
Little Copeland Creek	1.22	13	2
Crater Creek	3.98	21	8
Crater Peak	1.99	5	0
Crescent Ridge	2.15	4	11
Grayback Ridge	8.81	14	1
Maklaks Crater	2.72	7	9
Sand Ridge	3.87	18	14
Lower Sun Creek	8.20	10	20
Thousand Springs	0.16	4	0

* Red Blanket Canyon was not included in this analysis since it burned up in the XXX fire.

Once we determined the general locations of NSO and barred owl activity, we used the program SPreAD-GIS to model the distribution of sound at each location to determine the best areas to place the acoustic sound stations. As part of the model, we utilized the following inputs:

- 100 ft DEM
- GNR vegetation data
- Minimum June temperature data
- 1992-2013 Avg June humidity data
- 630 Hz frequency data

Using these parameters, we model how sound would travel over the landscape for each site. We placed 1 point within each polygon in an area that we thought would be the best location for sound collection based on topography. We then ran the SPreAd-GIS model and modeled sound based on this point. We then examined each modeled polygon to make certain the model adequately covered each area. If the model did not appropriately cover the area we added additional points until the entire area was covered. This provided us with a general location to place sound stations.

Site Selection

Once the general point is selected as described above, it will be up to the field crew to determine an appropriate location for the stations when they are at the site. Some things to consider when selecting the microsite are:

- Area should be protected from high winds.
- Avoid deploying near large reflective surfaces, such as rock walls.
- Avoid deploying close to constant noise sources such as streams, roads, and nesting birds.
- Prevent equipment / animal conflicts by avoiding game trails and other areas where animals are known to congregate.
- Microphone must be mounted. Small – medium diameter trees are typically used. If not present, alternative mounting options may be explored or a new site should be selected.

Once a site is determined, record “Site ID”, “Folder Name”, “Date Set”, “Time Set”, “Surveyor”, GPS location (NAD83 Zone 10), “GPS Accuracy”, “Elevation”, “Habitat”, “Ground Porosity”, and “Potential Noise” on the data sheet. A minimum of five photos should be taken, four from the sound station, facing out, in each of the cardinal directions and one of the sound station setup and immediate surroundings. Record photo numbers on data sheet.

Equipment Setup

Each biological sound station consist of a Roland R-05 MP3 recorder, Olympus ME51S microphone, 2 Urbanti 100mm funnels, a 40Ah 3.2V LiFePO4 battery, and a modified Pelican case. The wildlife team, as much as possible, standardizes our equipment to make certain results are comparable from site-to-site and year-to-year. An equipment checklist is provided in Appendix B that should be reviewed just prior to going into the field.

Microphone Setup: Microphones are incased in a plastic tube which then attaches to two funnels. This structure is securely lashed to a tree with parachute cord at approximately 60 inches above the ground. Once mounted to the tree (or other solid object) the microphone should not be easily moved by wind or animals. The tree should be large enough so it will not move with wind, but small enough that the microphones extend beyond the trunk. Thought should be put into the orientation of the microphone (topography, other sound stations, surrounding noise sources, historic owl locations, etc.). The microphone cord should not be loose or it can create noise or get snagged by an animal. Manage the slack in the cord, typically by wrapping around trunk.

Record the “Sound Station Number” as well as the “Orientation” of the Right and Left microphones on the data sheet.

Sound Recorder: Open the pelican case and check all the connections to make sure they are tight. Plug the lithium battery into the “DC IN” port on the R-05 unit. Plug the pelican jack into MIC port on the R-05 unit. As much as possible position the station so it is hidden or out of the way (e.g., base of tree, covered with branches or rocks).

Below are the step-by-step instructions on how to setup the Roland R-05 recorder. If one of the recorder options is not covered in this protocol, it is safe to assume the default is to be used. Complete the following steps:

1. Ensure an SD card is in the R-05 unit by opening the SD cover at the top of the unit. Be sure to check the card to make sure it is in the locked position and did not pop out.
2. Check the sliding button settings on back of unit.
 - Mic Gain: H
 - Limiter: Off
 - Low Cut: Off
3. Power on by sliding power switch toward POWER for a couple seconds.
4. Check to make sure the SD card isn't full by pressing FINDER button once. The root directory and all file names present will be displayed.
5. Navigate to the menu by pressing and holding the MENU button.
 - Highlight **Recorder Setup**, then press the red REC button
 - Sample Rate: 44.1 kHz
 - Rec Mode: MP3-96Kbps
 - Pre-Rec: OFF
 - File Name: Date
 - Auto Rec Start: OFF
 - Split type: 256 Mb
 - Record these parameters on data sheet
6. Navigate back to the menu by pressing the MENU button
 - Highlight **Display setup**, then press the red REC button
 - Contrast: 5
 - Backlight: 2
 - Display Timer: 2sec
 - Rec/Peak LED: Power Save
7. Navigate back to the menu by pressing the MENU button
 - Highlight **Power Manage**, then press the red REC button
 - Auto Power Off: OFF
 - Battery: Alkaline
8. Navigate back to the menu by pressing the MENU button
 - Highlight **Input Setup**, then press the red REC button
 - Rehearsal Time: 1min
 - Rec Monitor Sw: On
 - EXT Mic Type: STEREO
 - Plug-in Power: ON
 - Limiter/AGC: Limiter
 - Low Cut Freq: 200Hz
9. Navigate back to the menu by pressing the MENU button
 - Highlight **Date & Time**, then press the red REC button
 - Use GPS time to adjust the time on the R-05 to the appropriate time and date. When the time and date on the GPS and R-05 match, press red REC button.
10. Press the MENU button to display recording screen.
11. Press red REC button once to be in STANDBY mode. Use INPUT + and – to adjust input level to 60, record level on data sheet.
12. Press STOP button to exit STANDBY mode.
13. Press FINDER button once to display contents of SD card
14. Create a folder to save the MP3 files.
 - Press REC button once and select option 2, Make Folder.

- Press REC button.
 - Highlight NewFolder, and press the red REC button.
 - Highlight option 4, Rename, and press the red REC button. Use up and down arrows to change the selected letter fields. Rename the folder with site name. Wildlife sound stations will be named using a 4 letter abbreviation for the site name, followed by a two digit numeric that represents each unique station at a site, an underscore and a two digit year (e.g. BOSP01_13 for sound station #1 at Boundary Springs). Hit the REC button to save new folder name.
 - Save the MP3 files in new folder. Select folder name, press REC. Choose option 1 – Select, press REC
15. Check the microphone. From the recording screen, press red REC button once to enter STANDBY mode. Speak into right and left microphones and ensure bars on recording screen move appropriately.
 16. Once ready to go live, press red REC button again to record. Timer will begin counting up and “REC” will appear in the lower left corner of screen. Record start time on data sheet.
 17. Slide POWER switch to the HOLD position

Time Stamp: Once you are live, you want to make an audio timestamp by clearly stating the following information into the microphone.

- Your name
- Location (e.g. Boundary Springs Owl Activity Center, Station 1, Crater lake National Park)
- Site ID (e.g. BOSP01_13)
- Date
- Current GPS Time. To mark the time, say the words “When I clap my hands, the time will be 11:35:30”. When the GPS unit shows the correct time, clap your hands loudly.

Prior to Leaving the Site: Record anything of note about the location or your activities in the locations. For example, did you hear any owls while walking into the location or are you doing an owl survey once the station is setup.

Data Collections

In general, sound stations are deployed for a two week period. Upon arriving at the microphone, state your name, location, site ID, date, and GPS time. Record the “Date” and “Time” on the data sheet. On the Roland R-05 unit, slide the POWER switch out of the Hold position. Press STOP in the Roland R-05 unit. Indicate on the data sheet if the Roland R-05 was functioning. If not, explain why in the recovery notes section (e.g., battery dead, animal destroyed setup, etc.) Turn off the recorder by sliding down and holding the POWER switch. Take down the sound station and once packed away be sure to recheck the area to ensure you did not forget anything. Return to the office and download the data.

File Management

Once back at the office, sound files will need to be transferred to a safe location, files will need to be renamed, and data will need to be converted, reviewed and analyzed. MP3 files from the recording unit are renamed using the Acoustic Monitoring Toolbox (AMT) before converting the files to NVSPL files using AUDIO2NVSPL. Once files are in the NVSPL format, SPLAT, a program in

AMT is used to create spectrographs and audio for the data. Spectrographs are reviewed to determine if any owls called at the site. If a spectrograph appears to be an owl, the audio is listened to, and any owl species heard are recorded. Anecdotal observations are also noted for other sounds heard while listening for owls.

Transferring Data: Once back in the office you will need to transfer the sound files from the Roland R-05 recorder to a supplemental storage device. Sound files are very large and therefore not stored on the NPS server. Instead they are stored on 2 external hard drives. One drive is called “Raw Audio Files” and one drive is called “Working Files”. The raw audio files drive is used to store unmanipulated data and acts as a backup, the files on the working files hard drive are used to analyze the sound data. In addition to the hard drives, you will need noise canceling headphones, the SD Cards from the sound station, and the sound software. The sound software is located on the “Working Files” hard drive in a folder called CRLA_Natural_Sounds_Program_Files. Once you have these items, follow the steps below to transfer the sound data.

1. Remove the SD card from the Roland R-05 unit and insert it into a card reader.
2. Copy the MP3 files from the SD card to the “Raw Audio Files” hard drive. There should be a folder names with the year the sampling occurred, within this folder create a folder named for the biological station (e.g. BOSP01_13_Boundary Springs) you are downloading. THESE FILES SHOULD NEVER BE MANIPULATED. The files will be stored on the drive as raw data in case something happens to data while working with it.
3. On the “Working Files” hard drive, copy the Sounds Folder Template (Includes AUDIO, GRAPHICS, METADATA, NVSPL, SPL) to create a folder for each sound station. Name the folder so it matches the station name that is being analyzed.
4. Copy MP3s from SD card to the AUDIO folder that you just created.

Renaming Files: Each sound station can have many sound files, therefore we use a program called “Audio Renamer” to rename the acoustic files to something more meaningful. This program is located on the “Working Files” hard drive in the CRLA_Natural_Sounds_Programs_Files folder. Complete these steps to rename the files for each sound station.

1. Open Acoustic Monitoring Toolbox (AMT.exe), located within the “software” folder of the CRLA Natural Sounds Program Files folder.
2. Select Audio Renamer on right hand side
3. Click the button next to Roland R-05 on right under Recorder Model.
4. Enter Station ID in the box. The program does not allow the use of underscores like used in the Station ID, so omit it here. (e.g. BOSP0113)
5. Click File> Open Files. Find and select all MP3 files in AUDIO folder. Click Open. A list should appear in the Renamer box under Original file name and New file name. Click Rename in the lower right on the window.

Converting MP3 files to NVSPL files: The software that we use to view and listen to sound data requires files be in a text format known as NVSPL. The following steps will convert the MP3 files to a format that can be used.

1. Open Audio to NVSPL converter (AUDIO2NVSPL) which can be found in the NVSPL folder.
2. Enter Recording Unit (Site ID, BOSP0113)
3. Enter Investigator last name
4. Click on the “Stereo – Preserve Phase” button at the bottom of window.
5. Click File > Choose Audio Files. Find and select all MP3 files in AUDIO folder, click Open.
6. Click convert. Files will be created in the NVSPL folder. This is a lengthy process, and may take several hours to complete.

Reviewing Data

Now that the files have been converted to NVSPL files, you may now view and listen to the recordings and populate the database.

1. Open Acoustic Monitoring Toolbox (AMT), located in the CRLA Natural Sounds Program Files folder.
2. Click on the SPLAT button on the right hand side of the window.
3. Click File > Open Full Day and navigate to the sound files you want to listen to in the NVSPL folder. Click Open.
4. Under Options, make sure “Audio on R Channel” and “Normalize Audio” are checked.
5. Under Plot Options, make sure “4 line plot”, “3 px Y Scaling”, and “Unweighted Plot” are checked.
6. Under Plot Options, you can change the color if desired. We recommend changing the color to the last option “purple” which makes NSO recordings more clear.
7. You can now begin looking through the spectrograph for the signature (Figure 1) NSO/Barred Owl call. In the upper right corner, click the “+” button to advance the time ahead by 1 hour. Continue this process until you have reviewed the entire day.
8. If you see something that you want to listen to, click on a section of the spectrograph and drag over the desired area. Click the Extract Audio button on the top left of the spectrograph. Wait for it to load and once the Play button is activated, press Play.
9. The spectrograph signature of the classic NSO 4-note call, Barred Owl who-cooks call, and Great Horned Owl call have a somewhat similar signature (Figure 1). If you see anything that looks similar to the signature shown in these examples you should listen to them.
 - a. Note: Crows, Flies, and Drumming woodpeckers can make a similar signatures. In addition, signatures can be very light so be sure to look closely.
10. Review all sound files and on the data sheet document the date, call start time and end time, and species of the sound you are documenting. Be sure to document any owl species not just NSO or barred owls. Document any unique or high quality sounds that you may come across. Past examples include elk bugling, tree and rock falls, thunder, etc.
 - a. Report any possible NSO observation immediately to the Terrestrial Ecologist.
 - b. Look at the “Unique Audio Recordings” folder and be aware of what species we have a recording. If you come across a high quality recording of a species not in this folder, make a copy of the recording and place it here. The folder is located at:
Data\Sound Data\Unique Audio Recordings

11. Once a possible recording is identified, if possible complete traditional surveys at the site to confirm the recording.

Data Entry

As you review the recordings, you will need to enter the results onto the datasheet. Once the datasheet is complete the station and recording data will need to be entered into the acoustic database. The database has 2 components, a Front-End that contains the data entry screen and a Back-End that stores the data. You should NEVER open the back-end without talking to the Terrestrial Ecologist first. To enter data, open the front-end and follow these steps.

1. In the bottom, right side of the form, make certain the database is pointing to the back-end database.
 - a. If it is not, click the “Connect Data Tables” button and browse to the back-end database.
2. Click the “Enter/Edit Data” button.
3. Select your name from the list and hit “OK”
4. Assuming you are entering a new record, click the “Add New Record” button at the top of the screen.
 - a. If you are editing a record, find the record in the list and double click the “visit” date to open the record.
5. Select the “Location”
6. Enter the date and time the sound stations was made active
7. Enter the data and time the sound station was inactive
8. Select you name from the contact list and check each duty that applies.
9. On the vegetation tab enter the vegetation date
 - a.
10. On the equipment tab, select the unit number
 - a. Enter the DAR level
 - b. Enter the aspect of the right and left mic
11. On the recording tab, for each NSO, BO, GHO, or audio that might be worth document for outreach material (e.g., coyote call, elk bugle, thunder, etc.) record the following:
 - a. Date
 - b. Start and end time
 - c. Species – Use picklist, if not on the pick list type it in.
 - d. Avg db level
 - e. Avg frequency
 - f. Sound notes
12. Once done, click the “Close” button.
13. Exit out of the database and you are now completed.

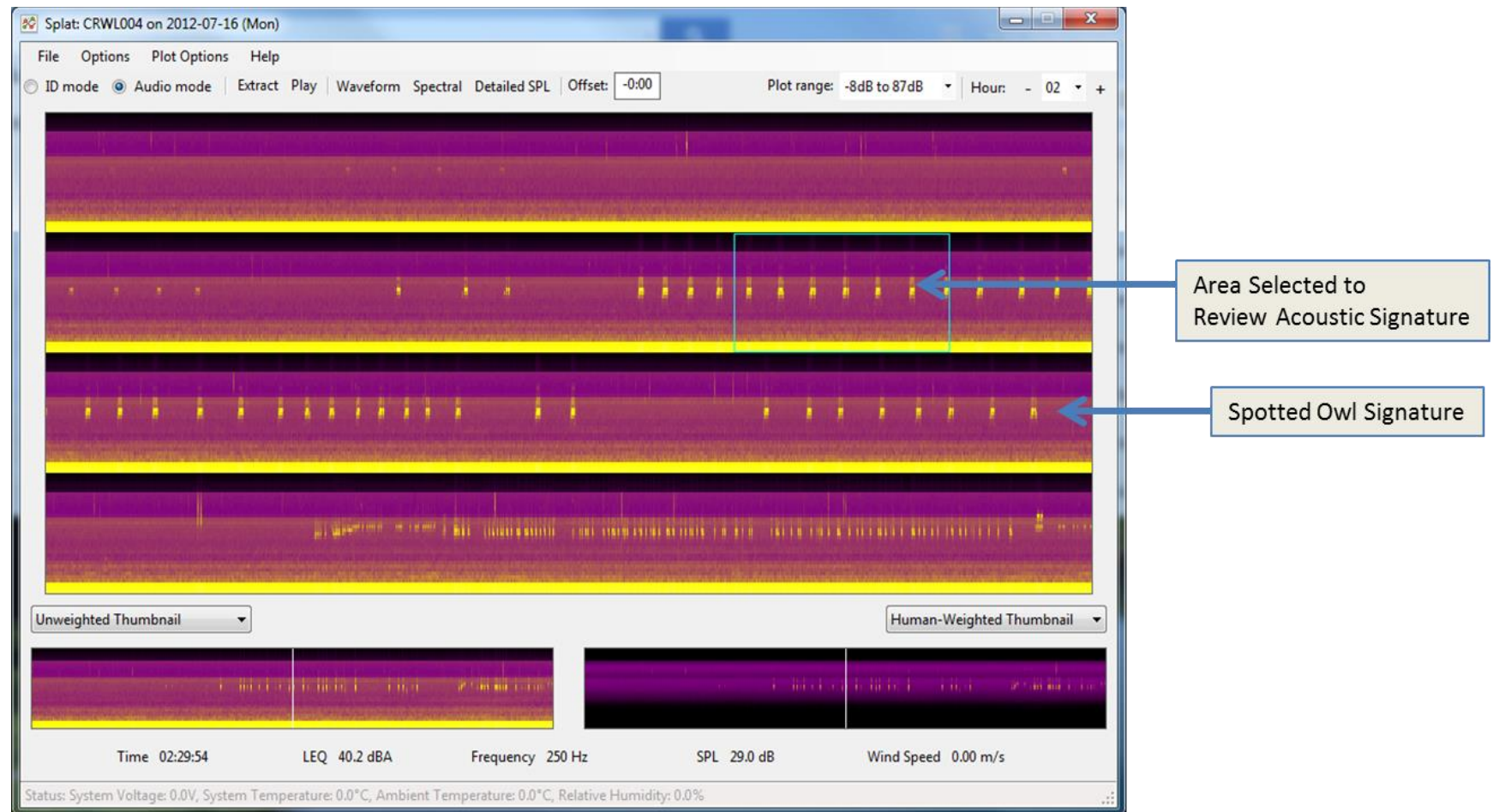


Figure 1. Example spectrograph showing a classic acoustic signature of a NSO 4 note call, Barred Owl Who-Cooks call, or a classic Great Horned Owl call.

Appendix A: CRLA Biological Sound Station Data Form

Site ID:		Folder Name:		Date Set:	
Investigator(s):				Time Set:	
Location: UTM NAD83 Zone 10					
Easting		Northing		GPS Accuracy	Elevation
Site Characteristics					
Habitat	Ground Porosity	Potential Noise		Photos	
Mixed Conifer	Snow	Road		North: Initial Name: _____ Final Name: _____	
Conifer	Grass	Trail		East: Initial Name: _____ Final Name: _____	
Aspen	Herbaceous	Water		South: Initial Name: _____ Final Name: _____	
Meadow	Bare Ground	Other: _____		West: Initial Name: _____ Final Name: _____	
Shrubland	Rock			Site: Initial Name: _____ Final Name: _____	
Riparian (stream)					
Wetlands					
Talus					
Equipment					
Sound Station Number			Microphone Orientation (in deg)		
			Right	Left	
Equipment / Settings					
Recorder	Low Cut Freq	Sample Rate	Rec Mode	Split Type	Input Level
Roland 05	200 Hz	44.1	MP3-96	256 mp	60
Recovery					
Date Recovered		Time Recovered		Functioning at Recovery? Y / N	
Deployment Notes					
Recovery Notes					

Appendix B: Equipment Checklist

Prior to going into the field you should review the following equipment checklist to make certain you have everything you need to setup and implement a sound station while in the field. The sound station should be tested before heading into the field to make certain everything works.

- Pelican Case
- Roland R-05 Recording Unit
- SD Card – 32GB (1)
- Lithium Battery
- AA Batteries (1)
- DC In – Battery Connection
- Microphone (1)
- Compass
- GPS Unit
- Leatherman
- Parachute Cord
- Camera
- Data Sheets
- Pencils

Appendix C: Unique Audio Recordings Already Obtained

- Cow Elk Calling
- Gray Jay
- Pileated Woodpecker
- Red tailed Hawk
- Steller's Jay
- Barred Owl
- Humming Bird