

Honours project 2022: How-to guide for Leach's storm-petrel sound analysis

Leach's storm-petrel

The Leach's storm-petrel (*Hydrobates leucorhous*) is a small nocturnal burrowing seabird present throughout the Atlantic and Pacific Oceans. This species was recently uplisted to "Vulnerable" on the IUCN Red list and as "Threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Pollet and Schutler 2018). Surveys on Bon Portage Island (NS) in 2017 indicated a 20% decrease in burrow occupancy from the last survey conducted in 2001. Their decline is likely due to a combination of factors, including light pollution, anthropogenic collisions (offshore oil rigs), increasing levels of contaminants (mercury, microplastics) in the Atlantic, increasing predator pressure, and loss of suitable breeding habitat.

Leach's storm-petrels (LHSP) have two distinct calls: the "chatter" call, usually produced during flight, and the "purr" call, exclusively emitted from petrels in their breeding burrows for mate communication. Detection of "purr" calls on an island would indicate a breeding population. We can identify storm-petrel presence through the placement of autonomous recording units in areas that they may occupy and then by analyzing these recordings for their calls.

Kaleidoscope

Kaleidoscope is a useful bioacoustics processing and analysis software. It has both a Lite (free) and a Pro (paid) version. The Lite version can be used to produce a "detector", which in this case is the narrowest set of parameters within which the target call is contained. When run, Kaleidoscope will extract all sounds within the user-given parameters.

The Pro version can be used to produce a "classifier". I have "taught" the software what a Leach's storm-petrel call (both purr and chatter) sounds like, and this information is encoded within a ".kcs" file. Kaleidoscope uses this ".kcs file" as a reference against which to compare your recordings and when to extract target calls. For the purposes of my project, I found the detectors and the classifiers performed best when splitting up the "purr" call into its two distinct sections: the "rattle" and the "breath". This guide will provide step-by-step guide to using both the detector parameters in Kaleidoscope Lite and classifier in Kaleidoscope Pro.

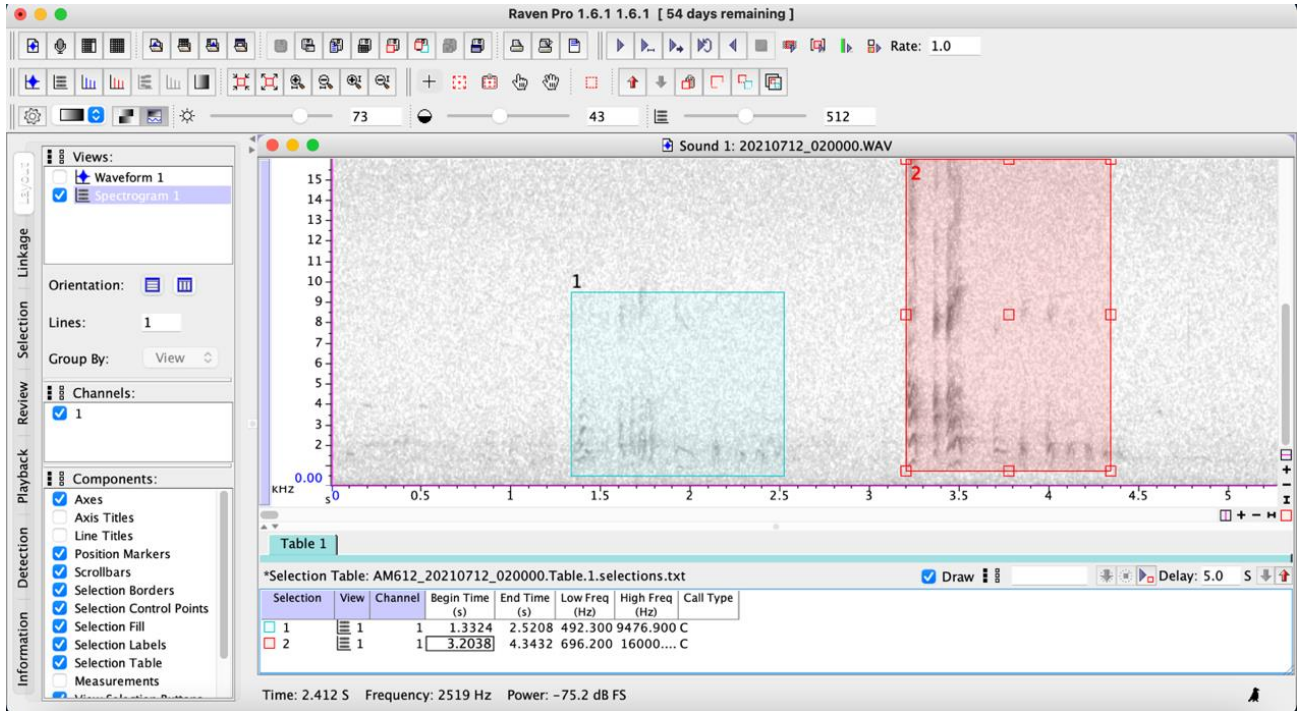


Figure 1 Example of the acoustic signature of the target chatter calls.

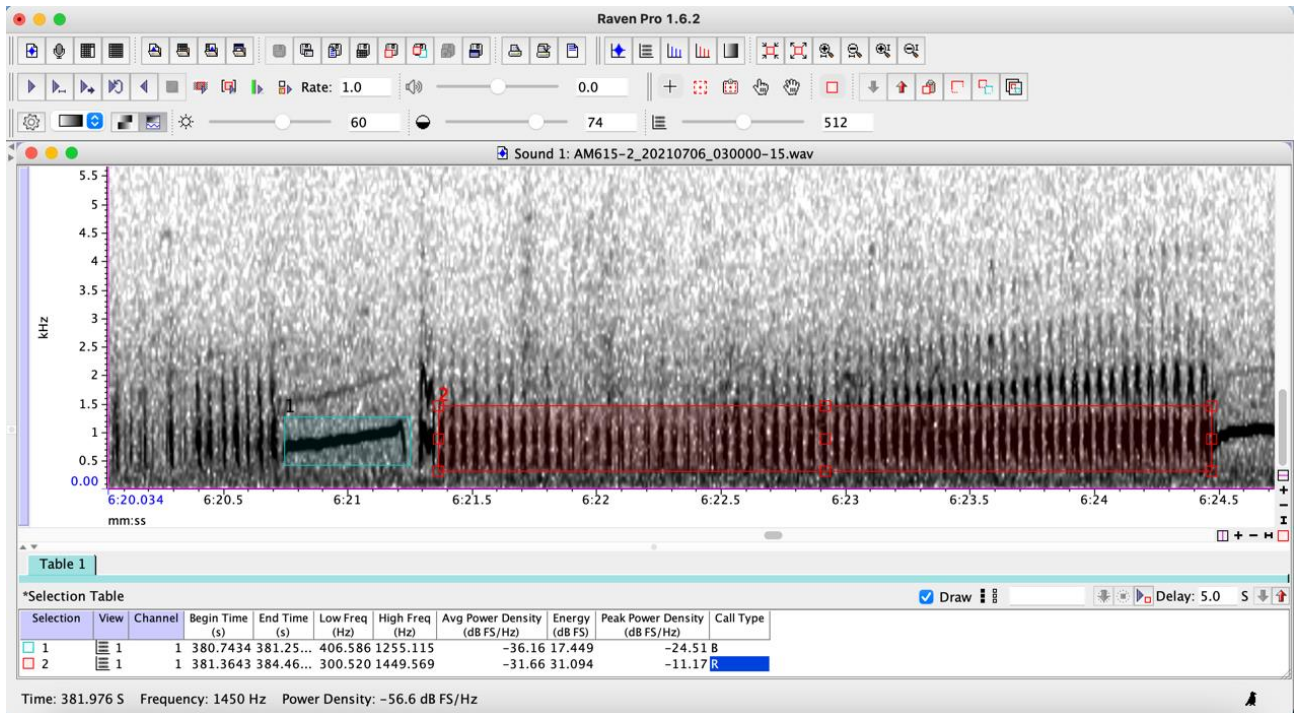


Figure 2 Example of the acoustic signature of the target “purr” calls. The “breath” portion is surrounded by a blue box and the “rattle” portion is surrounded by a red box.

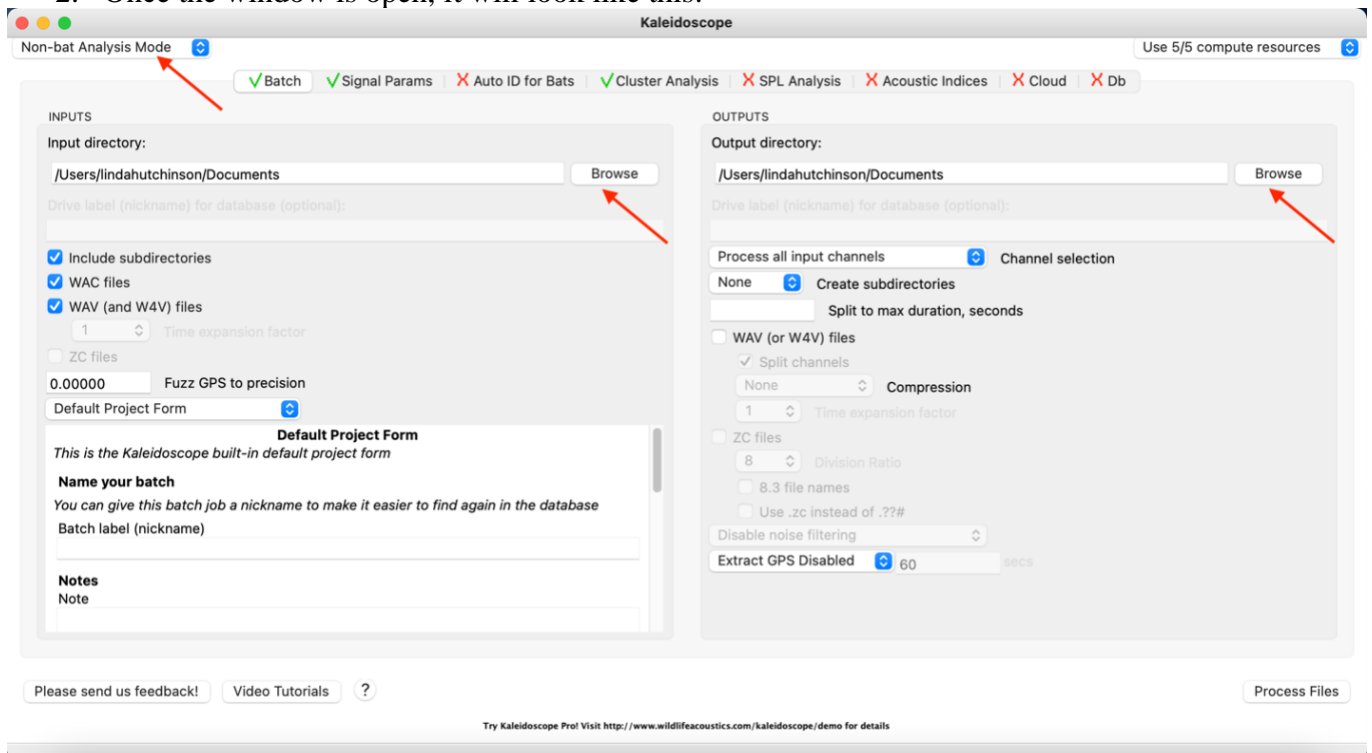
Setting Up

Before getting into Kaleidoscope, you will first want to set up your input and output folders.

1. Create a clearly labelled input folder containing all the audio files you want to analyze.
 - a. Ex. “LHSP_2022_audiofiles”
2. Create a clearly labelled output folder and leave it completely empty. This is where Kaleidoscope will save the output of your analysis in the form of a .csv Excel file.
3. Download the .kcs files I have created to your computer and keep them in the folders labelled with which call they will classify.

Opening Kaleidoscope

1. Download the application (<https://www.wildlifeacoustics.com/products/kaleidoscope/kaleidoscope-lite>) to your computer and open it.
2. Once the window is open, it will look like this:

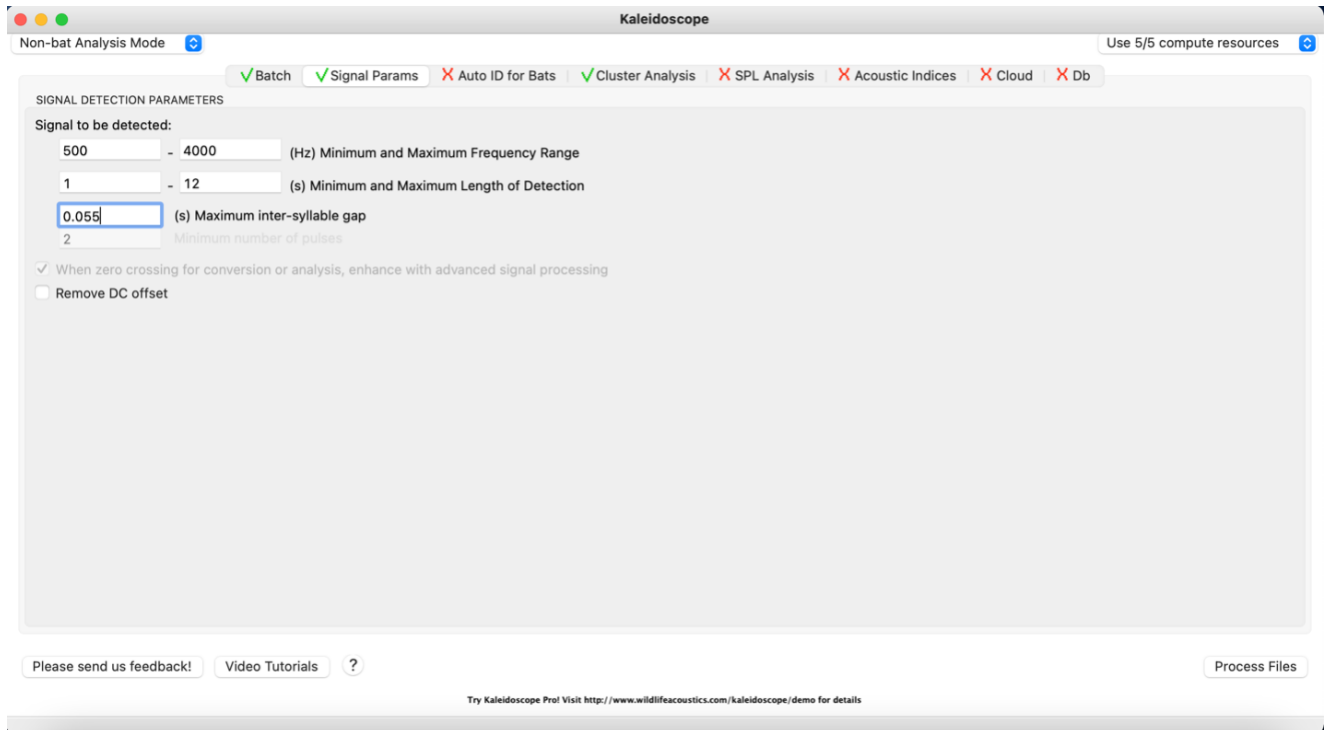


3. From the drop down in the top left corner, choose “Non-bat Analysis Mode” (red arrow in the above figure).
4. Running along the top of the window, there are 8 tab buttons. The important ones for your purposes are “Batch”, “Signal Params”, and “Cluster Analysis”. Click on the “Batch” tab.
5. Here, select the Input folder of audio files you previously created by clicking “Browse” under the “INPUTS” section on the left side of the window (red arrow in the above figure).

6. Select the empty Output folder you previously created by clicking “Browse” under the “OUTPUTS” section on the right side of the window (red arrow in the above figure).

Detector Instructions

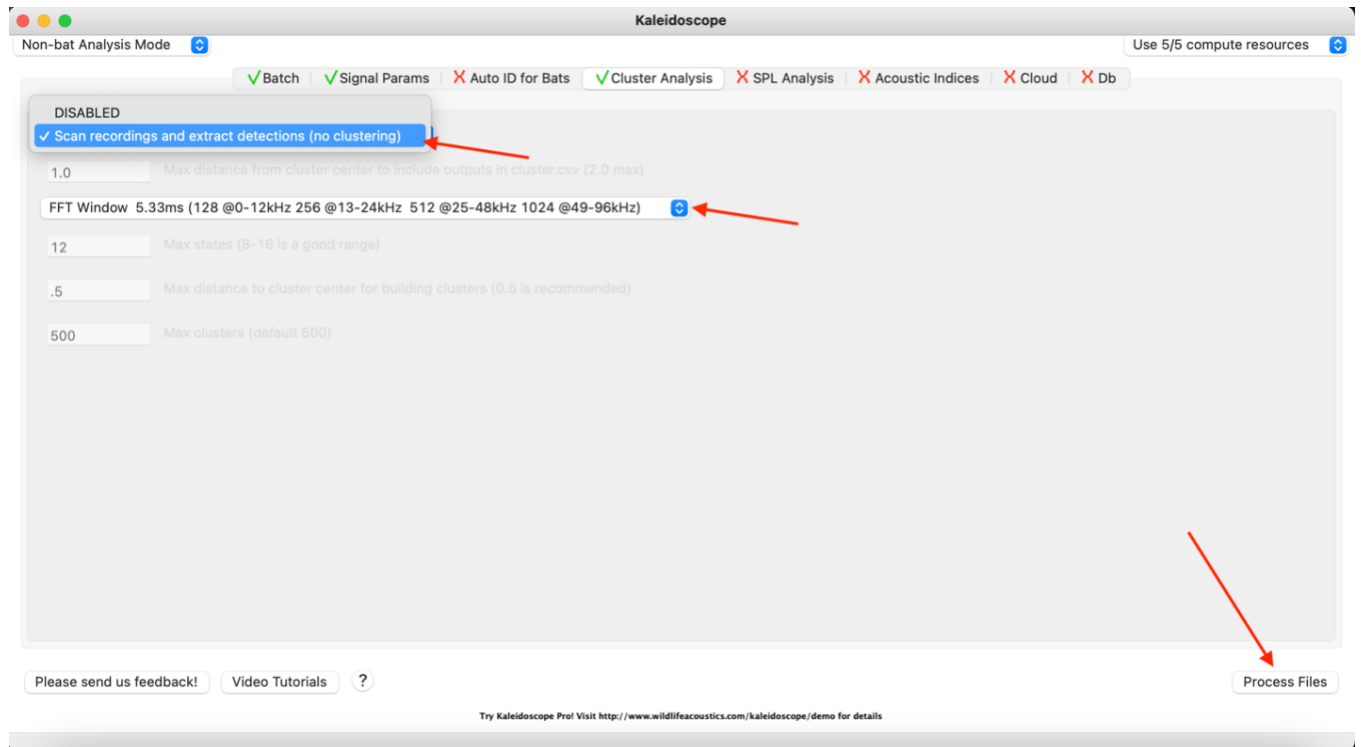
1. Click the “Signal Parameters” tab. The window should look like the figure below (I have entered the parameters for the rattle detector how they should be entered in the window).



2. Enter the following values into the appropriate boxes, depending on which LHSP call you would like to isolate:

Parameter	Rattle Detector Values	Breath Detector Values	Chatter Detector Values
Minimum frequency (Hz)	500	300	1000
Maximum frequency (Hz)	4000	1550	4500
Minimum duration (s)	1	0.3	0.8
Maximum duration (s)	12	0.6	3
Maximum intersyllable gap (s)	0.055	0	0.35

3. Click on the “Cluster Analysis” tab.
4. Under the first dropdown (where it says “DISABLED”), click on the “Scan recordings and extract detections (no clustering)” tab (red arrow in the figure below).



5. Click on the next drop-down selection menu (red arrow in the figure above). Select the FFT value that matches the LHSP call you would like to isolate:
 - a. Rattle: FFT Window 5.33ms
 - b. Breath: FFT Window 10.67ms
 - c. Chatter: FFT Window 5.33ms
6. Go back through your selections and make sure you have selected the correct input and output folders, as well as the correct parameters.
7. Now click “Process Files” in the bottom right corner of the screen (red arrow in the figure above).

Classifier Instructions

Activating Kaleidoscope Pro

1. Go to the “License” tab along the very top of the screen (next to “File” and “Help”),
2. Click on “Activate annual subscription” in the drop-down menu.
3. A License Configuration window will open asking for log-in information.
4. Enter the required information and press the Activate button.

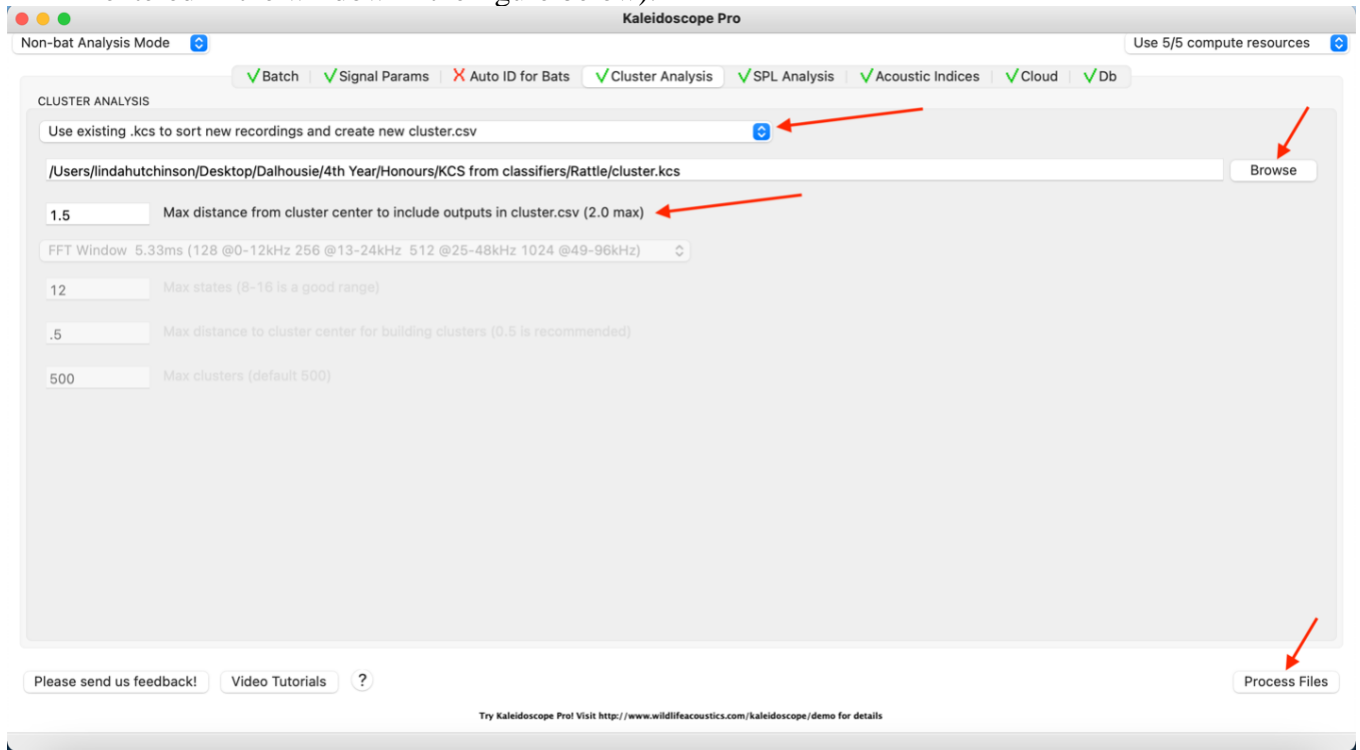
Running the Classifiers

1. As with the detectors, select an “Input” and “Output” folders under the “Batch” tab.
2. Click the “Signal Parameters” tab.

- Enter the following values into the appropriate boxes, depending on which LHSP call you would like to isolate (**some are different from the values in the detectors, so read them carefully):

Parameter	Rattle Detector Values	Breath Detector Values	Chatter Detector Values
Minimum frequency (Hz)	500	0	1000
Maximum frequency (Hz)	4000	1900	4500
Minimum duration (s)	1	0.2	0.8
Maximum duration (s)	12	0.85	3
Maximum intersyllable gap (s)	0.08	0.01	0.35

- Click on the “Cluster Analysis” tab.
- Under the first dropdown menu, click on the “Use existing .kcs to sort new recordings and create new cluster.csv” tab (red arrow in the figure below).
- Click on the “Browse” button (red arrow in the figure below) and locate the .kcs file you previously saved to your computer.
- Enter the value “1.5” in the “Max distance from cluster center to include outputs in cluster.csv” (I have entered the parameters for the rattle classifier how they should be entered in the window in the figure below).



- Now click “Process Files” in the bottom right corner of the screen (red arrow in the figure above).

Accessing and Interpreting Results

In the output folder you created, you will see a “cluster.csv” file. This is a summary of when each LHSP call was identified using the classifier and the sound parameters of each call.

Recall is the proportion of true positive detections made by the classifier to the actual number of target species vocalisations within the recordings. Precision is the proportion of detections from the classifier that were correct, AKA the proportion of true positives. The detectors have recall ranging from 30-65%, meaning that they are able to isolate approximately 30-65% of the true number of calls present in the recordings. However, they have a precision of approximately 90% each, meaning that 90% of the calls they isolate are LHSP. The classifiers have recall of about 40-70%, and precision of about 60-90%.

If you have any questions, do not hesitate to reach out to me by email at lihutchinson100@gmail.com

References

Pollet IL, Schutler D. 2018. Leach's storm petrel *Oceanodroma leucorhoa* population trends on Bon Portage Island, Canada. *Seabird*. 31:75-83.