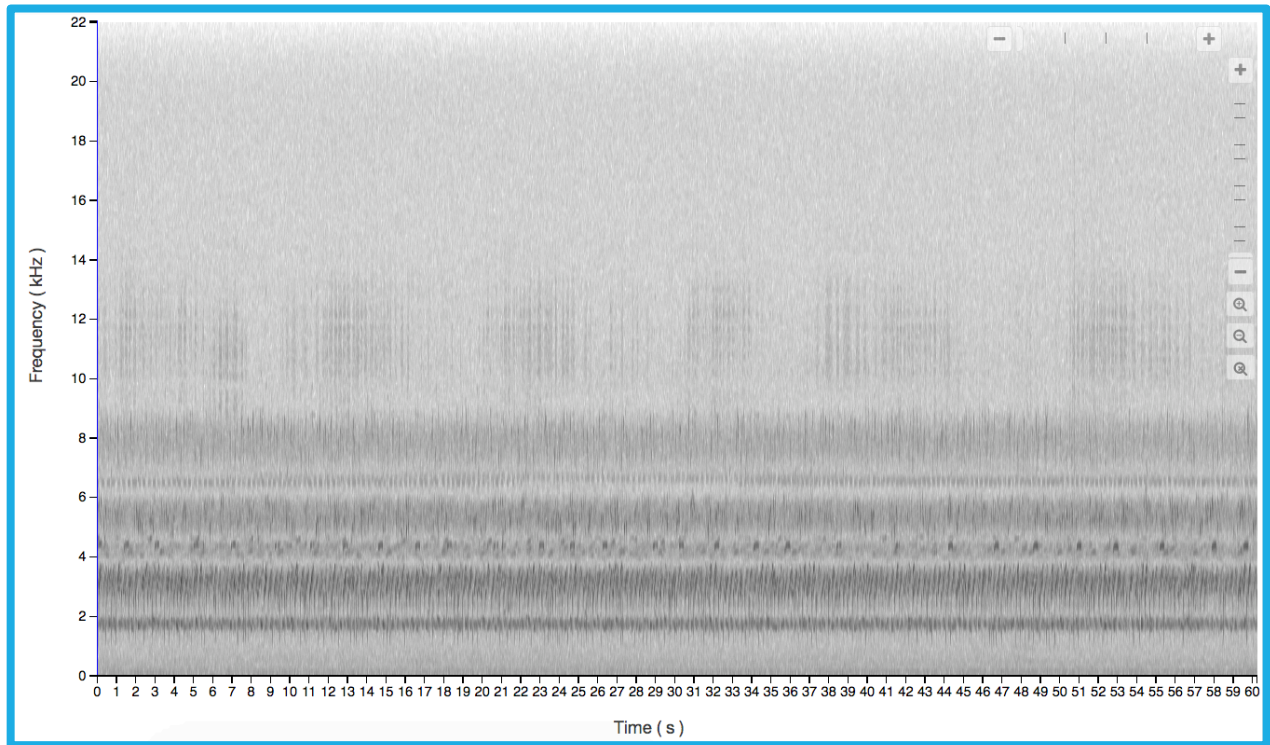
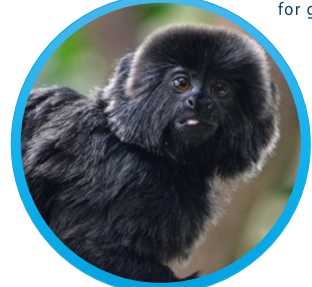


# ARBIMON II - USER MANUAL



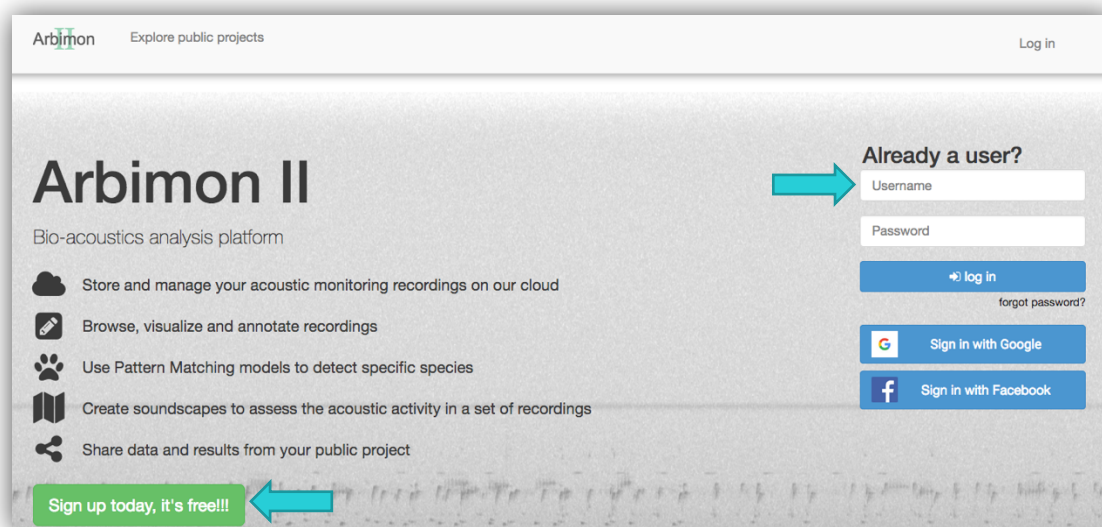
July 2018

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## 1. GETTING STARTED

- **Welcome:** go to <https://arbimon.sieve-analytics.com/> and click **sign up**.
- **Activate account:** register a username and password; an account activation link will be sent to your email (check your spam folder).
- **Login:** once activated, enter your username and password to begin.



## 2. STARTING A PROJECT


- Click  to create a new project.
- Name the project, provide a short project description and select who can see it:
  - **Public:** anyone can see the project and listen to the recordings; general public cannot modify any part of the project.
  - **Private:** the project is not displayed for the general public.
- On project tier choose:
  - **Free:** you will have 100 and 1,000 minutes of audio for storage and processing capacity, respectively. Click on **Create**.
  - **Paid:** view our plans at <https://www.sieve-analytics.com/contact> and contact [us](#).
- Click the **Search projects** box and type in the newly created project. Once it appears on the projects list, click on it to open the Dashboard.

### 3. MAIN MENU OVERVIEW



**Arbimon II** displays existing public projects and a project feed.



**Dashboard** displays the project summary and progress; edit these on  **Settings**



**Data** links to a left menu where you can add and manage sites, species and soundscape composition lists; upload, view and filter your recordings (creating playlists), compare between training sets and combine playlists (on Section #4).



**Visualizer** lets you browse through the recordings/spectrograms/soundscapes and listen to them; validate the target species presence/absence and create training sets for the species-specific identification models. In addition, you can identify the main source of the sounds that compose a soundscape (on Sec. #5).



**Analysis** links to a left menu where you can run species-specific identification models, apply these models to your data (Classifications), create soundscapes and audio event detection (on Sec. #6).



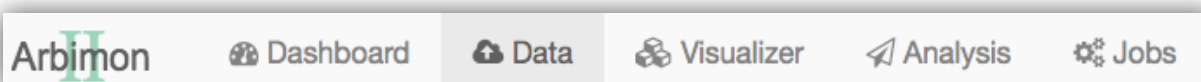
**Jobs** lets you check the progress of your analyses.



Move the mouse over the icon symbols to access a brief description of the button functionality.

### 4. DATA

#### 4.1 CREATING PROJECT SITES



Species


Soundscape  
Composition  
Classes


Uploads



Recordings

Training sets

Playlists

- From the main menu, click **Data**.
- On the left menu, press **Sites** and click  to add a project site.
- Assign a name (keep it short), add the location (decimal degrees) and altitude, and click **Save**. Repeat this step for each of your project sites.

-  For a better view/search, enter the project sites in an alphabetic numeric order (i.e. Site01, Site02, etc.).

 New Site
  Status

Name:



Site name

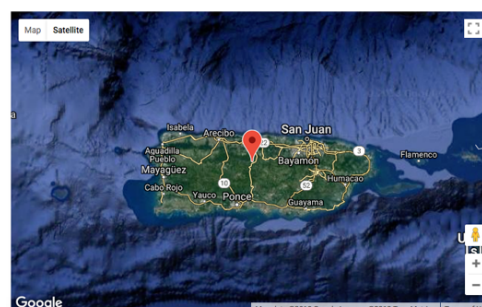
Location:




Lat  Longitude

Lon  Longitude

Alt  Altitude

 Save  Close



- ✚ A project may comprise one or more project sites (i.e. sample sites, experimental units, etc.).
- ✚ In addition, you can:
  - Drag the map pointer to view GPS coordinates.
  - Switch between map or satellite images.
  - Edit  and remove  your sites.
  - **Link recorder**  creates an access token for a site. Using this token, an ARBIMON recorder can upload its recordings to a specified site automatically by using a cellphone data plan (click [here](#)).

## 4.2 ADDING SPECIES

Sites

**Species**


Soundscape  
Composition  
Classes

Uploads

Recordings

Training sets

Playlists

- On the left menu, press **Species** and click  to access the species library.
- Search for the species by entering its name in the search field.
- Choose the species and sound type from the drop down menu and click **Select** to add it to the Project Species list.

Species Library

Porto

Q

Species	Family	Taxon	Sound
Melanerpes portoricensis	Picidae	Birds	Common Song
Loxigilla portoricensis	Emberizidae	Birds	Courtship Song
Spindalis portoricensis	Thraupidae	Birds	Territorial Song
Eleutherodactylus portoricensis	Eleutherodactylidae	Amphibians	Simple Call
			Simple Call 2
			Alternative Song
			Alternative Song 2
			Mechanical Song
			Nocturnal Song

Select

Close

- If the species is unavailable, type **unknown** in the search box and select a **Sp#** and the sound type from the drop down menu.

### 4.3 ADDING SOUNDSCAPE COMPOSITION CLASSES

Sites

Species


Soundscape  
Composition  
Classes

Uploads

Recordings


Training sets

Playlists

- On the left menu, press **Soundscape Composition Classes** and click  to add a new class in your project.

#### Soundscape Composition Classes

Geophony

Wind	
Rain	
Moving water	
New Class	

### 4.4 UPLOADING RECORDINGS

Sites

Species

Soundscape  
Composition  
Classes

Uploads


New Batch

Processing

Recordings




Training sets





Playlists

- On the left menu, press **Uploads** and then click  to fill up the batch info; then click **Save & Close**.
- Click **Add Files** to import the recordings (or drag & drop them) and hit **Start** to upload them.

#### Batch Info


You need to fill the batch info before you can start uploading

+ Add files
 Start
 Stop all
 Remove
Help

-  Always check the **recordings folder source** to avoid a mismatch of a recordings set and its site. **Misplaced recordings** can be removed by using filters in Section 4.5.
-  **Multiple uploads simultaneously:** open different tabs in the browser and upload the recording set for different sites at the same time. Alternatively, you can use the Desktop Uploader app by selecting the operative system.
-  **Computer went to sleep:** do not reload the web page. Click **Stop all** and then hit **Start**.
-  **Time length:** recordings greater than one minute will be automatically divided into one-minute files by default.



## 4.5 ORGANIZING DATA/CREATING PLAYLISTS

- On the left menu, press **Recordings** to verify the uploaded recordings. Here filters can be applied (e.g. sites, date & time, validations, etc.) to create playlists.
- Creating playlists helps manage the data and facilitates later analyses (i.e. to use them for species-specific identification models). For example, create a playlist with night-time recordings when modeling a nocturnal species.
- Click **Filters**, select among the different filter options and then click **Apply filters**. Now click  to save the recordings set as a new playlist.
- Assign a name and then click **Save & Close**.

Sites

Species

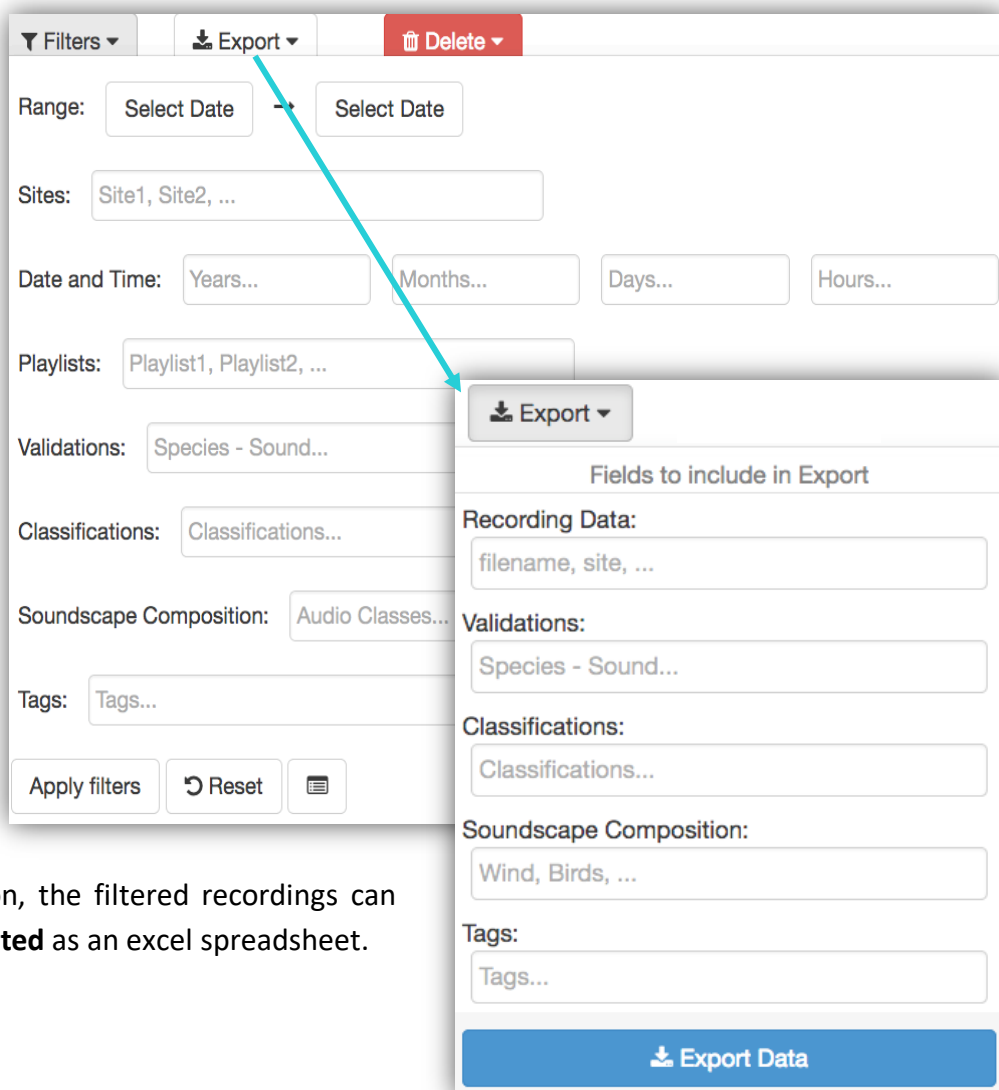
Soundscape  
Composition  
Classes

Uploads

Recordings

Training sets

Playlists



The screenshot shows the 'Recordings' section of the Sieve Analytics interface. On the left is a sidebar menu with options: Sites, Species, Soundscape Composition Classes, Uploads, Recordings (highlighted), Training sets, and Playlists. The main area displays a 'Filters' panel with various input fields: Range (two 'Select Date' buttons), Sites (a text box with 'Site1, Site2, ...'), Date and Time (four buttons: Years..., Months..., Days..., Hours...), Playlists (a text box with 'Playlist1, Playlist2, ...'), Validations (a text box with 'Species - Sound...'), Classifications (a text box with 'Classifications...'), Soundscape Composition (a text box with 'Audio Classes...'), and Tags (a text box with 'Tags...'). At the bottom of the filters are 'Apply filters', 'Reset', and a save icon. An 'Export' dropdown menu is open, showing a list of 'Fields to include in Export' with sections for Recording Data (filename, site, ...), Validations (Species - Sound...), Classifications (Classifications...), Soundscape Composition (Wind, Birds, ...), and Tags (Tags...). A large blue 'Export Data' button is at the bottom of the dropdown.

- In addition, the filtered recordings can be **Exported** as an excel spreadsheet.

## 4.6 TRAINING SETS VIEW

Sites

Species

Soundscape

Composition


Classes

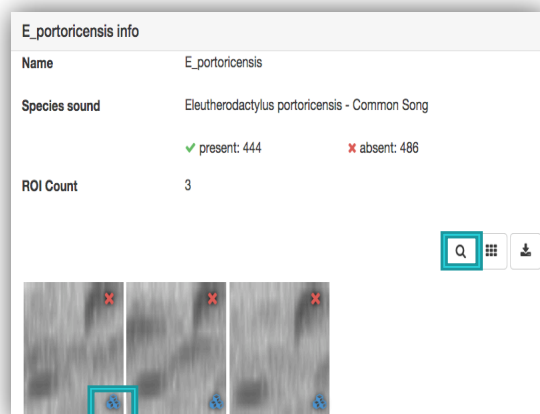
Uploads

Recordings

Training sets

Playlists

- On the left menu, press **Training Sets** to view the regions of interests (ROI) that were previously selected on the visualizer (See Section 5.3).
- A **ROI** is the best example of your focal species call. The selected ROIs should have similar acoustic properties (e.g. shape, bandwidth, duration, maximum and minimum frequency).
- Click the **detailed view icon** for a better examination of an individual ROI or click the **blue icon** on the right lower corner to listen the recordings in the visualizer.
- Move the mouse over the ROI thumbnails to see its information (e.g. duration, bandwidth, etc.).
- ROI information can be downloaded  as an excel spreadsheet.
- In addition, the training set's name can be edited and deleted; also, ROIs can be removed by clicking in the red X icon.



## 4.7 MERGING PLAYLISTS

Sites

Species

Soundscape

Composition

Classes

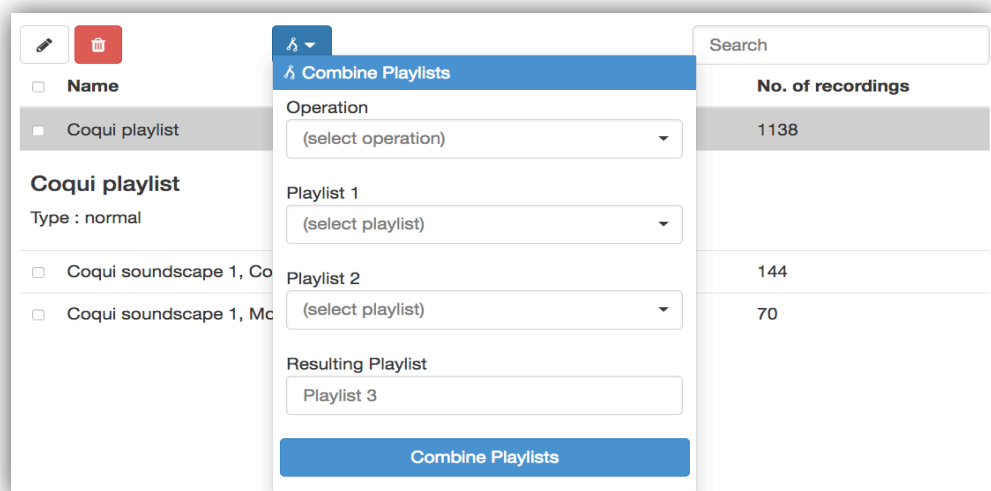
Uploads


Recordings

Training sets

Playlists

- On the left menu, press **Playlists** to view, edit or delete a playlist.

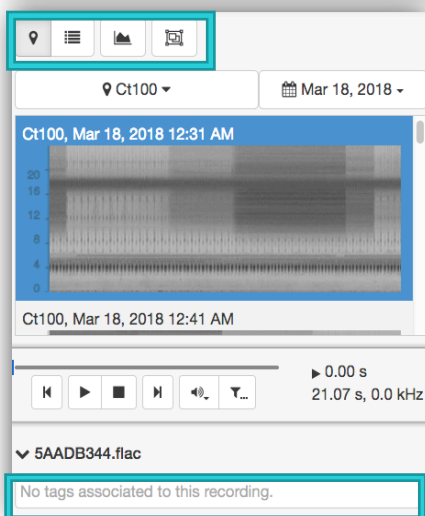
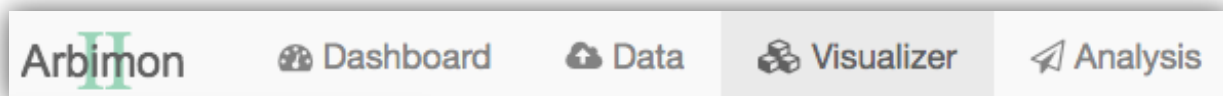




- In addition, click  to combine different playlists.



## 5. VISUALIZER

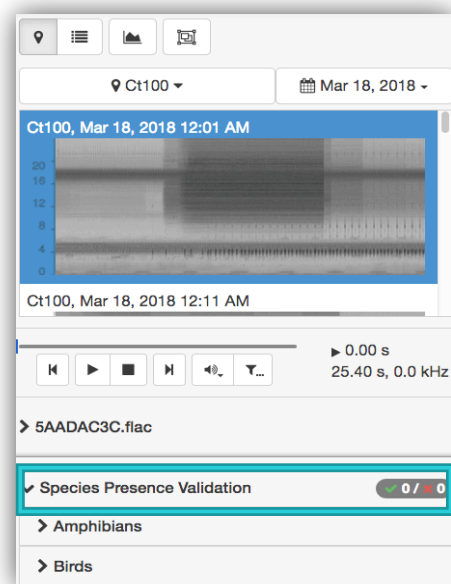
### 5.1 CREATING TAGS



- From the main menu, click **Visualizer** to browse and select recordings by Sites (select date), Playlists, Soundscapes or Audio Detection Events.
- Select a visualizer approach and click on the spectrogram **thumbnail** to open and listen the selected recordings in the visualizer; scroll down to check the next recordings.
- **Thumbnail manager:** on the left panel, click the **gain button**  to increase the recording's gain and/or click the **filter audio frequency button**  to filter specific sound frequencies.


- Click on the **Tags box**, select the interested area on the spectrogram and write the tag (e.g. species name, unknown sound, doubt, etc.) on the new box; then click **Enter**.

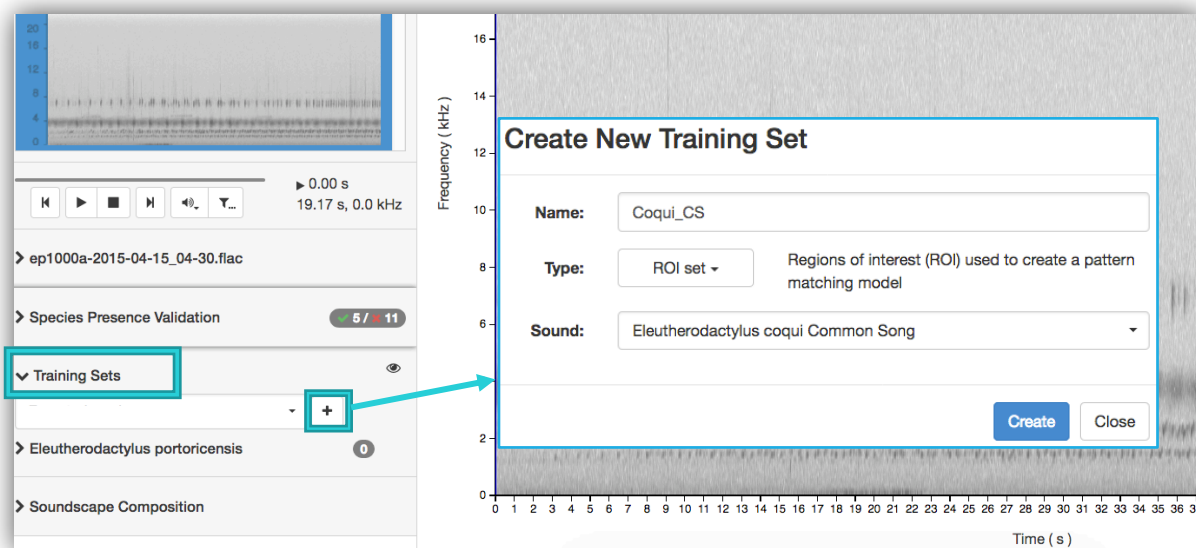
### 5.2 VALIDATING SPECIES PRESENCE



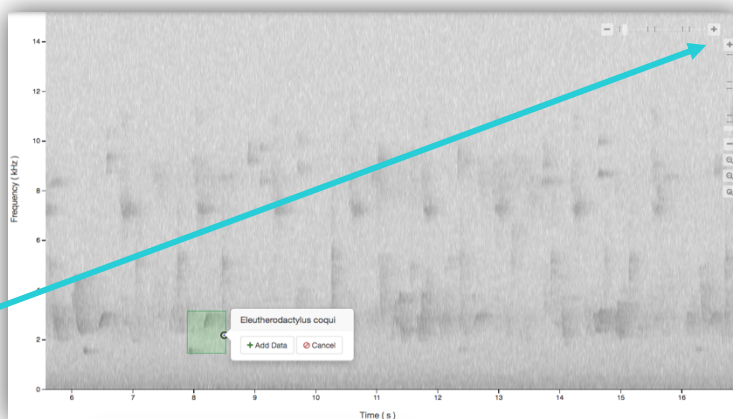
- On the left panel, scroll down and click **Species Presence Validation** section and then click on the species category (e.g. Amphibians, Birds, Mammals, etc.).
- Click **Play** to listen and determine if the species is present or absent.
- Repeat these steps for a recordings' subset.
- Subsets comprising at least 50 recordings with and 50 without the species call are recommended.

### 5.3 CREATING TRAINING SETS

- These validations are used to create the automated species-specific identification model.
- While validating the recordings, **ROIs** can be identified and added in a training set.
- Recommendations:** use the most common call of the species (e.g. territorial song) to create the call template. Select a maximum of 3 ROIs of the species call within a training set.
- To create a new ROI, first create a training set. Scroll down the left panel and click **Training sets**, then click  to add a new one.
- Assign a name, select ROI set (default) and your species sound (Section 4.2) from the drop menu and then hit **Create**.



- From the Training Sets menu, choose your new training set and on the visualizer draw a box around the spectrogram representing the species call (crop as closely as possible; use the **zoom** buttons on the right corner of the visualizer) and then click **Add Data**.



- Compare or Remove** training sets and ROIs (see Sec. 4.6).

## 6. ANALYSIS

### 6.1 MODEL CREATION





#### Models

Classifications

Soundscapes

Audio Event  
Detection

- From the main menu, click **Analysis**.
- On the left menu, press **Models** and then click  to create a model.
- Assign a name, select Pattern Matching as your Classifier (default) and the training set (includes the template of the species call [ROIs] and the validated data) from the drop menu.

 The validated data is divided into recordings that will be used to create the model (**Use in fitting**) and recordings that will be used to validate the model (**Use in validation**).

- Always enter an equal number of presence and absence for the “Use in fittings” entries (e.g. for a total of 100 validated recordings, enter 30 present and 30 absent for fitting the model, and 20 present and 20 absent to validate the model). Try different combinations. Increasing the number of Absent at the “Use in fitting” entry can improve a model’s precision (e.g. reducing the number of false positives).
- Click **Create**, wait a few minutes and then click on the **refresh icon**. The status of each analysis can be viewed in **Jobs** at the Main Menu.
- The new model will appear in the models list, click on it and then click on **show details** to view your results.

### Create a new model

**Model name:**

**Classifier:** Classifiers may change without notice. [Read more information.](#)

Pattern Matching



**Training Set:**

Coqui\_CS

**Validated recordings available** ⓘ

for: Eleutherodactylus coqui (Common Song)

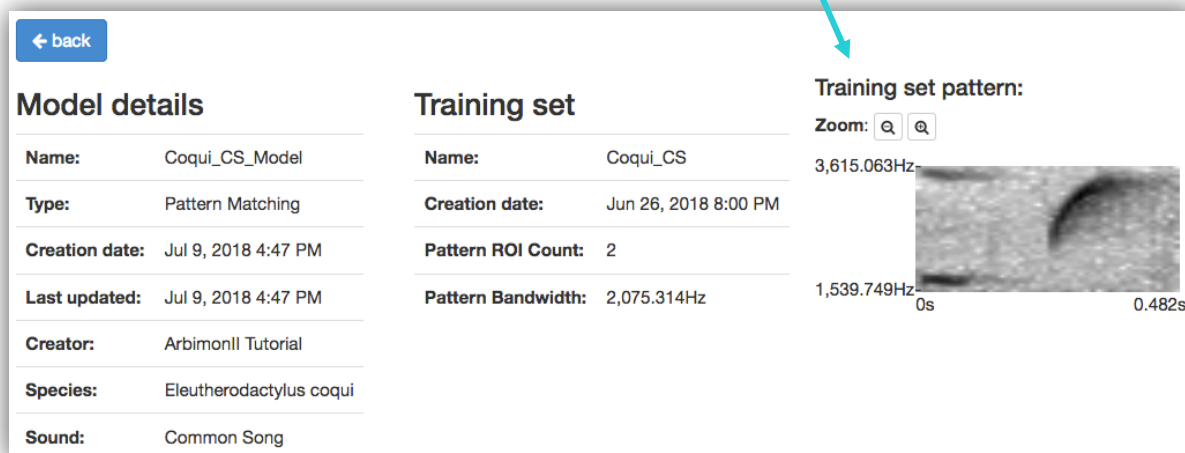
	Total:	Use in fitting:	Use in validation:
Present:	100	<input type="text"/>	0 <input type="text"/> / 0
Absent:	100	<input type="text"/>	0 <input type="text"/> / 0

 Create  Close

### 🎨 Random Forest Classifier (RF):

- The program creates a correlation vector between the call template and the spectrogram. The call template is applied to each of the validated recordings. In this step the template traverses each spectrogram and produces a vector of similarities for each recording (i.e. correlations between the template and sections of the spectrogram).
- The program extracts the vectors features of the validated recordings. In this step, 13 features of the correlation vector are extracted: mean, minimum, median, minimum, maximum, standard deviation, maximum-minimum, skewness, kurtosis, hyper-skewness, hyper-kurtosis, histogram, and cumulative frequency histogram.
- In addition, the features of the validated recordings (i.e. present, absent and the 13 vector factor) are input into a Random Forest Classifier. The goal is to train the RF model for a binary decision of presence or absence of the species call in a recording based on the feature vectors. Model performance can be accessed through the confusion matrix.

- 🎨 Model details shows the computed pattern (general template ROIs) that is used as the pattern matching model (i.e. Classifier).



- 🎨 **Accuracy** indicates overall how often your classifier is correct:

$(TP + TN) / (TP + TN + FP + FN)$  where  $TP + TN + FP + FN$  = total no. of validated recordings

- 🎨 **Precision** indicates how often your classifier is correct when it predicts that the species is present:

$TP / (TP + FP)$  where  $TP + FP$  = is the predicted species presence

- The **confusion matrix** provides a model validation statistic describing the performance of your binary Classifier (i.e. species presence or absence). Each column of the matrix represents the number of cases or values in a predicted class, while each row represents the values in an actual class.

		Predicted	
		Species	
Actual	present	Number of true positives (TP) <sup>1</sup>	Number of false negatives (FN) <sup>2</sup>
	absent	Number of false positives (FP) <sup>3</sup>	Number of true negatives (TN) <sup>4</sup>

<sup>1</sup>TP are cases in which your classifier predicts presence and the species is actually present.

<sup>2</sup>FN are cases in which your classifier predicts species absence, but the species is actually present (**Type II error**).

<sup>3</sup>FP are cases in which your classifier predicts species presence, but the species is actually absent (**Type I error**).

<sup>4</sup>TN are cases in which your classifier predicts species absence and the species is actually absent.

- Apply a Threshold:** this is an alternative approach that is based on setting manually the maximum similarity correlation level of the necessary vectors to assign a recording as having a positive detection.
- On **New Threshold**, enter different values and observe the changes in the confusion matrix.

- Try to adjust the threshold value to reduce the number of false positives.

### Threshold details

Saved threshold:

Suggested threshold: 0.664039

Current threshold: 0.4

New threshold:

Recalculate Save current threshold

### Statistics

Accuracy: 0.54

Precision: 0.73


### Confusion Matrix

Actual \ Predicted	Predicted	
	P	A
P	8	62
A	3	67

P = Present, A = Absent

### Validations

[Download](#) (Click in the row to view recording details)

- Click **Save current threshold**.
- These results can be downloaded  as an excel spreadsheets.
- Model Recommendations:**
  - We usually want to increase the number of true positives and negatives while reducing the number of false positives and negatives.
  - When evaluating the model results, the validation list below the confusion matrix allows you to explore recordings where user's presence/absence validations did not coincide with the RF model and Threshold model approaches.

## 6.2 CLASSIFICATION/RUNNING SPECIES-SPECIFIC IDENTIFICATION MODEL




- Classify all recordings:** the RF model and Threshold model can both be applied to all recordings. Each model will classify the presence or absence of the species call in each recording.

## Models

## Classifications

## Soundscapes

Audio Event  
Detection



- Before running a Classification, **create a playlist** (see Sec. 4.5) with the recordings that will be classified (e.g. nighttime, site or validated recordings, etc.). Each playlist should have no more than 20,000 recordings.
- On the left menu, press **Classification** and then click  to create a new classification.
- Assign a name, select a model and a playlist.
- Click **Create**, wait a few minutes and then click on the **refresh icon**. The status of each analysis can be viewed on **Jobs**.
- The new classification will appear in the list, click on it and then click on **show details** to view the results.
-  Peaks indicate the similarity between the computed pattern (i.e. Classifier) and where the species is deemed present across the entire recording.
- These results can be downloaded  as an excel spreadsheets for the eventual use in statistical analyses.
- The user can opt to use the results of a Classification of just one approach (RF or Threshold) or a Combined approach, in which the positives detections that are common to both approaches are selected. The Random Forest approach usually provides the highest number of positive detections, but also a higher number of false positives than the other two approaches (Threshold and Combine approach).
- The Threshold and the Combined approach are more conservative approaches that usually provide a lower number of detections and false positives.

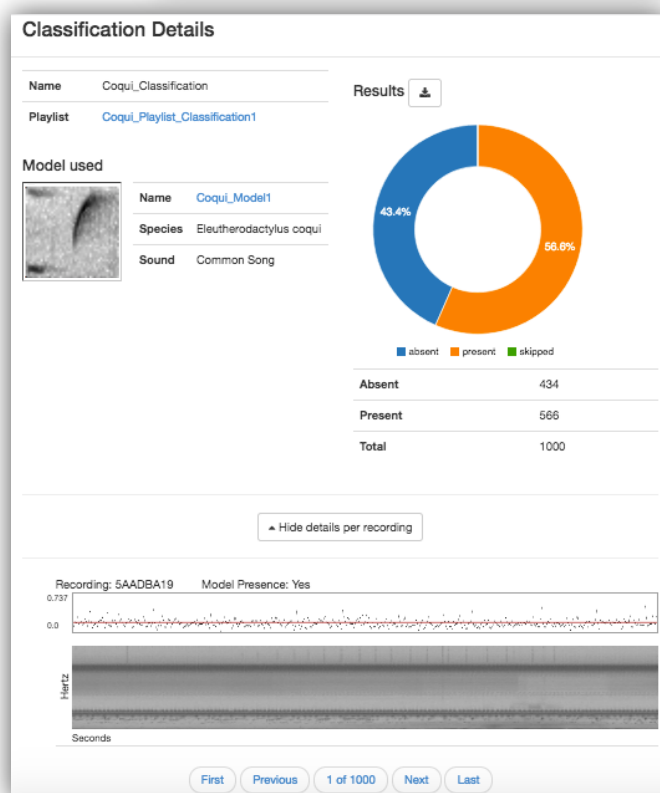
### Create a new classification

**Classification name:**

**Select Model:**

**Select Playlist:**

 Create  Close





## 6.3 POST-CLASSIFICATION VALIDATION

- The results from the classification can be further validated to eliminate any potential false positives.
- To create a post-classification validation, first create a playlist (see Sec. 4.5) with all the positive detections from the Classification, depending on the used approach (RF, Threshold, Combined, or the three of them).

The screenshot shows the Sieve Analytics interface for Post-Classification Validation. The interface includes several filter sections and a results table.

**Filters:**

- Range:** Select Date → Select Date
- Sites:** Site1, Site2, ...
- Date and Time:** Years... Months... Days... Hours...
- Playlists:** Playlist1, Playlist2, ...
- Validations:** Species - Sound... validation
- Classifications:** Coqui classification 1 - Jun 8, 2015 11:32 AM x
- Soundscape Composition:** Audio Classes...
- Tags:** Tags...

**Buttons:** Apply filters, Reset, [Menu Icon]

**Results Table:**

results	
Model: ✓, Th: ✓	
Model: ✓, Th: ✗	
Model: ✗, Th: ✓	
Model: ✗, Th: ✗	

- Listen to all or a subset of recordings to remove the false positive detections.

## 6.4 SOUNDSCAPES


Models






Classifications

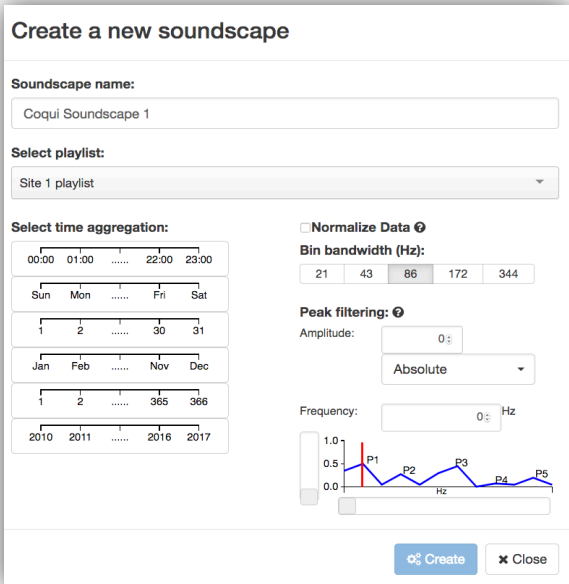
Soundscapes

Audio Event

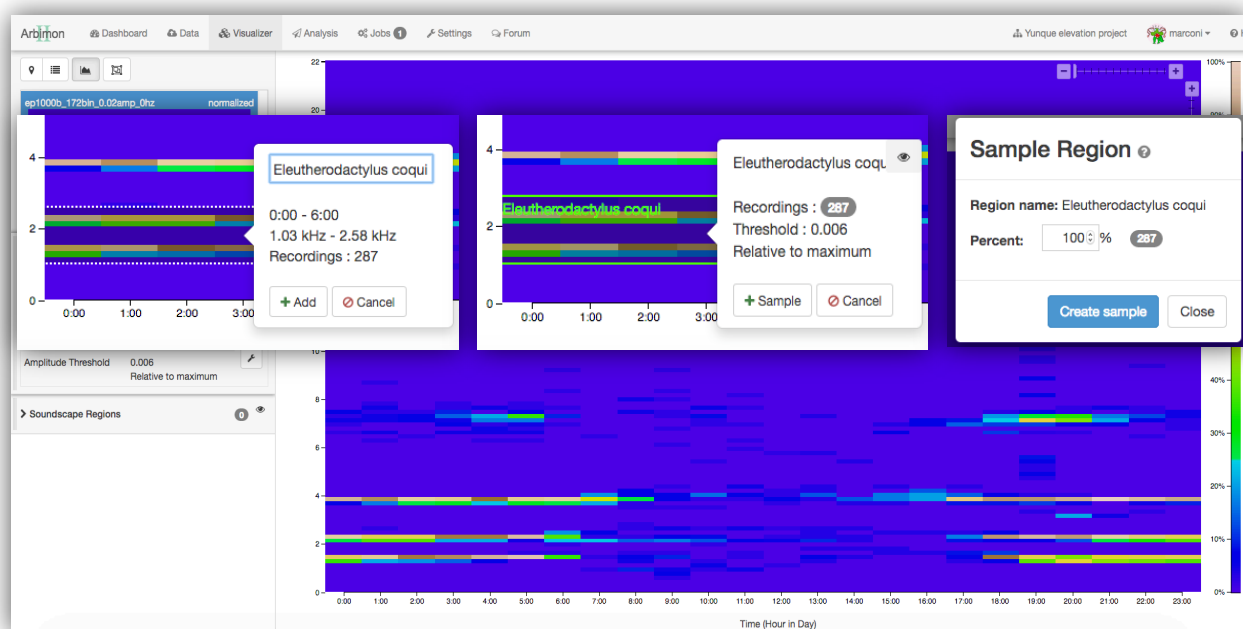
Detection

 **Soundscapes** are the subject of **acoustic ecology** that allows to visualize all the acoustic frequencies that emanate from the environment (e.g. rain, machines, animals). Soundscapes can be visually displayed by aggregating sounds in different temporal and spatial scales (e.g. time of day, season, altitude).

- On the left menu press **Soundscapes** and click  to begin.
- Assign a name, select a playlist from the drop menu (i.e. the group of recordings that will make up your soundscape).
- Select the **time aggregation** (e.g. time of the day, days of the week, months, years, etc.)
- Mark the **Normalize Data box**. This step will ensure that the data is normalized by dividing the number of recordings with a peak in a frequency bin by the total number of recordings collected during each time interval.
- Choose between the **Bin bandwidth sizes (Hz)**.
  -  Explore different bin sizes, maintaining the values of the other parameters and compare the obtained results.
- Select **amplitude threshold** and **amplitude type**:
  - **Absolute** – the raw amplitude value is assigned to each peak.
  - **Relative to maximum** – the threshold is taken as a proportion of the maximum amplitude of the largest peak within the recordings used to create the soundscape.
  -  If the recordings were collected using the same recorder model, then use “absolute”.
  -  If the recordings were collected with different recorders model, use “relative to maximum”.
- Select the **Frequency threshold** – determines the minimal distance between two peaks of sounds to be included in the soundscape.
  -  In practice, we leave this value at 0 because the selection of Bin bandwidth already deals with the frequency variation.



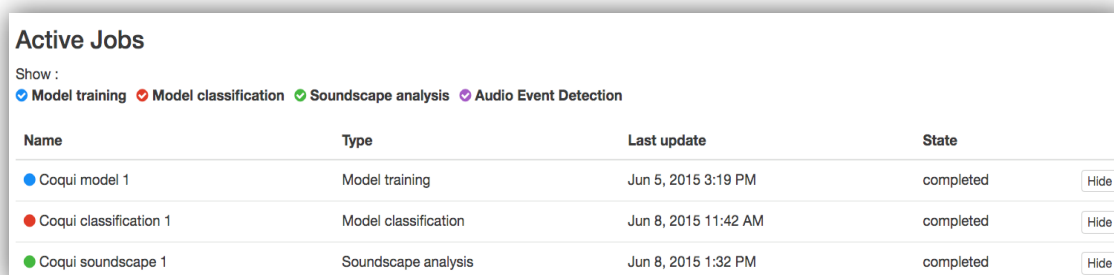
- Click **Create**, wait a few minutes and then click on the **refresh icon**. You can always view the status of your analyses by clicking on **Jobs**.
- In addition, you can export the soundscape results or delete it.
- Your new soundscape will appear in the list, click on it and then on **View** to appreciate your results on the **Visualizer**.
- The soundscape will display pixel shades or regions that represent the number of recordings that had an acoustic activity peak at the chosen time and frequency.
- You can always edit the visualization options: amplitude threshold and color palette.
- On the soundscape, select a sample region to examine the recordings that contribute to the selected acoustic activity peaks.
- Assign a name for the sample region (e.g. species name, doubt) and click **+ Add**, wait 5 seconds.
- Then click **+ Sample**, adjust the percentage to select the number of recordings to be inspected and then hit **Create sample**.



- Once you create the sample, click **View** to inspect the sample recordings. Here you can verify the species composition for that sampled region.

## 7. JOB PROGRESS

- Press **Jobs** in order to see your active jobs list. Here you can view the progress of each of your analyses.



**Active Jobs**

Show : ● Model training ● Model classification ● Soundscape analysis ● Audio Event Detection

Name	Type	Last update	State	
● Coqui model 1	Model training	Jun 5, 2015 3:19 PM	completed	Hide
● Coqui classification 1	Model classification	Jun 8, 2015 11:42 AM	completed	Hide
● Coqui soundscape 1	Soundscape analysis	Jun 8, 2015 1:32 PM	completed	Hide

- You can always hide discarded jobs.