CODE AND EXPERIMENTAL PROCEDURES.

GROUPE 5 (TEAM FWAFWA).
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https://github.com/laelume/bioacoustics/tree/main/risoux

Please visit the above site to view or download code!

This document describes the code and step-by-step experimental procedures used for our group project on the analysis of avian population distribution and call features across 4 elevation zones in the Risoux Forest of the Parc Naturel Regional du Haut-Jura, France.

##

DATA COLLECTION

Our raw data consists of 1128 1-minute WAV files sampled every 15 minutes over a 23.5-hour time period, from 2024-10-02 17:00:00 to 2024-10-03 16:30:00. The audio was recorded at 48kHz/16-bits using 12 randomly-oriented Audiomoths distributed spatially across a mountainside near (46.545496, 6.093823), generally facing Lac des Rousses.

##

CLASSIFICATION AND DETECTION USING BIRDNET

In this experiment, we classified a subset of regional birds using a pre-trained model of BirdNET with a confidence score of 0.75 (BirdNET_75). For further analysis, we selected a single species (Regulus regulus; herein referred to as regreg) based on its call recognizability and presence in all 4 elevation zones. We then re-ran BirdNet using a confidence score of 0.30 (BirdNET_30) to improve our detection rate. Files identified as containing regreg vocalizations were used for further analysis.

<birdnet_simplified.ipynb> (birdnet modified to run over our files)

##

FIRST PASS: ANNOTATION, FEATURE EXTRACTION, ANALYSIS

In the second phase of our experiment, one individual (human) manually verified and annotated a sample size greater than 50% of all positive detections of regreg found in the first pass of our model. BirdNET correctly identified the presence of regreg in 63 1-minute files, which were then assembled into a smaller dataset containing only true positives.

<WP1_75.csv> (annotations example)

Statistical analysis in R was done on our manually-annotated dataset to evaluate the relationship of altitude and time of day with respect to bird population distributions.

<feature_analysis_hautjura.R> (analyzing population vs. elevation)

A python script was executed on the audio file directory of this dataset to extract and export a variety of audio parameters to a CSV file. Audio files were cut into 3-second-slices to refine analysis and facilitate ease of file verification. This interval choice was based on the pre-defined birdnet parameters, as well as our chosen call duration. Audio slices with confirmed birdcalls in them were selected for analysis.

<tranche.ipynb> (find, label, and slice audio)

<audio_features_risoux.ipynb> (extract audio features)

<audio_features_3s.csv> (audio features of 60-s wavs) (example)

Further analysis was done in R using the CSV files of extracted audio parameters to determine the relationships between altitude and birdcall features.

<jura_acoustic_parameters_analyses.R> (analyzing acoustic parameters)

##

DATA SUBSETS: ANNOTATION, FEATURE EXTRACTION, ANALYSIS

In the third phase, we manually annotated a smaller subset of audio files to refine the accuracy of our methodology by increasing the precision with which we chose our data.

First, a random sample of 20 files was manually annotated from our audio dataset by assigning each annotator to randomly choose the same number of files from the same number of Audiomoths (5 files each from 3 Audiomoths per person). Statistical analysis was performed in R over this subset. It was later determined that our collective annotation methods varied too widely to produce a complete dataset, since call type was not considered.

Next, 46 audio files were annotated by a single individual (human) using BirdNET inside of Raven Lite. The files were selected based upon call duration, completeness, and clarity. Single syllables of bird calls were manually selected using a rectangular viewing window from within Raven Lite, and a feature table was exported. This information was used to build a CSV of annotations for all files in the subset.

The resultant annotated CSV was used for primary analysis of audio features in this study due to methodological consistency, completeness, and accuracy. Statistical analysis was performed in R to obtain relationships between altitudinal gradient, bird population dynamics, and birdcall features.

<WP Acoustic Features.csv> (example; annotated audio with parameters)

<jura_acoustic_parameters_analyses.R> (analyzing acoustic parameters)